Tampere University

LUCAS ARRAIS DE CAMPOS

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An investigation on measure scales, orofacial appearance, and aesthetic treatment in Finland and Brazil

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ACADEMIC DISSERTATION
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"… the instrument of knowledge can only by the movement of the whole soul be turned from the world of becoming into that of being, and learn by degrees to endure the sight of being, and of the brightest and best of being, or in other words, of the good."

– Plato, in *The Allegory of the Cave*

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Tampere, 1st February 2024

Lucas Arrais de Campos

ABSTRACT

Oral health-related quality of life (OHRQoL) refers to an individual's perception of their oral health and is an important aspect of patient-centered dentistry. Psychometric scales such as the 14-item Oral Health Impact Profile (OHIP-14), Orofacial Esthetic Scale (OES), and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) are used for measuring OHRQoL dimensions. Ensuring their data validity and reliability requires assessing psychometric properties across diverse samples and in different clinical and cultural settings.

The demand for aesthetic dental treatment has significantly increased recently. Studying self-perception of orofacial appearance (OA), an OHRQoL dimension assessed by OES and PIDAQ, helps understand these changes in dental practice. Both treatment demand and OA can impact individuals' well-being and are influenced by cultural and socioeconomic factors. Investigating these impacts and influences across diverse populations can elucidate the role of OA in one's life and the healthcare professionals' role in promoting health through aesthetic treatments.

This dissertation consists of four publications aiming to investigate OHRQoL in a cross-national context between Finland and Brazil. Publication I estimated the psychometric properties of OHIP-14 in dental and non-dental patient samples. Publication II proposed and estimated the psychometric properties of the Finnish versions of OES and PIDAQ. Publication III studied the measurement invariance of OES and PIDAQ and compared their scores between Finland and Brazil. Publication IV compared the self-perception OA and the demand for aesthetic dental treatment by sociodemographic characteristics in both countries. Additionally, the impact of OA on life satisfaction among Finns and Brazilians was estimated.

These publications are validation and cross-sectional studies using demographic questionnaire and psychometric scales. Data collection was conducted using paper-and-pencil for the Brazilian sample in Publication I (n = 1,930) and online for the Finnish sample in all publications (n = 3,636) and the Brazilian sample in Publications III and IV (n = 3,979). Psychometric properties were estimated using a confirmatory strategy. Cross-national measurement invariance was tested using multigroup analysis. Scale scores were compared between the countries and by sex,

age group, and income level. The probability of seeking or receiving aesthetic dental treatment was calculated for sociodemographic categories. Structural equation models estimated the impact of OA on life satisfaction.

As results, OHIP-14 data were not valid and reliable for non-dental patient samples, indicating that this scale is unsuitable for individuals not undergoing dental treatment. For dental patients, OHIP-14 presented adequate psychometric properties, however, these results were influenced by cultural factors and age. Finnish versions of OES and PIDAQ had adequate psychometric properties. OES presented measurement invariance, with no score differences between Finns and Brazilians. On the other hand, PIDAQ did not have measurement invariance; therefore, its scores are not directly comparable between the countries. Significant differences in self-perception of OA were observed concerning income level in Brazil, with those with low incomes experiencing a more negative psychosocial impact of OA on their lives.

Regarding the demand for aesthetic dental treatment, women were more likely to seek such treatment in both countries, reflecting the social pressure on the female body. In addition, younger and richer individuals in Brazil had a higher demand for this treatment. In general, Brazilians sought and received more aesthetic dental treatments than Finns. The structural model showed that OA had a significant impact on individuals' well-being, contributing to approximately 10% of the life satisfaction of Finnish and Brazilian adults.

In conclusion, individual and clinical characteristics may affect the validity and reliability of data from psychometric scales, potentially leading to misinterpretations. Aesthetic treatments in the orofacial region should consider patient perspectives and social context, as sociodemographic and cultural factors may influence self-perception of OA and the demand for the treatment. Furthermore, this dissertation provides evidence to advance the understanding of OHRQoL and foster discussion on its practical applications.

TIIVISTELMÄ

Suun terveyteen liittyvä elämänlaatu viittaa yksilön käsitykseen omasta suun terveydestään ja on tärkeä osa potilaskeskeistä hammaslääketiedettä. Psykometrisiä asteikkoja, kuten 14-kohtainen suun terveyden vaikutusasteikko (*14-item Oral Health Impact Profile* – OHIP-14), Hampaiston ja kasvojen ulkonäköasteikko (*Orofacial Esthetic Scale* – OES) ja Hampaiden estetiikan psykososiaalinen vaikutuskysely (*Psychosocial Impact of Dental Aesthetics Questionnaire* – PIDAQ), käytetään mittaamaan suun terveyteen liittyvän elämänlaadun ulottuvuuksia. Kyselyillä saatujen tietojen pätevyyden ja luotettavuuden varmistamiseksi on tarpeen arvioida psykometrisia ominaisuuksia erilaisissa otoksissa ja erilaisissa kliinisissä ja kulttuurisissa ympäristöissä.

Esteettisen hammashoidon kysyntä on kasvanut merkittävästi viime aikoina. Hampaiston ja kasvojen ulkonäön itsearvioinnin tutkiminen, jota arvioidaan OES:llä ja PIDAQ:lla, auttaa ymmärtämään näitä muutoksia hammaslääketieteessä. Sekä hoidon kysyntä että hampaiston ja kasvojen ulkonäkö voivat vaikuttaa yksilön hyvinvointiin, mitä lisäksi ohjaa kulttuuriset ja sosioekonomiset tekijät. Tutkimalla vaikutuksia yksilötasolla ja eri väestöryhmissä voidaan valaista hampaiston ja kasvojen ulkonäön roolia yksilön elämässä ja terveydenhuollon ammattilaisten roolia terveyden edistämisessä esteettisten hoitojen avulla.

Väitöskirja koostuu neljästä julkaisusta, joiden tarkoituksena on tutkia suun terveyteen liittyvää elämänlaatua Suomen ja Brasilian välillä. Julkaisu I arvioi OHIP-14 psykometrisiä ominaisuuksia yksilöillä, jotka eivät ole hammashoidossa ja potilailla, jotka juuri saavat hammashoitoa. Julkaisu II arvioi suomenkielisten versioiden OES ja PIDAQ psykometrisiä ominaisuuksia. Julkaisu III tutki OES:n ja PIDAQ:n mittausinvarianttisuutta ja tuloksia Brasilian ja Suomen välillä. Julkaisu IV vertaili hampaiston ja kasvojen ulkonäön ja esteettisen hammashoidon kysyntää sosiodemografisten ominaisuuksien mukaan molemmissa maissa. Lisäksi tutkittiin hampaiston ja kasvojen ulkonäön vaikutusta elämän tyytyväisyyteen suomalaisten ja brasilialaisten keskuudessa.

Julkaisut ovat validointi- ja poikkileikkaustutkimuksia, joissa käytettiin demografista kyselylomaketta ja psykometrisiä asteikkoja. Aineistonkeruu suoritettiin paperilla ja kynällä Brasiliassa julkaisussa I (n = 1.930) ja tietokonepohjaisena kaikissa suomalaisissa (n = 3.636) sekä brasilialaisissa (n = 3.979) otoksissa julkaisuissa III ja

IV. Psykometriset ominaisuudet arvioitiin vahvistavalla strategialla. Maiden välistä mittausten yhteneväisyyttä testattiin moniryhmäanalyysillä. Kyselyiden tuottamia pisteitä verrattiin maiden välillä ja sukupuolen, ikäryhmän ja tulotason mukaan. Todennäköisyys hakea tai saada esteettistä hammashoitoa arvioitiin sosiodemografisten luokkien mukaan. Rakenneyhtälömallin avulla arvioitiin hampaiston ja kasvojen ulkonäön vaikutusta elämän tyytyväisyyteen.

Tulokset osoittavat, että OHIP-14 tiedot eivät olleet päteviä ja luotettavia ei hammashoidossa olevilla henkilöillä, mikä viittaa siihen, että tämä asteikko ei sovi ko. henkilöille. Hammashoidossa olevilta potilailta saadut OHIP-14 tulokset ovat luotettavia, mutta näihinkin vaikuttavat kulttuuriset tekijät ja tutkittavien ikä. Suomenkieliset versiot OES:stä ja PIDAQ:sta osoittautuivat psykometrisilta ominaisuuksiltaan asianmukaisiksi. OES:ssa ei havaittu piste-eroja suomalaisten ja brasilialaisten välillä. PIDAQ käyttäytyi eri tavalla, minkä vuoksi sen tulokset eivät ole suoraan vertailukelpoisia maiden välillä. Merkittäviä eroja havaittiin kasvojen ja hampaiston ulkonäön arvioinnissa tulotason suhteen Brasiliassa. Matalan tulotason ryhmään kuuluvilla kasvojen ja hampaiston ulkonäöllä oli negatiivinen vaikutus elämään.

Koskien esteettisen hammashoidon kysyntää naiset todennäköisemmin hakivat tällaista hoitoa molemmissa maissa, heijastaen yhteiskunnallista painetta naisvartaloa kohtaan. Lisäksi nuoremmilla ja varakkaammilla yksilöillä Brasiliassa oli suurempi kysyntä esteettiselle hoidolle. Yleisesti ottaen brasilialaiset hakivat ja saivat enemmän esteettisiä hammashoitoja kuin suomalaiset. Tutkimus osoitti, että kasvojen ja hampaiden ulkonäöllä on merkittävä vaikutus yksilöiden hyvinvointiin, vaikuttaen noin kymmenesosaan suomalaisten ja brasilialaisten aikuisten elämäntyytyväisyydestä.

Yhteenvetona voidaan todeta, että yksilölliset ja kliiniset ominaisuudet voivat vaikuttaa psykometrisilla asteikoilla saatujen tulosten pätevyyteen ja luotettavuuteen, mikä saattaa johtaa virheellisiin tulkintoihin. Tehtäessä esteettisiä hoitoja kasvojen ja hampaiston alueella tulisi ottaa huomioon potilasnäkökulma ja sosiaalinen asema, sillä sosiodemografiset ja kulttuuriset tekijät voivat vaikuttaa hampaiston ja kasvojen ulkonäön itsearviointiin ja hoidon kysyntään. Lisäksi väitöskirja antaa tutkimusnäyttöä suun terveyteen liittyvän elämänlaadun ymmärtämisen edistämiseksi ja keskustelun herättämiseksi sen käytännön sovelluksista.

CONTENTS

ABBREVIATIONS

AVE	Average variance extracted
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence interval
CR	Composite reliability
DIF	Differential item functioning analysis
dPROMs	Dental patient-reported outcome measures
dPROs	Dental patient-reported outcomes
ECV	Explained common variance index
EFA	Exploratory factor analysis
GOHAI	Geriatric Oral Health Assessment Index
HRQoL	Health-related quality of life
II	Incomprehension index
INFIT	Information-weighted mean square
ku	Kurtosis
LM	Lagrange multipliers
MIQ	Malocclusion Impact Questionnaire
MIREAL	Mean of item residual absolute loadings index
ML	Maximum likelihood estimation method
MPI-Orthodontics	Multidimensional Pain Inventory for orthodontic patients
OA	Orofacial appearance
OES	Orofacial Esthetic Scale
OHIP	Oral Health Impact Profile
OHIP-14	14-item Oral Health Impact Profile
OHRQoL	Oral health-related quality of life
OIDP	Oral Impacts on Daily Performances
OQLQ	Orthognathic Quality of Life Questionnaire
OR	Odds ratio
OUTFIT	Unweighted mean square
PCA	Principal component analysis

PCM	Partial-credit model
PIDAQ	Psychosocial Impact of Dental Aesthetics Questionnaire
PROs	Patient-reported outcomes
QoL	Quality of life
rc	Reference category
RMSEA	Root mean square error of approximation
SD	Standard deviation
sk	Skewness
SRMR	Standardized root mean square residual
SWLS	Satisfaction with Life Scale
TLI	Tucker–Lewis index
UFSCAR	Federal University of São Carlos
UNESP	São Paulo State University
UNICAMP	State University of Campinas
UniCo	Unidimensional congruence index
UNIFESP	Federal University of São Paulo
USP	University of São Paulo
WHO	World Health Organization
WLSMV	Robust weighted least squares mean and variance adjusted estimation method

ORIGINAL PUBLICATIONS

This dissertation is based on the following original peer-reviewed publications, referred to as **Publication I-IV** in the text. The original publications are reproduced at the end of this dissertation.

I. **Campos, L. A.**, Peltomäki, T., Marôco, J., & Campos, J. A. D. B. (2021). Use of Oral Health Impact Profile-14 (OHIP-14) in Different Contexts. What Is Being Measured? *International Journal of Environmental Research and Public Health,* 18(24), 13412. https://doi.org/10.3390/ijerph182413412

II. **Campos, L. A.**, Kämäräinen, M., Silvola, A. S., Marôco, J., Peltomäki, T., & Campos, J. A. D. B. (2021). Orofacial Esthetic Scale and Psychosocial Impact of Dental Aesthetics Questionnaire: development and psychometric properties of the Finnish version. *Acta Odontologica Scandinavica*, 79(5), 335-343. https://doi.org/10.1080/00016357.2020.1857435

III. **Campos, L. A.**, Campos, J. A. D. B., Kämäräinen, M., Silvola, A. S., Marôco, J., & Peltomäki, T. (2022). Self-perception of orofacial appearance: Brazil-Finland cross-national study. *Acta Odontologica Scandinavica*, 80(8), 626-634. https://doi.org/10.1080/00016357.2022.2077432

IV. **Campos, L. A.**, Campos, J. A. D. B., Marôco, J., & Peltomäki, T. (2023). Aesthetic dental treatment, orofacial appearance, and life satisfaction of Finnish and Brazilian adults. *PLoS One*, 18(6), e0287235. https://doi.org/10.1371/journal.pone.0287235

AUTHOR'S CONTRIBUTION

L. A. Campos was the first author and had an equal level of contribution in all Publications. He contextualized the studies and designed the methodology collaboratively with other co-authors. The author prepared the survey in both paper (**Publication I**) and online (**Publications I-IV**) and organized the data collection strategy in Finland and Brazil. He conducted all statistical analyses, interpreted the results, and was responsible for data curation and visualization. **L. A. Campos** wrote the first drafts and took care of the submissions as the corresponding author for all the Publications. He also revised the manuscripts in accordance with peer review feedback and in agreement with the co-authors.

1 INTRODUCTION

Oral health-related quality of life (OHRQoL) is a multidimensional concept that can be defined as an individual's perspective and perceptions of own oral health (John, 2021). This is an important concept for identifying the patient's attitudes and perceptions, which are insufficiently studied aspects of evidence-based dentistry practice. Conducting studies that aim to enhance the understanding of OHRQoL in different cultures is relevant for advancing a patient-centered approach in dentistry. This will provide healthcare professionals with valuable insights to develop a more comprehensive view of the patient, enabling shared decision-making and individualized clinical management.

The challenge in investigating OHRQoL is its subjective nature that cannot be directly measured (latent construct). A standardized option for its measurement is using psychometric scales (Marôco, 2021b). This method requires conducting psychometric analyses to attest to the validity and reliability of the obtained data (Marôco, 2021b; Swami & Barron, 2019). The 14-item Oral Health Impact Profile (OHIP-14) is the most widely used scale for assessing the impact of an oral health disease or condition on an individual's life, both in clinical and research settings (Slade, 1997a). However, little attention is given to its psychometric properties, and when examined, significant divergence in results is observed among validation studies. Thus, one of the aims of this dissertation was to investigate the psychometric properties of OHIP-14 when applied to different samples from Finland and Brazil.

Self-perception of orofacial appearance (OA) is one of the dimensions of OHRQoL that has gained increased attention in recent years (Campos et al., 2022). The notable role the face plays in an individual's social interactions can be attributed to the emphasis on OA in contemporary societies. Furthermore, advancements in clinical materials and techniques increase the availability of treatments exclusively aimed at enhancing aesthetic appearance. As a consequence, a higher demand for aesthetic dental treatment is observed in dental practice (Abbasi et al., 2022).

The Orofacial Esthetic Scale (OES) (Larsson et al., 2010a) and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) (Klages et al., 2006) are psychometric scales for measuring self-perception of OA. The first assesses

satisfaction with OA and the second psychosocial impact of dental aesthetics on an individual's life. Although available in various languages, including Portuguese (Campos et al., 2020b; Sardenberg et al., 2011), there is no version of these scales in Finnish. For cross-national comparisons using psychometric scales, studying measurement invariance is a mandatory step in addition to evaluating the psychometric analyses (Bowen & Masa, 2015; Swami & Barron, 2019). It will provide information on whether the scale is capturing the subjective aspect similarly between countries and if the scores obtained are directly comparable (Bowen & Masa, 2015; Swami & Barron, 2019). The aim of this dissertation was also to translate and culturally adapt the OES and PIDAQ into Finnish, estimate their psychometric properties and measurement invariance when applied to adults in Finland and Brazil, and compare self-perception of OA between these countries.

Both self-perception of OA and the behavior of seeking aesthetic dental treatment can impact an individual's subjective well-being and are complex phenomena influenced by socioeconomic and cultural factors (Campos et al., 2022). Understanding these impacts and influences can help clarify the role of OA in one's life. It can also elucidate the importance of healthcare professionals in planning aesthetic treatments with a patient-centered approach to maximize their health gains. However, there is a lack of studies that investigate OA and the demand for aesthetic dental treatment, as well as their impact on well-being, in different sociodemographic characteristics and countries.

Therefore, the final part of this dissertation investigated the social determinants of health involved in the self-perception of OA and the demand for aesthetic dental treatment, while comparing Finnish and Brazilian adults. Further, the impact of OA on the life satisfaction of these individuals was studied, considering potential influences from having undergone aesthetic dental treatment and sociodemographic characteristics. This dissertation is rooted in evidence-based and patient-centered practice. It sheds light on individuals' attitudes and perceptions, challenging the 'eminence-based' practice characterized by clinician expertise dominance in clinical decision-making.

The choice of Finland and Brazil was based on significant sociocultural discrepancies between the countries. For example, Finland has strong gender equality policies and low gaps among socioeconomic strata. In contrast, Brazil has limited gender policies, resulting in significant gender disparities, and pronounced socioeconomic inequalities persist in this society. Identifying coherences and specificities between them is a good starting point for cross-national comparisons in the context of OHRQoL.

2 LITERATURE REVIEW

2.1 Oral health-related quality of life (OHRQoL)

The term 'quality of life' (QoL) is widely employed across various fields of knowledge and may denote different notions of a good life. Because it is given different meanings, QoL can be understood from diverse perspectives. To prevent misconceptions regarding the meaning of this term, Veenhoven (2013) conceptualized four possible perspectives of QoL based on the combination of two dichotomous yields: *chances* and *outcomes*, as well as *outer* and *inner qualities* (Table 1). The combination of *chances* and *outer qualities* deals with good living conditions, which is called the *livability* of the environment. *Chances* with *inner qualities* is called *life-ability* and denotes how well an individual can cope with life's problems. The intersection of *outcomes* and *outer qualities* results in *utility of life*. In other words, it represents the idea of how a good life contributes to external or environmental factors. Finally, the combination of *outcomes* and *inner qualities* correspond to the *enjoyment of life* from a subjective appreciation of life, that is, QoL in the eye of the beholder.

Table 1. Four perspectives on quality of life proposed by Veenhoven (2013).

	Outer qualities (Environment)	**Inner qualities (Individual)**
Life chances (Opportunities)	Livability of environment (good living conditions)	Life-ability of an individual (coping with the problems of life)
Outcomes (Life results)	Utility of life (functionality of life for environment)	Enjoyment of life (subjective appreciation of life)

Within the domain of healthcare knowledge, most of the time the concept of QoL refers to the one proposed by the World Health Organization (WHO), which defines it as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns" (WHO, 1998). Transposing this definition to Veenhoven's QoL model (Veenhoven, 2013), it fits very well with the perspective of the subjective appreciation of life, i.e., QoL from the individual's perception (Table 1). It is a multidimensional concept and involves biopsychosocial aspects, such as

physical health, psychological state, level of independence, social relationships, personal beliefs, and relationship with the environment (WHO, 1998).

This dissertation adopts the WHO's definition of QoL from now on. This decision is grounded in the broad applicability and significance of the WHO perspective within the healthcare domain, serving as the foundation for numerous research efforts and clinical practices. Moreover, this perspective aligns with various theoretical concepts that are the basis of this dissertation, as will be presented and defined below.

Health-related quality of life (HRQoL) is a term designated to encompass the health-related components of QoL (Guyatt et al., 1993; John, 2021). It is commonly defined as the impact of a medical condition or therapy/intervention as perceived by the patient (Guyatt et al., 1993; John, 2021). Since oral health is part of overall health and is related to a specific region of the human body, involving a wide range of diseases that can affect the patient, the concept of OHRQoL has been developed to address these specificities (John, 2021; Locker, 1988; Locker et al., 2000; Locker & Allen, 2007). Therefore, OHRQoL is a component of HRQoL, initially defined as the impact of orofacial conditions and dental treatments perceived by the patient (Locker, 1988; Locker et al., 2000).

Although this definition is widely known and used in current times (John, 2021), it reflects a simplistic and reductionist perspective of the complexity involved in the concept of OHRQoL. This is because it focuses solely on the impact of oral diseases, disorders, or dental treatments or interventions. Strictly adhering to this definition, it could only be applied to dental patients or individuals with symptoms or conditions in the oral region. Moreover, by emphasizing oral disease or disorder, this notion diverges from the WHO's definition that "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948). Thus, as proposed by Kressin (1997, p. 114), the OHRQoL needs to be understood as "a broad conception of health, encompassing the traditional definition of health, as well as an individual's subjective evaluation of the impact of health on well-being and functioning in everyday life". In this broader view, OHRQoL is a multidimensional concept involving biopsychosocial aspects related to oral health from an individual's perspective (Locker & Allen, 2007; Silvola, 2014), whether they are dental patients or not, and regardless of whether they have any condition affecting the orofacial region or not.

A possible measure of OHRQoL is referred to as patient-reported outcomes (PROs), or more specifically, dental patient-reported outcomes (dPROs), which can be defined as any report on the status of oral health condition, not necessarily an

"outcome", provided directly by a dental patient without interpretation or interference from others (John, 2018, 2021; Mittal et al., 2019; Reissmann, 2019, 2021). Despite its formal definition being limited to dental patients, following the same rationale as the broader concept of OHRQoL, dPROs can also be obtained from individuals in the general population, i.e., non-dental patients (Alhajj et al., 2017; Alhajj et al., 2020; Bimbashi et al., 2015; Campos et al., 2020b; Campos et al., 2022; John et al., 2012; Larsson et al., 2014b).

Even though OHRQoL and dPROs do not necessarily reveal the physical health condition observed on clinical examination, their relevance is growing in dentistry, whether in clinical practice, research, or education (Campos et al., 2020b; Cunningham & Hunt, 2001; Cunningham, 2020; Hua, 2019; John, 2018, 2021; Reissmann, 2019, 2021; Silvola, 2014). In clinical practice, OHRQoL and dPROs measures can evaluate the health outcomes and gains of a treatment from the patient's perspective (Cunningham & Hunt, 2001; John, 2021; Reissmann, 2019; Silvola, 2014). Also, when assessed during the first clinical examination and anamnesis, they may provide initial information about the impact of the disease or disorder perceived by the patient in their life, identifying better the patient's real needs and demands (Campos et al., 2020b; Hua, 2019; Reissmann, 2019). This identification is an important guide in the shared decision-making process between professional and patient, allowing for patient-centered treatment plans (Campos et al., 2020b; Reissmann, 2019). OHRQoL and dPROs measures can also be useful in treatment monitoring, in which the patient's point of view is obtained during treatment progress, and they may also improve dentist-patient interactions (Cunningham & Hunt, 2001).

In research, using OHRQoL and dPROs allows for the formulation of research questions and hypotheses that are relevant for both the academic community (i.e., researchers) and society (Cunningham, 2020; Hua, 2019; John, 2021). This process breaks the traditional hierarchical model in which research protocols are designed and conducted most of the time only and exclusively by the academic community and without the involvement of society. Bringing together and establishing a more horizontal relationship between these parties is essential for designing research that has positive social impacts (Cunningham, 2020), thereby increasing research effectiveness and reducing research waste (Hua, 2019; John, 2021). In addition, OHRQoL and dPROs measures are also important response variables (dependent variables). They serve as indicators for public health (John, 2021), to compare health gains between different types of treatments, and to identify priority treatment groups considering not only the biological and physical findings but also their impact from

the individual's perspective (Cunningham & Hunt, 2001). These findings are important for policymakers in making decisions regarding the organization and financing of health services (Cunningham & Hunt, 2001) and for establishing value-based oral health care, which focuses on the relationship between improving an individual's oral health outcomes and the associated costs involved (John, 2021; Listl, 2019).

For education, the inclusion and/or deepening of OHRQoL measures in training programs allows future or graduated health professionals to have a more holistic approach to their patients (Campos et al., 2022). This is because, through these measures, the professionals can expand their understanding that health is not only the absence of disease or physical problems but also involves the subjective aspect of the individual's perceptions. Thus, it becomes possible to train professionals who see their patients as human beings inserted in a specific social and life context in which the impact of health is perceived in a unique and singular way. Therefore, applying of OHRQoL and its measures, such as dPROs, whether in clinical practice, research, or education, is one of the key components for evidence-based, patient-centered dentistry (Hua, 2019; John, 2021; Reissmann, 2019).

2.2 Conceptual models of OHRQoL

Because OHRQoL is a latent concept, it is necessary that theoretical models, also called conceptual models, be developed to represent it more practically, facilitating the understanding of this concept (John, 2021). Until the 1980s, some conceptual models were proposed to explain certain aspects of OHRQoL (Antonovsky & Kats, 1970; Baldwin, 1980; Grembowski et al., 1989; Locker, 1988; Reisine & Bailit, 1980). Although this term was not yet well defined and usual during that time, these theoretical frameworks aimed to represent patients' perceptions regarding their oral health and dental treatment, considering motivational, psychological, attitudinal, behavioral, and biological factors.

Of these frameworks, the one that stood out and became a reference for OHRQoL studies is the conceptual model proposed by Locker (1988). It is based on oral disease and composed of 5 pathway outcomes called *impairment*, *functional limitation*, *physical and psychological pain and/or discomfort*, *disability*, and *handicap*. This model conceptualizes that the disease leads to *impairment*, which in turn can cause *functional limitation*, *pain and discomfort*, and *handicap*. Furthermore, *physical*, *psychological*, or *social disability* is considered as an intermediate between *functional limitation* and

handicap, as well as between *discomfort* and *handicap*, with the latter being the last outcome. This model also considers a sixth consequence of disease, which is *death*. However, because it is not a common and useful indicator for oral diseases and disorders, *death* is omitted from this model (Silvola, 2014). This conceptual model was tested in a large population sample (Nuttall et al., 2006), and based on the responses, an empirically derived model was created, which retained the outcomes but made some changes or eliminations to certain pathways.

Although the conceptual model proposed by Locker (1988), including its derived model (Nuttall et al., 2006), has been significant and relevant in OHRQoL studies, there are two major issues regarding its current use. Firstly, the theoretical model is based on oral disease and its consequences. In other words, it considers OHRQoL from the perspective of the absence/presence of disease. This deviates from the definition of health by the WHO (1948) and does not include individual and environmental factors that may be related to oral health (Peter et al., 2019). Second, Locker's model (1988) was derived from the 1980 WHO Classification of Impairments, Disabilities, and Handicaps model (WHO, 1980), which is no longer valid since 2001 (John, 2021). Therefore, Locker's model (1988) may not accurately represent the concept of OHRQoL in the current context.

Seeking to identify a more contemporary conceptual model of OHRQoL, John et al. (2014b) conducted a project using secondary data of dPROs from prosthodontic patients and general population in 6 countries. Based on the analysis of this data, a conceptual model with 4 dimensions was proposed, namely *oral function*, *orofacial pain*, *orofacial appearance* (OA), and *psychosocial impact* (Figure 1) (John et al., 2014a; John et al., 2014c; John et al., 2016). Later, Mittal et al. (2019) conducted a systematic review that included 36 different dPROs, which were grouped according to these proposed dimensions. Therefore, although not encompassing OHRQoL in its entirety, these findings suggest that this 4-dimensional conceptual model is a current and applicable theoretical framework in the context of contemporary dental practice (John, 2018).

The 4 dimensions of this model (John, 2018) are pointed out as important in public health and oral healthcare practice as they capture the main reasons an individual seeks dental treatment (John et al., 2020). *Orofacial function* is related to an impairment and the seek for improvement in functions such as chewing, swallowing, and speaking (John, 2018; John et al., 2020). *Orofacial pain* refers to the presence of pain in the teeth, oral cavity, and face (John, 2018; John et al., 2020), considering both its intensity and its impact on the individual's life (Bonafé et al., 2019a, 2019b; Campos et al., 2019a; Campos et al., 2019b).

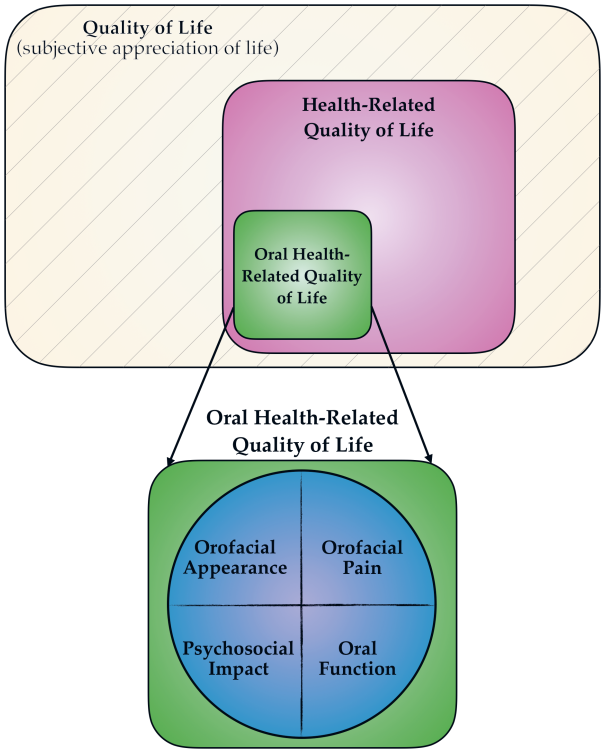


Figure 1. Four-dimensional conceptual model of Oral Health-Related Quality of Life (John, 2018), as a component of Health-Related Quality of Life and Quality of Life from the perspective of subjective appreciation of life.

OA refers to an individual's self-evaluation of their dental, oral, or facial appearance. It can be related to impairments in these appearances (John, 2018; John et al., 2020) or to an individual's desire to improve their appearance, even in the absence of a clinical impairment (Campos et al., 2020b; Campos et al., 2022). *Psychosocial impact* refers to broader psychosocial impacts and/or distress caused by an oral health condition (John, 2018; John et al., 2020). These 4 dimensions are correlated with each other and address broader dimensions of OHRQoL that can be further divided into specific subdimensions (constructs) (John, 2018; John et al., 2020; Mittal et al., 2019).

In the past, *orofacial function* and *orofacial pain* were the main reasons and focuses of dental treatments. However, nowadays, OA has been gaining prominence in the clinical setting, shaping professional practice related to oral healthcare (Campos, 2022; Campos et al., 2022; Larsson et al., 2021). For this reason, the OA dimension and some considerations regarding aesthetic dental treatments will be presented later in this dissertation, as a specific topic in Literature Review (section 2.4, page 35).

2.3 Measuring OHRQoL

Measuring OHRQoL is a challenge because it is a concept that is not directly measurable (latent concept) (Hair et al., 2019; Kline, 2023; Marôco, 2021b; Reissmann, 2021). In clinical practice, the dentist can engage in a conversation to obtain responses from the patients regarding their perceptions related to oral health (Reissmann, 2021). Although this approach is essential for establishing good dentist-patient communication, it does not provide valid and reliable data for measuring OHRQoL (Reissmann, 2021). This is because it occurs in a non-standardized way, where the dentist is often unsure what to ask. Additionally, different personality traits, such as extroversion *vs* introversion, can influence how much an individual speaks and expresses themselves, as well as their assertiveness (Ammi et al., 2023). Furthermore, it can take a long time, involving multiple visits to the clinic, to establish a space for the patient to adequately express themselves and be heard.

All of these aspects make the patient conversation as the sole method for measuring OHRQoL unfeasible to be considered in the treatment planning. Moreover, because it is not a scientific approach that generates valid and reliable data, this method is not suitable for research purposes (Reissmann, 2021). Therefore, the use of standardized methods that limit methodological biases for measuring OHRQoL becomes necessary. One option for this is the use of specific instruments called psychometric scales (Marôco, 2021b).

A psychometric scale is an instrument proposed based on a theoretical background to capture and measure a specific abstract concept (El-Den et al., 2020; John, 2021; Marôco, 2021b). It consists of items where the content reflects a dimension of the abstract concept (construct/latent factor) of interest (El-Den et al., 2020; Marôco, 2021b). The dimensionality of a psychometric scale, i.e., the number of dimensions/factors and how they are reflected by the items, is typically determined in the scale development process (El-Den et al., 2020). This organization of items into different dimensions and how they relate to each other represents the factor structure of the psychometric scale.

Typically, the response scale for items is coded numerically, such as Likert-type scales. Based on the responses given to the items, it is possible to calculate a score for each dimension of the scales' factor structure. This score reflects the individual's position on the spectrum of the latent construct dimension (John, 2021). However, merely applying a psychometric scale that has been described in the literature does not guarantee that the scores obtained from it are valid and reliable.

Validity refers to the degree to which a measure accurately represents what it is intended to measure, while reliability refers to the consistency of the measure (Hair et al., 2019; Marôco, 2021b; Swami & Barron, 2019). Commonly, these properties are attributed to a psychometric scale; however, a scale itself cannot be considered valid and reliable. These properties are inherent to the data/results obtained from the application of a psychometric scale in a specific sample, context, and moment (Marôco, 2021b; Nolte & Elsworth, 2014). Therefore, the previous use of a psychometric scale in various samples does not guarantee the validity and reliability of the data when the same scale is applied to a new sample. Thus, it is necessary to conduct analyses capable of attesting the psychometric properties of a scale when applied to a new sample, context, and/or moment (American Educational Research Association et al., 2014; Hair et al., 2019; Marôco, 2021b; Swami & Barron, 2019).

Moreover, it is necessary to conduct an additional analysis, called measurement invariance, when aiming to compare different samples using a psychometric scale, such as cross-national comparisons (Marôco, 2021b; Nolte & Elsworth, 2014; Swami & Barron, 2019). Measurement invariance verifies whether the scale captures the latent concept similarly across samples. This analysis is mandatory to ensure that the scores obtained by the scale in different samples can be interpreted in the same way, and therefore, directly compared (Bowen & Masa, 2015; Marôco, 2021b; Nolte & Elsworth, 2014). Differences in how the scale captures the latent concept can be observed due to variations in the latent phenomenon among samples and populations, obtaining non-comparable scores. The results of comparisons may lead to erroneous conclusions if measurement invariance is not conducted or if non-invariance is observed (Bowen & Masa, 2015; Nolte & Elsworth, 2014).

The psychometric scales proposed to measure OHRQoL and dPROs are also called dental patient-reported outcome measures (dPROMs) (John, 2018, 2021; Mittal et al., 2019; Reissmann, 2021). In a systematic review, Mittal et al. (2019) identified that, up until the year 2014, 20 dPROMs had been developed and made available in the English language specifically to measure oral health status. However, this number is even higher when considering scales developed or adapted after 2014 (Benson et al., 2016; Campos et al., 2019a; Patel et al., 2016), or those developed to assess general conditions but can be applied to orofacial conditions, such as pain scales applied to orofacial pain (Bonafé et al., 2017; Bonafé et al., 2019a, 2019b; Zucoloto et al., 2015).

Each of dPROMs was proposed to assess one or more narrower dimensions of OHRQoL (Mittal et al., 2019) and to be applied to a specific group, such as children (Benson et al., 2016; Jokovic et al., 2002; Patel et al., 2016; Silva et al., 2023), adult

prosthodontic patients (Larsson et al., 2010a; Larsson et al., 2010b), adult patients with severe dentofacial deformity requesting orthognathic treatment (Cunningham et al., 2000, 2002), and orthodontic patients (Campos et al., 2019a; Klages et al., 2006). Although most dPROMs are grounded in Locker's (1988) conceptual model of OHRQoL, the majority of these scales can be grouped into 4 major dPROs categories (Mittal et al., 2019), which are aligned with the 4-dimensional conceptual model of OHRQoL (*orofacial function*, *orofacial pain*, OA, and *psychosocial impact*) (John, 2021; Reissmann, 2021).

Some examples of dPROMs are Geriatric Oral Health Assessment Index (GOHAI) (Atchison & Dolan, 1990), Oral Health Impact Profile (OHIP) (Slade & Spencer, 1994; Slade, 1997a), Oral Impacts on Daily Performances (OIDP) (Adulyanon & Sheiham, 1997), OES (Larsson et al., 2010a; Larsson et al., 2010b), PIDAQ (Klages et al., 2006), Multidimensional Pain Inventory for orthodontic patients (MPI-Orthodontics) (Campos et al., 2019a), Malocclusion Impact Questionnaire (MIQ) (Benson et al., 2016; Patel et al., 2016), and Orthognathic Quality of Life Questionnaire (OQLQ) (Cunningham et al., 2000, 2002). Among these examples, 3 scales will be highlighted in this dissertation and described below. The first is a shortened version of OHIP, the OHIP-14 (Slade, 1997a), due to its widespread use by both researchers and clinicians (John et al., 2016). The other two are the OES (Larsson et al., 2010a; Larsson et al., 2010b) and the PIDAQ (Klages et al., 2006), both of which are dPROMs proposed to assess OA.

2.3.1 14-item Oral Health Impact Profile (OHIP-14)

The OHIP is a scale that was originally developed in English by Slade and Spencer (1994) to measure self-reported dysfunction, discomfort, and disability attributed to oral conditions, initially targeting the elderly Australian population (Slade, 1997b). This scale was proposed based on Locker's conceptual model of OHRQoL (Locker, 1988) and consists of 49 items distributed in 7 dimensions (*functional limitation*, *physical pain*, *psychological discomfort*, *physical disability*, *psychological disability*, *social disability*, and *handicap*) and has a 5-point Likert-type response scale. Several shortened versions of the OHIP have been proposed in the literature (Allen & Locker, 2002; Castrejón-Pérez & Borges-Yáñez, 2012; John et al., 2004; John et al., 2006; León et al., 2017; Slade, 1997a; Wong et al., 2007), but the most commonly used version is the one with 14 items, the OHIP-14 (Slade, 1997a).

The OHIP-14 was developed by reducing the items of the original OHIP through statistical procedures using data obtained from a sample of elderly Australians (Slade, 1997a). It preserves the 7-factor structure of the original OHIP proposal (Slade & Spencer, 1994). Centered on problems related to the mouth, teeth, or dentures, it includes items about experiencing difficulty pronouncing words, feeling a worsening of taste sensation, facing painful aching in the mouth, discomfort while eating certain foods, self-consciousness, and more. The complete description of item content as well as their allocation within the dimensions can be found in the Methods section of the dissertation (section 4.4.1: Table 3, Figure 3, pages 50–53).

This scale has been translated and culturally adapted into various languages, including Spanish (Montero-Martín et al., 2009), Polish (Rodakowska et al., 2014), Danish (Gera et al., 2020), Arabic (Khalifa et al., 2013), Japanese (Ikebe et al., 2004), Greek (Papagiannopoulou et al., 2012), Persian (Ravaghi et al., 2010), Chinese (Xin & Ling, 2006), German (John et al., 2006), Swedish (Larsson et al., 2014a), Finnish (Lahti et al., 2008), and Portuguese in a Brazilian context (Oliveira & Nadanovsky, 2005). Additionally, the OHIP-14 has been applied to samples and contexts beyond its original proposal, such as the general adult (non-patient) population (Montero et al., 2010; Soares et al., 2021; Xin & Ling, 2006), indigenous population (Soares et al., 2021), young orthodontic patients (Gera et al., 2020), postpartum and pregnant women (Musskopf et al., 2018; Oliveira & Nadanovsky, 2005; Santos et al., 2013), college students (Feng et al., 2022; Yang et al., 2023), and orthosurgical patients (Quintão et al., 2023).

Despite the globally widespread use of OHIP-14, this alone is not sufficient to attest to the validity and reliability of the data. To ensure that it measures the perceived impact of oral health on an individual's life, analytical strategies should be conducted to confirm that the 7-factor structure of OHIP-14 is preserved across different cultures, samples, and contextual settings. While 4 studies, using a sample of the general population of British adults (Nuttall et al., 2006), Brazilian dental patients (Zucoloto et al., 2014), and Chinese dental patients and college students (Feng et al., 2022; Yang et al., 2023), have tested and confirmed the original model of OHIP-14, there are contrasting findings from other studies that refute the 7-factor structure of OHIP (full or shortened version) (Baker et al., 2008; John et al., 2006; John et al., 2014a; John et al., 2014b; Montero et al., 2010; Santos et al., 2013; Soares et al., 2021; Xin & Ling, 2006).

Montero et al. (2010) conducted a study applying the OHIP-14 to a sample of 270 healthy Spanish workers who were undergoing routine medical examinations at an employment risk prevention center. Through both exploratory factor analysis

(EFA) and confirmatory factor analysis (CFA), these authors identified and subsequently confirmed a 3-factor structure of the OHIP-14, calling the dimensions as *functional limitation*, *pain-discomfort*, and *psychosocial impacts* (the items allocation within the dimensions can be found in the Methods – section 4.4.1: Figure 5, page 54). Using EFA and CFA, Santos et al. (2013) identified and confirmed a unifactorial model of the OHIP-14 when it was applied to two different samples: elderly Brazilians with or without oral health impact and postpartum Brazilian women.

Given the different proposals for factor structures of the OHIP-14 (1, 3, or 7 dimensions), and the influence of culture, study population (e.g., dental patients or non-dental patients), and other individual and clinical characteristics on this factor structure, there is still a need for further investigation. This investigation aims to confirm and build evidence as to whether the OHIP-14 preserves the latent concept that is intended to be measured when applied to diverse study populations from different countries.

2.3.2 Orofacial Esthetic Scale (OES) and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ)

The OES and PIDAQ are scales proposed for standardized measurement of self-perceived OA. The OES was originally proposed in the Swedish and English languages to assess the direct impact of OA on prosthodontics patients in Sweden (Larsson et al., 2010a; Larsson et al., 2010b). It is a unifactorial scale consisting of 7 items related to specific physical aspects of the orofacial region (face, facial profile, mouth, gum and alignment, shape and color of teeth) and it measures the dimension of *satisfaction with OA*. The OES also has an eighth item that is not part of the factor structure and assesses the satisfaction with the overall appearance of the face. The response scale is a numeric rating scale with 11 points, ranging from very dissatisfied to very satisfied. The scale in its entirety is presented in the Methods (section 4.4.2, Table 4, page 55).

The OES has already been translated and adapted into Spanish (Simancas-Pallares et al., 2018), French (N'Guyen-Van et al., 2019), German (Reissmann et al., 2015), Arabic (Alhajj et al., 2017), Albanian (Bimbashi et al., 2015), Greek (Togas et al., 2023), Croatian (Persic et al., 2011), Chinese (Zhao & He, 2013), Dutch (Wetselaar et al., 2015), Serbian (Kostić et al., 2023), Italian (Rella et al., 2023), and Portuguese (Campos et al., 2020b). Its use has also been tested with different study populations beyond prosthodontic patients, such as general dental patients (Campos

et al., 2020b; Rella et al., 2023; Simancas-Pallares et al., 2018; Togas et al., 2023; Wetselaar et al., 2015; Zhao & He, 2013) and the general population not undergoing dental treatment (Alhajj et al., 2017; Bimbashi et al., 2015; Campos et al., 2020b; John et al., 2012). The unifactorial structure has been confirmed in the translated versions when applied to different samples (Alhajj et al., 2017; Bimbashi et al., 2015; Campos et al., 2020b; John et al., 2012; Kostić et al., 2023; Persic et al., 2011; Reissmann et al., 2015; Rella et al., 2023; Simancas-Pallares et al., 2018; Togas et al., 2023; Wetselaar et al., 2015; Zhao & He, 2013).

The PIDAQ was proposed in German and English (Klages et al., 2006) to assess the impact of dental aesthetics on individuals' lives. It contains 23 items distributed in 4 dimensions (*dental self-confidence*, *social impact*, *psychological impact*, and *aesthetic concern*) and the response scale is a 5-point Likert-type scale. Participants respond to statements reflecting their attitudes, including avoiding looking at their own teeth in the mirror, holding back smiles to hide teeth, envying others' teeth, feeling satisfied or dissatisfied with their teeth, and concerns about how others perceive their teeth. For a detailed list of all items and their allocation within the dimensions, refer to the Methods section (section 4.4.3: Table 5, Figure 7, pages 56–59).

The PIDAQ has been translated and adapted into various languages and cultures, such as Spanish (Montiel-Company et al., 2013), Chinese (Lin et al., 2013), Croatian (Spalj et al., 2014), French (Ngom et al., 2013), Albanian (Ilijazi-Shahiqi et al., 2020), Italian (Bucci et al., 2015), Arabic (Alharbi et al., 2020), Swedish (Göranson et al., 2021), and Portuguese (Sardenberg et al., 2011). Despite its original proposal for application in young orthodontic patients (Klages et al., 2006), the PIDAQ has been extensively used in different clinical and epidemiological contexts (Bonafé et al., 2021; Campos et al., 2020a; Carbajal et al., 2022; Estay et al., 2020; Kovacevic Pavicic et al., 2019; Militi et al., 2021; Silva et al., 2022; Wang et al., 2021).

Although the 4-factor structure of the PIDAQ has been confirmed when applied to different samples and contexts (Bucci et al., 2015; Campos et al., 2020a; Ilijazi-Shahiqi et al., 2020; Montiel-Company et al., 2013; Spalj et al., 2014), some other studies have pointed to different factor structures (Alharbi et al., 2020; Bucci et al., 2017; Göranson et al., 2021; Lin et al., 2013). However, these last studies used only an exploratory data analysis strategy (EFA), without any subsequent confirmation of the new factor structure (CFA) or comparison between different factor structures. Because the 4-factor structure of the PIDAQ was defined *a priori* during its development, the first analytical step should be the confirmation or refutation of this structure using CFA (Marôco, 2021b). The EFA should be conducted only in the case of refutation or suspicion of the need for theoretical readjustment of the latent

construct underlying a psychometric scale (Marôco, 2021b). To date, no plausible theoretical justification or solid evidence has been found to justify alterations in the factor structure of PIDAQ. Therefore, the original proposal should be primarily considered in future investigations of its psychometric properties.

Due to their extensive use in different samples and cultures and their good psychometric properties, both the OES and the PIDAQ complement each other in providing a more accurate measurement of self-perception of OA (Campos, 2022). Before the beginning of the development of this dissertation, no Finnish version of either scale was found.

2.4 Orofacial appearance (OA): an important dimension of the OHRQoL

As previously mentioned, the OA dimension of OHRQoL, and consequently aesthetic dental treatments, have been gaining prominence within the field of dentistry (Campos, 2022; Campos et al., 2022; Larsson et al., 2021). To explain this phenomenon, it is necessary first to understand the social role of the physical appearance of the body. In both historical and contemporary contexts, the body represents the existence of individuals and societies, having a crucial influence on the functioning and dynamism of a society (Anderson-Fye, 2012; Eckel & Petrie, 2011; Lopes, 2011; Todorov, 2017; Woller, 2018). Its significance lies in its role as a tool for self-expression, with physical appearance impacting various aspects of an individual's life, particularly social interactions (Campos, 2022; Lopes, 2011; Pithon et al., 2014; Woller, 2018).

Although the human body is a unified biological entity comprising interconnected parts, individuals perceive the body parts differently when constructing a mental representation of their own body, known as body image (Schilder, 2013). Frederick et al. (2014) investigated satisfaction with different body parts in a sample of North Americans. Through EFA, the authors observed that the face components were allocated in a distinct factor from the other body components. A recent study (Campos et al., 2022) was conducted on a sample of adult Brazilians aiming at the elaboration of a body image model that simultaneously considers different body components and parts. As a result, a distinction was observed between self-perception of OA and other body parts.

The findings of these studies (Campos et al., 2022; Frederick et al., 2014) suggest that the face is interpreted and perceived differently compared to other body parts.

A possible explanation for this difference is that the orofacial region occupies a prominent space in interpersonal relationships (Bauer et al., 2012; Le Breton, 2015, 2019). Besides verbal communication, the orofacial region is described as the richest and most powerful tool for nonverbal communication (e.g., facial expressions) (Jack & Schyns, 2015). It also plays a significant role in recognizing individuals and constructing one's own identity (Le Breton, 2015, 2019; Mielke et al., 2022; Rahtz et al., 2018).

In addition, first impressions about an individual's personality and moral, behavioral, and social characteristics are shaped through OA (Eckel & Petrie, 2011; Holden, 2020; Le Breton, 2015; Sutherland & Young, 2022; Todorov, 2017; Woller, 2018). Upon a brief initial observation of one's face, individuals are able to judge attributes such as honesty, kindness, intelligence, task competence, attractiveness, and belongingness to a particular social group (Holden, 2020; Sutherland & Young, 2022; Todorov, 2017). Although these initial impressions exhibit limited accuracy (Todorov, 2017), they give rise to privileges and disadvantages based on OA, shaping social behavior and decision-making processes (Ahmed et al., 2023; Sutherland & Young, 2022). Examples of this impact can be observed in everyday situations, such as job seeking or searching for a romantic partner (Eckel & Petrie, 2011; Pithon et al., 2014; Todorov, 2017).

Individuals, as members of a society, internalize and recognize the importance of appearance, including OA, in their social interactions (Woller, 2018). They are constantly evaluating whether their physical attributes match their inner qualities or what they would like to look like to others (Campos, 2022; Woller, 2018). This evaluation is based on comparisons between the mental image they have constructed of their own OA with sociocultural standards and ideals of beauty. At times, these standards and ideals may deviate from reality and increasingly become illusory, often unattainable (Campos, 2022; Campos et al., 2022; MacCallum & Widdows, 2018). Consequently, when faced with a dissonance between their self-perception of their OA and the socially established standards, individuals may experience dissatisfaction with their OA, leading them to adopt behaviors aimed at altering it (Campos, 2022; Campos et al., 2022). Undergoing aesthetic procedures (Gillen & Markey, 2021), including aesthetic dental treatments, are among these behaviors.

2.4.1 Aesthetic dental treatments

The role of OA in dental treatments is not a novel concept. Studies discussing this topic can be traced back to the 1950s (Ament & Ament, 1970; Baldwin, 1980; Goldstein, 1969; Klima et al., 1979; Riedel, 1950). However, the context and discussion at that time differ from those of today. Early literature limited to how conventional dental treatments, primarily focused on function, could enhance the patient's OA. The advancements in materials, technology, and techniques have led to a shift in contemporary discussions, where new and conventional dental treatments aim primarily or even exclusively at improving OA. Examples of these treatments include dental whitening, orthodontics, and veneers.

Although not addressed or investigated in this dissertation, it is worth mentioning some treatments that go beyond the scope of mouth, teeth, and smiles, such as botulinum toxin, facial fillers, removal of buccal fat of the cheeks (bichectomy), and facial liposuction (Arellan, 2022; Li et al., 2022). These are aesthetic treatments aimed at altering OA, either with a rejuvenating effect or by reshaping facial features. They can be combined with intraoral dental treatments to provide greater aesthetic appeal and outcomes for the patient (Bhat et al., 2018; Laorpipat et al., 2022; Tran Cao, 2020). These treatments have been impacting the field of dentistry not only in the planning of the treatment but also in the professional practice. In some countries, such as Brazil, dental practitioners are now legally competent to perform these procedures (Arellan, 2022; Campos, 2022; Conselho Federal de Odontologia, 2019, 2020).

Given the importance of OA in societies and the now large availability of aesthetic dental treatments, the literature in the last two decades has stated a growing demand for these procedures (Abbasi et al., 2022; Samorodnitzky-Naveh et al., 2007; Tin-Oo et al., 2011; Wulfman et al., 2010). This statement is widely recognized and reported in clinical dental practice and some studies, described below, have aimed to quantify the desire or demand for aesthetic dental treatments. In a sample of young Israeli dental patients (n = 407, 18-26 years old), Samorodnitzky-Naveh et al. (2007) found that 77.4% expressed a desire to improve the appearance of their teeth. Wulfman et al. (2010) found that 38.0% of a sample of French seniors (n = 3.868, age ≥ 55 years old) had a desire to change their smile, with higher desires reported among women and younger participants.

Silva et al. (2018) conducted a study with a sample of Brazilians aged 31 years (n = 536), in which 81.9% of the participants reported interest in undergoing tooth whitening treatment. In another study conducted in Brazil, Campos et al. (2020a)

found that 71.5% of a sample of 505 dental patients [mean age: 36.3, (standard deviation (SD) = 11.4) years] had already undergone some kind of aesthetic dental treatment. A study conducted in Saudi Arabia (Al-Ansari et al., 2020) revealed that 49.5% of a sample of first-year dental students and clinic patients [n = 283, mean age: 26.9 (SD = 10.9) years] intended to seek aesthetic dental treatments. Additionally, for orthodontic patients in the same country (n = 417, 18-30 years old), Felemban et al. (2022) identified that the primary reason for seeking treatment was to enhance the appearance of their smiles.

On the other hand, a study (Dudea et al., 2012) conducted with 540 Romanians, ranging from teenagers to individuals older than 60 years [mean age: 35.9 (SD = 13.2)], revealed that this particular sample was not actively seeking aesthetic dental treatments, with only 18.0% citing aesthetics as the primary reason for visiting dental offices. In a study conducted in Finland, Forssell et al. (1998) observed that in a sample of 100 individuals who underwent orthognathic surgery (aged 17 to 55 years), functional motives were markedly more important than aesthetic motives when seeking this treatment.

Based on the aforementioned results, it seems that cultural and sociodemographic factors, such as sex and age, have influence the demand for aesthetic dental treatment. However, there is a lack of studies that investigate this demand simultaneously in different sociodemographic characteristics and countries. Furthermore, it is important to consider that the demand for aesthetic dental treatment is a behavior that also involves individual perspectives and perceptions, with self-perception of OA rising in importance and deserving further understanding.

2.4.2 Self-perception of OA

The complexity in understanding the perception of OA occurs because part of its variability among individuals is explained by idiosyncratic differences (Martinez et al., 2020). Cultural environments and life experiences significantly contribute to the construction of this perception, making it unique and distinct for each individual (Martinez et al., 2020). Nonetheless, there is also a shared contribution of demographic and cultural characteristics to the variability of perceptions, resulting in a degree of agreement among individuals (Martinez et al., 2020). While they do not fully explain perception, those are the characteristics extensively investigated in scientific research to achieve consensus on perception of OA in groups with similar

sample characteristics (Alhajj et al., 2020; Campos et al., 2020a; Campos et al., 2020b; Cunningham et al., 1995; Tin-Oo et al., 2011; Tong et al., 2017).

Regarding individual characteristics, Campos et al. (2020a) found in a sample of Brazilian dental patients [n = 505; mean age: 36.3 (SD = 11.4) years] that those with lower economic status, who had never undergone aesthetic dental treatment, and who were dissatisfied with their own smile, reported a greater psychosocial impact of dental aesthetics on their lives. In another study with the general Brazilian population [n = 1,072; mean age: 25.7 (SD = 5.7) years], Campos et al. (2020b) observed that individuals with higher economic status showed higher satisfaction with OA. It was observed that sex and age were not significantly related to self-perception of OA in both studies (Campos et al., 2020a; Campos et al., 2020b). This latter finding was similar to that found by Alhajj et al. (2020) in a sample of 268 dental patients from Yemen [mean age: 29.8 (SD = 9.2) years].

Contrarily, some other studies have pointed to a significant influence of sex and age variables on the self-perception of OA (Carlsson et al., 2014; Garg et al., 2017; Isiekwe et al., 2014; Kang & Kang, 2014; Kovacevic Pavicic et al., 2019; Romero-Maroto et al., 2015). However, the results of these studies are ambiguous, with no consensus on which category has better or worse self-perceptions of OA (i.e., women *vs* men, younger *vs* older individuals). These contradictions may arise from various reasons. One of them is the difference in study methodologies, where there is a lack of standardization in OA measurement and/or the utilization of statistical analyses that do not preserve the latent nature of this variable. Additionally, the studies were conducted using samples with different clinical and cultural characteristics, which can affect the influence of sociodemographic characteristics on the self-perception of OA.

Regarding cultural characteristics, there is a common belief that different cultures have distinct perceptions related to physical aspects, including OA (Tin-Oo et al., 2011). This is known as Culture-Specific Theory (Tong et al., 2017). On the other hand, other authors (Cunningham et al., 1995; Tong et al., 2017) have observed a cross-cultural agreement in the perception of physical traits, referred to as Cross-Cultural Coherence Theory (Tong et al., 2017). Hence, studies conducting cross-cultural comparisons and considering the latent nature of self-perception of OA become relevant for a better understanding of its construction by the individual.

2.5 Well-being and Satisfaction with Life Scale (SWLS)

Well-being can be defined as "a positive state experienced by individuals" (WHO, 2021). This concept is commonly referred to as subjective well-being and closely aligns with the aspect of *enjoyment of life* in Veenhoven's QoL model (Veenhoven, 2013) (Table 1, page 23). Life satisfaction is a cognitive aspect of subjective well-being from a hedonic perspective. This satisfaction involves the individual's judgment of how satisfied they are with life in general, based on comparisons with internalized standards (Diener et al., 1985; Pavot & Diener, 2008). Like OHRQoL, life satisfaction is a latent construct and, therefore, requires a psychometric scale for its measurement. The SWLS (Diener et al., 1985; Pavot & Diener, 2008) is an option for this measurement, allowing individuals to evaluate their life overall based on their own values, without considering specific aspects that may influence life satisfaction.

The SWLS is a unifactorial scale comprising 5 items with a 7-point Likert-type response format (Diener et al., 1985). The content of the items encompasses factors such as the proximity of participants' life to their ideal, the excellence of life conditions, and their satisfaction with life. The complete scale is presented in the Methods (section 4.4.4: Table 6, page 60). It was originally developed in English (Diener et al., 1985) and translated and adapted into various languages (Arrindell et al., 1999; Glaesmer et al., 2011; Pons et al., 2000; Realo & Dobewall, 2011; Sachs, 2003), including Portuguese (Gouveia et al., 2005) and Finnish (Realo & Dobewall, 2011). It has also demonstrated adequate psychometric properties when applied in different samples and contexts (Cerezo et al., 2022; Dirzyte et al., 2021; Espejo et al., 2021; Silva et al., 2021).

2.6 Impact of OA on well-being

After identifying the construction of self-perception of OA, estimating the impact of it on individuals' well-being is another important point to be considered. In the realm of psychology studies, a relationship between body image and well-being has been observed (Becker et al., 2019; Davis et al., 2020; Frederick et al., 2016; McLean et al., 2020; Sánchez-Cabrero et al., 2020; Swami et al., 2018; Zuffianò et al., 2018). Negative components of body image, such as body shame, have a negative impact on well-being (Becker et al., 2019; Davis et al., 2020; McLean et al., 2020), whereas positive components are positively related to social, psychological, emotional, and cognitive well-being (Davis et al., 2020; Frederick et al., 2016; Sánchez-Cabrero et

al., 2020; Swami et al., 2018; Zuffianò et al., 2018). These studies have taken into consideration the individuals' mental construction of physical appearance components, focusing only on the body from the neck down, thus excluding OA.

In turn, OA holds a privileged position in the physical appearance of the body (Campos et al., 2022; Larsson et al., 2021). Due to its role in an individual's oral health experience (John, 2021; Larsson et al., 2021) and its significance in social interaction and communication (Bauer et al., 2012; Jack & Schyns, 2015; Le Breton, 2015, 2019), there is often speculation and theorization about a direct impact of OA components on well-being (Davis et al., 1998; Larsson et al., 2021; Paulson et al., 2021; Wolfart et al., 2006), similar to what has been observed using body image components. However, there is a scarcity of studies that have directly measured this impact. Despite an exhaustive search, only one study was identified measuring this. In a sample of Brazilian adults (n = 1,940; age: 18-40 years old), Campos et al. (2022). observed that OA, measured by OES and PIDAQ, explained 9.9% to 14.3% of the variance in life satisfaction. Higher satisfaction with OA and lower psychosocial impact of dental aesthetics were associated with greater life satisfaction.

Given the significance of physical appearance in well-being and considering that OA explains approximately a tenth of life satisfaction (Campos et al., 2022), further investigation into this last relationship could be valuable for advancing evidence on this topic. It may contribute to the education and practice of healthcare professionals, providing them with a more holistic perspective and knowledge to develop patient-centered treatment plans (Campos, 2022; Campos et al., 2022). It may also provide support for discussions about the social role of dentistry in different cultures. For this investigation, it is also necessary to consider different sociodemographic variables, such as sex, age, and socioeconomic status. These variables may influence the self-perception of OA (Alhajj et al., 2020; Campos et al., 2020a; Campos et al., 2020b; Cunningham et al., 1995; Tin-Oo et al., 2011; Tong et al., 2017) and act as moderating factors in the relationship between OA and well-being.

3 AIMS OF THE STUDY

The general aims of this dissertation were to verify the psychometric properties of the OHIP-14 when applied to diverse samples and to cross-culturally compare the self-perception of OA, demand for aesthetic dental treatment, and the impact of OA on life satisfaction between Finland and Brazil. To address them, the specific objectives of the study were:

1. to evaluate the differential functioning of OHIP-14 items and the fit of different factor models of this scale in non-dental and dental patient samples from Finland and Brazil (**Publication I**).
2. to translate, culturally adapt, and estimate the psychometric properties of the Finnish version of the OES and the PIDAQ (**Publication II**).
3. to study the measurement invariance of the OES and the PIDAQ between Finland and Brazil (**Publication III**).
4. to study the frequency of individuals who have sought or received any aesthetic dental treatment between Finland and Brazil (**Publication III**).
5. to compare the satisfaction with OA and the psychosocial impact of dental aesthetics between Finnish and Brazilian populations, as well as according to sex, monthly income, and age (**Publications III and IV**).
6. to study the probability of Finnish and Brazilian adults seeking and undergoing aesthetic dental treatment according to sex, monthly income, and age (**Publication IV**).
7. to estimate the impact of self-perception of OA on life satisfaction in Finnish and Brazilian adults, considering the indirect effect of receiving aesthetic dental treatment and the moderating effects of sex, monthly income, and age on this impact (**Publication IV**).

4 SUBJECTS AND METHODS

4.1 Study design and sampling

All publications present cross-sectional studies with non-probabilistic convenience samples. Two data collections were conducted in Brazil, and one in Finland, inviting adults over 18 years old from both countries to participate in the studies. In addition, a sample of Brazilian dental patients from a previous study (Zucoloto et al., 2014) was included in **Publication I** for comparative purposes. For the analyses, only participants up to the age of 40 were included in **Publication I** to limit the effect of age and ensure comparability across samples and subsamples. In **all publications**, participants who did not respond to one or more items of the measurement scales were not included in the analyses.

The minimum sample size for each publication was calculated based on the analyses that require a larger sample size, such as CFA or structural equation modeling. The approach used for this calculation was that proposed by Hair et al. (2019), who recommend a minimum of 5-10 participants per parameter of the factor/structural model to be estimated. In **Publication I**, the largest model to be tested has 42 parameters (OHIP-14 model with 7 first-order factors), resulting in a minimum sample size of 210-420 participants. In **Publications II** and **III**, the largest factor model has 54 parameters (PIDAQ), with a minimum sample size of 270-540 participants. In **Publication IV**, it was considered a priori that 28 parameters would be estimated in the structural model, thus requiring a minimum sample size of 140-280 participants. The minimum sample size should be reached in each country. To increase the variability and representativeness of the data and reach the minimum sample size in subsamples of interest (i.e., test and validation samples, dental patient and general population/non-dental patient, male and female, monthly income classes, or age categories), a larger number of participants were recruited in each country than the minimum sample size.

4.2 Procedures and ethical aspects

The first data collection in Brazil was conducted from August 2018 to December 2019 for **Publication I**. Initially, adult patients being treated at the dental clinics (periodontology, dentistry, emergency, prosthodontics, oral medicine, and surgery clinics) of the School of Dentistry of Araraquara, São Paulo State University (UNESP), and the employees of the same institution were invited to participate in the study. They needed to agree to participate in the study and then sign an informed consent. Then, a snowball sampling strategy was used to recruit more participants. For that, after completing the data collection, the participants were asked to invite their colleagues and family members to participate in the research. Participants completed a self-administered demographic questionnaire followed by the OHIP-14 using the paper-and-pencil method.

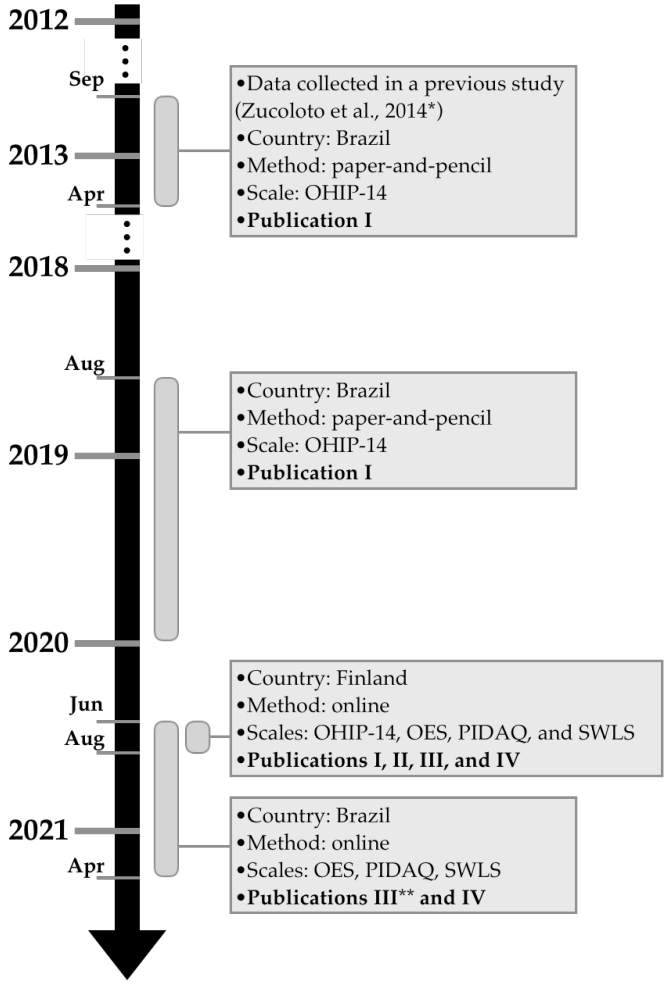
The data collection in Finland and the second one in Brazil were initially conducted between June and July 2020 using an online survey. This strategy was the most viable due to the onset of the COVID-19 pandemic, which imposed social isolation and made it impossible to use the paper-and-pencil collection strategy as previously done in Brazil. Students and staff from three universities in Finland (Tampere University, Tampere University of Applied Sciences, and University of Oulu) and from five public universities in the São Paulo State, Brazil [UNESP, University of São Paulo (USP), State University of Campinas (UNICAMP), Federal University of São Paulo (UNIFESP) and Federal University of São Carlos (UFSCAR)] were invited to participate in the study through institutional email. The invitation email included information on the aims of the study, ethical approval, and a link to the online survey. The survey was created using LimeSurvey software (LimeSurvey GmbH, Hamburg, Germany; http://www.limesurvey.org) on the server of Tampere University, Finland.

To begin the online survey, participants had to agree to participate in the study and then provide informed consent. The demographic questionnaire was presented first, followed by the measuring scales in random order (Finland: OHIP-14, OES, PIDAQ, and SWLS; Brazil: OES, PIDAQ, and SWLS). At the end of the survey, participants were asked to forward the invitation message and survey link to their contacts via email or social media (snowball sampling). In Brazil, the response rate to the survey was lower than in Finland, so the link had to remain open until March 2021 to obtain a similar sample size in both countries.

The data collected online in Finland were used in **all Publications**, and those collected online in Brazil were used in **Publications III** (partial data collected from

June to July 2020) and **IV** (total data collected from June 2020 to March 2021). Information and timeline of the data collections can be found in Figure 2.

The studies were approved by the Data Protection Officer at Tampere University, in accordance with the European Union's General Data Protection Regulation, and by the Research Ethics Committee of UNESP, School of Dentistry, Araraquara (CAAE: 01040312.5.0000.5416 and 88600318.3.0000.5416).



OHIP-14: 14-item Oral Health Impact Profile; OES: Orofacial Esthetic Scale; PIDAQ: Psychosocial Impact of Dental Aesthetics Questionnaire; SWLS: Satisfaction with Life Scale. *Zucoloto, M. L., Maroco, J., & Campos, J. A. D. B. (2014). Psychometric Properties of the Oral Health Impact Profile and New Methodological Approach. *Journal of Dental Research*, 93(7), 645-650. **In Publication III, partial data obtained between June and July 2020 were used.

Figure 2. Information and timeline of the data collections.

4.3 Study variables

In **Publication I**, information on sex (male, female, or other/not informed), age, and whether the individual was a dental patient was collected. For this publication, the sample obtained in each country was divided into two subsamples: dental patient and non-dental patient. In addition to these variables, in **Publications II, III,** and **IV**, information on marital status (single, married/common law/stable relationship, divorced, widower), monthly income, whether the individual likes his/her own smile, if anything bothers the individual about his/her smile, and whether the individual has sought or received any aesthetic dental treatment was collected.

The monthly income was collected based on information from Statistics Finland (2023) and *Centro de Políticas Sociais–FGV Social* (2023) and was categorized in Finland as 1: < 2,500 €; 2: 2,500 ├ 5,000 €; 3: 5,000 ├ 7,500 €; 4: 7,500 ├ 10,000 €; 5: ≥ 10,000 €; and in Brazil as 1: < R$ 1,255; 2: R$ 1,255 ├ 2,005; 3: R$ 2,005 ├ 8,641; 4: R$ 8,641 ├ 11,262; 5: ≥ R$ 11,262. For the analyses in **Publication IV**, although age was collected in years, it was categorized according to the 25th, 50th, 75th, and 90th percentiles when considering the samples from both countries simultaneously (1: < 23 years, 2: 23 ├ 29 years, 3: 29 ├ 39 years, 4: 39 ├ 52 years, and 5: ≥ 52 years).

For information on aesthetic dental treatment, the participants were asked to report whether they had sought or undergone any intraoral treatment primarily focused on enhancing appearance. Examples and predefined options were provided for participants to specify the type of aesthetic dental treatment (restorative procedures such as fillings and dental veneers, prosthetic treatments, orthodontics, and teeth whitening). Participants had the option to select "other" and specify the treatment if it did not align with any predefined categories or if they were uncertain about the category. In such cases, each response was individually reviewed by the researchers, and only intraoral treatments were considered for the analysis.

The characterization of the samples of each publication is presented in Table 2. In **Publication I**, most participants in all samples were female, and the mean age ranged between 26.6 and 29.0 years. In **Publications II, III,** and **IV**, the mean age of participants in the samples was 32.0–33.2 years and most participants were female, single, and not undergoing dental treatment. Regarding monthly income, 67.5% of Finnish participants being in the two lowest income categories (<5,000 €/month), while 17% of the Brazilian sample were in the two lowest categories (<R$ 2,005/month), suggesting a difference between the samples. However, although the monthly income categories follow standardized information from research institutes in each country (Statistics Finland, 2023; *Centro de Políticas*

Sociais–FGV Social, 2023), the same categories cannot be compared between countries as they represent distinct socioeconomic conditions. Therefore, direct comparisons between monthly income categories and countries were not conducted in this dissertation.

Table 2. Sample characterization according to each publication.

		Publication I*			Publications II, III, and IV		
		Fi[a]	Br[b]	Br[c] – Zucoloto et al.	Fi[a]	Br[d] – Partial	Br[d] – Total
n		2,907	1,930	439	3,636	1,468	3,979
Mean age in years (standard deviation)		26.6 (5.5)	25.0 (5.8)	29.0 (6.7)	32.0 (11.6)	33.2 (13.1)	33.0 (12.1)
Characteristic (%)							
Sex							
Male		22.4	30.2	26.0	23.4	27.1	29.8
Female		76.0	69.8	74.0	75.0	72.6	69.9
Other/not informed		1.6	-	-	1.6	0.3	0.3
Dental patient							
No		83.4	77.5	-	83.6	77.5	79.4
Yes		16.6	22.5	100.0	16.4	22.5	20.5
Marital status							
Single		-	-	-	66.5	62.3	59.8
Married/common law/stable relationship		-	-	-	28.8	32.9	35.4
Divorced		-	-	-	4.5	4.0	4.3
Widower		-	-	-	0.2	0.8	0.5
Monthly income							
Fi (€)	Br (R$)						
< 2,500	< 1,255	-	-	-	44.7	4.2	6.4
2,500 ├ 5,000	1,255 ├ 2,005	-	-	-	22.8	11.0	10.4
5,000 ├ 7,500	2,005 ├ 8,641	-	-	-	14.3	47.6	45.7
7,500 ├ 10,000	8,641 ├ 11,262	-	-	-	8.7	16.3	16.3
≥ 10,000	≥ 11,262	-	-	-	9.5	20.9	21.2
"Do you like your smile?"							
No		-	-	-	26.2	22.5	22.1
Yes		-	-	-	73.8	77.5	77.9
"Does anything bother you about your smile?"							
No		-	-	-	37.7	29.0	34.0
Yes		-	-	-	62.3	71.0	66.0

(Continued)

Table 2. Continued.

	Publication I*			Publications II, III, and IV		
	Fi[a]	Br[b]	Br[c] – Zucoloto et al.	Fi[a]	Br[d] – Partial	Br[d] – Total
"Have you sought or received any aesthetics dental treatment?"						
I have never sought aesthetic dental treatment	-	-	-	59.5	18.1	22.1
I have sought aesthetic dental treatment, but have not received it	-	-	-	2.1	10.0	10.4
I have received aesthetics dental treatment	-	-	-	36.2	63.4	58.2
I am currently receiving aesthetics dental treatment	-	-	-	2.2	8.5	9.3

Fi: Finland; Br: Brazil. *Age of the sample was limited up to 40 years to control for its effect on the dependent variable and ensure comparability across samples. [abcd]Similar lowercase letters indicate samples obtained from the same data collection (see Figure 2, page 47). [c]Data obtained from previous study: Zucoloto, M. L., Marôco, J., & Campos, J. A. D. B. (2014). Psychometric Properties of the Oral Health Impact Profile and New Methodological Approach. *Journal of Dental Research*, 93(7), 645-650. [d]Partial sample was used in **Publication III** and Total sample in **Publication IV**.

4.4 Measuring scales

4.4.1 OHIP-14

The Portuguese (Oliveira & Nadanovsky, 2005) and Finnish (Lahti et al., 2008) versions of the OHIP-14 (Slade, 1997a) were used to measure the impact of oral health on individuals' lives (Table 3). This scale contains 14 items with a 5-point Likert response scale (0: never, 1: hardly ever, 2: occasionally, 3: fairly often, and 4: very often). The OHIP-14 factor model was originally proposed by Slade (1997a) following the conceptual model of oral health proposed by Locker (1988) and containing 7 first-order factors (*functional limitation*, *physical pain*, *psychological discomfort*, *physical disability*, *psychological disability*, *social disability*, and *handicap*) (Figure 3.a).

Considering this factor model, Zucoloto et al. (2014) confirmed the possibility of obtaining a second- and third-order hierarchical model (second-order factors: *physical*, *psychological*, and *social*; Figure 3.b and c). Additionally, studies suggest other factor structures for the OHIP-14, such as the unifactorial model (Figure 4) (Santos et al., 2013) and the trifactorial model (factors: *psychosocial impacts*, *pain-discomfort*, and *functional limitation*, Figure 5) (Montero et al., 2010). All these factor models were tested in **Publication I**.

Table 3. 14-item Oral Health Impact Profile (OHIP-14).

	English version*	Portuguese version**	Finnish version#
Instruction	How often have you had the following oral health problems in the last year?	Gostaríamos de saber a frequência com que cada um dos problemas listados abaixo ocorreu com você durante o último ano	Kuinka usein teillä on ollut seuraavia suun terveyteen liittyviä ongelmia viimeisen vuoden aikana? Valitse vastausvaihtoehto joka kuvaa tilannettasi.
Response scale	0 = Never 1 = Hardly ever 2 = Occasionally 3 = Fairly often 4 = Very often	0 = Nunca 1 = Raramente 2 = Às vezes 3 = Frequentemente 4 = Sempre	0 = Ei lainkaan 1 = Hyvin harvoin 2 = Joskus 3 = Melko usein 4 = Hyvin usein
Item			
It1	Have you had trouble pronouncing any words because of problems with your teeth, mouth, or dentures?	Você teve problemas em pronunciar alguma palavra por causa de problemas com seus dentes, boca ou dentaduras?	Onko teillä ollut vaikeuksia sanojen lausumisessa hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It2	Have you felt that your sense of taste has worsened because of problems with your teeth, mouth, or dentures?	Você sentiu que o seu paladar piorou por causa de problemas com seus dentes, boca ou dentaduras?	Onko teistä tuntunut, että makuaistinne on heikentynyt hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It3	Have you had painful aching in your mouth?	Você teve dores em sua boca?	Oletteko tuntenut suussanne kipua tai särkyä?
It4	Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth, or dentures?	Você já achou desconfortável mastigar algum alimento por causa de problemas com seus dentes, boca ou dentaduras?	Onko teidän ollut hankala syödä joitakin ruokia hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It5	Have you been self-conscious because of your teeth, mouth, or dentures?	Você esteve preocupado por causa de problemas dentários?	Oletteko ollut vaivautunut hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It6	Have you felt tense because of problems with your teeth, mouth, or dentures?	Você se sentiu tenso por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko tuntenut olonne jännittyneeksi tai kireäksi hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It7	Has your diet been unsatisfactory because of problems with your teeth, mouth, or dentures?	Sua alimentação ficou prejudicada por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko joutunut hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia noudattamaan ruokavaliota, johon ette ole tyytyväinen?
It8	Have you had to interrupt meals because of problems with your teeth, mouth, or dentures?	Você teve que parar suas refeições por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko joutunut keskeyttämään ruokailun hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It9	Have you found it difficult to relax because of problems with your teeth, mouth, or dentures?	Você teve dificuldade de relaxar por causa de seus dentes, boca ou dentaduras?	Onko teidän ollut vaikea rentoutua hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It10	Have you been a bit embarrassed because of problems with your teeth, mouth, or dentures?	Você ficou envergonhado por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko ollut hämmentynyt tai nolostunut hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?

(Continued)

Table 3. Continued.

	English version*	Portuguese version**	Finnish version#
It11	Have you been a bit irritable with other people because of problems with your teeth, mouth, or dentures?	Você ficou um pouco irritado com outras pessoas por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko ollut ärtyisä muiden ihmisten seurassa hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It12	Have you had difficulty doing your usual jobs because of problems with your teeth, mouth, or dentures?	Você teve dificuldades em fazer suas atividades diárias por causa de problemas com seus dentes, boca ou dentaduras?	Onko teillä ollut vaikeuksia jokapäiväisissä askareissanne hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It13	Have you felt that life in general was less satisfying because of problems with your teeth, mouth, or dentures?	Você sentiu que a vida em geral ficou pior por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko mielestänne ollut tyytymätön elämäänne hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?
It14	Have you been totally unable to function because of problems with your teeth, mouth, or dentures?	Você ficou totalmente incapaz de exercer qualquer atividade por causa de problemas com seus dentes, boca ou dentaduras?	Oletteko ollut täysin toimintakyvytön hampaistanne, suustanne tai proteeseistanne johtuvien ongelmien takia?

*Slade, G. D. (1997). Derivation and validation of a short-form oral health impact profile. *Community Dentistry and Oral Epidemiology*, 25(4), 284-290. **Oliveira, B. H., & Nadanovsky, P. (2005). Psychometric properties of the Brazilian version of the Oral Health Impact Profile-short form. *Community Dentistry and Oral Epidemiology*, 33(4), 307-314. #Lahti, S., Suominen-Taipale, L., & Hausen, H. (2008). Oral health impacts among adults in Finland: competing effects of age, number of teeth, and removable dentures. *European Journal of Oral Sciences*, 116(3), 260-266.

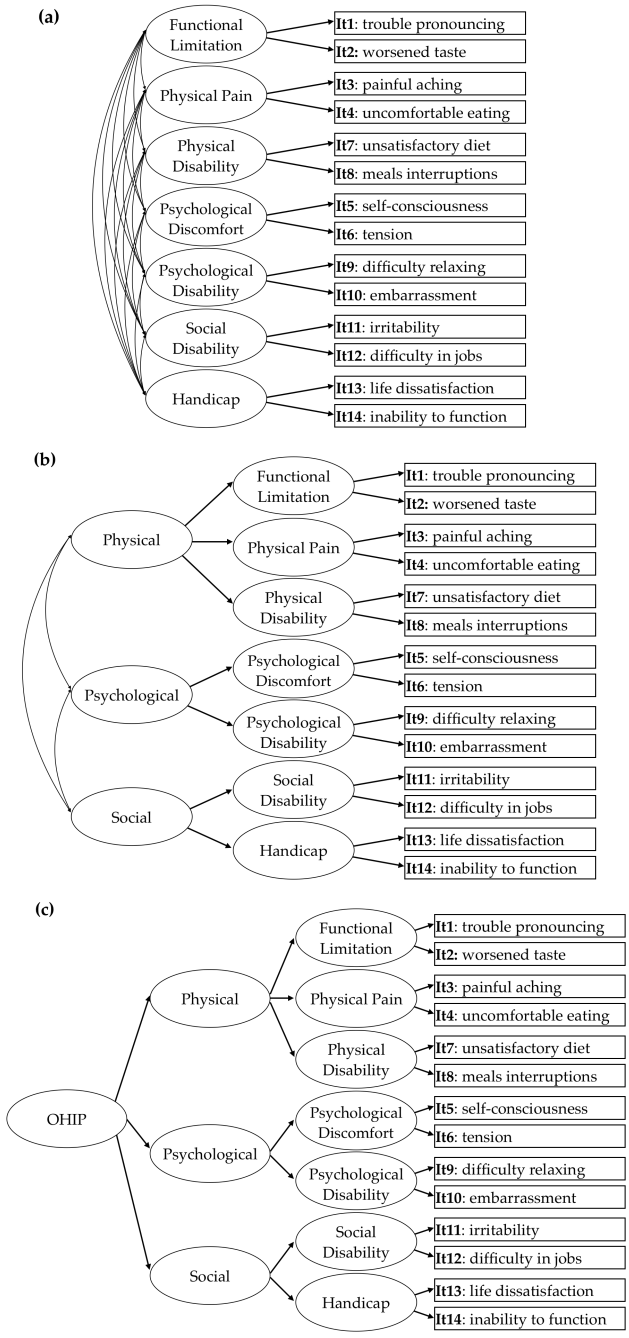


Figure 3. Factor models of the Oral Health Impact Profile-14 (OHIP-14) with 7 first-order factors: (a) first-order model; (b) second-order hierarchical model; (c) third-order hierarchical model.

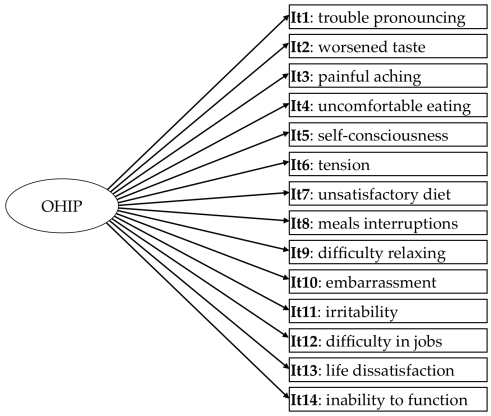


Figure 4. Unifactorial model of the Oral Health Impact Profile-14 (OHIP-14).

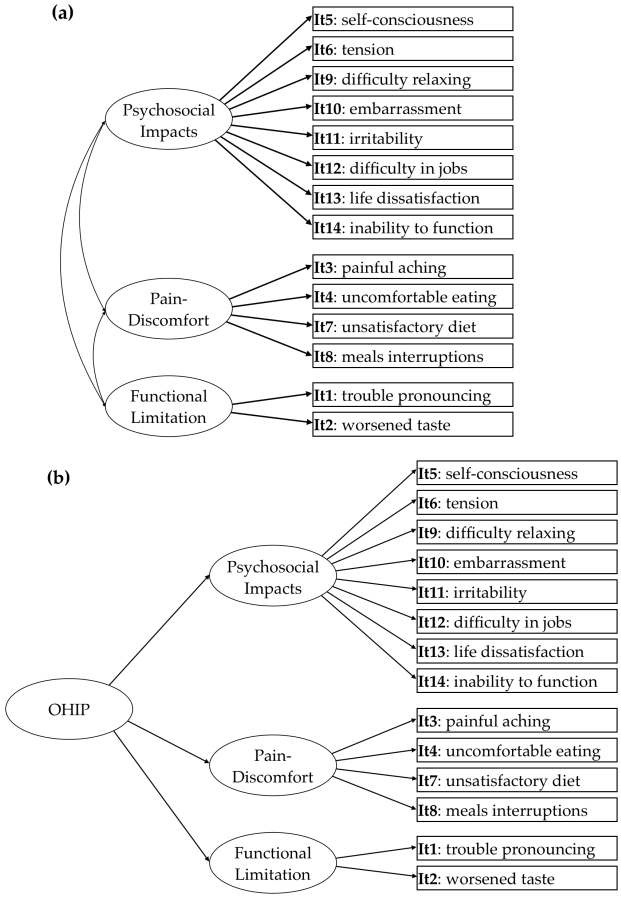


Figure 5. Factor models of the Oral Health Impact Profile-14 (OHIP-14) with 3 first-order factors: (a) first-order model; (b) second-order hierarchical model.

4.4.2 OES

The OES (Larsson et al., 2010a; Larsson et al., 2010b) measures satisfaction with OA and is a unidimensional scale. It contains 7 items with an 11-point numerical response scale ranging from 0 (very dissatisfied) to 10 (very satisfied) (Table 4, Figure 6). This scale also has an additional item that evaluates overall satisfaction with OA, but it is not included in the factor model nor for the calculation of the mean score (Larsson et al., 2010a; Larsson et al., 2010b).

The Portuguese version of OES (Campos et al., 2020b) was used in data collection in Brazil. Since there was no Finnish version of this scale, one of the aims of this dissertation was to translate and culturally adapt the OES into Finnish.

Table 4. Orofacial Esthetic Scale (OES).

	English version*	**Portuguese version****	**Finnish version#**
Instruction	How do you feel about the appearance of your face, mouth, teeth, and your tooth replacements (crowns, bridges, and implants)?	Como você se sente em relação à aparência dos seus dentes, boca e face (rosto).	Miten koet kasvojesi, suusi, hampaidesi ja korvattujen hampaidesi (kruunut, sillat ja implantit) ulkonäön? Valitse tilannettasi kuvaava numero.
Response scale	0 = very dissatisfied 10 = very satisfied	0 = muito insatisfeito(a) 10 = muito satisfeito(a)	0 = erittäin tyytymätön 10 = erittäin tyytyväinen
Item			
It1	Your facial appearance.	Sua aparência facial.	Kasvojesi ulkonäkö
It2	Appearance of your facial profile.	Aparência de seu perfil facial.	Kasvojesi sivuprofiilin ulkonäkö.
It3	Your mouth's appearance (smile, lips, and visible teeth).	Aparência de sua boca (sorriso, lábios e dentes visíveis).	Suusi ulkonäkö (hymy, huulet ja näkyvät hampaat).
It4	Appearance of your rows of teeth.	Aparência do alinhamento dos seus dentes.	Hammasriviesi ulkonäkö.
It5	Shape/form of your teeth.	Formato de seus dentes	Hampaidesi muoto.
It6	Color of your teeth.	Cor de seus dentes.	Hampaidesi väri.
It7	Your gum's appearance.	Aparência de sua gengiva.	Ikeniesi ulkonäkö.
It8	Overall, how do you feel. about the appearance of your face, your mouth, and your teeth?	No geral, como você se sente em relação à aparência de sua face, boca e dentes?	Kuinka koet kasvojesi, suusi ja hampaidesi ulkonäön kaiken kaikkiaan?

*Larsson, P., John, M. T., Nilner, K., Bondemark, L., & List, T. (2010). Development of an Orofacial Esthetic Scale in prosthodontic patients. *The International Journal of Prosthodontics*, 23(3), 249-256. **Campos, L. A., Marôco, J., John, M. T., Santos-Pinto, A., & Campos, J. A. D. B. (2020). Development and psychometric properties of the Portuguese version of the Orofacial Esthetic Scale: OES-Pt. *PeerJ*, 8, e8814. #The Finnish version was translated and culturally adapted in the present dissertation (**Publication II**).

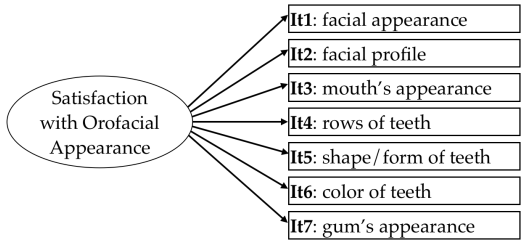


Figure 6. Factor model of the Orofacial Esthetic Scale (OES).

4.4.3 PIDAQ

The PIDAQ (Klages et al., 2006) measures the psychosocial impact of dental aesthetics and was originally developed with 23 items distributed in 4 factors (*dental self-confidence*, *social impact*, *psychological impact*, and *aesthetic concern*) (Table 5, Figure 7). The response scale is a 5-point Likert-type (0: I do not agree, 1: I agree a little, 2: I somewhat agree, 3: I strongly agree, and 4: I agree very strongly). For the study, an additional item that considers tooth colour was included in the *dental self-confidence* factor, as proposed by Campos et al. (2020a). In data collection in Brazil, the Portuguese version of the PIDAQ (Campos et al., 2020a; Sardenberg et al., 2011) was used. As there was no Finnish version of the PIDAQ, it was also aim of this dissertation to translate and culturally adapt this scale into Finnish (**Publication II**).

Table 5. Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ).

	English version*	Portuguese version**	Finnish version#
Instruction	The following statements describe how people can feel about the appearance of their teeth on a daily basis. Please read each sentence and indicate your opinion.	Leia as afirmativas abaixo que se referem à aparência dos dentes e aponte o grau com que você concorda com as mesmas.	Seuraavat väittämät kuvaavat kuinka ihmiset kokevat hampaidensa ulkonäön päivittäisessä elämässään. Lue väittämät ja valitse vastausvaihtoehto joka kuvaa tilannettasi.
Response scale	0 = I do not agree 1 = I agree a little 2 = I somewhat agree 3 = I agree a lot 4 = I totally agree	0 = Eu não concordo 1 = Eu concordo um pouco 2 = Eu concordo mais ou menos 3 = Eu concordo muito 4 = Eu concordo totalmente	0 = Ei lainkaan samaa mieltä 1 = Hieman samaa mieltä 2 = Jonkin verran samaa mieltä 3 = Paljon samaa mieltä 4 = Erittäin paljon samaa mieltä
Item			
It1	I don't like to see my teeth in the mirror.	Eu não gosto de ver meus dentes no espelho.	En halua katsoa hampaitani peilistä.
It2	I hold myself back when I smile so my teeth don't show so much.	Eu me contenho/controlo quando sorrio; assim, meus dentes não aparecem muito.	Pidättelen itseäni hymyillessäni, etteivät hampaani näkyisi niin paljon.
It3	I envy the nice teeth of other people.	Eu sinto inveja dos dentes bonitos de outras pessoas.	Kadehdin muiden ihmisten kauniita hampaita.
It4	I am proud of my teeth.	Eu tenho orgulho dos meus dentes.	Olen ylpeä hampaistani.
It5	If I don't know people well I am sometimes concerned what they might think about my teeth.	Se eu não conheço bem as pessoas, algumas vezes eu me preocupo com o que elas podem achar dos meus dentes.	Jos en tunne ihmisiä hyvin, olen joskus huolissani mitä he ajattelevat hampaistani.
It6	I am somewhat distressed when I see other people's teeth.	Eu fico um pouco incomodado quando vejo os dentes de outras pessoas.	Olen jonkin verran ahdistunut katsellessani muiden ihmisten hampaita.
It7	I like to show my teeth when I smile.	Eu gosto de mostrar meus dentes quando eu sorrio.	Näytän mielelläni hampaani, kun hymyilen.
It8	I don't like to see my teeth in photographs.	Eu não gosto de ver meus dentes em fotos.	En halua nähdä hampaitani valokuvissa.
It9	I'm afraid other people could make offensive remarks about my teeth.	Eu tenho receio de que outras pessoas possam fazer observações ofensivas/agressivas sobre os meus dentes.	Pelkään, että muut ihmiset tekevät loukkaavia huomautuksia hampaistani.
It10	Sometimes I am somewhat unhappy about the appearance of my teeth.	Às vezes eu fico um pouco triste com a aparência dos meus dentes.	Joskus olen jonkin verran onneton hampaideni ulkonäön vuoksi.
It11	I think most people I know have nicer teeth than I do.	Eu acho que a maioria das pessoas que eu conheço tem dentes melhores do que os meus.	Ajattelen, että useimmilla tuntemillani ihmisillä on kauniimmat hampaat kuin minulla.

(Continued)

Table 5. Continued.

	English version*	Portuguese version**	Finnish version#
It12	I am pleased when I see my teeth in the mirror.	Eu fico contente quando eu vejo meus dentes no espelho.	Olen tyytyväinen nähdessäni hampaani peilistä.
It13	Sometimes I think people are staring at my teeth.	Às vezes eu acho que as pessoas estão olhando fixamente para meus dentes.	Joskus minusta tuntuu, että ihmiset tuijottavat hampaitani.
It14	I am somewhat inhibited in social contacts because of my teeth.	De alguma forma eu fico inibido nos encontros sociais por causa dos meus dentes.	Olen jonkin verran pidättyväinen sosiaalisissa kontakteissa hampaideni vuoksi.
It15	I sometimes catch myself holding my hand in front of my mouth to hide my teeth.	Eu às vezes me pego colocando minha mão na frente da minha boca para esconder meus dentes.	Joskus huomaan pitäväni kättäni suuni edessä peittääkseni hampaani.
It16	I feel bad when I think about what my teeth look like.	Eu me sinto mal quando eu penso na aparência dos meus dentes.	Minusta tuntuu pahalta kun ajattelen, miltä hampaani näyttävät.
It17	My teeth are attractive to others.	Os meus dentes são atraentes para os outros.	Uskoisin, että hampaani ovat viehättävät toisten mielestä.
It18	I don't like to see my teeth when I look at a video of myself.	Eu não gosto de ver meus dentes quando eu assisto a um vídeo em que eu apareço.	En halua nähdä hampaitani, kun katson itseäni videolta.
It19	Remarks about my teeth irritate me even when they are meant jokingly.	Comentários sobre os meus dentes me irritam mesmo que seja de brincadeira.	Hampaisiini liittyvät huomauttelut ärsyttävät minua silloinkin, kun ne on tarkoitettu vitsiksi.
It20	I wish my teeth looked better.	Eu gostaria que meus dentes tivessem uma aparência melhor.	Toivon, että hampaani näyttäisivät paremmilta.
It21	I am satisfied with the appearance of my teeth.	Eu estou satisfeito com a aparência dos meus dentes.	Olen tyytyväinen hampaideni ulkonäköön.
It22	I sometimes worry about what members of the opposite sex think about my teeth.†	Eu às vezes me preocupo com o que pessoas que gostaria de me relacionar pensam sobre meus dentes.†	Olen huolissani mitä kiinnostuksen kohteeni ajattelee hampaistani.†
It23	I find my tooth position to be very nice.	Eu acho a posição dos meus dentes muito boa.	Mielestäni hampaideni asennot ovat erittäin hyvät.
It24	I like the color of my teeth.‡	Eu acho a cor dos meus dentes muito boa.‡	Mielestäni hampaideni väri on erittäin hyvä.‡

*Klages, U., Claus, N., Wehrbein, H., & Zentner, A. (2006). Development of a questionnaire for assessment of the psychosocial impact of dental aesthetics in young adults. *European Journal of Orthodontics*, 28(2), 103-111. **Sardenberg, F., Oliveira, A. C., Paiva, S. M., Auad, S. M., & Vale, M. P. (2011). Validity and reliability of the Brazilian version of the psychosocial impact of dental aesthetics questionnaire. *European Journal of Orthodontics*, 33(3), 270-275. #The Finnish version was translated and culturally adapted in the present dissertation (**Publication II**). † This item has been changed to *I sometimes worry about what people with whom I would like to have a relationship think about my teeth* following suggestions from the panel of researchers and experts in content validity analysis (**Publications II** and **III**). ‡ Item added following the proposal of Campos, L. A., Costa, M. A., Bonafé, F. S. S., Marôco, J., & Campos, J. A. D. B. (2020). Psychosocial impact of dental aesthetics on dental patients. *International Dental Journal*, 70(5), 321-327.

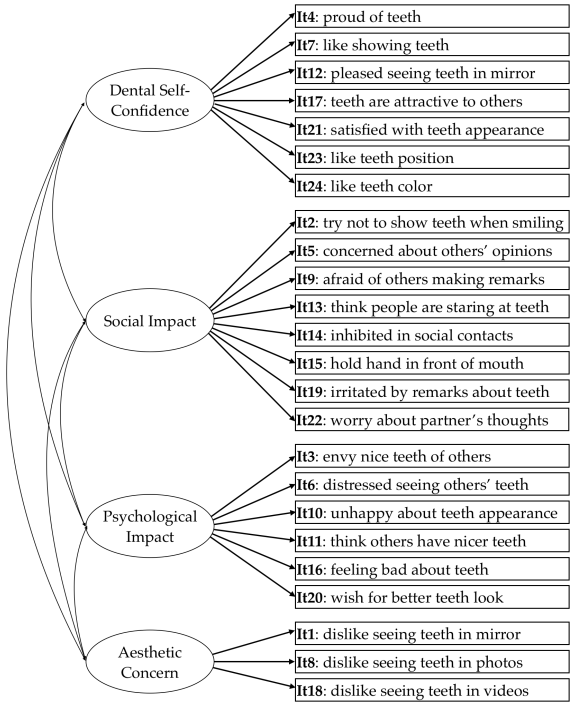


Figure 7. Factor model of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ).

4.4.4 SWLS

The Portuguese (Gouveia et al., 2005) and Finnish (Realo & Dobewall, 2011) versions of the SWLS (Diener et al., 1985) were used to measure life satisfaction, a cognitive aspect of subjective well-being. The SWLS consists of 5 items with a 7-point Likert response scale (1: strongly disagree, 2: disagree, 3: slightly disagree, 4: neither agree nor disagree, 5: slightly agree, 6: agree, and 7: strongly agree) (Table 6) that compose a single factor related to the individual's overall life satisfaction (Figure 8).

Table 6. Satisfaction with Life Scale (SWLS).

	English version*	Portuguese version**	Finnish version#
Instruction	Below are five statements that you may agree or disagree with. Using the 1-7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.	Abaixo você encontrará cinco afirmações com as quais pode ou não concordar. Indique o quanto concorda ou discorda com cada uma.	Arvioikaa elämäänne ja itseänne seuraavien yleisten väittämien nojalla. Valitse vastausvaihtoehto joka kuvaa tilannettasi.
Response scale	1 = Strongly disagree 2 = Disagree 3 = Slightly disagree 4 = Neither agree nor disagree 5 = Slightly agree 6 = Agree 7 = Strongly agree	1 = Discordo totalmente 2 = Discordo 3 = Discordo ligeiramente 4 = Nem concordo nem discordo 5 = Concordo ligeiramente 6 = Concordo 7 = Concordo totalmente	1 = Täysin eri mieltä 2 = Hyvin paljon eri mieltä 3 = Melko paljon eri mieltä 4 = Ei eri eikä samaa mieltä 5 = Melko paljon samaa mieltä 6 = Hyvin paljon samaa mieltä 7 = Täysin samaa mieltä
Item			
It1	In most ways my life is close to my ideal.	Na maioria dos aspectos, minha vida é próxima ao meu ideal.	Pääosin elän lähes ihanteellista elämää.
It2	The conditions of my life are excellent.	As condições da minha vida são excelentes.	Olosuhteet elämässäni ovat erinomaiset.
It3	I am satisfied with my life.	Estou satisfeito(a) com minha vida.	Olen tyytyväinen elämääni.
It4	So far, I have gotten the important things I want in life.	Até hoje, tenho conseguido as coisas importantes que quero na vida.	Olen saanut ne tärkeät asiat, joita olen elämältä halunnut.
It5	If I could live my life over, I would change almost nothing.	Se pudesse viver uma segunda vez, não mudaria quase nada.	Jos voisin elää elämäni uudestaan, muuttaisin tuskin mitään.

*Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of personality assessment*, 49(1), 71-75. **Gouveia, V. V., Barbosa, G. A., Andrade, E. O., & Carneiro, M. B. (2005). Measuring life satisfaction among physicians in Brazil. *Jornal Brasileiro de Psiquiatria*, 54(4), 298-305. #Realo, A., & Dobewall, H. (2011). Does life satisfaction change with age? A comparison of Estonia, Finland, Latvia, and Sweden. *Journal of Research in Personality*, 45(3), 297-308.

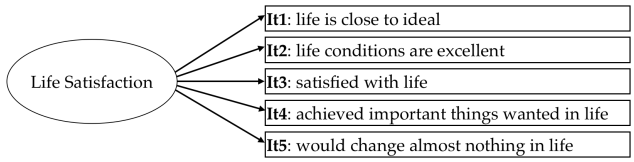


Figure 8. Factor model of the Satisfaction with Life Scale (SWLS).

4.5 Translation and cultural adaptation of OES and PIDAQ for the Finnish language

Initially, a panel of 3 researchers conducted an analysis of the items from the original versions of OES (Larsson et al., 2010a) and PIDAQ (Klages et al., 2006) to evaluate their content suitability for a Finnish context and sample. The panel proposed a sole modification, which entailed revising item 22 in the PIDAQ. The original statement, "I sometimes worry about what members of the opposite sex think about my teeth", was revised to read, "I sometimes worry about what people with whom I would like to have a relationship think about my teeth".

Then, the translation and cultural adaptation process followed guidelines recommended for cross-cultural adaptation of psychometric scales (Beaton et al., 2000). Two independent native Finnish translators with proficiency in English translated the scales into Finnish. Afterward, two researchers compared the translations and produced a preliminary version of the scales in Finnish. Another translator back-translated the preliminary version into English to verify accuracy and ensure that the original meaning was retained. These versions were used in the initial stages of the data validity analyses.

4.6 Data validity and reliability analyses

The validity and reliability evidence of the data obtained with the measuring scales in each publication's samples was assessed following the Standards for Educational and Psychological Testing (American Educational Research Association et al., 2014). Content validity, validity based on internal structure, and reliability measures were considered in **all Publications**. In **Publication I**, validity based on response process and consequence validity of OHIP-14 were assessed, while **Publication II** verified the evidence of validity based on relations to other variables of the Finnish version of OES and PIDAQ.

4.6.1 Content validity

Initially, a panel of 6 expert judges, comprising 3 Finnish native language experts and 3 Portuguese native language experts, assessed the content validity of the Finnish and Portuguese versions of OHIP and SWLS, as well as the Portuguese versions of

OES and PIDAQ. The panel evaluated the grammatical, semantic, and idiomatic terms of the items. They also assessed whether the content of the items preserved the concepts proposed in the original versions of the scales and was appropriated for the cultural context of each country. One modification was proposed to the Portuguese version of the PIDAQ. Specifically, it entailed the substitution of the term "member of the opposite sex" in item 22 with the more inclusive phrase "people I would like to have a relationship with", mirroring the approach taken during the Finnish translation of the scale. After this modification, the panel concluded that the grammatical, semantic, and idiomatic terms of those scales were clear and comprehensible for participants. Furthermore, they determined that the content of the items remained pertinent and relevant for use in Finnish and Brazilian samples. Regarding the Finnish versions of OES and PIDAQ, two researchers evaluated the original, preliminary, and back-translation versions and found them to be conceptually identical to the original versions, taking into account the Finnish context.

4.6.2 Pilot studies

Pilot studies were conducted with the target population of each data collection, using the measuring scales after attesting the content validity analysis. The procedures employed were consistent with those of the definitive data collections. The purpose of the pilot studies was to determine the completion time of the scales, as well as to estimate the Incomprehension Index (II) of the items (Campos et al., 2019a). The II measures the level of difficulty participants have in understanding the content of the items. Items with an II value below 15% are considered suitable for understanding by the target population. The pilot studies were conducted one month before the definitive data collections.

4.6.3 Validity based on internal structure

In **all Publications**, the validity based on the internal structure of the measuring scales' factor models (Figures 3 to 8) was evaluated using factorial, convergent, and discriminant validity. Prior to this, the psychometric sensitivity of the items was assessed through descriptive statistics of item responses, including mean, median, and SD, as well as measures of skewness (sk), and kurtosis (ku). Absolute values of sk and ku lower than 3 and 10, respectively, were indicative of non-severe violation

of the normal distribution (Kline, 2023), attesting to the psychometric sensitivity of the item and meeting one of the assumptions of subsequent analyses (Marôco, 2021b). Multivariate normality was assessed by calculating the ratio of multivariate kurtosis to critical ratios (ku_m/cr) (Marôco, 2021b). Absolute values of ku_m/cr lower than 3 indicated multivariate normality (Marôco, 2021b).

The factorial validity was estimated using CFA. The maximum likelihood (ML) estimation method was used for OES, while the robust weighted least squares mean and variance adjusted (WLSMV) estimation method was used for OHIP-14, PIDAQ, and SWLS. The selection of these estimation methods was based on the number of points on the scales' response options (Kline, 2023). The fit of the models to the data was assessed using the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) (Hu & Bentler, 1999; Marôco, 2021b). The factor loadings of the items (λ) were also estimated. The fit of the factor model to the data was considered adequate when CFI and TLI > 0.90, RMSEA < 0.10, SRMR < 0.08, and $\lambda \geq 0.50$ (Hu & Bentler, 1999; Marôco, 2021b). If the model did not show an adequate fit to the data, modification indices were calculated using the Lagrange Multipliers (LM) method, and values above 11 were examined to detect potential correlations between errors of items (Marôco, 2021b). The inclusion of correlation was only considered when the items belonged to the same factor and when their content had a theoretical approximation justifying such correlation (Marôco, 2021b).

Convergent construct validity was evaluated by the average variance extracted (AVE) (Fornell & Larcker, 1981). Adequate convergent validity was indicated by AVE values greater than 0.50 (Fornell & Larcker, 1981; Marôco, 2021b). For factor models with more than 1 factor, the discriminant validity was also evaluated through correlation analysis between the factors (Fornell & Larcker, 1981). Discriminant validity was considered adequate when the AVE values of the correlated factors were greater than or equal to the squared correlation between factors (AVE_i and $AVE_j \geq r_{ij}^2$).

Measurement invariance was tested to verify the maintenance of psychometric properties between the following independent samples/subsamples: 1. dental patient and non-dental patient subsamples, according to the country, for the OHIP-14 (**Publication I**); 2. Test and Validation subsamples derived from the random division of the total Finnish sample for the OES and PIDAQ scales (**Publication II**); 3. subsamples from each country according to sex, monthly income categories,

and age category for the OES and PIDAQ (**Publication IV**); and 4. Finnish and Brazilian samples for the OES and PIDAQ (**Publication III**).

Initially, the fit of factor models to the data of the samples/subsamples was verified using CFA, as described above. When configural invariance of the factor model was observed between samples/subsamples, the measurement invariance was conducted by multigroup analysis. This analysis used the difference in CFI values (ΔCFI) between the configural (M0) and metric (M1) models ($\Delta CFI_{M1\text{-}M0}$) and between the metric (M1) and scalar (M2) models ($\Delta CFI_{M2\text{-}M1}$). Measurement invariance was assumed when |ΔCFI| values were less than 0.01 (Marôco, 2021b; Nolte & Elsworth, 2014). If configural or measurement invariance was not observed, direct comparisons between samples or subsamples are limited. All the aforementioned analyses were performed in the R program (R Core Team, 2022) using the *lavaan* (Rosseel, 2012) and *semTools* (Jorgensen et al., 2022) packages.

Additionally, in **Publication I**, the suggestion of unidimensionality of the OHIP-14 dataset was examined for each subsample (dental patient and non-dental patient), based on the Unidimensional Congruence (UniCo), Explained Common Variance (ECV), and Mean of Item Residual Absolute Loadings (MIREAL) indices (Ferrando & Lorenzo-Seva, 2018). UniCo and ECV values greater than 0.95 and 0.85, respectively, and MIREAL values below 0.30 were considered indicative of a unidimensional structure, wherein the items could be treated as components of a single dimension (Ferrando & Lorenzo-Seva, 2018). This analysis was performed using the program Factor 11.05 for Windows (Ferrando & Lorenzo-Seva, 2017).

4.6.4 Data reliability

The data reliability was assessed using Cronbach's alpha coefficient for OES, and ordinal alpha coefficient for OHIP-14, PIDAQ, and SWLS, as well as composite reliability (CR) for all scales. A value of 0.70 or higher for both alpha coefficient and CR indicated satisfactory reliability (Marôco, 2021b). This analysis was performed using the *lavaan* package (Rosseel, 2012) in the R program (R Core Team, 2022).

4.6.5 Evidence of validity based on relations to other variables

The validity of the Finnish versions of the OES and PIDAQ (**Publication II**) were also assessed using Pearson's correlation analysis (r) between the OES factor (*satisfaction with orofacial appearance*), the first-order factors of PIDAQ (*dental self-*

confidence, *social impact*, *psychological impact*, and *aesthetic concern*), and the SWLS factor (*life satisfaction*). Since they measure constructs related to OA, a strong and positive correlation (positive convergent validity) is expected between the OES factor and the *dental self-confidence* factor of PIDAQ, and a strong and negative correlation (negative convergent validity) is expected between the OES factor and the other factors of PIDAQ (*social impact*, *psychological impact*, and *aesthetic concern*). Conversely, the SWLS factor is expected to show a weak correlation (discriminant validity) with the factors of OES and PIDAQ.

4.6.6 Validity based on response process

The validity based on response process was evaluated for OHIP-14 (**Publication I**). The following item fit statistics were considered: information-weighted mean square (INFIT) and unweighted mean square (OUTFIT). INFIT denotes how well people with a latent trait level equivalent to the item difficulty respond as expected, whereas OUTFIT represents how well people with a latent trait level different from the item difficulty respond as expected. Both statistics were estimated for each sample using the partial-credit model (PCM) and the *eRm* package (Mair et al., 2021) in the R program (R Core Team, 2022). Values of INFIT and OUTFIT ranging between 0.5 and 1.5 were indicative of an adequate fit of the item to the PCM, thereby making it suitable for measurement purposes.

Then, Differential Item Functioning analysis (DIF) was conducted between subsamples (dental patient and non-dental patient) from the same country. For this purpose, ordinal logistic regression was performed using the likelihood ratio chi-square statistics at a significance level of 1%. DIF can be classified as uniform (if the effect is constant) or non-uniform (if the effect varies). In this study, a general test of "total DIF effect" was used to identify both uniform and non-uniform DIF and control Type I error (Choi et al., 2011). Items exhibiting a significant "total DIF effect" ($p < 0.01$) were considered non-equivalent (Choi et al., 2011). DIF was performed using the *lordif* package (Choi et al., 2011) in the R program (R Core Team, 2022)

4.6.7 Consequence validity

After analyzing the results obtained in the previous analyses, the ethical implications and the quality of measures obtained when applying the OHIP-14 in different subsamples were evaluated (**Publication I**).

4.7 Analyses of responses to OES and PIDAQ items

In **Publication III**, mean scores of the responses given to the OES and PIDAQ items were calculated for subgroups formed by crossing the following variables: country (Finland, Brazil), whether the individual has received any aesthetic dental treatment (no, yes), whether the individual likes his/her own smile (no, yes), and whether something bothers the individual about his/her smile (no, yes). The interaction between these variables was assessed using a hierarchical log-linear analysis with backward elimination and Poisson's probability model (Marôco, 2021a). The significance of the log-linear models was assessed using G^2 and χ^2_P statistics adopting a significance level of 5%.

Significant association was observed between these variables ($G^2(3) = 2.42$, $p = 0.490$; $\chi^2_P(6) = 2.46$, $p = 0.484$). The most parsimonious model to describe the data distribution according to the variables has the following interactions: aesthetic dental treatment and something bothers the individual about his/her smile; country, aesthetic dental treatment and liking own smile; and country, liking own smile and something bothers the individual about his/her smile. Mean responses to the OES and PIDAQ items for the subgroups were plotted on a radar chart. Notably, the frequency of individuals in the subgroups who simultaneously reported not liking their own smile and having nothing bothering them about their smile was extremely lower than the other subgroups. Due to this reason, their mean responses were not considered in the plot. The analyses were performed using IBM SPSS Statistics 28 (IBM Corp., Armonk, NY, USA) and Microsoft® Excel for Mac (v.16).

4.8 Comparison of OES and PIDAQ scores

Mean scores for the OES and PIDAQ factors were computed for each participant, considering the items comprising the factor model fitted to the participant's respective sample data. First, the comparison of the mean scores between Finland

and Brazil was aimed (**Publication III**). If both the configural and measurement invariance of the factor models between the countries were observed, assumptions of normal distribution and homoscedasticity of the data were verified. The distribution of the scores in each sample was estimated by sk and ku. Absolute values of sk and ku lower than 3 and 10, respectively, indicated a non-severe violation of normal distribution (Kline, 2023). Data homoscedasticity was evaluated using Levene's test. If homoscedasticity was observed, the factor scores were compared using t-test with equal variances. Otherwise, Welch's t-test was used.

Subsequently, the aim was to compare the mean scores of OES and PIDAQ according to sex, monthly income, and age categories, for each country separately. After verifying the measurement invariance, the assumptions of normality and homoscedasticity were assessed as previously described. If data showed homoscedasticity, the scores were compared using ANOVA followed by Tukey post-hoc test. If heteroscedasticity was observed, the scores were compared using Welch's ANOVA followed by Games-Howell post-hoc test. The effect size of the difference between the groups was calculated using partial eta squared (η_p^2). All analyses were performed using IBM SPSS Statistics 28 (IBM Corp., Armonk, NY, USA) adopting a significance level of 5%.

4.9 Demand for aesthetic dental treatment

The prevalence and 95% Confidence Interval (95%CI) of individuals seeking and receiving aesthetic dental treatment were estimated for the total samples from Finland and Brazil. Country comparisons were conducted using the z-test ($\alpha = 5\%$). Subsequently, the same prevalence (95%CI) was calculated and compared (z-test, $\alpha = 5\%$) according to sex, monthly income category, and age category, separately for each country. Logistic regression model was conducted and the odds ratio (OR) with 95%CI was calculated to verify the relationship of these sociodemographic variables with seeking and receiving aesthetic dental treatment. Sex [reference category (rc): male], monthly income category (rc: < 2,500€/< R$1,255), and age category (rc: ≥ 52 years) were considered as independent variables. The selection of reference categories for the independent variables was based on previous studies that identified categories with the lowest prevalence of seeking/undergoing aesthetic treatments (Campos et al., 2022; Samorodnitzky-Naveh et al., 2007; Wulfman et al., 2010). This analysis was also conducted separately for each country. The analyses were performed using IBM SPSS Statistics 28 (IBM Corp., Armonk, NY, USA).

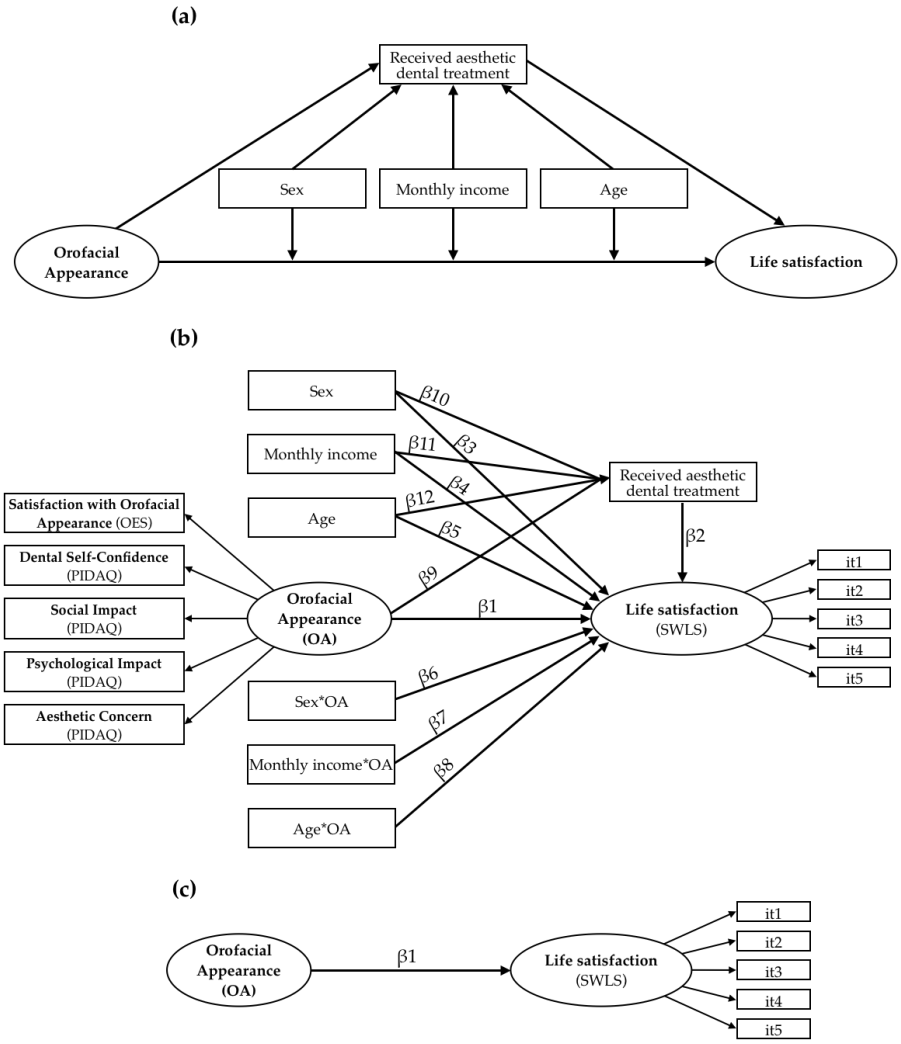
4.10 Structural equation analysis

Structural equation analysis was conducted to estimate the impact of self-perception of OA on life satisfaction (**Publication IV**). First, Principal Component Analysis (PCA) with Promin rotation was used to examine the feasibility of creating a single dimension (*orofacial appearance*) by combining the mean scores of the OES and the PIDAQ factors. The assumption of sampling adequacy for factoring was estimated by measures of sampling adequacy (MSA), with values higher than 0.7 considered adequate (Hair et al., 2019). The determination of the number of factors to be retained in the PCA was conducted using Parallel Analysis with random permutations of the observed data (Lorenzo-Seva et al., 2011). Furthermore, the suggestion of the unidimensionality of the OES and PIDAQ scores was evaluated to verify the adequacy of this one-factor model. For this purpose, the following indices and reference values, as previously presented in section 4.6.3 (page 64), were considered: UniCo > 0.95, ECV > 0.85, and MIREAL < 0.30 (Ferrando & Lorenzo-Seva, 2018). These analyses were performed using the program Factor 11.05 for Windows (Ferrando & Lorenzo-Seva, 2017).

Structural model was elaborated considering the *orofacial appearance* dimension as independent variable and *life satisfaction* dimension, assessed by SWLS, as the dependent variable. The variable 'received aesthetic dental treatment' (0 = no, 1 = yes) was inserted in the model as intermediate variable (indirect effect) between *orofacial appearance* and *life satisfaction*. The criteria for indirect effect were verified (Baron & Kenny, 1986; Valeri & Vanderweele, 2013) and bootstrap simulation analysis for Sobel's test was used for the evaluation of indirect effect path estimates (Kline, 2023). Moderation analysis was conducted to examine the potential moderating role of sex (1 = male, 2 = female), monthly income (Finland: 1 = < 2,500 €, 2 = 2,500 ├ 5,000 €, 3 = 5,000 ├ 7,500 €, 4 = 7,500 ├ 10,000 €, 5 = ≥ 10,000 €; Brazil: 1 = < R$ 1,255, 2 = R$ 1,255 ├ 2,005, 3 = R$ 2,005 ├ 8,641, 4 = R$ 8,641 ├ 11,262, 5 = ≥ R$ 11,262), and age (years) between *orofacial appearance* and *life satisfaction* dimensions.

Initially, CFA was conducted for the factor model of *orofacial appearance*, and the factor scores were subsequently predicted using the factor score matrix obtained from the analysis (Ng & Chan, 2020). Next, the interaction between factor scores and the moderation variables was added to the structural model. Also, a direct path from sex, monthly income, and age to 'received aesthetic dental treatment' was added in the model. Figure 9 shows the structural model elaborated in the present study. The fit of the model was considered adequate if CFI ≥ 0.90, TLI ≥ 0.90, RMSEA ≤

0.10, and SRMR ≤ 0.08 (Kline, 2023; Marôco, 2021b). The significance of the hypothesized causal path estimates (β) was evaluated using the z-test (α = 5%), and the effect size was measured by the proportion of variance explained (r^2). The analysis was performed for each country separately in R program (R Core Team, 2022) using the *lavaan* (Rosseel, 2012) and *semTools* (Jorgensen et al., 2022) package.



OHIP-14: 14-item Oral Health Impact Profile; OES: Orofacial Esthetic Scale; PIDAQ: Psychosocial Impact of Dental Aesthetics Questionnaire; SWLS: Satisfaction with Life Scale.

Figure 9. Structural model elaborated to estimate the impact of orofacial appearance on life satisfaction, the moderating role of sex, monthly income, and age, and the indirect effect of having received aesthetic dental treatment on this impact: (a) conceptual model; (b) statistical model; (c) refined model.

5 RESULTS

The results are reported without following the order of the Original Publications.

5.1 Pilot studies

Information regarding the participants of the pilot studies conducted prior to data collections, as well as information regarding the completion time and II of the scales, are found in Table 7. In all pilot studies, most of the participants were women and were not undergoing any dental care at the time of study participation. All scales had a quick mean completion time (<3 minutes) and presented II lower or equal to 10.8%. Therefore, the understanding of the items by the participants was considered adequate, confirming the content validity of the scales in both countries. Specifically for the Finnish versions of OES and PIDAQ, these results indicate that the preliminary versions obtained after translation and back-translation (section 4.5, page 61) were considered to be the final Finnish version, without the need for any changes. These versions are presented in Table 4 and Table 5 (pages 55 and 57, respectively). The data collection procedures in the pilot studies proved to be suitable and were consequently adopted in the final data collection without requiring any modifications.

Table 7. Participant characteristics, mean completion time (in minutes), and Incomprehension Index (II, in %) of measuring scales in pilot studies.

	Sample		
	Finnish	Brazilian (paper-and-pencil)	Brazilian (online)
Publication	I-IV	I	III and IV
n	37	57	30
Mean age in years (SD)	31.2 (11.0)	28.4 (5.5)	27.4 (4.4)
Women (%)	67.6	80.7	83.3
Dental patients (%)	10.8	19.4	13.3
OHIP			
Completion time (SD)	1.6 (0.9)	1.9 (0.7)	-
II	0.0-5.4	0.0-3.5	-
OES			
Completion time (SD)	1.1 (0.6)	-	1.1 (0.5)
II	0.0-2.7	-	0.0-3.3
PIDAQ			
Completion time (SD)	2.7 (1.3)	-	2.9 (1.2)
II	0.0-10.8	-	0.0-3.3
SWLS			
Completion time (SD)	0.8 (0.7)	-	0.9 (0.6)
II	0.0-2.7	-	0.0-3.3

SD: standard deviation; OHIP-14: 14-item Oral Health Impact Profile; OES: Orofacial Esthetic Scale; PIDAQ: Psychosocial Impact of Dental Aesthetics Questionnaire; SWLS: Satisfaction with Life Scale.

5.2 Data validity and reliability

5.2.1 OHIP-14 (Publication I)

5.2.1.1 Validity based on internal structure and reliability

Table 8 presents the descriptive statistics of the responses to OHIP-14 items according to each subsample (dental patient and non-dental patient). Six items of the OHIP-14 had high values of sk and ku for non-dental patient samples in both Finland and Brazil (Finland: items 1, 2, 7, 11, 12, and 14; Brazil: items 1, 2, 11, 12, 13, and 14). As these items violated the assumption of normal distribution, they could not be included in subsequent analyses to assess the validity based on the internal structure. Given that these 6 items account for 42.9% of the OHIP-14 items, it was decided not to continue with the analysis to these subsamples of non-dental patients.

Table 8. Descriptive statistics of the responses given to the Oral Health Impact Profile-14 (OHIP-14) items by the dental patients and non-dental patients subsamples from Finland and Brazil.

	Finland (dental patient/non-dental patient)				
Item	**Mean**	**Median**	**Standard deviation**	**Skewness**	**Kurtosis**
It1	0.5/0.2	0/0	0.9/0.6	1.8/3.6	2.1/14.4
It2	0.1/0.1	0/0	0.5/0.3	4.3/6.2	23.0/42.6
It3	1.8/1.3	2/1	0.9/0.8	0.2/0.3	0.4/–0.0
It4	1.4/0.7	1/0	1.1/0.9	0.4/1.3	–0.4/1.1
It5	1.3/0.7	1/0	1.1/0.9	0.4/1.2	–0.6/0.7
It6	1.3/0.6	1/0	1.2/0.9	0.6/1.4	–0.6/1.1
It7	0.4/0.1	0/0	0.8/0.4	2.1/4.3	4.4/22.1
It8	0.5/0.2	0/0	0.8/0.5	1.4/2.8	1.4/9.2
It9	1.0/0.4	1/0	1.1/0.8	0.9/1.9	0.0/3.3
It10	0.9/0.4	0/0	1.1/0.8	1.0/1.8	0.2/3.0
It11	0.6/0.2	0/0	0.8/0.5	1.4/3.1	1.2/10.5
It12	0.6/0.1	0/0	0.9/0.4	1.6/3.4	2.1/14.1
It13	0.8/0.4	0/0	1.0/0.7	1.3/2.2	1.0/4.6
It14	0.2/0.1	0/0	0.6/0.3	2.9/6.9	9.2/60.0
	Brazil (dental patient/non-dental patient/dental patient from previous study*)				
Item	**Mean**	**Median**	**Standard deviation**	**Skewness**	**Kurtosis**
It1	0.5/0.2/0.5	0/0/0	0.9/0.6/1.0	2.1/3.7/2.0	3.8/16.1/3.0
It2	0.4/0.2/0.7	0/0/0	0.9/0.6/1.2	2.1/3.5/1.5	4.0/13.4/0.9
It3	1.4/0.9/1.4	1/1/1	1.2/1.0/1.2	0.4/0.8/0.5	–0.5/0.1/–0.4
It4	1.5/0.8/1.6	1/0/2	1.3/1.0/1.3	0.5/1.2/0.3	–0.7/0.7/–0.9
It5	2.0/1.1/2.4	2/1/2	1.3/1.2/1.4	0.1/0.8/–0.3	–0.9/–0.2/–1.0
It6	1.7/0.8/1.4	2/0/1	1.4/1.1/1.4	0.2/1.3/0.6	–1.1/0.8/–1.0
It7	1.0/0.4/0.9	1/0/0	1.2/0.8/1.2	1.0/2.6/1.1	0.1/7.1/0.2
It8	0.9/0.3/1.0	0/0/1	1.2/0.7/1.1	1.3/2.9/0.8	0.6/9.4/–0.2
It9	1.0/0.4/1.1	0/0/1	1.2/0.8/1.3	1.0/2.1/0.8	–0.1/4.2/–0.4
It10	1.1/0.5/1.2	1/0/1	1.3/0.9/1.4	1.0/2.2/0.7	–0.2/4.1/–0.7
It11	0.6/0.3/0.7	0/0/0	1.0/0.7/1.0	1.8/3.3/1.4	2.5/11.1/1.3
It12	0.5/0.2/0.6	0/0/0	0.9/0.6/1.0	1.8/3.6/1.7	2.9/14.6/2.4
It13	0.6/0.2/0.6	0/0/0	1.0/0.6/1.1	1.9/3.7/1.9	2.8/14.8/2.7
It14	0.3/0.1/0.3	0/0/0	0.7/0.5/0.8	3.4/6.1/3.0	12.3/41.4/9.2

Slash punctuation marks were inserted between the estimates to separate the values obtained for each subsample. *Data obtained from previous study: Zucoloto, M. L., Marôco, J., & Campos, J. A. D. B. (2014). Psychometric Properties of the Oral Health Impact Profile and New Methodological Approach. *Journal of Dental Research*, 93(7), 645-650.

For the subsample of Brazilian dental patients obtained in a previous study (Zucoloto et al., 2014), all the responses given to the OHIP-14 items presented acceptable sk and ku values (Table 8) and multivariate normality ($|ku_m/cr| = 2.0$). For the subsamples of dental patients obtained in Finland and Brazil, a severe violation of the normal distribution was observed in only one item (Finland: item 2 – worsened taste, Brazil: item 14 – inability to function, Table 8). Thus, the item whose responses did not meet the assumption was not considered for the subsequent analyses. The multivariate normality was adequate for both subsamples ($|ku_m/cr| \leq 2.0$).

As a consequence, it was also necessary to exclude the factors in the original OHIP-14 factor model proposals (7 first-order factors, Figure 3, page 53) where

those items were allocated (Finnish dental patients: *functional limitation*; Brazilian dental patients: *handicap*). This was because each first-order factor is composed of only two items. The covariance matrix (CFA) of the first-order model (Figure 3.a, page 53) was not defined as positive. This means an inadequate fit to the data of dental patients. The hierarchical models with 7 first-order factors (Figure 3.b and c, page 53) had a satisfactory fit to the data from the previous study (Zucoloto et al., 2014) only upon restricting the variance of certain factors (Table 9). This implies the need for caution when interpreting these findings. These hierarchical models were not tested within the dental patient samples collected for this dissertation, as it was not theoretically plausible after excluding a first-order factor.

The models with 3 first-order factors (Figure 5, page 54) presented an adequate fit to the Brazilian dental patient samples, with satisfactory convergent validity and reliability, but with some limitations in discriminant validity (Table 9). For the Finnish dental patient subsample, it was necessary to exclude item 1 and the *functional limitation* factor in addition to the exclusion of item 2, as this factor is composed of only these two items. The factor model after exclusions presented an adequate fit and convergent and discriminant validity, as well as adequate reliability for the Finnish dental patient data (Table 9).

Regarding the unifactorial model (Figure 4, page 54), RMSEA values exceeded the recommended threshold value (Table 9). Nevertheless, it should be noted that this index tends to be overestimated in simple factor models (Kenny et al., 2015). Therefore, the SRMR is an alternative for decision-making regarding the fit of the model (Kenny et al., 2015). Thus, the unifactorial model presented an adequate fit, convergent validity, and reliability in the subsamples of dental patients from both countries (Table 9). Moreover, results of UniCo (≥ 0.98), ECV (≥ 0.87), and MIREAL (≤ 0.23) indicated that the data obtained from dental patient samples could be treated as unidimensional.

Table 9. Fit of factor models of the Oral Health Impact Profile-14 (OHIP-14) to subsamples data from Finland (Fi) and Brazil (Br).

			CFA#								α†	CR¶	AVE§
Factor Model	Sample*	excluded items	CFI	TLI	RMSEA	SRMR	λ	r^2	β-2nd order	β-3rd order			
7 Factors – 2nd Order**	Br (PS)	-	0.98	0.98	0.06	0.05	0.58-0.96	0.77-0.85	0.88-0.99	-	0.72-0.85	0.73-0.87	0.57-0.77
7 Factors – 3rd Order**	Br (PS)	-	0.98	0.98	0.06	0.05	0.58-0.96	-	0.88-0.99	0.93-0.98	0.72-0.85	0.73-0.87	0.57-0.77
3 Factors – 1st Order† †	Br	14	0.95	0.93	0.12	0.06	0.63-0.88	0.43-0.73	-	-	0.69-0.91	0.70-0.92	0.55-0.64
	Br (PS)	-	0.98	0.98	0.07	0.05	0.53-0.90	0.78-0.86	-	-	0.76-0.92	0.77-0.93	0.62-0.64
	Br (PS)	14‡	0.98	0.98	0.07	0.05	0.54-0.90	0.77-0.85	-	-	0.76-0.91	0.77-0.92	0.61-0.64
	Fi	1 and 2	0.97	0.96	0.10	0.06	0.64-0.89	0.63	-	-	0.87-0.93	0.88-0.94	0.64-0.65
3 Factors – 2nd Order	Br	14	0.95	0.93	0.11	0.06	0.63-0.88	-	0.75-0.98	-	0.69-0.91	0.70-0.92	0.55-0.64
	Br (PS)	-	0.98	0.98	0.07	0.05	0.53-0.90	-	0.93-0.97	-	0.76-0.92	0.77-0.93	0.62-0.64
	Br (PS)	14‡	0.98	0.98	0.07	0.05	0.54-0.90	-	0.93-0.97	-	0.76-0.91	0.77-0.92	0.61-0.64
Unifactorial	Br	14	0.92	0.91	0.13	0.08	0.47-0.87	-	-	-	0.93	0.94	0.55
	Br (PS)	-	0.97	0.97	0.08	0.06	0.52-0.86	-	-	-	0.95	0.95	0.59
	Br (PS)	14‡	0.98	0.97	0.08	0.05	0.53-0.87	-	-	-	0.94	0.95	0.58
	Fi	2	0.95	0.94	0.12	0.08	0.54-0.85	-	-	-	0.94	0.95	0.57

*Dental patient subsamples, PS: data obtained from previous study – Zucoloto, M. L., Marôco, J., & Campos, J. A. D. B. (2014). Psychometric Properties of the Oral Health Impact Profile and New Methodological Approach. *Journal of Dental Research*, 93(7) , 645-650. #CFA: Confirmatory factor analysis, CFI: comparative fit index, TLI: Tucker-Lewis index, RMSEA: root mean square error of approximation, SRMR: standardized root mean square residual, λ: factorial loading, r^2: square correlation coefficient between the factors, β: absolute value of β estimate. † α: ordinal alpha coefficient. ¶CR: composite reliability. § AVE: average variance extracted. ‡ Item excluded to obtain configural invariance between Brazilian subsamples. **restriction on error variance in *psychological disability* and *handicap* factors. † † *functional limitation* was excluded for the Finnish subsample.

Strong measure invariance was observed in the 3 first-order factor and unifactorial models between Brazilian dental patient subsamples obtained in the previous study (Zucoloto et al., 2014) and the one obtained for this dissertation (3 first-order factor model: $\Delta CFI_{M1\text{-}M0} = -0.007$, $\Delta CFI_{M2\text{-}M1} = -0.007$; unifactorial model: $\Delta CFI_{M1\text{-}M0} = -0.007$, $\Delta CFI_{M2\text{-}M1} = -0.010$). Item 14 was not included in this analysis to establish configural invariance between the subsamples. Measurement invariance was not tested between the dental patient and non-dental patient subsamples, as over 40% of the items did not present psychometric sensitivity in these latter subsamples. This result suggests that the OHIP-14 operates differently among these subsamples and may not be a suitable scale for assessing the oral health impact profile in non-dental patient samples.

5.2.1.2 Validity based on response process

The item fit statistics (INFIT and OUTFIT) are presented in Table 10. Overall, item difficulty was aligned with the latent trait of each subsample. DIF analysis indicated that at least one item was answered differently among subsamples from the same country (Table 10). These differences are also apparent in the item information function (Figure 10). Specifically for dental patient subsamples, OHIP-14 items were informative for various levels (mild to severe) of oral health impact on life (latent trait ≤ 2 explains 57.9–74.4% of the information captured by the scale). In non-dental subsamples, the items were informative most at extremely severe levels of impact (latent trait ≥ 2 explains 59.1–60.7% of the information captured by the scale).

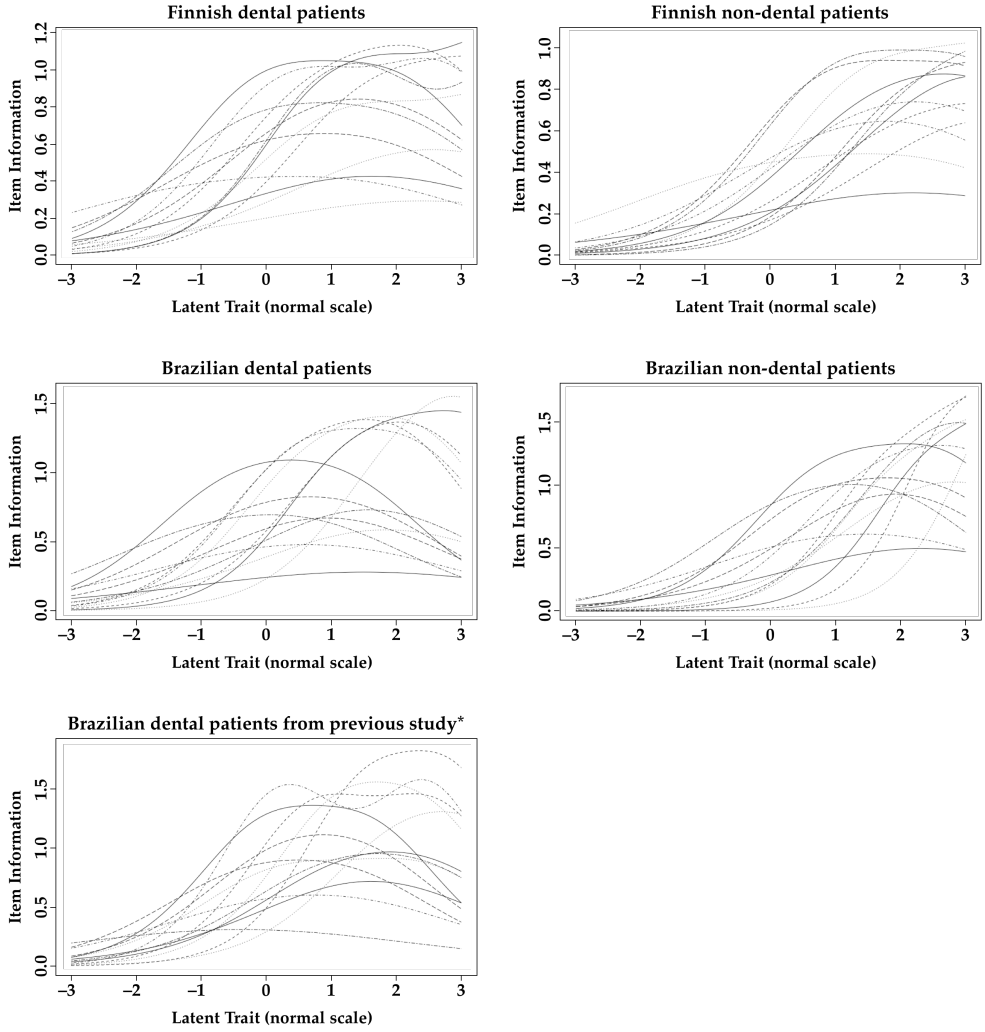
5.2.1.3 Consequence validity

The evidence presented in the other validity analyses raises ethical concerns about using the OHIP-14 in samples and contexts different from those for which the scale was originally proposed. The findings support the non-recommendation of using this scale for samples or individuals without oral health-related impairments. Using it in this context without first attesting the validity and reliability of the data can lead to misinterpretation of the obtained measurement. This can have a direct consequence on study conclusions, clinical protocol development, and treatment planning.

Table 10. Item fit statistics [information-weighted mean square (INFIT) and unweighted mean square (OUTFIT)] for each subsample from Finland and Brazil and Differential Item Functioning analysis (DIF) results for the Oral Health Impact Profile-14 (OHIP-14).

	Item Fit Statistics										DIF			
	Finnish subsamples				Brazilian subsamples						p-value for χ^2			
	Dental patient (1)		Non-dental patient (2)		Dental patient (3)		Non-dental patient (4)		Dental patient [PS] (5)		subsamples			
Item	INFIT	OUTFIT	INFIT	OUTFIT	INFIT	OUTFIT	INFIT	OUTFIT	INFIT	OUTFIT	1 vs 2	3 vs 4	3 vs 5	4 vs 5
it1	1.38	1.96	1.27	1.73	1.37	1.95	1.44	1.96	1.21	1.99	0.038	0.173	0.007	0.033
it2	1.16	1.36	1.00	1.17	1.20	1.05	1.05	1.28	0.88	0.66	0.408	0.020	<0.001	<0.001
it3	1.06	1.06	0.96	0.94	1.12	1.14	1.16	1.16	1.09	1.15	<0.001	0.221	0.197	0.070
it4	1.09	1.05	1.09	0.96	0.91	0.88	0.92	0.88	0.93	0.93	<0.001	0.349	0.789	<0.001
it5	0.85	0.83	0.77	0.70	0.90	0.90	0.89	0.87	1.36	1.39	<0.001	<0.001	<0.001	<0.001
it6	0.83	0.77	0.80	0.73	0.74	0.69	0.73	0.67	0.77	0.72	0.050	0.068	<0.001	0.485
it7	0.85	0.62	0.90	0.65	0.77	0.69	0.73	0.61	0.74	0.59	0.403	0.033	<0.001	0.011
it8	0.83	0.73	0.91	0.82	0.75	0.75	0.78	0.72	0.84	0.79	0.136	0.028	<0.001	<0.001
it9	0.78	0.70	0.79	0.61	0.76	0.68	0.89	0.86	0.71	0.63	0.134	0.067	0.321	<0.001
it10	1.00	1.00	0.97	0.90	1.21	1.32	1.18	1.26	0.95	1.06	0.194	0.482	0.060	<0.001
it11	0.75	0.59	0.80	0.48	1.11	1.04	0.92	1.03	1.00	0.87	0.168	0.080	0.730	<0.001
it12	0.74	0.74	0.79	0.51	0.74	0.70	0.76	0.62	0.97	0.86	0.001	0.564	0.220	<0.001
it13	0.78	0.85	0.89	0.79	0.86	0.70	0.70	0.41	0.77	0.86	0.642	0.395	0.027	0.903
it14	1.03	0.97	0.98	1.04	0.81	0.58	0.85	0.37	0.91	0.56	0.015	0.293	0.778	0.085

PS: data obtained from previous study – Zucoloto, M. L., Marôco, J., & Campos, J. A. D. B. (2014). Psychometric Properties of the Oral Health Impact Profile and New Methodological Approach. *Journal of Dental Research*, 93(7), 645-650.



*Zucoloto, M. L., Marôco, J., & Campos, J. A. D. B. (2014). Psychometric Properties of the Oral Health Impact Profile and New Methodological Approach. Journal of Dental Research, 93(7), 645-650.

Figure 10. Item information function obtained from Differential Item Functioning analysis of the items of Oral Health Impact Profile-14 (OHIP-14) applied to the subsamples from Finland and Brazil.

5.2.2 OES (Publications II-IV)

5.2.2.1 Validity based on internal structure and reliability

All responses given by the total sample from Finland and Brazil to the OES presented adequate values of sk and ku (Table 11), attesting the psychometric sensitivity of the items. Multivariate normality was also observed ($|ku_m/cr| \leq 0.6$). The factor model did not adequately fit to data for both samples (Finnish sample: CFI = 0.85, TLI = 0.77, RMSEA = 0.22, SRMR = 0.08, λ = 0.56-0.89, AVE = 0.55, $\alpha_{Cronbach}$ = 0.89, CR = 0.89; Brazilian sample: CFI = 0.85, TLI = 0.78, RMSEA = 0.21, SRMR = 0.07, λ = 0.49-0.90, AVE = 0.55, $\alpha_{Cronbach}$ = 0.89, CR = 0.90). When inspecting the LM, a high value of modification index (Finnish sample: LM = 1,359.3; Brazilian sample: LM = 1,724.6) was found between items 1 (facial appearance) and 2 (appearance of facial profile). Given that the OES is a unidimensional scale and there is a theoretical alignment between these items (addressing extraoral components), the model was refined by adding a correlation between the errors of items 1 and 2. This refined factor model of the OES presented an adequate fit and reliability to the samples data (Table 12).

Table 11. Descriptive statistics of the responses given to the items of the Orofacial Esthetic Scale (OES) by the total sample from Finland and Brazil

	Total sample – Finland/Brazil				
Item	**Mean**	**Median**	**Standard deviation**	**Skewness**	**Kurtosis**
It1	7.2/7.1	8/7	1.7/1.9	–1.1/–1.0	1.8/1.4
It2	6.6/6.7	7/7	2.1/2.2	–0.8/–0.8	0.4/0.4
It3	7.0/7.2	7/8	2.0/2.1	–0.9/–1.1	0.5/1.1
It4	6.8/7.1	7/8	2.3/2.5	–0.9/–1.0	0.2/0.4
It5	7.4/7.6	8/8	2.1/2.3	–1.1/–1.2	0.9/1.2
It6	6.3/6.2	7/7	2.2/2.4	–0.7/–0.6	0.0/–0.1
It7	7.9/7.9	8/8	1.8/2.2	–1.2/–1.3	1.9/1.7
It8	7.2/7.2	8/8	1.7/2.0	–1.1/–1.1	1.8/1.7

Slash punctuation marks were inserted between the estimates to separate the values obtained for each sample.

For subsamples categorized by sex, monthly income, and age in both countries, as well as for the test and validation subsamples within the Finnish sample, the items presented psychometric sensitivity and multivariate normality. When considering a correlation between the errors of items 1 and 2, the factor model of the OES also showed adequate fit for these subsamples (CFI > 0.90, TLI > 0.90, RMSEA $\leq$ 0.14, SRMR $\leq$ 0.06, λ = 0.50-0.91, AVE $\geq$ 0.51, $\alpha_{Cronbach}$ > 0.80, CR > 0.80).

Measurement invariance was observed among the subsamples according to sex, monthly income categories, and age categories. Measurement invariance was also present between the Finnish Test and Validation subsamples, indicating an adequate external validity of the psychometric results. Regarding the cross-national measurement invariance, the OES showed configural and scalar invariance, allowing direct comparisons of the factor score between Finland and Brazil.

Table 12. Fit of factor models of the Orofacial Esthetic Scale (OES), Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ), and Satisfaction with Life Scale (SWLS) to total sample data from Finland and Brazil.

	CFA*									
	CFI	TLI	RMSEA	SRMR	λ	r^2	$r_{e1\text{-}e2}$	α	CR¶	AVE§
Finland										
OES	0.95	0.92	0.13	0.04	0.53-0.89	-	0.61	0.89#	0.88	0.55
PIDAQ‡	0.97	0.96	0.09	0.05	0.64-0.95	0.62-0.87	-	0.88-0.94†	0.81-0.92	0.66-0.81
SWLS	0.99	0.99	0.15	0.03	0.67-0.92	-	-	0.92†	0.92	0.72
Brazil										
OES	0.96	0.94	0.11	0.04	0.57-0.88	-	0.64	0.89#	0.89	0.55
PIDAQ††	0.96	0.96	0.08	0.05	0.59-0.95	0.52-0.83	-	0.87-0.94†	0.84-0.95	0.65-0.73
SWLS	0.99	0.99	0.08	0.02	0.70-0.92	-	-	0.92†	0.91	0.68

*CFA: Confirmatory factor analysis, CFI: comparative fit index, TLI: Tucker-Lewis index, RMSEA: root mean square error of approximation, SRMR: standardized root mean square residual, λ: factorial loading, r^2: square correlation coefficient between the factors, $r_{e1\text{-}e2}$: correlation between errors of items 1 and 2. #Cronbach's alpha coefficient. †ordinal alpha coefficient. ¶CR: composite reliability. §AVE: average variance extracted. ‡refined model excluding items 9, 13, 14, and 15 due to the violation of the assumption of normal distribution of responses to items. ††refined model excluding item 6 due to low factor loading.

5.2.2.2 Evidence of validity based on relations to other variables for the Finnish version

Strong correlations between the OES factor and the PIDAQ factors were observed, attesting to adequate positive convergent validity (OES *vs dental self-confidence*: $r = 0.87$, $p < 0.001$) and negative convergent validity (OES *vs social impact*: $r = -0.69$, $p<0.001$; OES *vs psychological impact*: $r = -0.77$, $p < 0.001$; OES *vs aesthetic concern*: $r = -0.74$, $p < 0.001$). A weak correlation between the OES factor and the SWLS factor was observed ($r = 0.41$, $p < 0.001$), providing evidence of adequate discriminant validity.

5.2.3 PIDAQ (Publications II-IV)

5.2.3.1 Validity based on internal structure and reliability

In the Finnish sample, responses to items 9, 13, 14, and 15 presented non-acceptable sk and ku values (≥ 3.0 and ≥ 10, respectively, Table 13). Consequently, these items were not considered in the subsequent analyses for this sample. In Brazilian sample, all items presented psychometric sensitivity (Table 13). Multivariate normality was observed in both samples ($|ku_m/cr| \leq 1.8$).

Table 13. Descriptive statistics of the responses given to the items of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) by the total sample from Finland and Brazil.

	Total sample – Finland/Brazil				
Item	**Mean**	**Median**	**Standard deviation**	**Skewness**	**Kurtosis**
It1	0.6/0.9	0/0	0.9/1.2	1.7/1.2	2.5/0.5
It2	0.6/0.6	0/0	1.1/1.1	1.7/1.9	2.0/2.7
It3	1.3/1.1	1/1	1.2/1.3	0.7/1.0	–0.5/–0.1
It4	1.8/2.1	2/2	1.3/1.3	0.1/–0.2	–1.1/–1.1
It5	0.4/0.6	0/0	0.8/1.0	2.5/1.9	6.1/2.8
It6	0.3/0.6	0/0	0.7/1.0	2.6/1.7	6.5/2.0
It7	2.2/2.3	2/3	1.4/1.4	–0.2/–0.4	–1.2/–1.2
It8	1.0/0.9	0/0	1.3/1.3	1.1/1.2	0.1/0.2
It9	0.3/0.8	0/0	0.8/1.2	3.0/1.5	9.4/1.0
It10	0.6/0.9	0/0	0.9/1.2	1.7/1.3	2.6/0.6
It11	0.9/0.8	0/0	1.2/1.2	1.2/1.4	0.3/0.9
It12	2.0/2.1	2/2	1.2/1.3	–0.1/–0.1	–1.1/–1.1
It13	0.3/0.6	0/0	0.7/1.0	3.1/1.9	10.2/2.6
It14	0.2/0.3	0/0	0.6/0.8	3.3/2.9	11.2/7.8
It15	0.3/0.3	0/0	0.7/0.9	3.0/2.9	9.1/7.7
It16	0.4/0.5	0/0	0.8/1.0	2.4/2.1	5.3/3.8
It17	1.6/1.8	2/2	1.2/1.3	0.2/0.0	–1.0/–1.1
It18	0.6/0.7	0/0	1.1/1.2	2.0/1.6	2.9/1.6
It19	0.7/0.7	0/0	1.2/1.2	1.6/1.6	1.3/1.3
It20	1.7/1.9	1/2	1.3/1.4	0.4/0.2	–0.9/–1.3
It21	2.2/2.0	2/2	1.2/1.3	–0.3/–0.1	–1.0/–1.1
It22	0.6/0.7	0/0	1.0/1.1	1.9/1.6	2.8/1.4
It23	2.2/2.1	2/2	1.3/1.4	–0.3/–0.2	–1.1/–1.2
It24	1.7/1.6	2/2	1.2/1.3	0.0/0.2	–1.0/–1.1

Slash punctuation marks were inserted between the estimates to separate the values obtained for each sample.

The PIDAQ factor model (excluding items 9, 13, 14, and 15) presented adequate factorial and convergent validity and reliability for the Finnish sample (Table 12). However, discriminant validity was compromised between s*ocial impact* and

psychological impact, *social impact* and *aesthetic concern*, and *psychological impact* and *aesthetic concern* factors. For the Brazilian sample, although the complete factor model (including all items) presented adequate fit indices (CFI = 0.96, TLI = 0.96, RMSEA = 0.08, SRMR = 0.05), the factor loading of item 6 was below 0.50 ($\lambda = 0.36$). Thus, this item was excluded for this sample. The fit of this refined factorial model was adequate (Table 12).

For the subsamples, the items comprising the refined model presented adequate psychometric sensitivity and multivariate normality. The models fitted to the subsamples data. Metric or scalar measurement invariance was observed among the subsamples of each country according to sex, monthly income categories, and age categories, as well as between the Finnish Test and Validation subsamples. The PIDAQ factor model did not present configural invariance between Finnish and Brazilian samples (Finnish sample: exclusion of items 9, 13, 14, and 15; Brazilian sample: exclusion of item 6). Therefore, cross-national measurement invariance and comparisons of factor scores have not been conducted for this scale.

5.2.3.2 Evidence of validity based on relations to other variables for the Finnish version

As presented before, strong correlations between the PIDAQ factors and OES factor were observed (see section 5.2.2.2, page 80), attesting to adequate convergent validity. Discriminant validity was also adequate since weak correlations between the PIDAQ factors and the SWLS factor were observed ($|r| \leq 0.33$, $p < 0.001$).

5.2.4 SWLS (Publication IV)

The responses to the SWLS items presented a non-severe violation of the normal distribution (Table 14) and evidence of multivariate normality for both countries ($ku_m/cr = 0.3$). The factor model fit was adequate to the total sample data from Finland and Brazil (Table 12).

Table 14. Descriptive statistics of the responses given to the items of the Satisfaction with Life Scale (SWLS) by the total sample from Finland and Brazil.

Item	**Total sample –** Finland/Brazil				
	Mean	**Median**	**Standard deviation**	**Skewness**	**Kurtosis**
It1	5.0/4.9	5/5	1.3/1.6	–0.8/–0.8	0.4/–0.2
It2	5.2/5.1	5/5	1.3/1.5	–1.0/–0.9	0.8/0.1
It3	5.3/5.1	6/6	1.3/1.5	–1.1/–1.0	1.0/0.2
It4	5.1/5.6	5/6	1.4/1.3	–0.9/–1.3	0.4/1.8
It5	4.4/4.2	5/5	1.6/1.9	–0.4/–0.2	–0.7/–1.2

Slash punctuation marks were inserted between the estimates to separate the values obtained for each sample.

5.3 Responses to OES and PIDAQ items (Publication III)

Figure 11 shows the radar plot for mean scores to OES and PIDAQ items according to the groups formed by the interaction of the following variables: country, having received aesthetic dental treatment, liking one's own smile, and something bothering the individuals about their smile. Three clusters can be noticed, which are not related to different countries nor whether the individuals have received any aesthetic dental treatment. Liking one's own smile and being bothered by something about own smile were the variables for clustering.

Individuals who like their own smile and simultaneously reported that nothing bothers them about their smile (continuous lines, Figure 11) presented numerical values of the means related to greater satisfaction with their OA and a lower psychosocial impact of dental aesthetics. The opposite was observed for individuals who simultaneously did not like their own smile and reported that something bothers them about their smile (dotted lines, Figure 11). The third cluster, composed of individuals who like their smile, but something bothers them about their smile (dashed lines, Figure 11), presented intermediate values in relation to the other two clusters.

Additionally, patterns of responses to some specific items in each factor can be observed in Figure 11. For OES, individuals who do not like their own smile and who reported that something bothers them in their smile (dotted line clusters) had a higher mean value in item 7 ("gum's appearance") in relation to the other items. For the other two clusters, the mean response to items forms a figure that resembles an octagon, with no apparent discrepancy between them.

For PIDAQ factors, all clusters presented lower mean values in items 17 ("My teeth are attractive to others") and 24 ("I find my teeth colour to be very nice") in the *dental self-confidence* factor and higher value in items 3 ("I envy the nice teeth of

other people") and 20 ("I wish my teeth looked better") in the *psychological impact* factor. Individuals who do not like their own smile and reported that something bothers them about their smile (dotted line cluster) presented lower mean values in items 13, 14, and 15 ("Sometimes I think people are staring at my teeth", "I am somewhat inhibited in social contacts because of my teeth", and "I sometimes catch myself holding my hand in front of my mouth to hide my teeth", respectively) from the *social impact* factor and in item 6 ("I am somewhat distressed when I see other people's teeth") from the *psychological impact* factor.

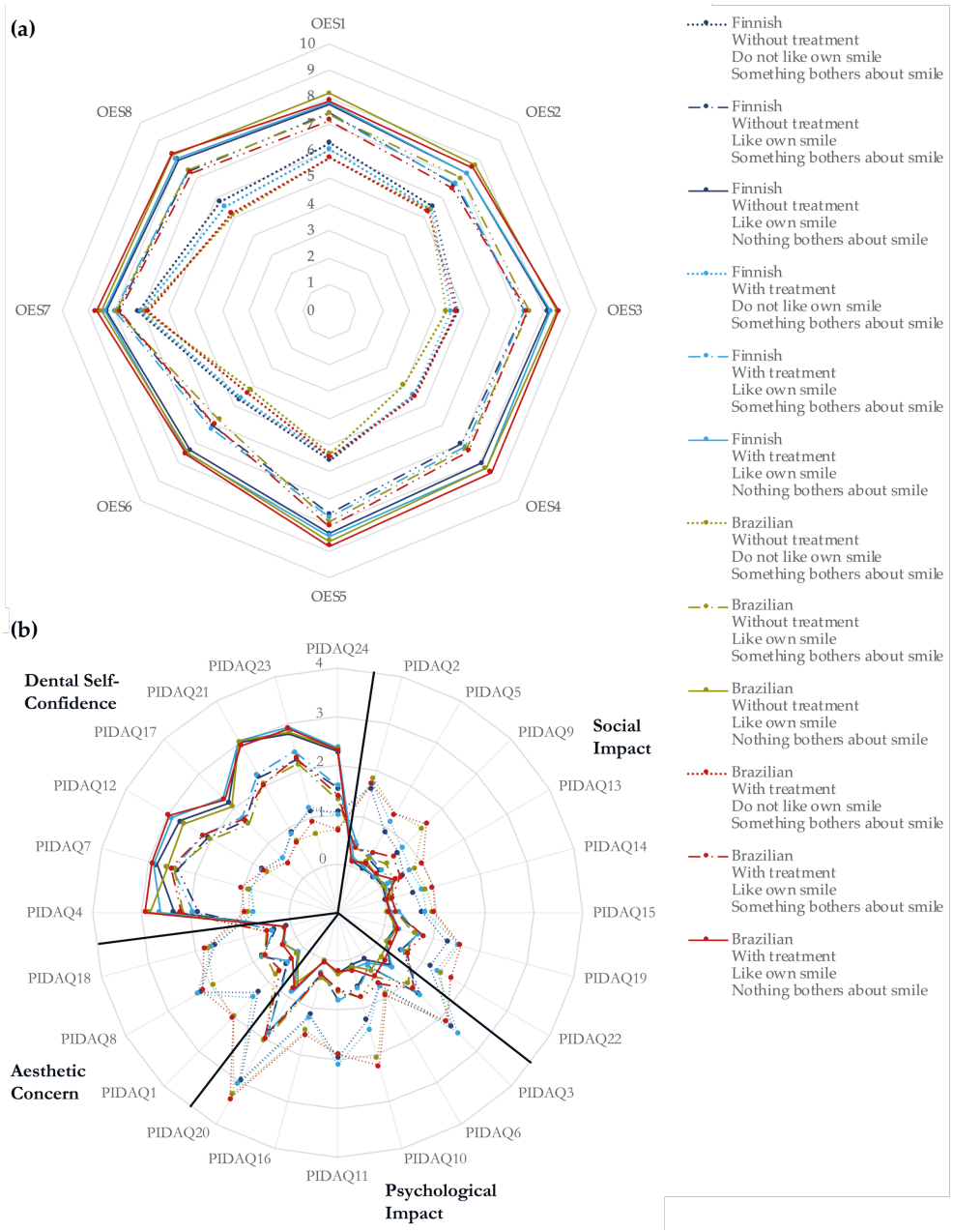


Figure 11. Mean scores given to the items of the (a) Orofacial Esthetic Questionnaire (OES) and (b) Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) according to the interaction between the country, whether the individuals have received any aesthetic dental treatment, whether the individuals like their own smile, and whether something bothers the individuals about their smile.

5.4 Comparison of OES and PIDAQ scores (Publications III and IV)

The OES mean score indicates a positive valence of satisfaction with OA in both countries. In the Finnish sample, this mean score was 7.01 (SD = 1.58), and in Brazil, it was 7.05 (SD = 1.69). The data presented a non-severe violation of normal distribution ($|sk| < 0.81$ and $|ku| < 0.57$) and heteroscedasticity between the countries (Levene's test: $F = 7.60$, $p = 0.006$). No statistically significant difference was observed between the two countries (Welch's t-test: $t = -0.85$, $p = 0.400$).

For PIDAQ, the mean factor scores indicate low psychosocial impact related to dental aesthetics in individual's lives: Finland – *dental self-confidence* = 1.95 (SD = 1.02), *social impact* = 0.57 (SD = 0.81), *psychological impact* = 0.87 (SD = 0.85), and *aesthetic concern* = 0.69 (SD= 0.90); Brazil – *dental self-confidence* = 1.93 (SD = 1.04), *social impact* = 0.56 (SD = 0.78), *psychological impact* = 1.06 (SD = 0.99), and *aesthetic concern* = 0.82 (SD = 0.99). The PIDAQ scores cannot be directly compared between the countries since the factor model did not present configural invariance (Finnish sample: exclusion of items 9, 13, 14, and 15; Brazilian sample: exclusion of item 6), and, therefore, the operationalization of the concept is different between the countries.

Table 15 presents the comparisons of OES and PIDAQ mean scores according to sex, monthly income category, and age category within each country. Statistically significant differences were observed between men and women in two PIDAQ factors: *social impact* and *psychological impact*. However, these differences had a low effect size ($\eta_p^2 = 0.002–0.022$), implying that the statistical significance could be attributed to an inflation of the type I error due to a high sample size. It can lead the statistical analyses to detect very small differences with no practical significance between groups.

The same issue is observed for the variables of monthly income and age. Statistical differences indicate that older individuals and those with higher monthly income are more satisfied with their OA and less psychosocially affected by dental aesthetics. However, the majority of the score differences were minimal and presented small practical significance ($\eta_p^2 = 0.007–0.042$). An exception to this was found in the comparison of the scores for *social impact* and *psychological impact* between the monthly income categories within the Brazilian sample. In these cases, the score difference between the lowest and highest income categories was approximately 1.0 point with a medium practical significance ($\eta_p^2 = 0.070–0.077$).

Table 15. Comparison of the mean scores (standard deviation) of the Orofacial Esthetic Scale (OES) and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) factors according to sex, monthly income, and age in the Finnish and Brazilian samples.

		Factor[#]				
		OES	PIDAQ			
Country	Characteristic	SOA	DSC	SI‡	PI¶	AC
Finland	**Sex**					
	Male	6.9 (1.6)	1.9 (1.0)	0.5 (0.8)	0.6 (0.7)	0.6 (0.9)
	Female	7.0 (1.6)	2.0 (1.0)	0.6 (0.8)	0.9 (0.9)	0.7 (1.0)
	Statistic test†	F=2.31	F_W=2.36	F_W=11.34	F_W=94.08	F_W=3.97
	p-value	0.128	0.142	0.001*	<0.001*	0.047*
	η_p^2	0.001	0.001	0.003	0.022	0.001
	Monthly income (€)					
	<2,500	6.8 (1.6)[a]	1.9 (1.0)	0.7 (0.9)[b]	1.0 (0.9)[b]	0.8 (1.0)[b]
	2,500 ├ 5,000	7.1 (1.6)[b]	2.0 (1.0)	0.5 (0.7)[a]	0.8 (0.8)[a]	0.7 (0.9)[a]
	5,000 ├ 7,500	7.1 (1.6)[b]	2.0 (1.1)	0.5 (0.7)[a]	0.8 (0.8)[a]	0.7 (0.9)[ab]
	7,500 ├ 10,000	7.2 (1.4)[b]	2.0 (1.0)	0.4 (0.6)[a]	0.7 (0.7)[a]	0.6 (0.8)[a]
	≥10,000	7.4 (1.3)[b]	2.1 (1.0)	0.4 (0.7)[a]	0.7 (0.8)[a]	0.5 (0.9)[a]
	Statistic test†	F_W=15.62	F=2.15	F_W=18.47	F_W=16.06	F_W=8.93
	p-value	<0.001*	0.072	0.001*	<0.001*	<0.001*
	η_p^2	0.016	0.002	0.020	0.017	0.009
	Age (years)					
	<23	6.9 (1.6)[a]	2.0 (1.0)	0.7 (0.9)[b]	1.0 (0.9)[b]	0.7 (1.0)[b]
	23 ├ 29	6.9 (1.6)[a]	1.9 (1.0)	0.6 (0.9)[b]	1.0 (0.9)[b]	0.8 (1.0)[b]
	29 ├39	7.0 (1.6)[ab]	1.9 (1.0)	0.6 (0.8)[b]	0.9 (0.9)[b]	0.7 (0.9)[ab]
	39 ├52	7.3 (1.5)[c]	2.0 (1.1)	0.4 (0.7)[a]	0.7 (0.7)[a]	0.6 (0.8)[a]
	≥52	7.2 (1.6)[bc]	1.9 (1.1)	0.4 (0.6)[a]	0.7 (0.7)[a]	0.6 (0.8)[a]
	Statistic test†	F=7.03	F_W=1.31	F_W=18.07	F_W=18.45	F_W=7.22
	p-value	<0.001*	0.266	0.001*	<0.001*	<0.001*
	η_p^2	0.008	0.001	0.016	0.017	0.007
Brazil	**Sex**					
	Male	7.1 (1.7)	2.0 (1.0)	0.5 (0.7)	0.9 (0.9)	0.8 (1.0)
	Female	7.1 (1.7)	2.0 (1.1)	0.6 (0.8)	1.1 (1.0)	0.8 (1.0)
	Statistic test†	F=0.05	F=3.30	F_W=8.44	F_W=11.46	F_W=2.43
	p-value	0.816	0.069	0.006*	0.001*	0.119
	η_p^2	<0.001	0.001	0.002	0.003	0.001
	Monthly income (R$)					
	<1,255	6.2 (2.1)[a]	1.5 (1.1)[a]	1.2 (1.1)[e]	1.7 (1.2)[e]	1.3 (1.2)[d]
	1,255 ├ 2,005	6.7 (2.0)[b]	1.8 (1.1)[b]	0.9 (1.0)[d]	1.4 (1.2)[d]	1.1 (1.2)[c]
	2,005 ├ 8,641	7.1 (1.7)[c]	2.0 (1.1)[c]	0.6 (0.8)[c]	1.1 (1.0)[c]	0.8 (1.0)[b]
	8,641 ├ 11,262	7.3 (1.6)[d]	2.1 (1.0)[d]	0.4 (0.7)[b]	0.8 (0.9)[b]	0.7 (0.9)[ab]
	≥11,262	7.5 (1.5)[d]	2.2 (1.0)[d]	0.3 (0.5)[a]	0.7 (0.8)[a]	0.6 (0.8)[a]
	Statistic test†	F_W=34.36	F=28.47	F_W=71.28	F_W=67.60	F_W=31.41
	p-value	0.001*	<0.001*	<0.001*	<0.001*	<0.001*
	η_p^2	0.039	0.028	0.077	0.070	0.035

(Continued)

Table 15. Continued.

Country	Characteristic	SOA	DSC	SI‡	PI¶	AC
Brazil	**Age (years)**					
	<23	6.8 (1.7)[a]	1.8 (1.1)[a]	0.9 (0.9)[d]	1.4 (1.1)[c]	1.0 (1.1)[b]
	23 ├ 29	7.1 (1.7)[b]	2.0 (1.1)[b,c]	0.6 (0.8)[c]	1.1 (1.0)[b]	0.8 (1.0)[a]
	29 ├39	7.3 (1.7)[b]	2.1 (1.0)[c]	0.5 (0.7)[b]	0.9 (0.9)[a]	0.7 (1.0)[a]
	39 ├52	7.3 (1.8)[b]	2.1 (1.1)[c]	0.4 (0.7)[a]	0.8 (0.9)[a]	0.7 (0.9)[a]
	≥52	7.1 (1.9)[b]	1.9 (1.1)[a,b]	0.4 (0.7)[a,b]	0.9 (0.9)[a]	0.8 (1.0)[a]
	Statistic test†	F_W=13.98	F=10.92	F_W=37.37	F_W=39.20	F_W=10.07
	p-value	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
	η_P^2	0.014	0.011	0.018	0.042	0.011

#SOA: Satisfaction with Orofacial Appearance; DSC: Dental Self-Confidence; SI: Social Impact; PI: Psychological Impact; AC: Aesthetic Concern. †F: ANOVA; F_W: Welch's ANOVA. *p<0.05. [ab]different letters indicate significant statistical difference among groups according to the factor (Tukey or Games-Howell post hoc test, α=5%). ‡For Finnish sample, items 9, 13, 14, and 15 were not considered for the calculation of the score. ¶For Brazilian sample, item 6 was not considered for the calculation of the score.

5.5 Demand for aesthetic dental treatment (Publications III and IV)

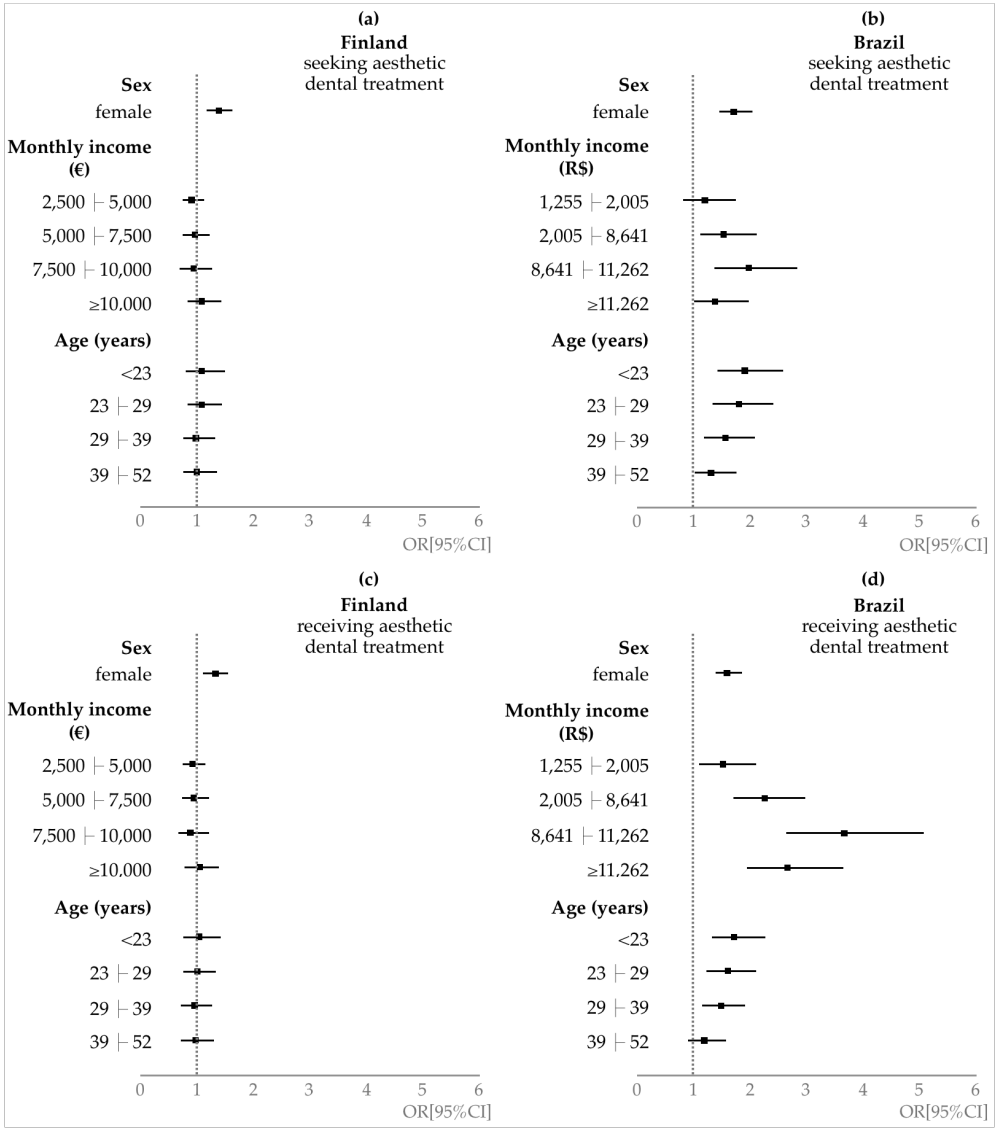
As shown in the sample characterization (section 4.3, Table 2, page 49), differences in demand for dental aesthetic treatment between Finland and Brazil can be observed ($p < 0.001$). While most Finns (59.5%, 95%CI = 57.9–61.1%) have neither sought nor undergone this type of treatment, most Brazilians (77.9%, 95%CI = 76.6–79.2%) have sought or undergone it. Furthermore, though the adherence rate is high among those who sought dental aesthetic treatment, it differed between the countries ($p < 0.001$). In the Finnish sample, 94.8% (95%CI = 93.7–95.9%) of those who sought dental aesthetic treatment actually underwent it, whereas in the Brazilian sample, this value was 86.7% (95%CI = 85.5–87.9%).

The prevalence and probability of seeking or receiving aesthetic dental treatment according to sex, monthly income, and age are shown in Table 16 and Figure 12, respectively. Women exhibited a higher prevalence and probability of seeking and undergoing aesthetic dental treatment compared to men in both Finland and Brazil. No difference was found in seeking and receiving aesthetic dental treatment based on monthly income and age in the Finnish sample. In contrast, younger people and those with higher monthly income had higher prevalence and chances of seeking and receiving such treatment in the Brazilian sample. These cross-country differences can be observed in Figure 12, where the OR values are located to the left (OR > 1.0) for various sociodemographic categories in the Brazilian sample, while the OR values intersect the value of 1 for age and economic level categories in the Finnish sample.

Table 16. Prevalence [% (95% confidence interval)] of the participants from Finland and Brazil who have sought and received aesthetic dental treatment in each category according to sex, monthly income, and age.

Characteristic		Finland		Brazil	
		Sought aesthetic dental treatment	Received aesthetic dental treatment	Sought aesthetic dental treatment	Received aesthetic dental treatment
Sex					
Male		34.7 (31.5–37.9)	33.5 (30.3–36.7)	70.6 (68.0–73.2)	60.2 (57.4–63.0)
Female		42.5 (40.6–44.4)	40.0 (38.1–41.9)	81.1 (79.5–82.7)	70.8 (70.3–71.3)
p-value#		<0.001*	<0.001*	<0.001*	<0.001*
Monthly income					
Finland (€)	Brazil (R$)				
<2,500	<1,255	41.6 (39.2–44.0)	39.4 (37.0–41.8)	73.2 (67.7–78.7)[a]	51.2 (45.0–57.4)[a]
2,500 ├ 5,000	1,255 ├ 2,005	39.0 (35.7–42.3)	37.3 (34.0–40.6)	76.8 (72.7–80.9)[ab]	60.9 (56.2–65.6)[b]
5,000 ├ 7,500	2,005 ├ 8,641	39.6 (35.4–43.8)	37.7 (33.5–41.9)	79.6 (77.7–81.5)[b]	68.3 (66.2–70.4)[c]
7,500 ├ 10,000	8,641 ├ 11,262	38.8 (33.5–44.1)	35.9 (30.6–41.2)	81.5 (78.5–84.5)[b]	75.7 (72.4–79.0)[d]
≥10,000	≥11,262	41.9 (36.7–47.1)	39.6 (34.4–44.8)	73.6 (70.6–76.6)[a]	67.7 (64.5–70.9)[c]
p-value#		0.218	0.246	<0.001*	<0.001*
Age (years)					
<23		42.0 (38.4–45.6)	39.6 (36.0–43.2)	80.6 (77.9–83.3)[c]	68.4 (65.3–71.5)[b]
23 ├ 29		41.4 (38.7–44.1)	38.7 (36.0–41.4)	79.9 (77.3–82.5)[bc]	67.9 (64.9–70.9)[b]
29 ├ 39		39.0 (35.5–42.5)	37.1 (33.6–40.6)	79.0 (76.6–81.4)[bc]	69.2 (66.5–71.9)[b]
39 ├ 52		39.8 (35.7–43.9)	37.7 (33.6–41.8)	75.8 (72.5–79.1)[b]	66.7 (63.1–70.3)[ab]
≥52		39.2 (34.0–44.4)	38.0 (32.8–43.2)	68.7 (64.3–73.1)[a]	61.9 (57.3–66.5)[a]
p-value#		0.241	0.324	<0.001*	0.006*

#the value presented is the lowest p-value found in pairwise comparison using z test (α=5%) between the categories of the variable of interest. *p<0.05. [ab]different letters indicate significant statistical difference.



Note. Reference category: sex = male; monthly income = < 2,500€/< R$ 1,255; and age = ≥ 52 years.
Logistic Regression Models [y_1 = seeking aesthetic dental treatment; y_2 = receiving aesthetic dental treatment; X_1 = sex; Monthly income (MI): X_{MI}, 2 = 2,500 ├ 5,000€/R$ 1,255 ├ 2,005; 3 = 5,000 ├ 7,500€/R$ 2,005 ├ 8,641; 4 = 7,500 ├ 10,000€/R$ 8,641 ├ 11,262; 5 = ≥ 10,000€/≥ R$ 11,262; Age (years): X_A, 1 = < 23; 2 = 23 ├ 29; 3 = 29 ├ 39; 4 = 39 ├ 52]: (a): $y_1 = -0.668+0.332X_1-0.081X_{MI2}-0.037_{MI3}-0.051X_{MI4}+0.087X_{MI5}+0.092X_{A1}+0.093X_{A2}-0.004X_{A3}+0.011X_{A4}$
(b): $y_1 = 0.049+0.551X_1+0.198X_{MI2}+0.444_{MI3}+0.688X_{MI4}+0.339X_{MI5}+0.655X_{A1}+0.596X_{A2}+0.463X_{A3}+0.288X_{A4}$
(c): $y_2 = -0.669+0.285X_1-0.072X_{MI2}-0.045_{MI3}-0.106X_{MI4}+0.054X_{MI5}+0.049X_{A1}+0.017X_{A2}-0.038X_{A3}-0.020X_{A4}$
(d): $y_2 = -0.780+0.472X_1+0.424X_{MI2}+0.816_{MI3}+1.303X_{MI4}+0.986X_{MI5}+0.547X_{A1}+0.480X_{A2}+0.399X_{A3}+0.180X_{A4}$

Figure 12. Odds ratio (OR) with 95% confidence interval (95%CI) for seeking and receiving aesthetic dental treatment in Finland and Brazil according to sex, monthly income, and age.

5.6 Structural equation analysis

The data regarding the factor scores of OES and PIDAQ from Finland and Brazil meet the assumptions for PCA (MSA ≥ 0.81). PCA and Parallel Analysis resulted in the retention of a single factor (Table 17). In both Finnish and Brazilian samples, values of UniCo > 0.98, ECV > 0.89, and MIREAL < 0.27 were observed, thereby confirming the viability of treating the factor scores of OES and PIDAQ as a single dimension called *orofacial appearance*. Consequently, this dimension was considered in the structural model (Figure 9, page 69) as the independent variable.

Table 17. Principal component analysis (PCA) and parallel analysis results for factor scores of the Orofacial Esthetic Scale (OES) and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) in the Finnish and Brazilian samples.

	Finnish/Brazilian sample			
	PCA		Parallel Analysis	
Dimensions	Real-data eigenvalues	Proportion of variance	Mean of random eigenvalues	95th percentile of random eigenvalues
1	3.71*/3.72*	0.74/0.74	1.05/1.04	1.07/1.06
2	0.62/0.58	0.12/0.12	1.02/1.02	1.04/1.03
3	0.25/0.29	0.05/0.06	1.00/1.00	1.01/1.01
4	0.23/0.26	0.05/0.05	0.98/0.98	0.99/0.98
5	0.18/0.15	0.04/0.03	0.95/0.96	0.97/0.97

Slash punctuation marks were inserted between the estimates to separate the values obtained for each sample. *Suggesting component to be retained by Parallel Analysis (real-data eigenvalues > mean of random eigenvalues).

The complete structural model (Figure 9, page 69) did not present an adequate fit to the samples (CFI ≤ 0.64, TLI ≤ 0.56, RMSEA ≥ 0.195, SRMR ≥ 0.278). None of the demographic variables presented a moderating effect (p ≥ 0.10, Table 18). It was also observed that the variable 'having received aesthetic dental treatment' did not have an indirect effect on the impact of OA on life satisfaction for either of the samples (p > 0.17, Table 18). Therefore, the models were refined by excluding this variable, as well as those sociodemographic variables (Figure 9.c, page 69).

The refined model presented an adequate fit to the samples (Finnish Sample: CFI = 0.97, TLI = 0.95, RMSEA = 0.087, SRMR = 0.068; Brazilian Sample: CFI = 0.97, TLI = 0.96, RMSEA = 0.076, SRMR = 0.047). The path estimates are presented in Table 18. The OA presented a significant impact on life satisfaction in both countries. Individuals who are more satisfied with their own OA and who perceive a lesser psychosocial impact of dental aesthetics have higher life satisfaction. The model showed an explained variance for life satisfaction of 9.8% in the Finnish sample and 13.1% in the Brazilian sample.

Table 18. Path estimates of the structural models elaborated to assess the impact of orofacial appearance on life satisfaction, the moderation role of sex, monthly income, and age, and the indirect effect of having received aesthetic dental treatment on this impact.

	Finnish sample				Brazilian sample			
Path estimate	B	β	SE	p-value	B	β	SE	p-value
Completed model								
OA → LS (β1)	0.52	0.45	0.16	0.002	0.47	0.44	0.10	<0.001
ADT → LS (β2)	0.04	0.01	0.04	0.279	0.13	0.05	0.04	0.002
Sex → LS (β3)	0.33	0.11	0.05	<0.001	0.12	0.04	0.02	0.007
MI → LS (β4)	0.21	0.22	0.02	<0.001	0.37	0.30	0.02	<0.001
Age → LS (β5)	-0.01	-0.07	<0.01	<0.001	0.01	0.08	<0.01	<0.001
Sex*OA → LS (β6)	-0.12	-0.18	0.07	0.099	-0.07	-0.11	0.04	0.101
MI*OA → LS (β7)	-0.01	-0.03	0.02	0.523	-0.02	-0.06	0.02	0.159
Age*OA → LS (β8)	<0.01	0.03	<0.01	0.621	<0.01	-0.01	<0.02	0.790
OA → ADT (β9)	-0.01	-0.04	0.01	0.030	0.01	0.03	0.01	0.104
Sex → ADT (β10)	0.06	0.05	0.02	0.001	0.11	0.10	0.02	<0.001
MI → ADT (β11)	<0.01	<0.01	0.01	0.845	0.05	0.12	0.01	<0.001
Age → ADT (β12)	<0.01	<0.01	<0.01	0.995	<0.01	-0.08	<0.01	<0.001
Indirect effect[#]								
OA → ADT → LS (β9*β2)	<0.01	<0.01	<0.01	0.384	<0.01	<0.01	<0.01	0.166
Refined model[†]								
OA → LS (β1)[‡]	0.34	0.31	0.02	<0.001	0.38	0.36	0.02	<0.001

B: non-standardized path estimate; β: standardized path estimate; SE: standard error; OA: orofacial appearance dimension; ADT: have received aesthetic dental treatment; LS: life satisfaction; MI: monthly income. β1 to β12: path estimates corresponding to Figure 9 (page 69). #Indirect effect assessed by Sobel' s test with bootstrap simulation. † Model refined by excluding the variables have received aesthetic dental treatment, sex, monthly income, and age (Figure 9.c, page 69). ‡ Explained variance for life satisfaction: Finnish sample = 0.098, Brazilian sample = 0.131.

6 DISCUSSION

6.1 Psychometric scales for assessment of OHRQoL

6.1.1 OHIP-14

In **Publication I**, the psychometric properties and dimensionality of the OHIP-14 were verified in samples of Brazilian and Finnish dental and non-dental patients. Previous studies have investigated these issues across various samples (Castaño Joaquí et al., 2023; Feng et al., 2022; Melbye, 2023; Montero et al., 2010; Santos et al., 2013; Soares et al., 2021; Xin & Ling, 2006; Yang et al., 2023; Zucoloto et al., 2014). The importance of this kind of research lies in the widespread use of the OHIP-14, where the validation and reliability of data when using this scale are often neglected.

It was observed that the data obtained with the OHIP-14 did not adequately measure the oral health impact in samples of non-dental patients from both Finland and Brazil. Six items in the scale did not meet the assumption of approximating a normal distribution of responses. Although the use of CFA with the robust estimation method (WLSMV) can tolerate slight violations of this assumption (Marôco, 2021b), the data from these samples presented a severe violation of normality. A decision was made to exclude these 6 items to mitigate potential biases in the results, as they failed to adequately capture the variability of responses within these subgroups. Since this exclusion accounted for approximately 43% of the scale items, the factor model of OHIP-14 and its underlying theoretical framework were not suitable for these samples.

These findings were supported by the analysis of validity based on response processes, showing that the OHIP-14 items were informative only at high levels of the latent trait. This could be explained because the OHIP-14 content mainly focuses on dental, oral, or prosthesis problems in the past year. Therefore, participants need to have had some severe oral health issue to endorse a response other than 0. It is unlikely that individuals with any oral problems would be included in a non-dental patient sample, as they typically seek dental treatment to address such problems. As

the scale may not fully capture the oral health impact profile, interpreting results (scores) obtained with the OHIP-14 in non-dental patient samples should be approached cautiously. Consequently, conclusions drawn for these samples based on OHIP-14 results may be inaccurate.

Some studies diverge from these findings. Montero et al. (2010) found that the 3-factor model fit to a sample of Spanish non-dental patients, and Feng et al. (2022) and Yang et al. (2023) reported that the 7-factor model fit to a sample of Chinese college students. These divergences may be attributed to cultural factors that can influence the perception of oral health impact or even the seeking or availability of dental treatment in countries. Additionally, differences in the analytical strategies were observed when comparing **Publication I** with the study by Montero et al. (2010). While the current dissertation employed the robust WLSMV method, Montero et al. (2010) conducted CFA using the ML estimation method. However, this method is not recommended for ordinal response scales (Kline, 2023), such as that of the OHIP-14, and assumes a normal distribution of data, which was not mentioned in the study (Montero et al., 2010). This, in turn, limits the interpretation and assessment of the model fit. While these discrepancies exist among studies, it emphasizes the need to first assess the content validity of the OHIP-14 items to ensure their suitability for a given context and cultural background of a non-dental patient sample. Subsequently, it becomes essential to evaluate the validity and reliability of the data using an appropriate analytical approach.

The 7-factor model (Slade, 1997a), which adheres to the conceptual model proposed by Locker (1988), did not fit to the data from Brazil and Finland dental patients even after excluding 1 item that did not exhibit psychometric sensitivity. This model only demonstrated an adequate fit to the dental patient data collected in a previous study conducted in 2014 (Zucoloto et al., 2014). Even then, this fit was achieved only after adding second-order factors and variance restrictions. The difficulty of fitting the 7-factor model has previously been raised and questioned by Baker et al. (2008). These authors suggest there is an overlap of concepts among the dimensions, and the content of the items no longer reflects these dimensions. The most plausible explanations for these issues include both the outdated theoretical concepts underlying the dimensions (John, 2021) and the reduction process that led to the 7-factor model of OHIP-14. This reduction was based on a data-driven approach from a specific sample (Slade, 1997a) rather than relying on the theory of the scale. Furthermore, this reduction retained only two items per factor. While this aligns with the minimum expected number of items per factor, a model where factors

have two items is more prone to technical problems (Kline, 2023), such as observed in the dissertation.

The 3-factor model of the OHIP-14 found by Montero et al. (2010) sounds theoretically plausible as it allows the measurement of 3 of the 4-dimensional conceptual model of OHRQoL (John, 2018). This conceptual model is the most applicable to contemporary dentistry. The 3-factor model showed adequate fit to the data of the Brazilian dental patient sample. In the Finnish dental patient sample, model fit was achieved by removing the *functional limitation* dimension. These findings suggest the adequacy of this factor model of the OHIP-14 for measuring OHRQoL in dental patients. However, the results should be carefully interpreted, as this model may vary among samples, and it alone is not capable of fully covering the 4-dimensional conceptual model of OHRQoL.

Another alternative is the unifactorial model proposed by Santos et al. (2013), which presented an adequate fit to the data from the dental patient samples in Brazil and Finland. In addition, the values of the unidimensionality indices (UniCo, ECV, and MIREAL) suggest that the OHIP-14 items should be treated as a single dimension. Thus, while the 3-factor model also demonstrated a good fit to the data, the unifactorial model was better suited for measuring the oral health impact profile in the dental patient samples. Although the unidimensional model does not align with the 4-dimensional conceptual model, it provides important information about OHRQoL, specifically, the perception of the impact of a given oral condition on an individual's life.

Despite these findings, some points must be considered before using the OHIP-14 in future research or clinical settings. The choice of the factor model to be adopted should initially be based on the theoretical concept one intends to measure. Subsequently, the validity and reliability of the data should be assessed to confirm the fit of the factor model (Hair et al., 2019; Marôco, 2021b). Clinicians, for whom this type of analysis may not be feasible, should guide this decision by evidence obtained in a population with characteristics similar to those of their patients. Otherwise, the scores obtained using OHIP-14 may be arbitrary, negatively impacting the treatment plan, which can lead to under- or overtreatment.

Although the OHIP-14 fitted well to dental patient samples, it is important to emphasize that no oral conditions or types of treatment were specified for the samples in this dissertation. Specific groups of patients can also affect how OHIP-14 works. For example, the OHIP-14 may not fit properly for dental patients whose concerns are exclusively related to orofacial appearance, as the content of the scale

is related to the other dimensions of OHRQoL (*psychosocial impact*, *orofacial pain,* and *oral function*).

An in-depth review of the OHIP-14 as a measure scale is necessary. Undoubtedly, this scale holds great importance in the literature related to OHRQoL and remains useful in certain contexts nowadays. However, the OHIP was developed over two decades ago, and its underlying theoretical model is no longer applicable in the present-day scenario. Studies that investigate new factor structures of this scale, including **Publication I**, tend to seek new theories based on statistical results that can be applied to the OHIP. While this has scientific merit, it contradicts the expected rationality when using a psychometric scale as a measurement tool, wherein a priori theoretical background should guide its development (Marôco, 2021b). The focus and efforts of new studies should be an extensive exploration of new conceptual theoretical models of OHRQoL that can be applicable in today's context (Baker et al., 2008).

6.1.2 OES and PIDAQ

In **Publication II**, the OES and PIDAQ were translated and culturally adapted for the Finnish language. Although Finland belongs to the Nordic European cultural cluster, it is a country with a different background compared to other cluster members, which makes its culture unique (Liljander, 2019; Paasi, 1997). The translation and cultural adaptation of a Finnish version of those scales are important not only for providing dentists in Finland with valuable clinical tools but also for obtaining a standardized measurement of OA. Such standardization facilitates cross-country comparisons, contributing to the advancement of knowledge concerning the sociocultural factors that influence the perception of OA.

A change in the content of item 22 of the PIDAQ was proposed during the translation process. The original version used the term "opposite sex" to refer to other individuals for whom the respondent feels attraction and/or would like to establish a romantic relationship. The panel of researchers considered it necessary to change this term to a gender-neutral one, as the original version was based on a stereotyped view of attraction between men and women. Maintaining the original term could potentially cause discomfort or offense to some respondents. The same change was made to the Portuguese version of the PIDAQ (**Publications III** and **IV**). It is recommended that future studies using different PIDAQ versions consider evaluating the necessity of such adaptations. This emphasizes the need for

conducting content validity analyses in studies using psychometric scales, even well-established ones, to identify potential changes and adaptations that may be necessary when applying them to new samples and contexts.

The psychometric properties of the PIDAQ were subsequently estimated in **Publications II** and **III**. For the Finnish sample, 4 items from the *social impact* dimension did not present the assumption of psychometric sensitivity (severe violation of the normal distribution of responses) and were excluded from the factor model. This result may reflect some characteristics of the Finnish population, in which an increase in feelings of loneliness and social isolation has been observed in recent years (Anttila et al., 2020; Rönkä et al., 2018). Additionally, data collection took place during the early stages of the Sars-CoV-2 pandemic, when social distancing measures were in effect, potentially making social aspects less relevant to the respondents. Thus, future studies are necessary to verify the factor structure of the PIDAQ in the Finnish population in a context where social isolation measures are not in place.

For the Brazilian sample, all items of the PIDAQ presented adequate psychometric sensitivity. However, 1 item from the *psychological impact* dimension had a low factor loading in CFA (item 6: 'I am somewhat distressed when I see other people's teeth', $\lambda = 0.36$). As such, it was excluded from the factor model. This result differs from a previous study that utilized the PIDAQ in a sample of Brazilian dental patients, in which this item showed an appropriate factor loading ($\lambda = 0.57$) (Campos et al., 2020a). This difference may once again be attributed to the context of the pandemic during data collection, which can alter individuals' perceptions. Additionally, the sample in the previous study (Campos et al., 2020a) consisted solely of dental patients, while the one in **Publication II** also included individuals who were not undergoing treatment. For dental patients, oral health becomes a recurring topic in their lives, and they may put greater importance on it compared to non-dental patients (Bimbashi et al., 2015; Campos et al., 2020b; Zhao & He, 2013). This may influence the responses to the items and the model fit.

The Finnish and Portuguese versions of the PIDAQ presented adequate psychometric properties after the exclusion of those specific items in each sample. The 4-factor structure was confirmed, consistent with previous studies (Campos et al., 2020a; Klages et al., 2006; Klages et al., 2015; Montiel-Company et al., 2013; Spalj et al., 2014; Wahab et al., 2022; Wan Hassan et al., 2017). It is important to clarify that the exclusion of items does not represent a reduction of the psychometric scale for its future use. It is a necessary analytical step to fit the factor model and ensure data validity for a specific sample and context (Marôco, 2021b). Therefore, future

applications of these versions of the scale should consider all items and subsequently examine the factor structure that best fits the new set of data obtained.

Regarding the psychometric properties of the OES (**Publications II** and **III**), the unifactorial model was confirmed for both the Finnish and Brazilian samples, but only after the inclusion of a correlation between the errors of items 1 (facial appearance) and 2 (appearance of facial profile). Allowing correlated errors that were not previously identified in the original theoretical and factor model can pose issues, potentially introducing bias in parameter estimates for the factor model (Hermida, 2015). This practice influences the interpretation of results compared to models that do not account for correlated errors. However, when there is a theoretical rationale, allowing correlated errors is an approach to ensure and attest to the validity and reliability of data obtained with a psychometric scale (Hair et al., 2019; Kline, 2023; Marôco, 2021b). In the case of the OES, the need for the correlation between errors of items 1 and 2 has also been observed in previous studies (Campos et al., 2020b; John et al., 2012), and two theoretical justifications may support this. First, these two items could be associated with a second factor representing satisfaction with the appearance of extraoral components, while the remaining items reflect intraoral components (John et al., 2012). Although this seems theoretically plausible, given the widespread use of the OES as a unifactorial scale and the substantial scientific evidence about that, it is still recommended that this scale be used as a single factor, as originally proposed (Larsson et al., 2010a; Larsson et al., 2010b).

Secondly, the correlation between these items may suggest that, when applying the OES to general populations, respondents might not distinguish the facial profile as a distinct component of their facial appearance (Varatharaju et al., 2021). This is understandable, as an individual's own facial profile is not a commonly observed aspect. Since these items may be analytically considered as overlapping, a preliminary thought might be to review the factor structure of the OES by reducing items. A shortened scale offers advantages in minimizing the burden on respondents, making it easier to administer, and increasing response rates (Bela Andela et al., 2022). While this is true and appealing, it is essential to remember that the OES is already a brief and quickly administered scale (Campos et al., 2020b). Moreover, retaining these items can be valuable for investigating individual responses to each item. The facial profile is a component considered in some dental treatment goals, such as orthodontics and orthognathic surgery. By assessing the responses to this specific OES item, it may be possible to identify individuals dissatisfied with this component, thus providing relevant information for the development of patient-centered treatment plans (Campos et al., 2020b).

6.2 Self-perception of OA and demand for aesthetic dental treatment

6.2.1 Cross-national comparisons: Why Finland *vs* Brazil?

Culture can be described by various definitions. According to anthropologist Kluckhohn (1951, p. 86), "culture consists in patterned ways of thinking, feeling and reacting, acquired and transmitted mainly by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts". The central core of this definition is based on traditional ideas and, most importantly, the values attributed to them (Kluckhohn, 1951; Kroeber & Kluckhohn, 1952; Liljander, 2019). These shared values, as previously reported, can influence the demand for aesthetic dental treatment, the construction of self-perception of OA and its impact on well-being, and the role of demographic variables in these aspects. However, little has been explored on this matter. Thus, aiming to identify coherences and specificities, a good starting point would be cross-national comparisons between countries with significant sociocultural differences.

Finland and Brazil are two countries with such sociocultural differences. In this dissertation, the adopted perspective for understanding culture is through Hofstede's model (Hofstede, 2001, 2011), which provides an insightful cultural lens to explore these disparities. Drawing on Kluckhohn's ideas (Kluckhohn, 1951), Hofstede defines culture as "the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede, 2001, p. 9; Hofstede et al., 2010, p. 6). Hofstede's model is based on the premise of shared values and considers six dimensions of culture, which are presented and briefly described in Table 19. Based on empirical data (Hofstede, 2001, 2011), countries, including Finland and Brazil, were assigned scores for each dimension on a bipolar scale ranging from 0 to 100.

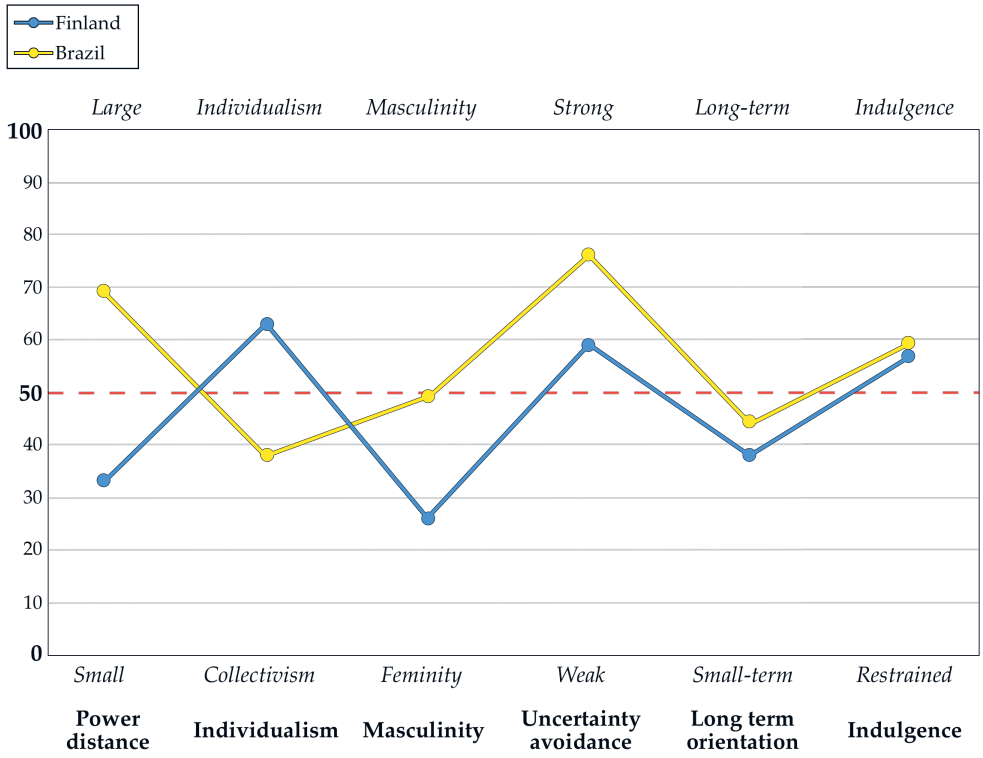
Table 19. Hofstede's dimensions of culture and their definitions (Hofstede, 2001, 2011).

Dimension	**Definition**
Power distance (small *vs* large)	The way a society deals with inequality among people. In cultures with a large power distance (higher scores), hierarchy is valued and accepted by society, whereas in cultures with a small power distance (lower scores), professional and interpersonal relationships tend to be more horizontal.
Individualism (individualism *vs* collectivism)	Related to the degree of integration of individuals into groups in society. Individualistic cultures (higher scores) value independence, autonomy, and individual achievements, while collectivistic cultures (lower scores) emphasize interdependence, group cohesion, social harmony, and belonging.
Masculinity *vs* Femininity	Explores the motivation of individuals in a society: wanting to be the best (masculine) or finding pleasure in what one does (feminine). Masculinity (higher scores) indicates a competitive society focused on individual achievements and success. Femininity (lower scores) embodies an emphasis on caring for others and quality of life.
Uncertainty avoidance (strong *vs* weak)	Reflects a culture's tolerance for uncertainty and ambiguity. Cultures with strong uncertainty avoidance (higher scores) tend to prefer strict rules, clear organizational structures, and resistance to change, while cultures with weak uncertainty avoidance (lower scores) are more open to ambiguity and change.
Long-term *vs* Short-term orientation	The way a culture deals with time and planning. Cultures with long-term orientation (higher scores) tend to value perseverance and adaptation for the future, while cultures with short-term orientation (lower scores) emphasize respect for traditions and adherence to social norms.
Indulgence (indulgence *vs* restraint)	The extent to which a culture allows relatively free gratification of basic and natural human desires and impulses. Cultures with high indulgence (higher scores) value freedom, fun, and personal gratification, while cultures with high restraint (lower scores) tend to value control of desires and the promotion of stricter social norms.

Hofstede's dimensions model, along with the scores assigned to each country, is not without criticism (Liljander, 2019). The model oversimplifies the inherent complexity of culture into 6 dimensions, without considering potential cultural changes over time (Chu et al., 2019; Signorini et al., 2009). It also employs a stereotypical nomenclature for the *masculinity vs femininity* dimension (Wu, 2006). The scores were obtained in a business context and initially assigned almost 40 years ago (Hofstede, 1984), which could make them outdated (Liljander, 2019). They also did not take into account possible subcultures present within a single country (Chu et al., 2019). There is a lack of evidence regarding the psychometric properties of the

scale used in the studies to assign the dimension scores to countries (Gerlach & Eriksson, 2021; Taras et al., 2023). Furthermore, it should be clarified that Hofstede's dimensions have not been investigated or addressed in the publications of this dissertation.

Despite the limitations of Hofstede's model, comparing the dimensions scores between Finland and Brazil can be of great value in understanding some of the cultural differences between the countries. This can provide insights into the findings of this dissertation and broaden the perspectives for future cross-national studies on OA and demand for aesthetic treatments. Figure 13 shows the scores for Hofstede's dimensions of culture for both countries.



Data source: data for this figure were collected from Hofstede (1984, 2001) and Hofstede et al. (2010) and are available at https://www.hofstede-insights.com/country-comparison-tool (accessed August 3, 2023).

Figure 13. Scores for Hofstede's dimensions of culture (Hofstede, 2001, 2011) for Finland and Brazil.

Among the observed differences between the countries, 3 dimensions stand out: *power distance*, *individualism*, and *masculinity vs femininity*. In the first dimension, Brazil exhibited a high score indicating a large power distance, reflecting a society that accepts and endorses social inequalities and supports hierarchies. In cultures with a large power inequality, one's status becomes a symbol of power and an indicator of social position (Hofstede et al., 2010). Finland showed a low score in this dimension, indicating a society where inequalities should be minimized, with few hierarchical systems, and with equality and freedom of expression (Gyekye & Salminen, 2005; Hofstede et al., 2010; Liljander, 2019).

Regarding the dimension of *individualism*, Brazil has a low score indicating collectivism. This suggests a significant and strong sense of belongingness of people to a united and cohesive group (Hofstede et al., 2010). Finland has scores that characterize its society as individualistic, with low interdependence among its members, where stronger ties are concentrated within the immediate family (Hofstede et al., 2010). On the other hand, Finland has low scores in the *masculinity vs femininity* dimension, corresponding to a society that values equality, solidarity, and the quality of life of its population (Hofstede et al., 2010). Brazil has an intermediate score in this dimension.

Beyond Hofstede's dimensions, there are additional social differences between the two countries that can be identified. Gender equality is one of these differences, with Brazil having limited and weak gender equality policies, resulting in a society marked by disparities between women and men, such as wage gaps, low representation of women in various aspects of society, and a high rate of violence against women (Caicedo-Roa & Cordeiro, 2023; World Economic Forum, 2022). Conversely, Finland has strong policies and achieved one of the highest levels of gender equality among countries (World Economic Forum, 2022).

Finland is also classified as a country with low socioeconomic inequalities among socioeconomic classes (López-Roldán & Fachelli, 2021). While differences may be discernible, the majority of the Finnish population shares similar living conditions, facilitating democratic access to healthcare. There is also a social norm in Finland that promotes equal opportunities for its population (Kukkonen & Sarpila, 2021). At least on the surface, this norm seems to lead to a reduction of disparities between socioeconomic classes. In contrast, Brazil has a high inequality among socioeconomic classes (López-Roldán & Fachelli, 2021). In addition to substantial disparities in living conditions and lifestyles, differences in healthcare access also exist among different socioeconomic groups.

Although little explored in literature, some geographical and historical differences between countries can also influence the social value attributed to physical appearance. Finland has a subarctic continental climate characterized by long and cold winters, which leads to the routine of wearing winter clothing. Consequently, it is not typical to expose one's body in social interactions. Brazil has a vast territory with a tropical climate with a high average temperature. It is common for people to dress in very light clothes, and the exposure of the body in social interactions is a daily occurrence.

Additionally, the history of slavery in Brazil contributed to the establishment of strong roots in the valuation of physical appearance. During that time, slavery was based on race, and social divisions that were essentially built upon physical characteristics. Slaves were often priced based on their physical attributes, including their dental appearance. This reinforces the ongoing presence of inequality and hierarchical power structures that can still influence the importance attributed to physical appearance in Brazilian society.

6.2.2 Comparisons between total samples from Finland and Brazil

Initially, the measurement invariance of the OES and PIDAQ factorial model was examined between general Finnish and Brazilian samples (**Publication III**). It also aimed to compare satisfaction with OA (OES scores), the psychosocial impact of dental aesthetics (PIDAQ scores), and the prevalence of individuals seeking or receiving aesthetic dental treatments (**Publication III**).

Regarding the OES, measurement invariance and no statistical difference in the mean scores were observed between the countries. These findings align with the Cross-Cultural Coherence Theory (Cunningham et al., 1995; Tong et al., 2017), rejecting the hypothesis that satisfaction with OA differs between Brazil and Finland. It is important to emphasize that these results relate to a single component of self-perception, and other differences concerning physical appearance-related issues may still exist between the countries. This is highlighted by the higher prevalence of individuals in Brazil who have undergone aesthetic dental treatments in contrast to Finland.

This difference in prevalence does not necessarily mean that Brazilians seek more aesthetic dental treatments than Finns to improve their OA due to a lower self-perception. This rationale is supported by the findings that undergoing an aesthetic dental treatment did not influence responses to the items of OES and PIDAQ.

Therefore, what may explain this difference are sociocultural factors (section 6.2.1, page 99) that attribute distinct values to this type of treatment in each country. Aesthetic treatment also encompasses commercial behavior, consumption habits, and social prestige (Holden, 2020). In countries such as Brazil, which have high social inequalities and where society accepts and endorses these inequalities (high score in the *power distance* dimension in Hofstede's model), aesthetic dental treatment can be associated with high social status and power.

Another difference between the countries was the lack of configural invariance observed in the results of PIDAQ measurement invariance. In other words, this construct is measured differently in Brazil and Finland. Although this implies that the PIDAQ scores cannot be directly compared, this finding suggests that there is a difference in how Finns and Brazilians perceive the impact of dental aesthetics on their lives. This could be because the PIDAQ addresses social issues, and, as pointed out earlier (section 6.2.1, page 99), Brazil and Finland have marked differences that can influence the role of physical aspects in social interactions. Hence, in contrast to the satisfaction with OA, the cultural differences hypothesis (Culture-Specific Theory) (Tin-Oo et al., 2011) can be accepted for the psychosocial impact of dental aesthetics.

When analyzing responses to the OES and PIDAQ items, it was found that neither the country nor undergoing aesthetic dental treatment influenced these responses. Instead, individual characteristics such as liking one's own smile and whether the individual was bothered by any specific physical aspect influenced the responses. Thus, it is relevant for the dentist to be capable of identifying the patient's feelings and concerns about their physical appearance. This facilitates the plan of patient-centered treatment that also aims to enhance self-perception. Establishing a strong dentist-patient relationship with effective communication becomes essential for this identification and the assessment of the risk-benefit of an aesthetic treatment (Song et al., 2020). Furthermore, the dentist can use words through open dialogue to instigate changes in the way the patient perceives their own appearance.

It is worth mentioning that some patients may have symptoms or disorders like body dysmorphic disorder or anxiety (Dons et al., 2022). In this regard, high scores on item 20 of PIDAQ ('I wish my teeth looked better') deserve attention, as an excessive desire to enhance one's appearance may be associated with those symptoms or disorders and signs of addiction to aesthetic treatment (Gorbis & Kim, 2017). In such cases, neither aesthetic treatments nor dentist-patient dialogue may fully address the patient's concerns or alleviate the psychosocial impact of OA on their life (Gorbis & Kim, 2017). While it is not the dentist's role to treat these

symptoms or disorders, they are closely linked to the patient's overall health and well-being. Therefore, the dentist should be capable of recognizing such cases, assessing the patient's history of previous aesthetic procedures, and considering a referral to a qualified professional, such as a psychologist or psychiatrist, who can effectively evaluate and address the patient's emotional and mental health (Gorbis & Kim, 2017).

6.2.3 The influence of sociodemographic characteristics

In **Publication IV**, the influence of sociodemographic characteristics on the self-perception of OA and the demand for aesthetic dental treatment was investigated within each country. In both Finland and Brazil, women were more likely than men to seek and undergo aesthetic dental treatment despite their self-perception of OA being statistically similar to that of men. These findings refute the notion that the higher demand for aesthetic treatment by women is driven by a poorer self-perception of OA compared to men. Instead, they support the idea that external factors and the internalization of social norms contribute to this phenomenon (Åberg, 2020; Fredrickson & Roberts, 1997; Macé, 2018; Sarpila & Räsänen, 2011).

This is not surprising, given that Western cultures are marked by patriarchal roots (Macé, 2018) and objectification of the female body (Fredrickson & Roberts, 1997), resulting in more body-altering behaviors among women. However, gender equality varies between countries (section 6.2.1, page 99). Although Finland possesses strong and effective policies (Åberg, 2020; Elomäki & Ylöstalo, 2021), the results in **Publication IV** are in line with prior studies (Åberg, 2020; Sarpila & Räsänen, 2011), which emphasize the persistent presence of social norms that place aesthetic pressure on women in this country. In future discussions and revisions of gender equality policies in Finland (Elomäki & Ylöstalo, 2021), it is important to include agendas focused on reshaping the still-imposed social norms related to the female body.

In Brazil, due to the weak gender equality policies and significant social inequalities between the sexes (Caicedo-Roa & Cordeiro, 2023), the increased pressure on women regarding their physical appearance also functions as a means for male dominance and the maintenance of inequalities (Åberg, 2020). Reducing this pressure is certainly relevant, but, above all, it is necessary to establish stronger and more effective policies in Brazil to enable the development of a safe, fair, and representative society for the entire population, including women.

Regarding age, in agreement with previous studies (Alhajj et al., 2020; Campos et al., 2020a; Campos et al., 2020b), there were no differences with practical significance in the perception of OA between the age groups in both countries. In Brazil, younger individuals have sought and undergone more aesthetic dental treatments. In Finland, on the other hand, no differences in the demand for such treatment were observed among the age groups. This difference in demand between the two countries can be explained by speculating on 3 distinct yet not mutually exclusive hypotheses: 1. in Brazil, a country characterized by a strong sense of social belonging (low score in the *individualism* dimension in Hofstede's model), there is a high value placed on OA. It is considered a key component of social interactions (Campos et al., 2022; Pithon et al., 2014) and a form of capital (aesthetic capital) (Sarpila et al., 2021), influencing social acceptance and job opportunities (Pithon et al., 2014). Consequently, young Brazilians seek aesthetic treatments to fit beauty standards, with the goal of improving their socio-professional integration. 2. beauty standards vary across countries, and the ideal of an attractive smile in Brazil is similar to that in the USA (Almufleh et al., 2020). This ideal includes straight and very white teeth, which can only be achieved through treatments. And 3. Finland is a country with a society characterized by equality and solidarity (low score in the *masculinity vs femininity* dimension in Hofstede's model) and a social norm of equal opportunity (Kukkonen & Sarpila, 2021). This encourages Finns to be aware of discriminatory issues that violate this norm, including those related to physical appearance (Kukkonen & Sarpila, 2021). As a result, many Finns may avoid adopting behaviors, including undergoing aesthetic treatment, that contribute to these issues.

The results related to monthly income also varied between the countries. In Finland, the absence of differences in the demand for aesthetic dental treatment and self-perception of OA among monthly income classes can be attributed to low socioeconomic inequality (López-Roldán & Fachelli, 2021) and the aforementioned societal commitment to equality (Hofstede et al., 2010; Kukkonen & Sarpila, 2021). In Brazil, individuals from middle and upper socioeconomic classes had more demand and access to aesthetic dental treatments than those from lower classes.

This highlights income as a social determinant of health in countries with high social inequality, like those in Latin America (Breilh, 2013; Ruiz Mendonza & Morales Borrero, 2015). Furthermore, these findings reinforce the hypothesis that aesthetic dental treatment holds social prestige and consumption values in such countries (Holden, 2020). It is possible to link these values to the other results in **Publication IV**, in which lower-income Brazilians exhibited a higher negative social and psychological impact of dental aesthetics on their lives. The relation between

this impact and not having undergone aesthetic dental treatment may be associated with dissatisfaction with a physical characteristic, as well as with an unfulfilled desire for consumption, consequently leading to a sense of not belonging to higher socioeconomic classes.

6.2.4 Impact of self-perception of OA on life satisfaction

In **Publication IV**, the impact of OA on the subjective well-being of both Finns and Brazilians was estimated. Consistent with previous studies (Campos et al., 2022; Ma & Zhang, 2022; Swami et al., 2018) that found the influence of physical appearance on one's well-being, it was observed that OA had a significant impact on life satisfaction in both samples. This impact was similar between the countries, explaining approximately 10% of the variability of life satisfaction, and it was not moderated by sociodemographic characteristics. This can be attributed to the role that orofacial region plays in individuals' lives, involving factors beyond sociocultural aspects (Le Breton, 2015). In addition to being one of the most important tools for communication (Campos et al., 2022; Mielke et al., 2022), unique physical features provide individuals with a part of their sense of self-identity (Campos et al., 2022; Le Breton, 2015).

Given the importance of the orofacial region, aesthetic treatments in this area should be carefully planned on an individual basis. This should involve a thorough medical history, a proper clinical examination, and consideration of patients' attitudes and perceptions. Thus, the chances of achieving treatment outcomes addressing physical aspects that enhance the patient's sense of sociocultural belonging (Holden, 2020) while preserving unique features that maintain their individuality (Le Breton, 2015) are increased. Otherwise, these characteristics may be altered by the treatment, potentially harming the patient by depriving them of their sense of self-identity (Le Breton, 2015), which may lead to dissatisfaction with the outcomes.

Special attention should be given to orthognathic treatments, where a significant change in OA is expected as an outcome (Ashton-James & Chemke-Dreyfus, 2019). The elective patients for this type of treatment have severe dentofacial discrepancies that can negatively impact their lives, such as low social acceptance, low self-esteem, and low self-confidence (Agirnasligil et al., 2019; Alanko et al., 2022; de Araujo et al., 2020). By combining orthodontics with surgery, one of the aims of orthognathic treatment is to achieve a dentoskeletal balance to fit the patient's OA within socially

normative aesthetic standards. Hence, the patient is anticipated to experience enhanced psychosocial benefits following this treatment, including an increased sense of belonging and self-esteem (Agirnasligil et al., 2019; Alanko et al., 2022; de Araujo et al., 2020; Paunonen et al., 2020). Even so, this cannot be generalized to all orthognathic patients since the individual psychological adjustment to a new face is complex and may take time (Ashton-James & Chemke-Dreyfus, 2019; Cadogan & Bennun, 2011; Frid et al., 2022). This may persist for months after the surgery, during which the patient may experience negative feelings due to the difficulty of recognizing themselves with an altered face (Cadogan & Bennun, 2011). Consequently, it is advisable that in these treatments, or others involving significant changes in OA, there should be effective dentist-patient communication (Bergkulla et al., 2017; Song et al., 2020). Additionally, predictive image simulations (Kato et al., 2023) should be done so that the patient already has some idea of the expected outcome. And, most importantly, such patients should be accompanied by professionals such as psychologists before and after surgery (Paul & Rolland, 2023).

The structural model analysis conducted in **Publication IV** also revealed that having undergone aesthetic dental treatment did not have an indirect effect on the impact of OA on life satisfaction. However, it is important not to interpret this as indicating that such treatment does not affect on an individual's life. It is possible that this effect was not captured in the findings of the present dissertation because the samples consisted of the general population rather than patients with a specific orofacial condition. The aesthetic dental treatment, when appropriately indicated, may serve as a powerful means of restoring and/or promoting the patient's well-being. Improvement in physical aspects in these cases is expected to enhance self-perception of OA, which, in turn, can provide psychological benefits and have a positive impact on the patient's life satisfaction.

A counterargument is also valid when aesthetic dental treatments are performed indiscriminately, without precise indications and individualized planning. In some cases, the patient's demand for this treatment is not solely motivated by the desire to improve a specific physical aspect but rather by psychological symptoms or disorders (Gorbis & Kim, 2017), consumer behaviors (Holden, 2020), or social pressures (Åberg, 2020; Macé, 2018) as discussed above. In these cases, the treatment may not bring long-term benefits to the patient (Campos et al., 2022; Gorbis & Kim, 2017). On the contrary, it may have a negative impact on the patient's well-being by potentially worsening psychological symptoms or disorders and perpetuating social pressures and inequalities.

6.3 Studies limitations and strengths

The cross-sectional design in **Publication IV** was a limitation of the study since it does not allow for cause-and-effect inference of the structural model results. Convenience sampling was also a limitation of the studies, which may affect the generalizability of the results for the whole Finnish and Brazilian population. Nonetheless, this sampling method is commonly used in observational studies focusing on assessing the psychometric properties of scales across diverse samples and contexts (Campos et al., 2019a; Campos et al., 2020b; John et al., 2012; Soares et al., 2021; Zucoloto et al., 2014). Trying to minimize these limitations, large sample sizes were obtained to get comprehensive results that closely reflect the variability of the study population. Moreover, the validity and reliability of data obtained using psychometric scales were attested by robust analysis and following rigorous guidelines (Hair et al., 2019; Kline, 2023; Marôco, 2021b).

Limitations also arise from online data collection, particularly in Brazil, where individuals with internet access tend to have higher levels of education and belong to higher socioeconomic strata. Alhajj et al. (2020) observed that individuals with these characteristics exhibit a higher degree of concern for oral health, have extensive access to health treatments, and maintain better hygiene conditions, which may result in greater satisfaction with OA. Consequently, it can also hinder the generalization of the results for the whole population. Acquiring a large sample size and attesting to the validity and reliability of the data further tend to minimize this limitation, as it allowed for the detection of differences among various monthly income groups in Brazil. It is important to note that data collection took place during the COVID-19 pandemic and social isolation, making an online strategy the most feasible one at that time. However, as discussed earlier, the potential influence of the pandemic on participants' responses, especially those related to social aspects, cannot be ignored.

Another limitation to consider regarding the sampling is the snowball strategy that began with university members. This might have resulted in a higher number of participants who are university students and academic staff, which may not be representative of the Finnish and Brazilian populations. It should be mentioned that the academic community plays an important role in shaping society by contributing to the generation and dissemination of ideas and values (Brennan et al., 2004; Smolentseva, 2022). Therefore, understanding the OHRQoL of these individuals could help identify the values being promoted in society regarding this topic.

The strategy for collecting information on monthly income posed a limitation in comparing socioeconomic categories between Finland and Brazil. In this

dissertation, the categories proposed by research institutes in each country (Statistics Finland, 2023; *Centro de Políticas Sociais–FGV Social*, 2023) were adopted. This was the most viable strategy for the online data collection protocol given the absence of a standardized approach to comparing socioeconomic status (SES) across multiple countries (Psaki et al., 2014; Sacre et al., 2023). However, it is important to note that these categories were established based on the unique socioeconomic and cultural contexts of each country, rendering a direct comparison between them unfeasible. This is because the same category (for example, the lowest) in Finland and Brazil may indicate different lifestyles, life opportunities, living conditions, and purchasing power, among other factors. Therefore, it becomes relevant first to identify and establish indicators of socioeconomic status that provide a valid and reliable estimate, allowing for direct cross-national comparisons (Psaki et al., 2014; Sacre et al., 2023). With these indicators, future studies will be able to deepen the investigation of the relationship between socioeconomic status, the demand for aesthetic dental treatment, and OHRQoL.

In **Publication I**, the use of samples of dental patients without specifying a clinical condition can also be considered a limitation, as the clinical condition can potentially affect the psychometric properties of OHIP-14. However, the study aimed to discuss more deeply what OHIP-14 measures and highlight the contrasting of its use in different samples. This provides solid scientific evidence regarding the scale's utility and offers relevant insights for decision-making concerning the choice of the OHIP-14 as a measurement scale for research or clinical contexts. In **Publication IV**, only intraoral treatments were considered as aesthetic dental treatments. While some intraoral clinical features are associated with a more youthful appearance (e.g., gingival display and shape and length of incisors) (May et al., 2019), most treatments aimed at rejuvenation effects are extraoral (Li et al., 2022). Therefore, this study may not have captured the age-related consumption of aesthetic treatments for rejuvenation purposes.

The construct used to measure well-being in **Publication IV** was life satisfaction. This addresses the cognitive aspect of well-being from a hedonic perspective, which focuses on an individual's experiences of pleasure and enjoyment. Nonetheless, it deals only with one dimension of well-being, which is a multidimensional concept. Other examples of dimensions include emotional well-being, also from a hedonic perspective, and social and psychological well-being, components of the eudaimonic perspective (Swami et al., 2018). The latter focuses on experiences of meaning and purpose. Hence, it is important to acknowledge that OA may have differing impacts on other dimensions of well-being that could not be observed in this study.

6.4 Practical applications and future perspectives

The results of this dissertation provide solid evidence related to OHRQoL and emphasize the significance of individuals' perceptions in dental practice. This contributes to strengthening the foundation of evidence-based dentistry (Bondemark, 2019), enriching knowledge in one of its less-explored facets: patient values (Kelly et al., 2015). Some of the practical applications and future perspectives, focusing on specific results, have already been discussed in this section of the dissertation. Overall, what is elicited is the need for ongoing discussions and investigations regarding the psychosocial aspects related to dental treatments and their measurement tools.

In a clinical context, dentists possess an accurate clinical eye for assessing physical and biological aspects, yet they often lack the knowledge and experience required to address psychosocial aspects (Leadbeatter & Holden, 2021; Tsoi & Ding, 2023). Much of contemporary dental practice adopts a business model (Holden et al., 2022) in which treatment is sometimes regarded only as a commercial product, moving away from the purpose of health promotion and the altruistic principles of the dental profession (Holden et al., 2022). It is expected that the present findings will supply dentists with additional information to expand their knowledge and understanding of psychosocial aspects. This, in turn, may contribute to their clinical decision-making ability and make them increasingly capable of developing patient-centered treatment plans.

Furthermore, the dissertation is also expected to contribute to a discussion on public health and the management of taxpayers' money. In Finland, for example, the public healthcare system provides orthodontic treatment free of charge to children and adolescents whose malocclusions meet specific criteria for treatment need (Silvola, 2014). For adults, this treatment is partially subsidized only in cases of severe malocclusion with functional involvement (Silvola, 2014). Both these criteria and severity are solely based on physical and biological findings measured by a professional, without considering the patient's perspective. As discussed, it is not only the physical characteristics that may be affecting individuals' lives. In this way, many individuals who do not meet the clinical criteria but would significantly benefit from the treatment are denied access. Including patient's perspectives can assist in prioritizing both treatments at the individual level and among system beneficiaries. This approach may also help prevent overtreatment within the public healthcare system.

In scientific research, this dissertation advances the understanding of OHRQoL and paves the way for future studies in interdisciplinary areas. This begins with the presentation of the psychometric properties of various scales measuring individual perception. The standardized method of measurement allows the investigation of the influence of factors in this perception by comparing different samples, contexts, and countries. It is worth noting the need for analytical rigor in these comparisons. Measurement invariance is a critical analysis, ensuring that the latent phenomenon assessed by psychometric scales remains similar across different samples or populations (Bowen & Masa, 2015; Swami & Barron, 2019). It is recommended that researchers join efforts to conduct studies following the guidelines for appropriate psychometric properties and measurement invariance procedures to unveil the factors involved in the OHRQoL in different contexts and populations.

The utilization of psychometric scales involves a quantitative method that should start from a conceptual model of OHRQoL compatible with the study population. However, these conceptual models may be flawed, whether due to being outdated (John, 2021), developed from a data-driven approach (Slade, 1997a), or proposed exclusively from the researchers' standpoint (Cunningham, 2020). It is essential to consider the perspective of the study population in the development of conceptual models so that they can reflect current social reality and, consequently, for data obtained from scales based on them to have practical utility. One strategy to achieve this is through qualitative research methods (Chai et al., 2021), which enable a comprehensive understanding of individuals' experiences and perceptions, identifying new and relevant issues on OHRQoL. It is important to acknowledge that no conceptual model can fully encompass the multidimensional nature of OHRQoL. Additionally, OHRQoL is a dynamic concept that may evolve in response to shifting societal values. Therefore, investigating new aspects and attitudes related to OHRQoL should be an ongoing commitment.

It is also of interest that future longitudinal studies be conducted to establish causality in the results obtained in structural equation modeling. Given the findings that demonstrate the influence of sociodemographic and cultural factors on the demand for dental treatment and OHRQoL, these theoretical and analytical models should include various other variables that are interdisciplinary. Examples of such variables include but are not limited to age (including younger generations than those examined in this dissertation), occupational status, personality traits, the presence of depressive and anxiety symptoms, diagnosis of body dysmorphic disorders, malocclusion classification, other dental clinical indices, extraoral aesthetic treatment, overall health status, and consumer behavior.

OHRQoL measures are used as epidemiological data for public health. In Finland and Brazil, the scales used for this purpose were OHIP and OIDP, respectively (Ministério da Saúde, 2012; Suominen-Taipale et al., 2008). Both scales are grounded in Locker's conceptual model (Locker, 1988) and should face criticism outlined in section 6.1.1 (page 93) and **Publication I** regarding the validity and reliability of the data, as well as the outdated nature of this conceptual model. For this reason, future research should consider selecting psychometric scales that measure OHRQoL dimensions relevant to the country and grounded in current models. Additionally, it is imperative to include an analytical step after data collection to ensure the validity and reliability of the obtained data.

In both clinical and research settings, a persistent challenge is determining how to effectively apply OHRQoL measures in healthcare. This is essential to provide patients with comprehensive care for achieving maximum health recovery and promotion. While a direct answer to this challenge remains unclear, the training of dental professionals is a complicating factor for its resolution. Both undergraduate and postgraduate dental programs are well-known for their strong technical emphasis and expertise in specific areas of dentistry, which are required for the dental profession. However, these programs often lack the depth of interdisciplinary and transdisciplinary knowledge that supports OHRQoL. Consequently, this limitation becomes an obstacle to understanding the underlying concepts and measurement of OHRQoL dimensions.

Therefore, it is important to update dental curricula to include and deepen knowledge about social, psychological, and commercialistic theoretical-practical concepts (Campos et al., 2022; Gorbis & Kim, 2017; Holden et al., 2022; Leadbeatter & Holden, 2021). This can provide the professional with skills that have been previously explored in discussion and will be summarized as follows: being able to take a detailed medical history and use psychometric scales for identifying the real patient's needs, as well as for detecting clues related to psychological symptoms or disorders (Campos et al., 2022; Gorbis & Kim, 2017); being aware of social pressures, norms and inequalities as well as knowing how social characteristics can impact one's general and oral health (Campos et al., 2022; Leadbeatter & Holden, 2021); planning treatments and making clinical decisions taking into account the patient's perspectives, perceptions, and social context (Leadbeatter & Holden, 2021); balancing the performance between being a health professional and a businessperson, making the patient's needs prevail (Holden et al., 2022); and thinking critically about their own professional performance and social role (Campos et al., 2022; Leadbeatter & Holden, 2021).

It is emphasized that the suggestion of this update is not meant to replace the current curricula and business model of the dental profession but rather to complement them. The main idea is that in the future dentists will get closer to evidence-based dentistry, expanding a holistic view in the elaboration of patient-centered treatment plans, while contributing to society based on the altruistic foundations of their profession (Campos et al., 2022; Holden et al., 2022).

7 CONCLUSIONS

This dissertation presented 4 publications with the aim of cross-culturally investigating OHRQoL between Finland and Brazil. The psychometric properties of measurement scales were evaluated. Sample characteristics affect the validity and reliability of the data obtained from them, and as such, these data may not accurately represent reality, potentially leading to misinterpretations. Focus was given to the dimension of OA and its impact on subjective well-being. Sociodemographic and cultural factors can influence self-perception of OA and are involved in the demand for aesthetic dental treatment. A summary of the main findings of the dissertation and conclusions based on the 7 specific objectives are provided below.

1. The factor models did not fit to non-dental patients' data, indicating that OHIP-14 may not be suitable for measuring OHRQoL in these samples. In dental patient samples, the items were informative for various levels of oral health impact. The validity of the OHIP-14 data in dental patient samples was confirmed when using unifactorial model. However, culture and age influenced the unifactorial model structure, highlighting the need for assessing the psychometric properties of OHIP-14 when applied to new samples of dental patients.
2. The data obtained from adult Finns using the proposed Finnish versions of OES and PIDAQ were valid and reliable. These scales emerge as standardized tools for evaluating satisfaction with OA and the psychosocial impact of dental aesthetics in clinical and research settings.
3. The factor model of OES presented measurement invariance for Finns and Brazilians, allowing for direct comparisons of its scores between the two countries. The factor model of PIDAQ did not exhibit configural invariance. This may indicate differences in how the psychosocial impact of OA is perceived among the samples. Therefore, PIDAQ scores are not directly comparable.

4. Brazilians sought and received more aesthetic dental treatments than Finns. Cultural identity may be related to the social value attributed to aesthetic dental treatment, involving individual perception, consumption habits, and social prestige.

5. Satisfaction with OA scores presented no difference between Brazil and Finland. The differences in self-perception of OA among gender and age categories in both countries did not show practical significance. Among Brazilians, individuals with low incomes experienced a higher negative psychosocial impact of OA on their lives compared to those with high incomes. This could be associated with dissatisfaction with physical characteristics, as well as an unfulfilled desire to consume and have access to a high-status treatment.

6. The demand for aesthetic dental treatment was influenced by sociodemographic and cultural factors. In both Finland and Brazil, women were more likely to seek this treatment, reflecting greater societal pressure on the female body. In Finland, there were no differences in demand according to income and age, while younger and richer individuals were more likely to seek aesthetic dental treatment in Brazil. This indicates a strong role of consumerism and social prestige in countries with high socioeconomic inequalities.

7. Self-perception of OA had a significant impact on individuals' subjective well-being, contributing to approximately one-tenth of the life satisfaction of Finnish and Brazilian adults. No indirect effect of having received aesthetic dental treatment, nor a moderating effect of sex, age, and income on this impact was observed. Thus, aesthetic treatment in the orofacial region should be patient-centered, considering their perspectives and perceptions to achieve clinical success and promote well-being.

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PUBLICATIONS

PUBLICATION I

Use of Oral Health Impact Profile-14 (OHIP-14) in Different Contexts. What Is Being Measured?

Lucas Arrais Campos, Timo Peltomäki, João Marôco, Juliana Alvares Duarte Bonini Campos

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Use of Oral Health Impact Profile-14 (OHIP-14) in Different Contexts. What Is Being Measured?

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Abstract: The Oral Health Impact Profile-14 (OHIP-14) has been used to assess the impact that oral health problems can have on an individual's life. Different theoretical models were proposed to evaluate the results. The aims of this study were to evaluate the fit of different factorial models of the OHIP-14 to non-dental patients (NDP) and dental patients (DP) samples from Brazil and Finland and to estimate the differential functioning of the items in the OHIP-14 between the samples. Two studies were conducted, one in Brazil and the other in Finland, composed of five samples (Brazil—Sample 1 (S1): DP, n = 434, age: 25.3 [SD = 6.3] years; S2: NDP, n = 1486, age: 24.7 [SD = 5.6] years; S3: DP, n = 439, age: 29.0 [SD = 6.7] years; Finland—S4: DP, n = 482, age: 26.3 [SD = 5.4] years; S5: NDP, n =·2425, age: 26.7 [DP = 5.5] years). The fit of the OHIP-14 models to the data was estimated using a confirmatory strategy (validity based on the internal structure). Differential item functioning (DIF) between samples was estimated. For NDP from both countries, the response pattern severely violated the normality assumption in six items of the OHIP-14, indicating that the instrument does not fit for these samples. For DP, the model with the best fit was unifactorial, which deals with the estimation of the general impact of oral health on an individual's life, without addressing specific dimensions. Configural invariance was refuted between samples. DIF indicated that the characteristic of the sample (NDP and DP) in both countries interfered in the response given to the items, with the response level being more adequate for the latent PD trait. The validity of data related to the impact of oral health problems on an individual's life was confirmed through a unifactorial model. OHIP-14 works properly in DP samples and was limited in NDP samples, being also influenced by cultural context and age.

Keywords: psychometrics; oral health; validation study

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1. Introduction

Oral health-related quality of life (OHRQoL) is a multidimensional concept that involves biopsychosocial aspects related to oral health [1] and is based on the World Health Organization definition that considers health as the state of complete physical, mental and social well-being. Nevertheless, OHRQoL is commonly viewed from a reductionist perspective, in which only the individual's own perception is considered, not including biopsychosocial aspects. Most studies describe OHRQoL as the impact of orofacial conditions and dental treatments perceived by the individual [2,3]. This is the definition adopted in this study.

Although the OHRQoL by itself does not reveal the clinical oral status, this perspective allows the identification of an individual's perception of oral health and its relevance and impact on their life. For research, this relevance lies in the possibility that the OHRQoL represents an indicator for public health [3], which may be a guide both in relation to the limitations of oral health of populations and the impact of oral health and/or dental treatments on people's lives. In clinical practice, information about OHRQoL allows the development of a patient-centered treatment plan. For education, OHRQoL allows health professionals, graduated or in training, to see their patient not only as an aspect and/or physical problem to be treated, but as a human being inserted into unique life contexts and whose involvement in health is perceived in a unique way. All these points contribute to the construction of more humane evidence-based dentistry focused not only on technique and/or disease elimination, but also on health promotion. However, as it is a concept that is not directly measurable (latent), evaluating the OHRQoL can be a challenge.

To measure OHRQoL, specific instruments are used, such as the Geriatric Oral Health Assessment Index (GOHAI) [4], Oral Impacts on Daily Performances (OIDP) [5], and the Oral Health Impact Profile (OHIP) [6,7]. The latter is the most widely used both by researchers and clinicians [8]. The OHIP was originally developed by Slade and Spencer [6] in Australia, containing 49 items (OHIP-49) formulated from statements obtained in interviews with dental patients. These items were distributed considering seven dimensions (functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap) elaborated from the theoretical model proposed by Locker [9]. Shortened versions of this instrument were developed, highlighting the Oral Health Impact Profile-14 (OHIP-14) [7].

A reduction of items was performed using statistical procedures on sample data from Australian individuals aged over 60 years [5]. Since its publication, the OHIP-14 has been translated and adapted into different languages [10–14]. It has also been widely applied in different samples and contexts different from those in which the instrument was proposed and evaluated, for example, in the general population (non-patient) [12,13,15], young orthodontic patients [11], indigenous population [15] and postpartum women [10,16].

However, as OHIP-14 is an instrument for measuring a latent concept, it is necessary to ensure that it really can measure what it was proposed to measure, that is, the perception of the impact that an oral health problem can have on an individual's life. Previous use of the instrument in different samples is not able to guarantee this. Therefore, it seems necessary to carry out analytical analyses capable of attesting to the validity of data obtained in different samples and/or contexts using the instrument.

Although two studies, one using a sample of the general population of British adults [17] and the other Brazilian dental patients [18], confirmed the adequacy of the original factorial structure of OHIP-14, other studies have refuted that OHIP (full or shortened version) has this factorial structure [12,13,15,16,19]. Montero et al. [13] found a trifactorial structure of the OHIP (psychosocial impacts, pain-discomfort and functional limitation) in a sample of Spanish workers who were undergoing routine medical examinations at an employment risk prevention center. Santos et al. [16] found unifactorial structure in Brazilian samples of postpartum women and elderly individuals, including individuals with and without oral health impairment. However, it is worth noting that most of these studies used the OHIP-14 in a different context and population from those in which the instrument was elaborated, paving the way for questioning whether this instrument can preserve the latent concept that it should measure.

Given the different proposals for factorial structures for OHIP-14 and knowing that its fitting may be influenced by culture, study population (e.g.,: dental patient or non-dental patient) and other individual and clinical characteristics, the present study was conducted to build evidence concerning the measurement validity of the OHIP-14 when applied to different populations from different countries. The aims of the present study were to evaluate the fit of different factorial models of the OHIP-14 (seven factors, three-factor and one-factor) to different samples (non-dental patient and dental patient) from Brazil

and Finland and to estimate the differential functioning of the items in the OHIP-14 in the non-dental patient and dental patient samples.

2. Methods

To address the aims, two studies were conducted independently, one in Brazil (Study 1) and one in Finland (Study 2). The possibility to conduct studies in countries with distinct cultural characteristics is interesting, as it has the potential to strengthen the evidence of OHIP-14's functionality and the validity and reliability of the obtained data. It should be clarified that the selection of Brazil and Finland for the study was specifically based on the convenience of the researchers whose work is located in these countries. The description of the two studies is found below.

2.1. Study Design and Sampling

Both studies were cross-sectional studies with non-probabilistic convenience sampling. Individuals between 18 and 40 years of age were included in the study. Age was limited to 40 years to minimize the effect of this variable on the results.

The proposal by Hair et al. [20] was adopted to calculate the minimum sample size. The authors recommend a minimum of 5–10 participants per parameter to be tested in the factorial model. Considering that the factorial model with the largest number of parameters tested in this study has 42 parameters (Figure 1a), the minimum sample size is 210–420 individuals. However, because we aimed to estimate psychometric properties and differential item functioning of OHIP-14 for non-dental patients and dental patients, the number of participants should be large enough in each sample.

In addition, a third sample of Brazilian dental patients (Faculty of Dentistry of Araraquara—UNESP) (Sample 3) from our previous study [18] was used in Study 1. To make comparisons between samples, Sample 3 was limited to only patients aged between 18 and 40 years. Despite the delimitation of the age group, the mean age of Sample 3 was higher than that observed in Samples 1 and 2. Table 1 presents general descriptions of the samples.

2.2. Procedures and Ethical Aspects

In Study 1, adult patients attending the clinics of the Faculty of Dentistry of Araraquara—UNESP (periodontology, dentistry, emergency, prosthodontics, oral medicine, and surgery clinics) from August 2018 to December 2019 were invited to participate in the study for composing Sample 1. For Sample 2, staff from the same university were invited to participate. After completing the data collection, they were asked to invite their families and colleagues to participate in the study (snowball sampling). The measuring instrument was self-filled using the paper-and-pencil method.

In Study 2, an online survey was used since data collection took place after the onset of the COVID-19 pandemic, which imposed social isolation, making the paper-and-pencil collection strategy as performed in Study 1 unfeasible. For Sample 4 and Sample 5, students and staff from Tampere University and University of Oulu were initially invited to participate via institutional email from June to July 2020. The invitation message described the purpose of the study and had a link to the online measurement instrument. The online form was created using the LimeSurvey program (LimeSurvey GmbH, Hamburg, Germany; http://www.limesurvey.org (accessed on 24 October 2021)) located on the Tampere University server. To identify individuals who were undergoing dental treatment at the time of participation in the study, a question was prominently inserted before accessing the page with the items OHIP-14. The snowball sampling strategy was adopted to recruit more participants. Thus, at the end of the online survey, participants were asked to send the research link to their personal contacts via email and social networks.

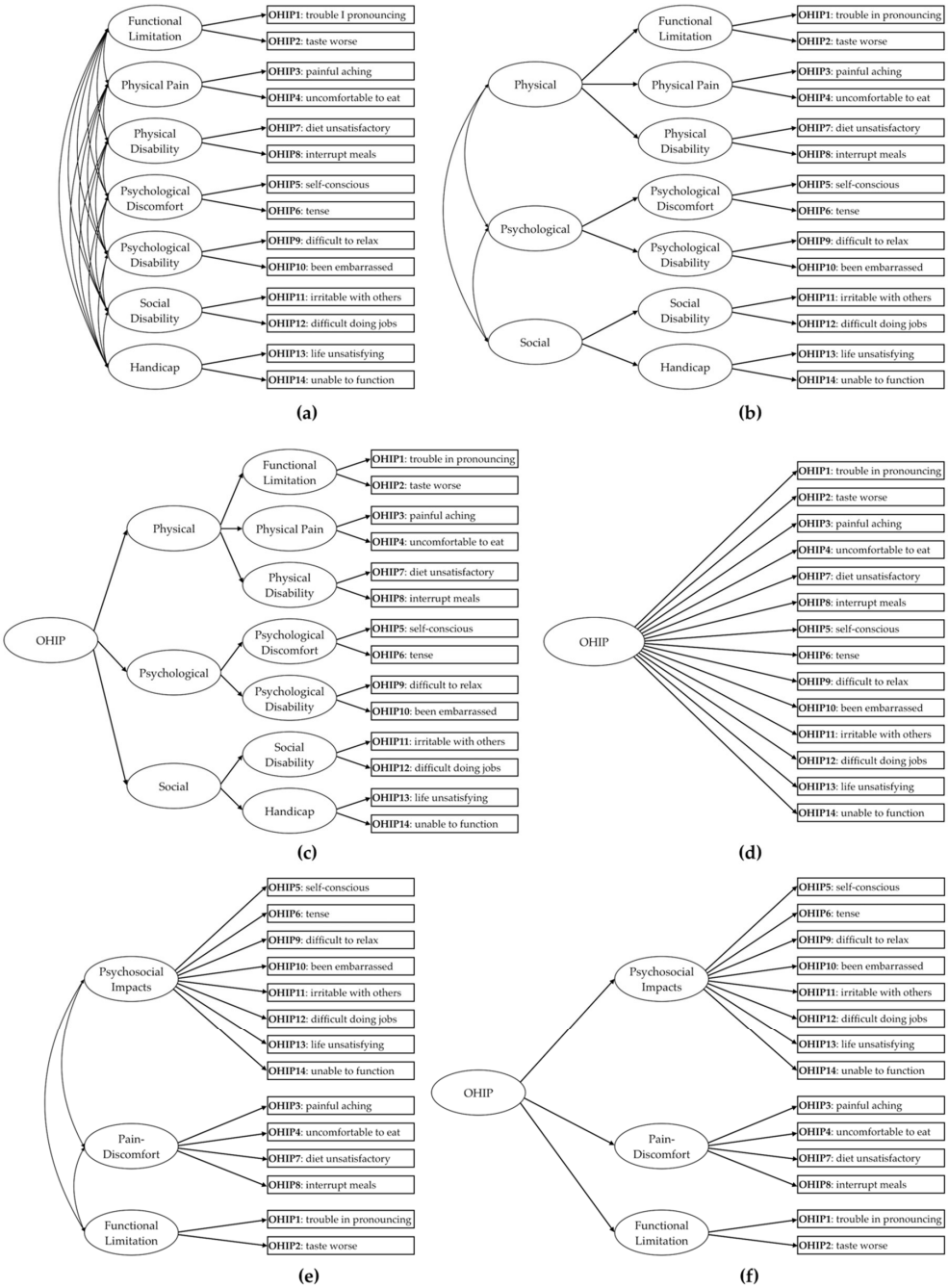

Figure 1. Factorial models of the Oral Health Impact Profile-14 (OHIP-14) tested in the study: (**a**) 7 first-order factors; (**b**) and (**c**) second- and third-order hierarchical models with 7 first-order factors; (**d**) unifactorial model; (**e**) trifactorial model; (**f**) second-order hierarchical model with 3 first-order factors.

Table 1. Description of study samples.

	Study 1—Brazil			Study 2—Finland	
	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**
Population	Dental patients	Non-dental patients	Dental patients (Zucoloto et al. [18])	Dental patients	Non-dental patients
Year of data collection	2018–2019	2018–2019	2012–2013	2020	2020
Collection method	paper-and-pencil	paper-and-pencil	paper-and-pencil	online	online
n	434	1486	439	482	2425
% women	76.5	67.9	74.0	80.7	75.0
Mean age (standard deviation) in years	25.3 (6.3)	24.7 (5.6)	29.0 (6.7)	26.3 (5.4)	26.7 (5.5)

Study 1 was approved by the Research Ethics Committee of São Paulo State University (Unesp), School of Dentistry, Araraquara (CAAE: 01040312.5.0000.5416 and 88600318.3.0000.5416). Approval for Study 2 data collection was obtained from the Data Protection Officer at Tampere University, in accordance with the European Union's General Data Protection Regulation. In both studies, only individuals who gave informed consent participated in the study.

2.3. Measuring Instrument

To assess the profile of the impact of oral health on the lives of individuals, the Portuguese and Finnish versions [10,14] of the OHIP-14 [7] were used. This instrument has a 5-point Likert-type response scale (0: never, 1: hardly ever, 2: occasionally, 3: fairly often, 4: very often).

The original factor structure of the OHIP-14 [7] was elaborated following the theoretical model proposed by Locke [9], containing seven first-order factors (dimensions: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap) [7] (Figure 1a). Following this proposal, Zucoloto et al. [18] also showed that it is possible to obtain a second-order hierarchical model (second-order factors: physical, psychological, and social, Figure 1b) and the inclusion of a third-order hierarchical factor (Figure 1c). The unifactorial (Figure 1d) and the first- and second-order trifactorial (psychosocial impacts, pain-discomfort, and functional limitation, Figure 1e,f) models were also tested, as some studies suggest these structures [13,16].

2.4. Validity of Data Analysis

The evidence of validity of the data obtained by OHIP-14 in the samples was verified following the proposal of the Standards for Educational and Psychological Testing [21]. Content validity, validity based on internal structure, validity based on response process and consequence validity were considered.

2.5. Content Validity

Content validity was initially assessed in each study by a panel of three expert judges (Study 1: native Portuguese experts; Study 2: native Finnish experts). They assessed the grammatical, semantic, and idiomatic terms of the items. They also evaluated whether the content of the items preserves the concept proposed (impact of oral health on an individual's life) in the English version [6,7] of the instrument and if it suited the context of each country. Then, a pilot study was conducted among the target population of each study, following the same procedures as the definitive study, to assess the Incomprehension Index of the items. This index verifies whether there are difficulties in understanding the content of the items by the participants. Values below 15% were considered indicative that the item is suitable for understanding in the population.

2.6. Validity Based on Internal Structure

The OHIP-14 factorial models tested are shown in Figure 1. The validity based on the internal structure was evaluated through factorial, convergent, and discriminant validity. Initially, the psychometric sensitivity of the items was verified through descriptive statistics (mean, median, standard deviation, minimum and maximum values, skewness, and kurtosis) of the answers given by the participants. Absolute values of skewness and kurtosis lower than 3 and 10, respectively, were indicative of non-severe violation of the normal distribution [22], attesting to the psychometric sensitivity of the items [23].

Factorial validity was estimated using confirmatory analysis with the robust Weighted Least Squares Mean and Variance Adjusted (WLSMV) estimation method. The indices used to evaluate the fit of the model to the data were the comparative fit index (CFI), the Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) [23,24]. The factorial loadings (λ) of the items were also considered. The fit of the factorial model to the data was considered adequate when CFI and TLI > 0.90, RMSEA < 0.10, SRMR < 0.08, and $\lambda \geq 0.50$ [23,24]. If necessary, the modification indices, estimated by Lagrange Multipliers (LM), were inspected to verify the existence of correlation between item errors (LM > 11) [23].

Convergent validity was evaluated based on the Average Extracted Variance (AVE) [25]. Values of AVE $\geq$ 0.50 were considered adequate [25] for factorial models with more than one factor, the discriminant validity was also estimated through correlational analysis between the factors [25], being considered adequate if AVE_i e $AVE_j \geq r_{ij}^2$. These analyses were performed in the R program (R Core Team, 2020) using the *lavaan* package [26].

Data reliability (by factor and for each model) was estimated using the ordinal alpha coefficient (α) and composite reliability (CR) [23]. Values of α and CR equal to or greater than 0.70 were considered indicative of adequate reliability [23]. The suggestion of the unidimensionality of the dataset of each sample was also evaluated considering the Unidimensional Congruence (UniCo), Explained Common Variance (ECV) and Mean of Item Residual Absolute Loadings (MIREAL) indices [27] obtained by the Factor program (V11.0427) [28]. Values of UniCo > 0.95, ECV > 0.85 and MIREAL < 0.30 suggested that the items can be treated as components of a single dimension [27].

After fitting the models to the data, the measurement invariance of the tested models was verified between the samples of each country. When observing the configural invariance of the factorial models between the different samples (Sample 1 vs. 2, Sample 1 vs. 3, Sample 2 vs. 3, and Sample 4 vs. 5), the measure invariance was estimated by multigroup analysis using the CFI difference (ΔCFI). The WLSMV estimation method was used considering ΔCFI between the configural (M0) and metric (M1) models ($\Delta CFI_{M1\text{-}M0}$) and between the metric and scalar (M2) models ($\Delta CFI_{M2\text{-}M1}$). A decrease in CFI ($\Delta$CFI) above 0.01 was considered indicative of the absence of measurement invariance [23,29].

2.7. Validity Based on Response Process

The validity based on responses process was initially evaluated considering the following item fit statistics: information-weighted mean square (INFIT: people with a latent trait level equivalent to the item difficulty do not respond as expected) and unweighted mean square (OUTFIT: people with a latent trait level different from the item difficulty do not respond as expected). Both statistics were estimated for each sample considering the partial-credit model (PCM) and using the eRm package [30] in the R program (R Core Team, 2020). Values of INFIT and OUTFIT between 0.5 and 1.5 were indicative of an adequate fit of the item to the PCM, being considered productive for measurement.

Then, Differential Item Function analysis (DIF) was conducted between samples of each country (Samples: 1 vs. 2, 1 vs. 3, 2 vs. 3, and 4 vs. 5). For this purpose, ordinal logistic regression was performed based on the likelihood ratio chi-square statistics, considering a significance level of 1%. DIF can be classified as uniform (if the effect is constant) or non-uniform (if the effect varies), and, in this study, a general test of "total DIF effect" was used in order to maximize the capacity of the identification of both uniform and non-uniform

DIF and to control Type I error [31]. DIF was performed using the *lordif* package [31] in the R program (R Core Team, 2020) and the items that presented a significant "total DIF effect" ($p < 0.01$) were considered non-equivalent [31].

2.8. Consequence Validity

Considering the results obtained in the previous analyses, the ethical consequences and quality of the measures obtained from the use of OHIP-14 in different study samples (dental patient and non-dental patient) were evaluated.

3. Results

3.1. Content Validity

In both studies, the panel of expert judges considered that the grammatical, semantic and idiomatic terms of the OHIP-14 versions (in Portuguese and Finnish) are clear for the participants' understanding and that the content of the items is pertinent and relevant for the assessment of the impact of a problem related to oral health on an individual's life. In Study 1, 57 Brazilians participated in the pilot study (81.0% women, mean age: 28.4 (standard deviation = 5.5) years) and in Study 2, 37 Finns (67.6% women, mean age: 31.2 (standard deviation = 11.0) years). In Brazil, the OHIP-14 items presented an Incomprehension Index between 0.0% and 3.5% and in Finland this index was between 0.0% and 5.4%. Therefore, the understanding of the items by the participants was considered adequate, attesting the content validity of OHIP-14 in both countries.

3.2. Validity Based on Internal Structure

The summary measures of the responses given by the participants are shown in Table 2. The responses from non-dental patient samples from both countries (Samples 2 and 5) showed high values of skewness and kurtosis in six items of the OHIP-14. In Brazil, items 1, 2, 11, 12, 13, and 14, and in Finland items 1, 2, 7, 11, 12, and 14, indicated severe violation of the normal distribution. Thus, as these items did not meet a relevant assumption, they could not be included in subsequent analyses to assess validity based on the internal structure. As the number of items that violated this assumption represents 42.9% of the items in the OHIP-14, a decision was made to not proceed with the analyses for these samples.

Regarding the samples of dental patients, all the responses given to the OHIP-14 items by the participants in Sample 3 (Brazil) presented adequate values for skewness and kurtosis. For Sample 1 (Brazil) and Sample 4 (Finland), a severe violation of the normal distribution was observed in only one item (Brazil: item 14 "unable to function", Finland: item 2 "taste worse"). Thus, the item whose responses did not meet the assumption was not considered for the subsequent analyses.

Concerning the factorial models referring to the original OHIP-14 proposal (Figure 1a–c), due to the need to exclude the item that violated the assumption of normality in Sample 1 and Sample 4 (items 14 and 2, respectively), it was also necessary to exclude the factor where the items were allocated (Sample 2: "Handicap"; Sample 4: "Functional Limitation"), since in these models each first-order factor is composed of only two items. The covariance matrix of the first-order factorial proposal of the OHIP-14 (Figure 1a) was not defined as positive for the tested samples (Samples 1, 3 and 4), indicating that this model does not present an adequate fit to the data.

The second- and third-order hierarchical models containing seven first-order factors (Figure 1b,c) presented an adequate fit to the Sample 3 data only after restricting the variance of some factors (Table 3), suggesting caution in interpreting these results. For samples 1 and 4, these hierarchical models were not tested, because, given the exclusion of a first-order factor, there is no theoretical plausibility for the elaboration of these models.

Table 2. Descriptive statistics of the responses given to the items of the Oral Health Impact Profile-14 by the participants of each study.

Study 1—Brazil (Sample 1/Sample 2/Sample 3) *							
Item	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**	**Skewness**	**Kurtosis**
It1	0.50/0.20/0.54	0/0/0	0.94/0.60/1.05	0/0/0	4/4/4	2.06/3.74/1.96	3.75/16.11/2.98
It2	0.43/0.21/0.73	0/0/0	0.87/0.61/1.20	0/0/0	4/4/4	2.13/3.48/1.46	3.97/13.41/0.95
It3	1.45/0.91/1.38	1/1/1	1.15/0.98/1.17	0/0/0	4/4/4	0.43/0.85/0.51	−0.54/0.06/−0.41
It4	1.47/0.77/1.59	1/0/2	1.26/1.04/1.32	0/0/0	4/4/4	0.47/1.24/0.33	−0.74/0.74/−0.91
It5	2.03/1.12/2.42	2/1/2	1.23/1.19/1.35	0/0/0	4/4/4	0.12/0.84/−0.31	−0.87/−0.21/−1.01
It6	1.71/0.79/1.39	2/0/1	1.35/1.10/1.41	0/0/0	4/4/4	0.25/1.31/0.55	−1.09/0.85/−0.98
It7	1.02/0.35/0.90	1/0/0	1.25/0.79/1.20	0/0/0	4/4/4	1.05/2.63/1.14	0.02/7.09/0.24
It8	0.86/0.28/1.05	0/0/1	1.17/0.70/1.11	0/0/0	4/4/4	1.26/2.94/0.75	0.63/9.35/−0.16
It9	0.99/0.44/1.13	0/0/1	1.22/0.85/1.29	0/0/0	4/4/4	1.00/2.12/0.82	−0.07/4.18/−0.42
It10	1.07/0.48/1.25	1/0/1	1.32/0.94/1.38	0/0/0	4/4/4	0.99/2.15/0.71	−0.24/4.11/−0.74
It11	0.62/0.26/0.70	0/0/0	1.04/0.72/1.05	0/0/0	4/4/4	1.79/3.28/1.42	2.48/11.12/1.33
It12	0.54/0.20/0.58	0/0/0	0.94/0.60/0.97	0/0/0	4/4/4	1.85/3.58/1.73	2.93/14.62/2.44
It13	0.57/0.21/0.58	0/0/0	1.04/0.64/1.10	0/0/0	4/4/4	1.89/3.69/1.90	2.82/14.85/2.67
It14	0.26/0.09/0.28	0/0/0	0.74/0.46/0.75	0/0/0	4/4/4	3.43/6.08/2.99	12.34/41.42/9.22
Study 2—Finland (Sample 4/Sample 5) *							
Item	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**	**Skewness**	**Kurtosis**
It1	0.51/0.19	0/0	0.94/0.58	0/0	4/4	1.75/3.57	2.09/14.40
It2	0.14/0.05	0/0	0.48/0.26	0/0	4/3	4.32/6.18	22.99/42.61
It3	1.84/1.27	2/1	0.86/0.83	0/0	4/4	0.25/0.30	0.40/−0.04
It4	1.36/0.66	1/0	1.09/0.89	0/0	4/4	0.41/1.29	−0.42/1.12
It5	1.31/0.67	1/0	1.11/0.92	0/0	4/4	0.42/1.21	−0.65/0.70
It6	1.28/0.63	1/0	1.20/0.91	0/0	4/4	0.56/1.35	−0.64/1.10
It7	0.39/0.12	0/0	0.75/0.44	0/0	4/4	2.08/4.31	4.35/22.07
It8	0.53/0.20	0/0	0.79/0.50	0/0	4/4	1.38/2.85	1.38/9.20
It9	0.99/0.42	1/0	1.08/0.75	0/0	4/4	0.86/1.87	0.00/3.32
It10	0.87/0.43	0/0	1.08/0.77	0/0	4/4	1.03/1.84	0.16/2.99
It11	0.57/0.18	0/0	0.84/0.49	0/0	4/4	1.35/3.06	1.15/10.50
It12	0.56/0.15	0/0	0.86/0.45	0/0	4/4	1.56/3.43	2.06/14.08
It13	0.78/0.35	0/0	1.03/0.69	0/0	4/4	1.29/2.15	1.03/4.60
It14	0.22/0.05	0/0	0.57/0.28	0/0	4/4	2.92/6.91	9.22/60.01

Note: Slash punctuation marks were inserted between the estimates to separate the values obtained for each sample. * Sample 1: Brazil, dental patient, paper-and-pencil; Sample 2: Brazil, non-dental patient, paper-and-pencil; Sample 3: Brazil, dental patient, paper-and-pencil; Sample 4: Finland, dental patient, online; Sample 5: Finland, non-dental patient, online.

The models containing three first-order factors (Figure 1e,f) showed an adequate fit to the samples of Brazilian dental patients (Table 3, Samples 1 and 3) and the convergent validity and reliability were adequate. Discriminant validity had limitations in both samples. For Sample 4, in addition to item 2, it was also necessary to exclude item 1 and the "Functional Limitation" factor for the model to present an adequate fit. This model also had convergent and discriminant validity and adequate reliability for the data in Sample 4 (Table 3). The hierarchical model was not tested for this sample, since the factorial model now has two first-order factors, with no theoretical and analytical plausibility for the inclusion of a second-order factor.

In relation to the unifactorial model (Table 3), RMSEA values above 0.10 in Samples 2 and 4 were observed. This index is overestimated in simple factorial models [32]; therefore, the SRMR is an alternative for decision-making regarding the fit of the model [32]. In addition to an adequate fit to the data, the unifactorial model showed adequate convergent validity and reliability in samples of dental patients from both countries. Furthermore, values of UniCo $\geq$ 0.98, ECV $\geq$ 0.87 and MIREAL $\leq$ 0.23 were observed in these samples, indicating that the data obtained from samples of dental patients can be treated as unidimensional.

Table 3. Fit of factorial models of the Oral Health Impact Profile-14 to data from different samples.

Model	Sample *	Excluded Items	n	CFA #								α †	CR ¶	AVE §	Observation
				CFI	TLI	RMSEA	SRMR	λ	r^2	β-2nd Order	β-3rd Order				
7 Factors—2nd Order	Sample 3	-	439	0.985	0.980	0.064	0.046	0.58–0.96	0.77–0.85	0.88–0.99	-	0.72–0.85	0.73–0.87	0.57–0.77	Factors with restriction on error variance: Psychological Disability e Handicap
7 Factors—3rd Order	Sample 3	-	439	0.985	0.980	0.064	0.046	0.58–0.96	-	0.88–0.99	0.93–0.98	0.72–0.85	0.73–0.87	0.57–0.77	Factors with restriction on error variance: Psychological Disability e Handicap
3 Factors—1st Order	Sample 1	14	434	0.947	0.933	0.115	0.065	0.63–0.88	0.43–0.73	-	-	0.69–0.91	0.70–0.92	0.55–0.64	-
	Sample 3	-	439	0.980	0.976	0.071	0.053	0.53–0.90	0.78–0.86	-	-	0.76–0.92	0.77–0.93	0.62–0.64	-
	Sample 3	14 ‡	439	0.983	0.979	0.069	0.047	0.54–0.90	0.77–0.85	-	-	0.76–0.91	0.77–0.92	0.61–0.64	-
	Sample 4	1 and 2	482	0.972	0.965	0.098	0.064	0.64–0.89	0.63	-	-	0.87–0.93	0.88–0.94	0.64–0.65	Excluded factor: Functional Limitation
3 Factors—2nd Order	Sample 1	14	434	0.947	0.933	0.115	0.065	0.63–0.88	-	0.75–0.98	-	0.69–0.91	0.70–0.92	0.55–0.64	-
	Sample 3	-	439	0.980	0.976	0.071	0.053	0.53–0.90	-	0.93–0.97	-	0.76–0.92	0.77–0.93	0.62–0.64	-
	Sample 3	14 ‡	439	0.983	0.979	0.069	0.047	0.54–0.90	-	0.93–0.97	-	0.76–0.91	0.77–0.92	0.61–0.64	-
Unifactorial	Sample 1	14	434	0.925	0.910	0.134	0.077	0.47–0.87	-	-	-	0.93	0.94	0.55	-
	Sample 3	-	439	0.972	0.967	0.082	0.059	0.52–0.86	-	-	-	0.95	0.95	0.59	-
	Sample 3	14 ‡	439	0.975	0.970	0.082	0.053	0.53–0.87	-	-	-	0.94	0.95	0.58	-
	Sample 4	2	482	0.949	0.938	0.120	0.078	0.54–0.85	-	-	-	0.94	0.95	0.57	-

Note: * Sample 1: Brazil, dental patient, paper-and-pencil; Sample 3: Brazil, dental patient, paper-and-pencil; Sample 4: Finland, dental patient, online. # CFA: confirmatory factor analysis, CFI: comparative fit index, TLI: Tucker-Lewis index, RMSEA: root mean square error of approximation, SRMR: standardized root mean square residual, λ: factorial loading, r^2: square correlation coefficient between the factors, β: absolute value of β estimate. † α: ordinal alpha coefficient. ¶ CR: composite reliability. § AVE: average extracted variance. ‡ Item excluded to obtain configural invariance between Sample 1 and Sample 3.

In the samples of Brazilian dental patients (Study 1, Samples 1 and 3), strong measure invariance was observed in the factorial model with three first-order factors ($\Delta CFI_{M1\text{-}M0} = -0.007$, $\Delta CFI_{M2\text{-}M1} = -0.007$) and in the unifactorial model ($\Delta CFI_{M1\text{-}M0} = -0.007$, $\Delta CFI_{M2\text{-}M1} = -0.010$). It is noteworthy that, to enable the invariance analysis, the OHIP-14 was considered without item 14 to establish configural invariance. This strategy was used to present an analysis related to the stability of measurement functioning between independent samples. The measurement invariance was not tested between the samples of the non-dental patients and dental patients from both countries. As shown above, more than 40% of the items did not present psychometric sensitivity in the samples of the non-dental patients (Sample 2 and Sample 5) and it was not possible to fit the factorial models to the data in these samples. This result is an indication that the OHIP-14 works differently between the samples and that it does not seem to be an adequate instrument to identify the construct of the oral health impact profile on life in non-dental patient samples.

3.3. Validity Based on Response Process

Table 4 presents item fit statistics. It is observed that, in general, the OHIP-14 items present difficulties compatible with the latent trait of each one of the samples. However, the results of DIF analysis (Table 4) indicate that at least one item was responded to significantly differently between the study samples. This difference can also be observed by the item information function in the samples (Figure 2). In general, the OHIP-14 items are informative for different levels (mild to severe) of impact of oral health on life for dental patient samples only (Sample 1, Sample 3 and Sample 4; latent trait ≤ 2 responds from 57.9% to 74.4% of the amount of information obtained by the instrument), while for the non-dental patient samples (Sample 2 and Sample 5) they are informative only when extremely severe levels of impact are present (latent trait ≥ 2 responds de 59.1% to 60.7% of the amount of information obtained by the instrument).

Table 4. Item fit statistics (information-weighted mean square [INFIT] and unweighted mean square [OUTFIT]) for each sample and Differential Item Functioning (DIF) analysis results between samples.

	Item Fit Statistics										DIF *p*-Value for χ^2			
	Sample 1		Sample 2		Sample 3		Sample 4		Sample 5		Sample 1 vs. 2	Sample 1 vs. 3	Sample 2 vs. 3	Sample 4 vs. 5
Item	Infit	Outfit	Infit	Outfit	Infit	Outfit	Infit	Outfit	Infit	Outfit				
it1	1.37	1.95	1.44	1.96	1.21	1.99	1.38	1.96	1.27	1.73	0.173	0.007	0.033	0.038
it2	1.20	1.05	1.05	1.28	0.88	0.66	1.16	1.36	1.00	1.17	0.020	<0.001	<0.001	0.408
it3	1.12	1.14	1.16	1.16	1.09	1.15	1.06	1.06	0.96	0.94	0.221	0.197	0.07	<0.001
it4	0.91	0.88	0.92	0.88	0.93	0.93	1.09	1.05	1.09	0.96	0.349	0.789	<0.001	<0.001
it5	0.90	0.90	0.89	0.87	1.36	1.39	0.85	0.83	0.77	0.70	<0.001	<0.001	<0.001	<0.001
it6	0.74	0.69	0.73	0.67	0.77	0.72	0.83	0.77	0.80	0.73	0.068	<0.001	0.485	0.050
it7	0.77	0.69	0.73	0.61	0.74	0.59	0.85	0.62	0.90	0.65	0.033	<0.001	0.011	0.403
it8	0.75	0.75	0.78	0.72	0.84	0.79	0.83	0.73	0.91	0.82	0.028	<0.001	<0.001	0.136
it9	0.76	0.68	0.89	0.86	0.71	0.63	0.78	0.70	0.79	0.61	0.067	0.321	<0.001	0.134
it10	1.21	1.32	1.18	1.26	0.95	1.06	1.00	1.00	0.97	0.90	0.482	0.06	<0.001	0.194
it11	1.11	1.04	0.92	1.03	1.00	0.87	0.75	0.59	0.80	0.48	0.080	0.73	<0.001	0.168
it12	0.74	0.70	0.76	0.62	0.97	0.86	0.74	0.74	0.79	0.51	0.564	0.22	<0.001	0.001
it13	0.86	0.70	0.70	0.41	0.77	0.86	0.78	0.85	0.89	0.79	0.395	0.027	0.903	0.642
it14	0.81	0.58	0.85	0.37	0.91	0.56	1.03	0.97	0.98	1.04	0.293	0.778	0.085	0.015

Note: Sample 1: Brazil, dental patient, paper-and-pencil; Sample 2: Brazil, non-dental patient, paper-and-pencil; Sample 3: Brazil, dental patient, paper-and-pencil; Sample 4: Finland, dental patient, online; Sample 5: Finland, non-dental patient, online.

3.4. Consequence Validity

The evidence obtained in both studies supports consequence validity, pointing out the consequences of using the OHIP-14 in different contexts in which the instrument was developed for application. It is important to emphasize that a psychometric instrument, such as the OHIP-14, is elaborated to measure a dimension (construct) in a specific population context. Thus, its use in a different population context from the one originally proposed needs to be previously evaluated, as the results obtained may have consequences both for

an individual's life and for the definition of a treatment plan and/or clinical follow-up. Thereby, the evidence presented in Studies 1 and 2 indicates an ethical concern in obtaining and using the OHIP-14 measure and supports the non-indication of using this instrument in individuals or samples without impairment of oral health.

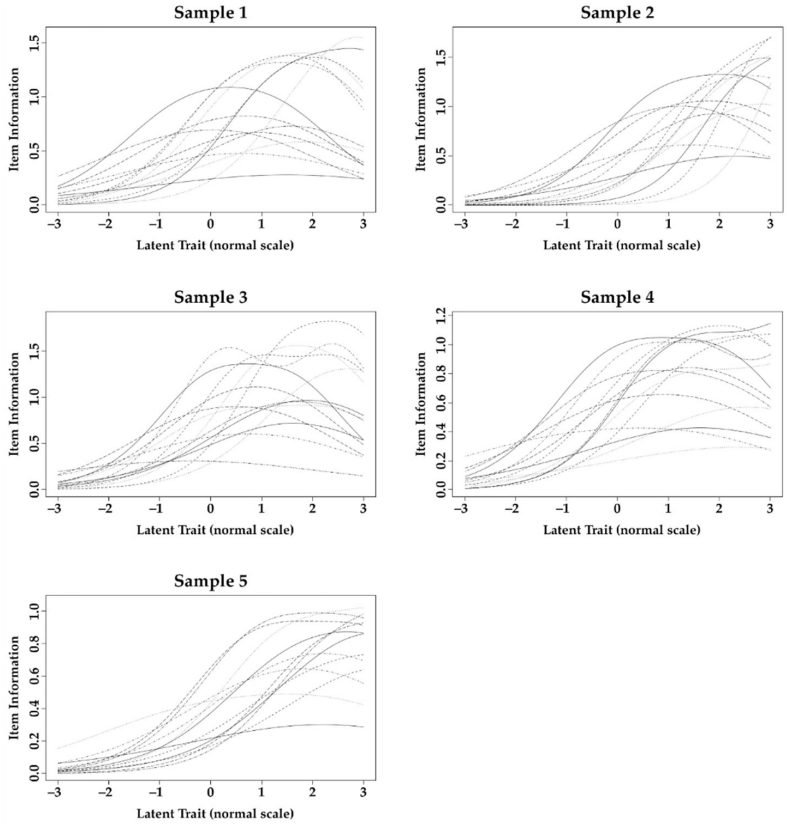

Figure 2. Item information function obtained from Differential Item Functioning analysis of the items of Oral Health Impact Profile-14 applied to the samples of the studies.

4. Discussion

This study presented results regarding how OHIP-14 works in samples of dental patients and non-dental patients in two different countries. Although previous studies have sought information regarding both the dimensionality (factorial structure) of the OHIP and its fit to data from different samples [2,13,15,16,18], this topic is still relevant for the following reasons. First, despite wide use of the OHIP-14, evaluation of the validity of the data obtained has often been neglected. As OHIP-14 is a psychometric instrument, it is necessary to ensure that it measures what it proposes to measure when applied to different samples and/or contexts. This assessment is made through validity analyses, as proposed in the Standards for Educational and Psychological Testing [21]. Second, validity does not refer to the instrument itself, but to the data obtained from its application in a specific sample and context. Therefore, obtaining evidence on how the instrument works in different samples can contribute to the decision to choose the OHIP-14 as a measurement instrument, whether for research or clinical purposes.

The study revealed that the OHIP-14 did not work properly in samples of the non-dental patients in either Brazil or Finland. In other words, OHIP-14 did not adequately

measure the profile of the impact of oral health on an individual's life. This differs from the results presented by Montero et al. [13], who found an adequate fit of the trifactorial model to a Spanish sample of non-dental patients. The difference can be attributed both to the impact of oral health on life being perceived differently between countries, as well as to the analytical strategy used in the studies. Despite using confirmatory factor analysis to verify the fit of the OHIP-14 to the data, Montero et al. [13] used the Maximum Likelihood (ML) estimation method, which assumes that the data have normal distribution. However, meeting this assumption was not mentioned, limiting the possibility to verify the fit of the model to the data. In the present study, we adopted the robust estimation method (WLSMV), indicated for an ordinal response scale (such as that of the OHIP-14) and a set of responses with a slight violation of the assumption of normal distribution [22]. However, 6 items of the OHIP showed severe violation of normal distribution in samples of the non-dental patients both in Brazil and Finland, limiting the confirmatory analysis, even using the robust estimator. Furthermore, this severe violation of normality would imply the need to exclude approximately 43% of the instrument's items since they do not adequately capture the variability of responses in this population. This indicates that the OHIP-14 does not measure properly what it is proposed to measure in these samples. This may have occurred since the content of these items refers to orofacial problems, which seem to be less prevalent in non-dental patients. Therefore, the application of OHIP-14 in non-dental patient samples deserves attention as it may not measure the intended OHRQoL-related dimension; thus, the obtained result may not represent reality and lead to erroneous conclusions for these samples.

For dental patient samples, the OHIP-14 presented adequate fit and measurement validity. However, it was necessary to verify which factor structure proposed in the literature fitted properly to the present data. The structure based on Locker's theoretical model [9] on 7 first-order factors was tested first. This structure presented adequate fit for only one of the datasets of dental patient samples (Sample 3) and this was only possible after the inclusion of hierarchical factors and variance restriction. The difficulty of fitting this model was previously observed by Baker et al. [19], who suggest that this structure may contain overlapping concepts, making its fit difficult. Furthermore, Baker et al. [19] suggested that the dimensions presented do not necessarily reflect the content of the items, since the dimensions were elaborated based on the 1980 WHO Classification of Impairments, Disabilities, and Handicaps model [33], which was no longer valid after 2001 [3]. Thus, it is essential to identify the dimensionality of OHIP-14, as well as its underlying theoretical concept, to ensure the validity of data obtained in new samples and current contexts.

Montero et al. [13] found a trifactorial structure (Psychosocial Impacts, Pain-Discomfort, and Functional Limitation) of the OHIP-14 using exploratory factor analysis. This structure seems interesting because it allows the identification of three dimensions that are present in the most current theoretical proposal elaborated by John [3,34]. In this new perspective, the OHRQoL is structured from the dimensions Psychosocial Impact, Orofacial Pain, Oral Function, and Orofacial Appearance, which represent the reasons that lead an individual to seek dental treatment. When the trifactorial model was tested, we observed an adequate fit to the data from Brazilian dental patient samples. For the Finnish dental patient sample, adequate fit for this proposal was only achieved after eliminating the Functional Limitation dimension. These findings show that the theoretical proposal of OHIP-14 as a trifactorial model is plausible for measuring the different dimensions of OHRQoL in dental patient samples. We also emphasize that, if the researcher/professional aims to assess the OHRQoL in a broader way, seeking to contemplate the four dimensions proposed by John [3,34], an investigation protocol that includes other additional psychometric instruments and/or that uses a more comprehensive instrument is necessary, such as the OHIP-49, as the OHIP-14 cannot fully cover this theoretical model.

The unifactorial model of the OHIP-14 was proposed by Santos et al. [16] In the present study, the unifactorial model presented an adequate fit to data from dental patient

samples, both in Brazil and Finland. It was also observed that the unidimensionality indices (UniCo, ECV and MIREAL) suggest that, for these samples, although the trifactorial model presented adequate fit, the unifactorial model is more interesting. Thus, the unifactorial model was the one that was best applied to measure the oral health impact profile on the lives of participants in the present study samples.

In view of the results and what was revealed in the introduction of this study, those who choose to use the OHIP-14, whether for clinical or research purposes, are cautioned to be mindful of the way in which the OHIP-14 results are interpreted. Some studies refer to the construct assessed as quality of life or OHRQoL in general, but what is actually measured is the perception of the impact of a given oral condition on an individual's life [18], which can be considered as a single construct (unifactorial model) or from different dimensions (trifactorial model). Thus, it is only one of the components of what is considered quality of life, which in turn is a complex and multidimensional concept that includes components, for example, related to good living conditions, life functionality and the ability to cope with life's challenges [35]. Therefore, OHIP-14 results as a sole measure, without considering population characteristics (nationality, age, etc.) and oral condition, may be difficult to be interpreted. Those results should be considered in addition to the clinical findings, providing the professional with important information regarding the patient's perspective regarding the impact of the oral condition on their life [3,34]. With this information in hand, the professional will be able to move towards the real demands and expectations of patients, placing them in the central role in the elaboration of treatment.

Another point to note is that the OHIP, whether in its complete or reduced version, was elaborated more than two decades ago, having its theoretical structure based on a model (WHO Classification of Impairments, Disabilities, and Handicaps [33]) that is no longer applied. Despite the undeniable usefulness of the OHIP nowadays, it is necessary to take a critical look at how much the items in this instrument really fit into different samples and current contexts. Based on the present study, it is not recommended its use for data collection without prior evaluation of the validity of the obtained data. It can be recommended to ensure how OHIP-14, or any psychometric instrument [21], works when applied to a specific population and in a new context.

The results of this study corroborate the above issues since the way OHIP-14 works was affected by the characteristics of the target population and was not fitted for the non-dental patients. Furthermore, although we have considered dental patient samples regardless of oral condition and treatment, specific groups of these patients can also affect how OHIP-14 works. For example, the OHIP-14 may not work properly for a group of dental patients with demand exclusively related to orofacial appearance, as the content of the items in this instrument is more related to the other dimensions of the OHRQoL (Psychosocial Impact, Orofacial Pain and Oral Function). For clinicians, the choice of an instrument should be based on this evidence obtained in a population with characteristics similar to those of their patients, otherwise the result attributed to the instrument answered by the patient may be arbitrary, which will negatively influence the plan of treatment, where under or over treatment may occur.

Convenience sampling can be considered as a limitation of this study. This type of sampling is, however, commonly used in observational studies that aim to estimate the psychometric properties of measurement instruments in different samples/contexts [10,13,15,18]. The use of a sample of dental patients in general, without specifying a clinical condition, can also be considered a limitation since, as previously mentioned, the clinical condition can affect how the instrument works. However, we clarify that our aim with this study was to open a deeper discussion about what we are measuring with the OHIP-14 and highlighting, as a starting point, the comparison between dental patient and non-dental patient samples. Future investigations that conduct studies in populations with specific clinical conditions are of interest to verify the impact that each one of these can have on the way to measure the oral health impact construct on patients' lives. It is hoped that the

results obtained and discussions raised in this study can serve as a basis for reflections for these new studies.

Despite these limitations, consistent evidence was presented in this study regarding the non-operationalization of the OHIP-14 in non-dental patient samples in Brazil and Finland and the possible ways in which it works in dental patient samples from both countries. Thus, it is expected that the study will contribute to the advancement of Evidence-Based Dentistry, as it provides information to alert researchers to the responsibility and need to obtain valid data with adequate interpretation when using OHIP-14 in different samples. For clinicians, we emphasize the need to choose and use the best way to gather information that may be relevant to the development of a patient-centered treatment plan.

5. Conclusions

The validity of data related to the impact of oral health problems on individuals' lives was confirmed through a unifactorial model. OHIP-14 works properly in dental patient samples and was limited in non-dental patient samples and was also influenced by cultural context and age.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of São Paulo State University (protocol codes: CAAE 01040312.5.0000.5416 and 88600318.3.0000.5416) and by the Data Protection Officer at Tampere University, in accordance with the European Union's General Data Protection Regulation.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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PUBLICATION II

Orofacial Esthetic Scale and Psychosocial Impact of Dental Aesthetics Questionnaire: development and psychometric properties of the Finnish version

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ORIGINAL ARTICLE

Orofacial Esthetic Scale and Psychosocial Impact of Dental Aesthetics Questionnaire: development and psychometric properties of the Finnish version

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ABSTRACT

Objective: To develop the Finnish version of the Orofacial Esthetic Scale (OES-Fi) and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-Fi) and estimate the psychometric properties of these instruments applied to adult Finns.

Methods: The English versions of the instruments were translated into Finnish and back-translated. Thereafter, OES-Fi and PIDAQ-Fi were established in a pilot study. The factorial validity was estimated using Confirmatory Factor Analysis (CFI, TLI, SRMR) in independent samples (Test and Validation samples). The measurement invariance of the factorial models was tested using multigroup analysis (ΔCFI). Convergent validity [Average Variance Extracted (AVE)] and reliability [Composite Reliability (CR) and α] were estimated.

Results: A total of 3636 individuals [mean age = 32.0 (SD = 11.6) years, 75% women] participated in the study. After refinements, the factorial model of the instruments showed an adequate fit to the data (CFI ≥0.94, TLI ≥0.90, SRMR ≤0.07) and showed measurement invariance in two independent samples (|ΔCFI| <0.01). Convergent validity (AVE = 0.54–0.82) and reliability (α = 0.86–0.94) were adequate.

Conclusion: The data obtained using OES-Fi and PIDAQ-Fi were valid and reliable. Thus, these instruments could be useful for evaluating individual satisfaction with orofacial appearance and the psychosocial impact of dental aesthetics in a clinical or research setting.

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Introduction

The role of orofacial appearance in dental treatment has been acknowledged for many decades [1,2]. Although this used to be limited to how conventional dental treatments (focussed on function) could improve aesthetics [1], several treatments are currently available that focus on this purpose (e.g. tooth whitening, orthodontics and veneers) with an increasing demand for them [3]. Thus, it is important to assess the individual's perception of their orofacial appearance in both a clinical and a research context [4,5]. In the clinical context, this information will allow for the elaboration of a patient-centred treatment plan that can satisfy the individual's expectations [4–6]. At the same time, the clinician's role as expert has to be emphasized to bring evidence-based information to the patient-centred concept. In a research context, this will help increase knowledge of the importance of orofacial appearance on an individual's life and how it can be affected by different cultures, oral conditions and types of treatment [6].

However, the perception of orofacial appearance cannot be directly measured. A standardized way of conducting this assessment is to use specific instruments known as dental patient-reported outcome measures (dPROMs) [4,6,7]. The Orofacial Esthetic Scale (OES) [8] and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) [9] are dPROMs that are intended to assess orofacial appearance. The OES is a one-factor scale that assesses the direct impact of aesthetics based on satisfaction with specific aspects [8]. In Sweden, it was originally proposed to be applied to prosthodontics patients [8]. The PIDAQ has four factors (Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern) and assesses the psychosocial impact of

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dental aesthetics on the individual's life [9]. It was originally proposed in the German language for orthodontic patients [9]. Both instruments were also originally published in English [8,9]. To obtain more evidence about perception of orofacial appearance and the influence of local characteristics and cultural factors, it is necessary for dPROMs to be available in different languages.

For this purpose, the OES and PIDAQ have been translated and adapted for several countries, including Croatia [10,11], Brazil [12,13], Spain [14,15], China [16,17], Republic of Kosovo [18,19], and France [20,21]. Despite translations being available for both instruments, there is no Finnish version of OES and PIDAQ. Although translation and cultural adaptation is the starting point for using these instruments in different countries, these dPROMs are psychometric instruments. Thus, an evaluation of their psychometric properties is necessary when they are being applied to new samples. This is the only way to ensure that the data obtained using these instruments are valid and reliable. Previous studies from different countries have attested to the adequate psychometric properties of OES and PIDAQ for different sample settings, such as dental patients and the general population [11,12,17,22–26].

Although classified as being in the Nordic European cultural cluster, Finland has a different background in relation to the other countries in this cluster, which makes its culture unique [27,28]. Thus, the development of the Finnish version of OES and PIDAQ will not only be of interest to professionals in the country but will also increase knowledge of the influence of local characteristics and cultural factors on the perception of orofacial appearance. A comparison of this perception with other countries will also be possible. The aims of this study were to develop the Finnish version of the Orofacial Esthetic Scale (OES-Fi) and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-Fi), and to estimate the psychometric properties of these instruments when applied to adult Finns.

Methods

Study design and participants

This was a cross-sectional study with a non-probabilistic sample. Finnish individuals over 18 years of age were included in the study. Initially, students and staff from Tampere University and the University of Oulu were invited to participate in the study. The snowball strategy was then used to recruit participants.

The minimum sample size was calculated based on the proposal of Hair et al. [29]. They recommend a minimum of 5–10 individuals per model parameter to be estimated. Considering the largest model to be tested in this study has 54 parameters (first-order factorial model of the PIDAQ), the minimum sample size required was 270–540 individuals. A higher number of participants was recruited to reach the minimum sample size in each subsample of interest (Test Sample, Validation Sample, Dental Patients and General Population) and to increase the representativeness of the data for the study population.

Study variables

For sample characterization, the following demographic information was collected: age, sex, marital status, socioeconomic status (estimated according to Classification of Socioeconomic Groups 1989 [30]), monthly income, whether the individual is currently a dental patient and whether the individual has sought or received any aesthetics dental treatment. The responses to these questions were self-reported by the participants.

Measurement instruments

The orofacial appearance and psychosocial impact of dental aesthetics were evaluated using the Orofacial Esthetic Scale (OES) [8] and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) [9], respectively.

The OES is a one-factor scale (Orofacial Appearance) comprising seven items (Supplemental File 1) intended to assess satisfaction with specific orofacial aesthetics components. This instrument also has one item, which has not been considered in the factorial model, for assessing satisfaction with overall orofacial appearance (Supplemental File 1, item 8). OES has an 11-point rating scale ranging from 0 (very dissatisfied) to 10 (very satisfied).

The PIDAQ originally comprised 23 items distributed in four factors: Dental Self-Confidence (Supplemental File 1, items 4, 7, 12, 17, 21, and 23), Social Impact (Supplemental File 1, items 2, 5, 9, 13, 14, 15, 19, and 22), Psychological Impact (Supplemental File 1, items 3, 6, 10, 11, 16, and 20) and Aesthetic Concern (Supplemental File 1, items 1, 8, and 18). For the present study, an additional item was added to the Dental Self-Confidence factor, as proposed by Campos et al. [26], which considers tooth colour (Supplemental File 1, item 24). Based on the theory of this instrument and the high correlation found among the first-order factors in the previous study [26], a hierarchical model with the second-order factor called *Psychosocial Impact* was also considered. The response scale is a 5-point Likert-type scale ranging for 0 to 4 (0: I do not agree, 1: I agree a little, 2: I somewhat agree, 3: I agree a lot, 4: I totally agree).

Development of the OES-Fi and the PIDAQ-Fi

Before beginning the translation process for the instruments, the content of the items was analyzed by the researchers (LAC, JADBC and TP) to verify the adequacy of the content for the sample and context. It was decided to change the wording of item 22 of the PIDAQ from "I sometimes worry about what members of the opposite sex think about my teeth" to "I sometimes worry about what people with whom I would like to have a relationship think about my teeth". Two independent translators (native speakers of Finnish with English proficiency, MK, A-SS) then translated the English version of the instruments into Finnish. The translations were compared by the researchers (LAC and TP) who prepared a preliminary Finnish version of the instruments [32]. These versions were back-translated into English by another

independent translator. Two researchers (LAC and TP) compared the original, preliminary and back-translated versions and found them to be conceptually identical with the original versions, taking into account the Finnish context.

A pilot study was conducted with these preliminary versions to estimate the Incomprehension Index (II). This index aims to verify any difficulties by the participants in understanding the item's content. If the values of II for the items are lower than 15%, the version is considered adequate [33].

Psychometric indicators of OES-Fi and PIDAQ-Fi

The sensitivity of OES-Fi and PIDAQ-Fi were estimated using the mean, median, standard deviation, skewness and kurtosis of the responses to the items. Skewness and kurtosis absolute values below 3 and 10, respectively, were indicative of non-severe violation of normal distribution [34], attesting to the psychometric sensitivity of the item and meeting one of the assumptions of subsequent analyses [35]. Multivariate normality was evaluated using the ratio of multivariate kurtosis and the critical ratios (ku_m/cr). Values of ku_m/cr lower than 3 were indicative of multivariate normality [35].

To evaluate the construct validity of OES-Fi and PIDAQ-Fi, the factorial, convergent and discriminant validities were estimated. For these, the total sample was randomly divided into two subsamples (Test Sample and Validation Sample).

The factorial models of the OES and PIDAQ tested were the original models proposed by Larsson et al. [8] and Klages et al. [9], respectively. The factorial validity was estimated using Confirmatory Factor Analysis (CFA). The maximum likelihood (ML) estimation method was used for OES and the robust weighted least squares mean and variance adjusted (WLSMV) estimation method was used for PIDAQ. The choice of estimation methods was based on the number of points on the instruments' response scale [34]. The fit of the models to the data was assessed using the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The factor loadings of the items (λ) were also estimated. Values of CFI and TLI $\geq$ 0.90, RMSEA $<$ 0.10, SRMR $\leq$0.08 and $\lambda \geq 0.50$ were indicative of an acceptable fit of the model to the data [35,36]. If the model did not show an adequate fit to the data, the modification indices (estimated using the Lagrange Multiplier [LM] method) with values above 11 were inspected to check for any correlations between errors of items [35]. Also, after fitting the first-order factorial model of PIDAQ to the data, the second-order hierarchical model was tested.

To certify the keeping of the factorial models in the independent samples (Test and Validation), the fit of the models was tested in Test and Validation subsamples. First, a confirmatory factor analysis was performed for each subsample and then a multigroup analysis using the CFI difference (ΔCFI) was performed to verify the measurement invariance of the factorial models. For OES-Fi, the ΔCFI for factor loadings (ΔCFI_{λ}), intercepts (ΔCFI_i) and residuals (ΔCFI_{res}) was considered. For PIDAQ-Fi, the ΔCFI between configurational and metric models ($\Delta CFI_{M1\text{-}M0}$) and between metric and scalar models ($\Delta CFI_{M2\text{-}M1}$) was considered. Measurement invariance was assumed when values of $|\Delta CFI|$ were less than 0.01.

After checking the fit of the OES-Fi model, Pearson's correlational analysis (r) was performed between the Orofacial Appearance factor and item 8 of this scale, which refers to assessment of satisfaction with overall orofacial appearance.

The Average Variance Extracted (AVE), proposed by Fornell and Larcker [37], was estimated for each first-order factor to attest to the convergent validity. Values of AVE $\geq$ 0.50 were indicative of adequate convergent validity [35]. The discriminant validity was estimated using correlation analysis between the factors [37]. The discriminant validity was considered adequate when AVE values of the correlated factors were above or equal to the squared correlation between factors (AVE_i and $AVE_j \geq r_{ij}^2$) [35,37].

The concurrent validity of the OES-Fi and PIDAQ-Fi was evaluated using Pearson's correlational analysis (r) between Orofacial Appearance factor (OES-Fi) and first-order factors of the PIDAQ-Fi (Dental Self-Confidence, Social Impact, Psychological Impact and Aesthetic Concern). To assess the divergent validity of these instruments, the Finnish version of the Satisfaction With Life Scale (SWLS) [31] was used. SWLS is a one-factor scale comprising 5 items and the response scale is a 7-point Likert-type. The data obtained with this instrument in the sample of the present study were valid and reliable (Confirmatory Factor Analysis: CFI = 0.98, TLI = 0.97, RMSEA = 0.106, SRMR = 0.023, and $\lambda \geq 0.64$; Cronbach's alpha coefficient = 0.90). The divergent validity was assessed using the correlation (Pearson's correlational analysis – r).

The reliability was assessed using Cronbach's alpha coefficient (for OES) or ordinal alpha coefficient (for PIDAQ), and was considered adequate if $\geq$0.70 [35]. To verify whether the OES-Fi and PIDAQ-Fi discriminate between individuals undergoing dental treatment (Dental Patient) and those not undergoing dental treatment (General Population), the fit of the models and the measurement invariance, as described above, were verified in these subsamples. If invariance was observed, the mean scores of the OES-Fi and PIDAQ-Fi factors were compared between these groups.

The distribution of the scores was estimated by the skewness and kurtosis. Absolute values below 3 and 10, respectively, were indicative of non-severe violation of normal distribution [34]. Factor scores, estimated as a mean of the responses given to the items, were used to test differences between groups. Factor scores showed a distribution close to the normal distribution (skewness $\leq |1.9|$ and kurtosis $\leq |3.5|$). The homoscedasticity of the factor scores in the different groups was evaluated using Levene's test. If the data showed homoscedasticity, the comparisons were performed using a t-test with equal variances. If the data showed heteroscedasticity, the comparisons were performed using Welch's t-test. The significance level adopted was 5%.

The analyses were performed using IBM SPSS Statistics 22 (IBM Corp., Armonk, NY) and the "lavaan" [38] and "semTools" [39] packages of the R program (R Core Team, 2016).

Procedures and ethical aspects

The individuals were invited to participate in the study *via* email. The invitation email described the aims of the study and included a link to an online questionnaire. The questionnaire contained the measurement instruments and was created using LimeSurvey software (LimeSurvey GmbH, Hamburg, Germany; URL http://www.limesurvey.org) on the server of Tampere University. At first, the participants answered the demographic questions. The measurement instruments (OES-Fi and PIDAQ-Fi) were then presented in random order between the participants. All responses to the OES-Fi and PIDAQ-Fi were mandatory. Data collection was carried out between 16 June and 30 July 2020.

Approval for data collection was obtained from the Data Protection Officer at Tampere University, in accordance with the European Union's General Data Protection Regulation. This approval was attached to the invitation email.

Results

Development of the OES-Fi and PIDAQ-Fi – pilot study

Thirty-seven individuals participated in the pilot study. Of those, 67.6% were female, 62.2% single/cohabiting, 32.4% married and 5.4% divorced. Four individuals (10.8%) were currently receiving dental care, one was undergoing dental treatment to improve aesthetics. The mean age was 31.2 (standard deviation = 11.0) years and 51.4% of the participants had already received dental treatment for the purpose of improving aesthetics. Regarding socioeconomic status, 24.3% were upper-level employees in administrative, managerial, professional and related occupations, 2.7% were lower-level employees in administrative and clerical occupations, 18.9% were manual workers and 54.1% were students. The monthly income of 70.3% of the participants was less than or equal to €5000.

All OES-Fi items presented an Incomprehension Index between 0.0 and 2.7%. Understanding of the content of the items was considered adequate and the version tested in the pilot study was considered to be the final version of OES-Fi (Supplemental File 1). Regarding PIDAQ-Fi, items 6 and 19 presented II = 2.7%, item 22, II = 5.4%, item 8, II = 8.1% and items 1, 17 and 18 presented II = 10.8%. Although II was less than 15%, the researchers (LAC and TP) inspected the contents of these items and identified no need for adjustments. The other items of PIDAQ-Fi presented II = 0.0%. The final version of this instrument is shown in Supplemental File 1.

Psychometric indicators of OES-Fi and PIDAQ-Fi

A total of 3636 Finnish individuals participated in the study. The mean time to complete the demographic questionnaire, OES-Fi and PIDAQ-Fi, was 6.3 (SD = 2.8) min. Table 1 shows the characterization of total sample and subsamples (Test and Validation). The majority of participants were female, single and were not currently receiving dental care. Splitting

Table 1. Participants' characteristics [mean (SD) or *n* (%)].

	Test sample ($n = 1820$)	Validation sample ($n = 1816$)	Total sample ($n = 3636$)
Age (years)	32.08 (SD = 11.81)	31.84 (SD = 11.48)	31.96 (SD = 11.64)
Sex			
Female	1367 (75.1)	1360 (74.9)	2727 (75.0)
Male	422 (23.2)	427 (23.5)	849 (23.3)
Other/no response	31 (1.7)	29 (1.6)	60 (1.7)
Marital status			
Single	1217 (67.1)	1195 (66.0)	2412 (66.6)
Married/common law/stable relationship	517 (28.5)	526 (29.0)	1043 (28.7)
Divorced	73 (4.0)	89 (4.9)	162 (4.5)
Widower	7 (0.4)	1 (0.1)	8 (0.2)
Socioeconomic status			
Self-employed persons	14 (0.8)	25 (1.4)	39 (1.1)
Upper-level employees in administrative, managerial, professional and related occupations	321 (17.6)	318 (17.5)	639 (17.6)
Lower-level employees in administrative and clerical occupations	145 (8.0)	153 (8.4)	298 (8.2)
Manual workers	228 (12.6)	232 (12.8)	460 (12.7)
Students	1032 (56.7)	1028 (56.6)	2060 (56.6)
Pensioners	10 (0.5)	5 (0.3)	15 (0.4)
Other	70 (3.8)	55 (3.0)	125 (3.4)
Monthly income			
Less than €2500	813 (44.8)	808 (44.6)	1621 (44.7)
€2500–5000	420 (23.2)	405 (22.4)	825 (22.8)
€5001–7500	254 (14.1)	261 (14.4)	515 (14.3)
€7501–10000	149 (8.2)	168 (9.3)	317 (8.7)
€10001–12500	57 (3.1)	53 (2.9)	110 (3.0)
More than €12500	120 (6.6)	116 (6.4)	236 (6.5)
Are you receiving dental treatment?			
Yes	312 (17.1)	286 (15.7)	598 (16.4)
No	1508 (82.9)	1530 (84.3)	3038 (83.6)
Have you sought or received any aesthetics dental treatment?			
I have never sought aesthetics dental treatment	1064 (58.9)	1080 (59.9)	2144 (59.5)
I recently sought aesthetics dental treatment	38 (2.1)	39 (2.1)	77 (2.1)
I have received aesthetics dental treatment	671 (37.2)	636 (35.3)	1307 (36.2)
I am currently receiving aesthetics dental treatment	33 (1.8)	48 (2.7)	81 (2.2)

each sample into two (Test Sample and Validation Sample) showed no differences in these characteristics.

The descriptive statistics of the responses given to the OES-Fi and PIDAQ-Fi items by the subsamples (Test, Validation, General Population and Dental Patient) are shown in Table 2. All responses given to the OES-Fi items presented adequate values of sk and ku for CFA, while responses to the PIDAQ-Fi, items 9, 13, 14, and 15 presented non-acceptable sk and ku for the Test, Validation and General Population subsamples. Thus, these items were not considered in the subsequent analyses of these subsamples. The data showed multivariate normality for both instruments (ku_m/c.r.: OES-Fi $\leq$ 0.92; PIDAQ-Fi $\leq$ 2.89).

The factorial model of OES-Fi did not show an adequate fit to the Test Sample ($\lambda = 0.55$–0.89, CFI = 0.852, TLI = 0.778, RMSEA = 0.210, and SRMR = 0.075). When inspecting the LM, a high value was observed between the errors of item 1 (it1. Your facial appearance) and 2 (it2. Appearance of your facial profile) (LM = 640.130). After inserting a correlation between the errors of items 1 and 2, an adequate fit of the model was obtained (Table 3). This refined factorial model of OES-Fi also showed an adequate fit to the Validation Sample data (Table 3). It is observed that only the RMSEA did not present the suggested threshold value (<0.10). This occurs because in simple factorial models with few degrees of freedom, the RMSEA is overestimated [12,40]. In such cases, the SRMR is an alternative index to the RMSEA for decision making regarding the factorial model fit [12]. There was a strong correlation between the OES-Fi factor (Orofacial Appearance) and the response given to item 8 of the OES-Fi ($r = 0.87$; $p < .001$). The convergent validity and reliability were adequate for the data of both subsamples. There was measurement invariance between these samples ($\Delta CFI_{\lambda} = 0.000$, $\Delta CFI_{i} = 0.000$; $\Delta CFI_{res} = -0.001$), indicating the adequate external validity of the results.

Regarding the PIDAQ-Fi, both first- and second-order models (excluding items 9, 13, 14, and 15) presented adequate factorial and convergent validity and reliability for the Test and Validation Samples (Table 3). Discriminant validity was compromised in the Social Impact versus Psychological Impact, Social Impact versus Aesthetic Concern, and Psychological Impact versus Aesthetic Concern factors. These results contribute to the theoretical proposal of a second-order hierarchical model. The factorial models of the PIDAQ-Fi showed measurement invariance between the samples ($\Delta CFI_{M1\text{-}M0} = 0.000$, $\Delta CFI_{M2\text{-}M1} = -0.001$).

The factorial models of OES-Fi and PIDAQ-Fi showed an adequate fit to the Dental Patient and General Population samples (Table 3) and invariance between these samples (OES-Fi: $\Delta CFI_{\lambda} = 0.000$, $\Delta CFI_{i} = 0.000$, $\Delta CFI_{res} = -0.004$; PIDAQ-Fi: $\Delta CFI_{M1\text{-}M0} = 0.000$, $\Delta CFI_{M2\text{-}M1} = -0.007$). It should be noted that the model with configurational invariance (excluding items 9, 13, 14 and 15) was used to verify the maintenance of the factorial model of PIDAQ for these subsamples.

There was a strong correlation between OES-Fi factor and PIDAQ-Fi factors, indicating adequate concurrent validity of the instruments (Orofacial Appearance versus Dental Self-Confidence: $r = 0.87$, $p < .001$; Orofacial Appearance versus Social Impact: $r = -0.69$, $p < .001$; Orofacial Appearance versus Psychological Impact: $r = -0.77$, $p < .001$; Orofacial Appearance versus Aesthetic Concern: $r = -0.74$, $p < .001$). It was observed a weak correlation of the SWLS factor with the OES-Fi factor and the first-order factors of the PIDAQ-Fi, indicating adequate divergent validity of OES-Fi and PIDAQ-Fi (SWLS versus Orofacial Appearance:; SWLS versus Dental Self-Confidence: $r = 0.87$, $p < .001$; SWLS versus Social Impact: $r = -0.69$, $p < .001$; SWLS versus Psychological Impact: $r = -0.77$, $p < .001$; SWLS versus Aesthetic Concern: $r = -0.74$, $p < .001$).

The comparisons of the factor scores of the OES-Fi and PIDAQ-Fi between the Dental Patient and General Population sample is shown in Table 4. Dental patients showed less satisfaction with their orofacial appearance (significantly lower OES-Fi scores) and a greater psychosocial impact of dental aesthetics (significantly lower Dental Self-Confidence score and significantly higher Social Impact, Psychological Impact and Aesthetic Concern scores) than the General Population.

Discussion

This study developed and estimated the psychometric properties of the OES-Fi and PIDAQ-Fi. The results point to the adequate validity and reliability of the data obtained using these instruments when applied to adult Finns and a discriminatory capacity between dental patients and the general population.

The present study was proposed due to the need to assess the perception of orofacial appearance in different cultures and contexts in light of the various dental treatments that focus on improving aesthetics. dPROMs are instruments that assess patient outcomes, with OES and PIDAQ being widely used in the literature to assess the direct and indirect impact, respectively, of orofacial appearance [8,9].

During the translation process, the researchers evaluated the content of the instruments' items and changed the content of item 15 of the PIDAQ. The original item used the term "opposite sex" to designate anyone with whom the participant would like to have a relationship. The content of item was changed to gender-neutral since retaining the original content was considered to be outdated and could cause discomfort or offence to some of the participants. This serves as a reminder that when any psychometric instrument is applied to a new sample, it is important to form a panel of researchers and specialized professionals to evaluate the content of the items, even if there is already a version of the instrument for the language to be used. It will then be possible to verify whether the content of each item is appropriate for use or whether any changes could be made to apply the instrument to a specific sample in the current context.

After establishing the OES-Fi and PIDAQ-Fi in a pilot study, the psychometric properties of both were estimated. When analyzing the descriptive statistics of the responses given to the items, it was noted that four items (items 9, 13, 14 and 15) from the Social Impact factor of PIDAQ-Fi severely violated the normal distribution. This may be related to the social interaction characteristics of the sample or to the

Table 2. Descriptive statistics of the responses given by the participants of each subsample to the items of the Orofacial Esthetic Scale (OES-Fi) and the items of the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-Fi) (Test Sample: $n = 1820$; Validation Sample: $n = 1816$; General Population: $n = 3038$; Dental Patient: $n = 598$).

	OES-Fi (Test Sample/Validation Sample/General Population/Dental Patient)					PIDAQ-Fi (Test Sample/Validation Sample/General Population/Dental Patient)				
Item	Mean	Median	Standard deviation	Skewness	Kurtosis	Mean	Median	Standard deviation	Skewness	Kurtosis
it1	7.2/7.2/7.2/7.1	8.0/8.0/8.0/7.0	1.7/1.6/1.6/1.9	−1.2/−1.1/−1.1/−1.1	1.8/1.8/1.9/1.4	0.5/0.6/0.5/0.7	0.0/0.0/0.0/0.0	0.9/0.9/0.9/1.0	1.7/1.7/1.8/1.4	2.6/2.3/2.7/1.4
it2	6.6/6.6/6.6/6.4	7.0/7.0/7.0/7.0	2.1/2.1/2.1/2.3	−0.8/−0.8/−0.8/−0.7	0.3/0.4/1.4/0.0	0.6/0.7/0.6/0.9	0.0/0.0/0.0/0.0	1.0/1.1/1.0/1.2	1.8/1.6/1.8/1.3	2.2/1.7/2.4/0.4
it3	7.0/6.9/7.0/6.6	7.0/7.0/7.0/7.0	2.0/2.0/2.0/2.3	−0.9/−0.9/−1.0/−0.7	0.6/0.5/0.7/−0.1	1.3/1.3/1.2/1.6	1.0/2.0/1.0/1.0	1.2/1.2/1.2/1.3	0.7/0.7/0.8/0.4	−0.5/−0.5/−0.4/−0.9
it4	6.8/6.8/6.9/6.4	7.0/7.0/7.0/7.0	2.3/2.3/2.3/2.5	−0.9/−0.8/−0.9/−0.7	0.3/0.1/0.3/−0.3	1.8/1.8/1.8/1.6	2.0/2.0/2.0/2.0	1.3/1.2/1.3/1.3	0.0/0.1/0.0/0.3	−1.0/−1.1/−1.1/−1.0
it5	7.4/7.3/7.4/7.1	8.0/8.0/8.0/8.0	2.0/2.1/2.0/2.3	−1.1/−1.1/−1.1/−0.9	1.0/0.9/1.0/0.4	0.4/0.4/0.3/0.6	0.0/0.0/0.0/0.0	0.8/0.8/0.8/1.0	2.6/2.5/2.7/1.8	6.3/6.0/7.4/2.4
it6	6.3/6.2/6.3/5.9	7.0/7.0/7.0/6.0	2.2/2.2/2.2/2.4	−0.7/−0.7/−0.7/−0.5	0.0/0.0/0.1/−0.4	0.3/0.3/0.3/0.5	0.0/0.0/0.0/0.0	0.8/0.7/0.7/0.9	2.6/2.5/2.7/1.8	6.6/6.3/7.8/2.6
it7	7.9/7.8/7.9/7.6	8.0/8.0/8.0/8.0	1.9/1.8/1.8/2.1	−1.3/−1.2/−−1.2/−1.1	1.9/1.9/2.0/1.1	2.2/2.1/2.2/1.9	2.0/2.0/2.0/2.0	1.4/1.4/1.4/1.4	−0.2/−0.2/−0.2/0.0	−1.2/−1.2/−1.2/−1.4
it8	7.2/7.2/7.2/6.9	8.0/8.0/8.0/7.0	1.7/1.7/1.6/1.9	−1.1/−1.1/−1.2/−1.0	1.7/1.8/1.9/1.0	0.9/1.0/0.9/1.2	0.0/0.0/0.0/1.0	1.3/1.3/1.2/1.4	1.2/1.1/1.2/0.8	0.1/0.0/0.2/−0.6
It9	–	–	–	–	–	0.3/0.3/0.3/0.5	0.0/0.0/0.0/0.0	0.8/0.7/0.7/0.9	3.1/3.0/3.2/2.2	9.4/9.2/11.1/4.3
It10	–	–	–	–	–	0.6/0.6/0.5/0.9	0.0/0.0/0.0/0.5	0.9/0.9/0.9/1.1	1.8/1.7/1.8/1.3	2.8/2.4/3.1/0.8
It11	–	–	–	–	–	0.9/0.9/0.8/1.1	0.0/0.0/0.0/1.0	1.2/1.2/1.2/1.3	1.2/1.2/1.3/0.8	0.3/0.3/0.6/−0.6
It12	–	–	–	–	–	2.1/2.0/2.0/1.8	2.0/2.0/2.0/2.0	1.2/1.3/1.2/1.3	−0.2/0.0/−0.1/0.1	−1.0/−1.1/−1.0/−1.1
It13	–	–	–	–	–	0.3/0.3/0.2/0.4	0.0/0.0/0.0/0.0	0.7/0.7/0.6/0.9	3.2/3.0/3.2/2.4	11.0/9.2/11.1/5.8
It14	–	–	–	–	–	0.2/0.2/0.2/0.4	0.0/0.0/0.0/0.0	0.6/0.7/0.6/0.8	3.4/3.1/3.6/2.3	12.2/10.2/13.6/4.9
It15	–	–	–	–	–	0.3/0.3/0.2/0.5	0.0/0.0/0.0/0.0	0.7/0.8/0.7/1.0	3.0/3.0/3.2/2.2	9.5/8.6/10.7/4.0
It16	–	–	–	–	–	0.4/0.4/0.4/0.6	0.0/0.0/0.0/0.0	0.8/0.8/0.8/1.0	2.4/2.3/2.5/1.7	5.8/4.9/6.4/2.2
It17	–	–	–	–	–	1.6/1.6/1.6/1.4	2.0/2.0/2.0/1.0	1.2/1.2/1.2/1.2	0.1/0.2/0.1/0.4	−1.0/−1.0/−1.0/−0.9
It18	–	–	–	–	–	0.6/0.6/0.5/0.8	0.0/0.0/0.0/0.0	1.0/1.1/1.0/1.2	2.0/1.9/2.1/1.4	3.2/2.7/3.6/0.8
It19	–	–	–	–	–	0.7/0.7/0.6/0.9	0.0/0.0/0.0/0.0	1.2/1.2/1.1/1.3	1.6/1.5/1.7/1.2	1.5/1.2/1.7/0.0
It20	–	–	–	–	–	1.7/1.8/1.7/2.1	1.0/1.5/1.0/2.0	1.3/1.3/1.3/1.3	0.4/0.4/0.4/0.1	−0.9/−1.0/−0.8/−1.2
It21	–	–	–	–	–	2.2/2.1/2.2/1.9	2.0/2.0/2.0/2.0	1.2/1.2/1.2/1.3	−0.4/−0.2/−0.3/0.0	−0.9/−1.0/−0.9/−1.1
It22	–	–	–	–	–	0.5/0.6/0.5/0.8	0.0/0.0/0.0/0.0	1.0/1.0/1.0/1.2	1.9/1.8/2.0/1.3	3.1/2.6/3.5/0.7
It23	–	–	–	–	–	2.2/2.2/2.2/2.1	2.0/3.0/3.0/2.0	1.3/1.3/1.3/1.3	−0.3/−0.3/−0.3/−0.1	−1.1/-1.0/−1.0/−1.2
It24	–	–	–	–	–	1.7/1.7/1.7/1.5	2.0/2.0/2.0/1.0	1.2/1.1/1.2/1.2	0.0/0.0/0.0/0.2	−1.0/−1.0/−1.0/−1.0

Table 3. Fit of the factorial model of the Orofacial Esthetic Scale (OES-Fi) and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-Fi) applied to different subsamples (Test, Validation, General Population and Dental Patient).

		CFA[a]									
Sample/subsample	*n*	CFI	TLI	RMSEA	SRMR	λ	$r_{e1\text{-}e2}$	r^2	β	α	AVE[d]
OES-Fi[e]											
Test Sample	1820	0.95	0.92	0.129	0.044	0.54–0.89	0.59	–	–	0.89[b]	0.54
Validation Sample	1816	0.95	0.92	0.129	0.042	0.52–0.89	0.63	–	–	0.89[b]	0.55
General Population	3038	0.95	0.92	0.126	0.042	0.52–0.89	0.61	–	–	0.88[b]	0.54
Dental Patient	598	0.94	0.90	0.142	0.045	0.56–0.89	0.62	–	–	0.89[b]	0.56
PIDAQ-Fi, first order											
Test Sample[f]	1820	0.97	0.96	0.093	0.050	0.64–0.96	–	0.60–0.85	–	0.88–0.93[c]	0.67–0.80
Validation Sample[f]	1816	0.97	0.96	0.096	0.050	0.64–0.94	–	0.65–0.87	–	0.87–0.94[c]	0.65–0.82
General Population[f]	3038	0.97	0.96	0.094	0.049	0.64–0.95	–	0.41–0.86	–	0.88–0.93[c]	0.66–0.81
Dental Patient[g]	598	0.96	0.95	0.095	0.065	0.60–0.95	–	0.53–0.83	–	0.91–0.94[c]	0.67–0.80
Dental Patient[f]	598	0.97	0.96	0.101	0.057	0.61–0.95	–	0.49–0.87	–	0.86–0.94[c]	0.63–0.81
PIDAQ-Fi, second order							–				
Test Sample[f]	1820	0.97	0.96	0.093	0.052	0.64–0.96	–	–	0.85–0.95	0.88–0.93[c]	0.67–0.80
Validation Sample[f]	1816	0.97	0.96	0.095	0.052	0.64–0.94	–	–	0.87–0.96	0.87–0.94[c]	0.65–0.82
General Population[f]	3038	0.97	0.96	0.094	0.051	0.64–0.94	–	–	0.76–0.95	0.88–0.93[c]	0.66–0.81
Dental Patient[g]	598	0.96	0.95	0.097	0.070	0.60–0.95	–	–	0.84–0.97	0.91–0.94[c]	0.67–0.80
Dental Patient[f]	598	0.97	0.96	0.101	0.060	0.61–0.95	–	–	0.87–0.97	0.86–0.94[c]	0.63–0.81

[a]CFA: confirmatory factor analysis, CFI: comparative fit index, TLI: Tucker-Lewis index, RMSEA: root mean square error of approximation, SRMR: standardised root mean square residual, λ: factor loading, $r_{e1\text{-}e2}$: correlation between errors of item 1 and item 2; r^2: square correlation coefficient between the factors, β: absolute value of β estimate
[b]α: Cronbach's alpha coefficient
[c]α: ordinal alpha coefficient
[d]AVE: average variance extracted
[e]With correlation between errors of items 1 and 2
[f]Items 9, 13, 14, and 15 excluded due to the violation of the assumption of normal distribution of responses to items or to obtain configurational invariance between the subsamples
[g]Complete model

Table 4. Comparison of the factor scores of the Finnish version of the Orofacial Esthetic Scale (OES-Fi) and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ-Fi) between the General Population sample ($n = 3038$) and the Dental Patient sample ($n = 598$).

				95% confidence interval		Levene's test		*t*-test	
Factor	Sample	Mean	SD[a]	Lower limit	Upper limit	*F*	*p* Value	*t*	*p* Value
OES-Fi									
Orofacial Appearance	General Population	7.06	1.54	7.01	7.12	23.620	<.001	4.345[b]	<.001
	Dental Patient	6.73	1.76	6.58	6.87				
PIDAQ-Fi									
Dental Self-Confidence	General Population	1.99	1.01	1.95	2.02	1.468	.226	5.112	<.001
	Dental Patient	1.75	1.06	1.67	1.84				
Social Impact[c]	General Population	0.52	0.77	0.50	0.55	60.974	<.001	6.899[b]	<.001
	Dental Patient	0.80	0.94	0.73	0.88				
Psychological Impact	General Population	0.82	0.82	0.79	0.85	44.290	<.001	7.186[b]	<.001
	Dental Patient	1.13	0.96	1.05	1.20				
Aesthetic Concern	General Population	0.65	0.91	0.62	0.69	43.148	<.001	5.507[b]	<.001
	Dental Patient	0.91	1.07	0.83	1.00				

[a]Standard deviation.
[b]Welch's *t*-test.
[c]The mean scores were calculated from the items that belong to this factor (excluding items 9, 13, 14 and 15) in the factorial model with configurational invariance between the samples.

period in which the data were collected. Regarding the sample, in recent years, the Finnish population has shown loneliness [41] and an increase in social isolation [42]. Regarding data collection, it was conducted during the Sars-CoV-2 pandemic period, which required social distancing measures to control the spread of the virus. Thus, since psychometric sensitivity is an assumption and their retention in the factorial model could cause a bias in the results, these items were not included in the subsequent analyses. However, it should be noted that these items must be considered and carefully analyzed in future studies that apply PIDAQ-Fi to new samples.

When estimating the psychometric properties of OES-Fi, the one-factor model was confirmed, as observed in other versions of this instrument [8,12,18,22]. However, it was necessary to insert a correlation between the errors of items 1 and 2 to fit the model to the data. The suggestion and need to insert the correlation between the errors of these items has already been previously reported in studies that used other versions of OES in the general population [12,22]. It could be speculated that the specification and distinction of the facial profile in relation to the face as a whole is difficult in samples of general populations, since the own facial profile view is not usual. Even so, it is important to have a specific item for this, because, in addition to a facial profile being a feature of therapeutic goal of some dental treatments (such as orthodontics and orthognathic surgery), it becomes possible to identify individuals who are dissatisfied with their facial profile, and provides relevant information for the elaboration of an individualized treatment plan [43].

Regarding the PIDAQ-Fi, the results that fit the factorial model to the data confirm the four-factor structure of PIDAQ, corroborating the findings when PIDAQ is applied to other samples and contexts [11,24–26]. In addition, a high correlation was observed in the present study between three factors of PIDAQ, which compromised the discriminant validity and, considering the theory of the instrument, provides support for the elaboration of a second-order hierarchical model (SOHM). The SOHM showed an adequate fit to the data, as has already been observed in a Brazilian sample [26]. These authors suggested that, after confirming the SOHM, it is possible to obtain a general score for the psychosocial impact of dental aesthetics, in addition to the scores for each first factor. We emphasize that the Dental Self-Confidence factor is positive, while the other factors are negative, i.e. they have a different direction of response scale. Thus, the value of responses given to the Dental Self-Confidence factor should be reversed if the reader wishes to calculate a general score for this instrument.

As observed in this study, the measurement invariance of a factorial model in independent samples is evidence of the maintenance of the model, which is important for supporting the use of the instrument in similar samples. Nevertheless, the invariance between know-groups, such as General Population versus Dental Patient, shows that each instrument operates similarly in these samples, allowing comparison of the factor scores between them. In addition to this invariance, the present study also found that the instruments are able to discriminate between these groups. Dental patients had lower OES-Fi and Dental Self-Confidence factor (PIDAQ-Fi) scores and higher scores for the other factors of PIDAQ-Fi, which represent the greater psychosocial impact of dental aesthetics. This is in accordance with results in the literature [12,17,18] that suggest that this difference is because dental patients already have a degree of dissatisfaction with some aspects of oral health and because they are more aware of the orofacial region, which could increase its impact on their lives.

The data collection strategy and the convenience sample design can be cited as a limitation of this study. Data collection was carried out online. Members of two different universities were invited to participate in the study, following by a snowball strategy. This provided a higher number of participants who are university students and academic staff. Although this sample may not be a real representation of the Finnish population, it should be mentioned that the academic community plays an important role in society, with one of its attributes being the formation and dissemination of ideas and values [44]. Thus, knowledge of the perception of the orofacial appearance of these individuals could help identify the values that are disseminated about this perception. Regarding the convenience sample, it should be noted that this design is usually used in studies that evaluate the psychometric properties of an instrument [12,22,33]. In an attempt to minimize this limitation, we obtained a large sample and estimated the measurement invariance of the models in independent samples, which evidenced the external validity of the results.

Despite the limitations, the present study provides the Finnish version of two instruments for standardized measurement of orofacial appearance and its impact on an individual's life and evidence of their use in different contexts. Thus, it is expected to contribute to both clinical practice and research. In clinical practice, the dentist will have more information to be able to develop a patient-centered treatment plan. In research setting, the standardized method of measurement allows the investigation of the influence of factors in this perception by comparing different samples, contexts and countries.

Conclusion

The data obtained using OES-Fi and PIDAQ-Fi were valid and reliable. Thus, these instruments could be useful for evaluating satisfaction with orofacial appearance and the psychosocial impact of dental aesthetics in a clinical or research context.

Disclosure statement

The authors report no conflict of interest.

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PUBLICATION III

Self-perception of orofacial appearance: Brazil-Finland cross-national study

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ORIGINAL ARTICLE

Self-perception of orofacial appearance: Brazil–Finland cross-national study

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ABSTRACT

Objective: (i) To study the measurement invariance of Orofacial Esthetic Scale (OES) and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ), (ii) to compare the perception of orofacial appearance (OA) and (iii) to study the frequency of individuals who have sought or received aesthetic dental treatment between Brazil and Finland.

Methods: This was a cross-sectional observational study with snowball non-probability sample selection. Students and staff from universities in Finland and Brazil were invited to participate. Data were collected online using a demographic questionnaire, OES and PIDAQ. The samples consisted of 3636 Finns (75.0% female; age: 32.0 years) and 1468 Brazilians (72.6% female; age: 33.2 years). The frequency of receiving aesthetic dental treatment was estimated. If configurational invariance was observed, cross-national measurement invariance was verified by multigroup analysis. When measurement invariance was attested, factor scores were compared using Welch's t-test.

Results: OES showed configurational and measurement invariance and no significant difference between the countries. Despite similarity in satisfaction with OA, 71.9% of Brazilians had received aesthetic dental treatment, while 59.4% of Finns had never sought such treatments. PIDAQ did not present configurational invariance between the countries.

Conclusion: Although there is no difference in satisfaction with OA, seeking and receiving aesthetic dental treatment is significantly greater for Brazilians. Psychosocial impact of OA is perceived differently in the studied countries.

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Introduction

Appearance and function of the orofacial components have a great influence on an individual's life. Facial expressions enable one to communicate even/also non-verbally and express feelings [1,2]. Personal assessment and social contexts support the construction of the concept of orofacial appearance (OA) by the individual. OA is important not only for individuals to construct their identity but also for their social interaction and insertion [3–6], which has led to an increase in concern related to OA. This is reflected in the increase in demand for aesthetic treatments in recent years [7], which occurs both in the desire to improve a physical aspect and also in relation to expectations involving emotional and psychosocial aspects [1,7,8]. Thus, if the health professional performing an aesthetic treatment wishes to develop a proper patient-centred treatment plan, it is important to understand and evaluate more broadly a patient's perception and expectations of OA and what leads them to seek this treatment.

Understanding the perception of OA is complex, since individual idiosyncratic behaviours, constructed from individual experiences and life in a specific culture, contribute to the formation of this perception [9]. Despite variability in perception of OA explained by idiosyncratic differences, some characteristics seem to be shared [9]. These can be individual or cultural characteristics [7,10–12]. Regarding individual characteristics, Campos et al. [10] observed that dental patients who have received aesthetic dental treatment and therefore like their own smile, dental appearance seems to have a lower psychosocial impact on their lives. Regarding cultural factors, it is a common thought that physical aspects (body and orofacial appearance) are perceived differently in

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different cultures (culture-specific theory) [7], but some authors have observed agreement in the perception of traits (cross-cultural coherence theory) [11,12]. Therefore, studies that compare OA in countries with different cultures may be relevant for a better understanding of this perception.

Because perception of OA cannot be measured directly (latent variable), psychometric instruments are used. Two instruments for standardized measurement of OA are the Orofacial Esthetic Scale (OES) [13] (Supplemental File 1) that assesses satisfaction with OA and the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) [14] (Supplemental File 1) that assesses psychosocial impact of the appearance of teeth on an individual's life. Although the OES and PIDAQ were developed for prosthodontic patients and young orthodontic patients, respectively [13,14], previous studies have attested to adequate psychometric properties of these instruments when applied to different sample settings, including the general population [10,15–24]. In addition, a previous study [16] and a previous analysis (Supplemental File 2) found strong correlation between OES factor and PIDAQ factors. Thus, since the constructs evaluated in OES and PIDAQ are distinct and present high correlation, it becomes interesting the simultaneous application of OES and PIDAQ to explore the perception of OA more deeply.

When using the instruments for cross-national comparisons, the validity and reliability of the data should be firstly analysed [25]. Then, a study should be done to determine whether the used instruments operate similarly between countries (measurement invariance) [25]. It should be mentioned that this analysis is mandatory to ensure that scores obtained in different populations using psychometric instruments can be interpreted in the same way and therefore direct comparisons are allowed [26]. If the measurement invariance is not performed or the non-invariance between different populations is observed, the results of comparisons may lead to erroneous conclusions. This may occur because the latent phenomenon may differ between populations, making scores not comparable [26].

To the best of our knowledge, no previous studies compared the perception of OA using a standardized method and preserving the latent nature of this variable between countries with different cultures. Thus, the present study was conducted to build evidence about the influence of culture on the perception of OA. Information related to receiving aesthetic dental treatment in different countries was also collected. It is noteworthy that this type of treatment involves, in addition to improving the physical aspect, social and behavioural aspects [27]. To study receiving aesthetic dental treatment together with the perception of OA can produce knowledge about the real demands and expectations of individuals from different cultures who seek aesthetic dental treatment.

The aims of this study were (i) to study the measurement invariance of the OES and the PIDAQ, (ii) to compare the satisfaction with OA and the psychosocial impact of dental aesthetics and (iii) to study the frequency of individuals who have sought or received any aesthetic dental treatment between Brazil and Finland. It was hypothesized that comparison between Brazil and Finland, countries with geographical differences and cultural discrepancies, would result in a difference in perception of OA as suggested in culture-specific theory [7].

Methods

Study design and sampling

This is a cross-sectional study with non-probability snowball sample selection. Initially, students over the age of 18 years and staff from two universities in Finland (Tampere University and University of Oulu) and from five public universities in the São Paulo State, Brazil (UNESP, USP, UNICAMP, UNIFESP and UFSCAR) were invited by email to participate in the study. Then, a snowball strategy sampling was used to expand the samples. For this purpose, participants were asked to forward the survey link to their personal contacts. The researchers provided guidance for distributing the link *via* email or social media. The convenience and snowball sampling strategies were chosen since data collection took place during the Covid-19 pandemic, which would not make another sampling strategy feasible that would meet the aims of the present study.

The minimum sample size was calculated following the proposal of Hair et al. [28], who recommend a minimum of 10 participants per parameter of a factorial model to be tested. The largest factorial model to be tested is the first-order factorial model of PIDAQ, which has 54 parameters (24 items + 24 errors + 6 correlations). Therefore, the minimum sample size required for each country is 540 individuals. A higher number of participants was recruited to increase the variability and the representativeness of the data for the study populations.

Information on sex, age, monthly income, whether the individual is currently a dental patient, likes their own smile, anything bothers them about her/his smile and whether the individual has sought or received any aesthetic dental treatment was collected. The frequencies were estimated with a 95% confidence interval and comparisons between countries were performed using the z test ($\alpha = 5\%$). The satisfaction with orofacial appearance and the psychosocial impact of dental aesthetics were studied by the OES [13,15,16] and the PIDAQ [14,16,29], respectively.

Procedures and ethical aspects

Data collection was carried out online between 16 June and 30 July 2020. The invitation email contained information regarding the aims of the study and a link to the online questionnaire, which was created with the LimeSurvey software (LimeSurvey GmbH, Hamburg, Germany; URL http://www.limesurvey.org) on the server of Tampere University, Finland. To start the questionnaire, the participant gave informed consent. The demographic questions, including dental information, were initially presented followed by OES and PIDAQ in random order. Responses to OES and PIDAQ items was mandatory.

In Finland, approval for data collection was obtained from the Data Protection Officer of Tampere University, in accordance with the European Union's General Data Protection Regulation. The approval was included in the invitation message. In Brazil, the study was approved by the Research Ethics Committee of São Paulo State University (Unesp), School of Dentistry, Araraquara (CAAE: 88600318.3.0000.5416).

Measurement instruments

The OES is a one-factor scale containing seven items rated in a 11-point numeric scale (from 0: very dissatisfied to 10: very satisfied) [13]. An eighth item, which is not considered in the factorial model, is also present on the scale and evaluates the satisfaction with the overall orofacial appearance (Supplemental File 1). The Finnish (OES-Fi) and Portuguese (OES-Pt) versions of the OES were used [15,16].

The PIDAQ was originally developed with 23 items distributed into four factors (dental self-confidence, social impact, psychological impact, aesthetic concern) [14]. Responses were given in a five-point Likert-type scale (0: I do not agree, 1: I agree a little, 2: I somewhat agree, 3: I strongly agree and 4: I agree very strongly). The Finnish (PIDAQ-Fi) and Portuguese (PIDAQ-Pt) versions were used [16,29]. In both versions, the 24th item, which considers the colour of the teeth, was included in the dental self-confidence factor (Supplemental File 1) [10,16].

Data validity and reliability

To certify that the data obtained at present study is valid and reliable, a previous study [16] verified the fit of the factorial models of OES-Fi and PIDAQ-Fi for the data of the Finnish sample using Confirmatory Factor Analysis. Although previous studies have attested the psychometrics properties of the Portuguese versions of OES [15] and PIDAQ [10], the present study used a different sample setting and method of administering the instruments (paper-pencil vs. digital online). This may affect the way that the participants answer the items and how the instruments capture the proposed concept [30]. Therefore, the fit of the factorial models for the Brazilian sample was verified. The results are shown in Supplemental File 2.

Cross-national measurement invariance and comparison of factor scores

The configurational, metric and scalar invariances were evaluated to verify if the performance of the measuring instruments is the same between the Brazilian and Finnish samples. When configurational invariance of the factor model was observed between countries, cross-national measurement invariance was verified by multigroup analysis using the CFI difference for factor loadings (ΔCFI_λ), intercept (ΔCFI_i) and residuals (ΔCFI_{res}) [31]. Values of $|\Delta CFI|$ lower than 0.01 were indicative of measurement invariance. It is worth clarifying that cross-national invariance is necessary to compare the mean scores between countries. Thus, if configurational or measurement invariance was not observed, direct comparisons between the countries is limited. The analyses were performed using the 'lavaan' [32] and 'semTools' [33] packages of the R program (R Core Team, 2016).

When configurational and measurement invariance of the instruments were observed between countries, the factor scores were calculated for each country from the mean of the responses to the items. Homoscedasticity of the factor scores in different countries was evaluated by the Levene's test. If homoscedasticity was observed, the factor scores were compared using t-test with equal variances. Otherwise, the comparison was performed using Welch's t-test. The significance level adopted was 5%. The analyses were performed using IBM SPSS Statistics 22 (IBM Corp., Armonk, NY, USA).

Responses to OES and PIDAQ items

The mean scores to the items were calculated for the subgroups obtained from the crossing of the following variables: country (1 = Finland, 2 = Brazil), whether the individual has received any aesthetic dental treatment (0 = no, 1 = yes), whether the individuals like their own smile (0 = no, 1 = yes) and whether something bothers the individuals about their smile (0 = no, 1 = yes). The interaction of these variables was evaluated using a hierarchical log-linear analysis with backward elimination and Poisson's probability model [34]. The significance of the log-linear models was assessed using G^2 and χ^2_P statistics adopting a significance level of 5%. The mean responses to the OES and PIDAQ items according to the subgroups were plotted on a radar chart. The analyses were performed using IBM SPSS Statistics 22 (IBM Corp., Armonk, NY, USA), Microsoft® Excel for Mac (v.16).

Results

A total of 5104 individuals participated in the study. The mean age in the Finnish sample ($n = 3636$) was 32.0 (95%CI: 31.6–32.3) years and in the Brazilian sample ($n = 1468$) 33.2 (95%CI: 32.5–33.9) years. The characteristics of the participants according to the country is shown in Table 1. In both samples, the majority of the participants were female, reported not being currently under any dental care, liked their own smile and reported that some specific aspect of their smile bothers them. Regarding aesthetic dental treatment, the difference between the countries was observed, with the majority of the Brazilian participants reporting having received this treatment, while the majority of Finns reported never having sought or received such a treatment.

Cross-national measurement invariance and comparison of factor scores

The OES showed configurational and measurement invariance between the countries ($\Delta CFI_\lambda = -0.002$, $\Delta CFI_i = -0.004$, $\Delta CFI_{res} = -0.013$). For the Finnish sample, the OES

Table 1. Participants' characteristics (% (95% confidence interval = 95%CI)).

Characteristic	Sample (% (95%CI))		z test[a]
	Finnish ($n = 3636$)	Brazilian ($n = 1468$)	p value
Sex			
Female	75.0 (73.6–76.4)	72.6 (70.3–74.9)	.128
Male	23.4 (22.0–24.8)	27.1 (24.8–29.4)	.157
Other/no response	1.6 (1.2–2.0)	0.3 (0.0–0.6)	.837
Marital status			
Single	66.5 (65.0–68.0)	62.3 (59.8–64.8)	.023
Married/common law stable relationship	28.8 (27.3–30.3)	32.9 (30.5–35.3)	.104
Divorced	4.5 (3.8–5.2)	4.0 (3.0–5.0)	.872
Widower	0.2 (0.1–0.3)	0.8 (0.3–1.3)	.860
Are you undergoing dental treatment?			
No	83.6 (82.4–84.8)	77.5 (75.4–79.6)	<.001
Yes	16.4 (15.2–17.6)	22.5 (20.4–24.6)	.022
Have you sought or received any aesthetic dental treatment?			
I have never sought aesthetic dental treatment	59.4 (57.8–61.0)	18.1 (16.1–20.1)	<.001
I have sought aesthetic dental treatment, but have not received it	2.2 (1.7–2.7)	10.0 (8.5-11.5)	.033
I have received or I am currently receiving aesthetic dental treatment	38.4 (36.8–40.0)	71.9 (69.6–74.2)	<.001
Do you like your smile?			
No	26.2 (24.8–27.6)	22.5 (20.4–24.6)	.182
Yes	73.8 (72.4–75.2)	77.5 (75.4–79.6)	.016
Does anything bother you about your smile?			
No	37.7 (36.1–39.3)	29.0 (26.7–31.3)	.001
Yes	62.3 (60.7–63.9)	71.0 (68.7–73.3)	<.001

[a]z test: to compare prevalence between Finnish and Brazilian samples.

Table 2. Distribution of the participants according to country, if individual has received aesthetic dental treatment, if the individual likes their smile and whether something bothers the individual about her/his smile.

Liking own smile	Something bothers about smile	Finland		Brazil		Total
		Aesthetic dental treatment		Aesthetic dental treatment		
		No	Yes	No	Yes	
No	No	48	21	2	1	72
	Yes	528	350	106	221	1205
Yes	No	819	470	126	296	1711
	Yes	826	546	176	535	2083
	Total	2221	1387	410	1053	5071

mean score was 7.01 (standard deviation = 1.58) and for Brazil was 7.05 (standard deviation = 1.69), which points to positive valence of satisfaction with OA in both countries. The data for each country presented non-severe violation of normal distribution ($|sk|<0.81$ and $|ku|<0.57$) and heteroscedasticity between the countries was observed (Levene's test: $F = 7.60$, $p = .006$). No statistically significant difference was observed between countries (Welch's t-test: $t = -0.85$, $p = .40$). Despite this result, it is worth noting the significant difference observed in the frequency of seeking and receiving aesthetic dental treatment between countries.

The PIDAQ factorial model did not present configurational invariance between Finnish and Brazilian samples (PIDAQ-Fi: exclusion of items 9, 13, 14 and 15; PIDAQ-Pt: exclusion of item 6). Therefore, cross-national measurement invariance and comparisons of factor scores have not been performed for this instrument.

Responses to OES and PIDAQ items

Table 2 presents the distribution of the participants according to country, whether the individual has received any aesthetic dental treatment, like their own smile and anything bothers the individuals about their smile. According to the hierarchical log-linear modelling, a statistically significant association was observed between the variables ($G^2(3) = 2.42$, $p = .490$; $\chi^2 p(6) = 2.46$, $p = .484$). The most parsimonious model to describe the distribution of the observed data presents the following interactions: aesthetic dental treatment and something bothers the individual about their smile; country, aesthetic dental treatment and liking own smile and country, liking own smile and something bothers the individual about their smile. The parameter estimates of the final log-linear model are shown in Table 3. Therefore, the interaction between these variables was considered for subsequent analyses.

The frequency of individuals in the four groups that simultaneously reported not liking their own smile and that nothing bothers them about their smile (Table 2, first line) is extremely lower than the other groups. For this reason, their mean responses were not considered in the following plot. Figure 1 shows the radar plot for mean scores to OES and PIDAQ items according to the groups established by the variables presented in Table 3. Three clusters can be noticed, which clusters are not related to different countries. In addition, whether the individuals have received any aesthetic dental treatment was also not related to the clusters. Whether the individuals like their own smile and whether they are bothered by something about their own smile were the variables for clustering. Individuals who like their own

Table 3. Estimates of the parameters of the final log-linear model considering the interactions between country, if individual has received aesthetic dental treatment, if the individual likes their smile and whether something bothers the individual about her/his smile.

Parameter[a]	Estimate	Standard error	95% CI	z	*p*
Constant	6.28	0.04	6.19–6.36	150.50	<.001
[Country = 1]	0.04	0.06	−0.07–0.15	0.73	.465
[Treatment = 0]	−1.08	0.07	−1.23–−0.94	−15.03	<.001
[Like smile = 0]	−0.88	0.08	−1.04–−0.73	−11.14	<.001
[Something bothers in smile = 0]	−0.573	0.06	−0.70–−0.45	−8.93	<.001
[Treatment = 0]*[Something bothers about smile = 0]	0.19	0.07	0.06–0.32	2.85	.004
[Country = 1]*[Treatment = 0]*[Like smile = 0]	1.92	0.13	1.68–2.18	15.08	<.001
[Country = 1]*[Treatment = 0]*[Like smile = 1]	1.48	0.08	1.32–1.63	18.82	<.001
Country = 1]*[Treatment = 1]*[Like smile = 0]	0.41	0.10	0.21–0.613	4.06	<.001
[Country = 2]*[Treatment = 0]*[Like smile = 0]	0.36	0.14	0.09–0.63	2.64	.008
[Country = 1]*[Like smile = 0]* [Something bothers about smile = 0]	−2.09	0.14	−2.37–−1.81	−14.76	<.001
Country = 1]*[Like smile = 1]* [Something bothers about smile = 0]	0.39	0.08	0.24–0.54	5.15	<.001
Country = 2]*[Like smile = 0]* [Something bothers about smile = 0]	−4.18	0.58	−5.33–−3.04	−7.17	<.001

[a]Parameters with redundant estimates (sum of parameters is null) have been eliminated to simplify the presentation. Reference values: country: 1 = Finland, 2 = Brazil; treatment (whether individual has received any aesthetic dental treatment): 0 = no, 1 = yes; like smile (whether the individuals like their own smile): 0 = no, 1 = yes; and something bothers about smile (whether something bothers the individuals in their smile): 0 = no, 1 = yes.

smile and who reported that nothing bothers them about their smile (continuous lines) presented numerical values of the means related to a lower psychosocial impact of dental aesthetics and a greater satisfaction with their facial appearance. The opposite was observed for individuals who do not like their own smile and who reported that something bothers them about their smile (dotted lines). The third cluster, composed of individuals who like their smile but something bothers them about their smile (dashed lines), presented intermediate values in relation to the other two clusters.

In Figure 1, patterns of responses to the items in each factor can be observed. For OES, the cluster with individuals who do not like their own smile and who reported that something bothers them in their smile (dotted line) showed a higher mean value in item 7 ('gum's appearance') in relation to the other items. For the other two clusters, the mean response to items forms a figure that resembles an octagon, with no apparent discrepancy between them.

For PIDAQ factors, all clusters showed lower mean values in items 17 ('My teeth are attractive to others') and 24 ('I find my teeth colour to be very nice') in the dental self-confidence factor and higher value in items 3 ('I envy the nice teeth of other people') and 20 ('I wish my teeth looked better') in the Psychological Impact factor. The cluster with individuals who do not like their own smile and who reported that something bothers them about their smile (dotted line) presented lower mean values in items 13, 14 and 15 ('Sometimes I think people are staring at my teeth', 'I am somewhat inhibited in social contacts because of my teeth' and 'I sometimes catch myself holding my hand in front of my mouth to hide my teeth') from the social impact factor and in item 6 ('I am somewhat distressed when I see other people's teeth') from the psychological impact factor.

In general, there was a low psychosocial impact related to dental aesthetics in the lives of individuals (mean (standard deviation)) of PIDAQ factor scores: Brazil – dental self-confidence = 1.93 (1.04), social impact = 0.56 (0.78), psychological impact = 1.06 (0.99) and aesthetic concern = 0.82 (0.99); Finland – dental self-confidence = 1.95 (1.02), social impact = 0.57 (0.81), psychological impact = 0.87 (0.85) and aesthetic concern = 0.69 (0.90)). However, as stated above, it is emphasized that the PIDAQ scores cannot be directly compared, since the operationalization of the concept is different between the countries.

Discussion

This cross-national study aimed to study the measurement invariance of the OES and PIDAQ factorial model. Furthermore, it aimed to compare the satisfaction with OA, the psychosocial impact of dental aesthetics and the frequency of individuals who have sought or received any aesthetic dental treatment between Brazilian and Finnish adults. This study emerged since OA has shown greater importance within dentistry, where the demand for treatments that improve OA has increased [7]. The identification of factors involved both in the perception of OA and in the demand for aesthetic dental treatment can assist the professional in the elaboration of a treatment that targets not only what the patients desire but also what they really need [6]. Thus, verifying the influence of culture on these aspects, by comparing countries with different characteristics, becomes relevant.

The OES presented measurement invariance and no statistically significant difference in mean scores between the countries, rejecting the hypothesis that the satisfaction with OA is different between Finland and Brazil. So, while there may be different beauty standards related to physical traits, the results support the cross-cultural coherence theory [11,12], which maintains that there is an agreement on the perception of specific aesthetic trait between different countries and cultures. Despite this, Brazilians had a higher frequency of individuals who had received any aesthetic dental treatment compared to Finns. It can be suggested that a cultural identity may be related to the value attributed to aesthetic dental treatment. Therefore, even though an aesthetic treatment aims to improve a physical aspect, it can also involve commercial behaviours, resulting in consumption habits and social prestige [27]. In addition, the latter are evident in countries with high social discrepancy, such as Brazil, which may explain the difference between countries. The idea that aesthetic treatment has also a consumerism component is supported by the result that having an aesthetic dental treatment had no influence on responses to the items

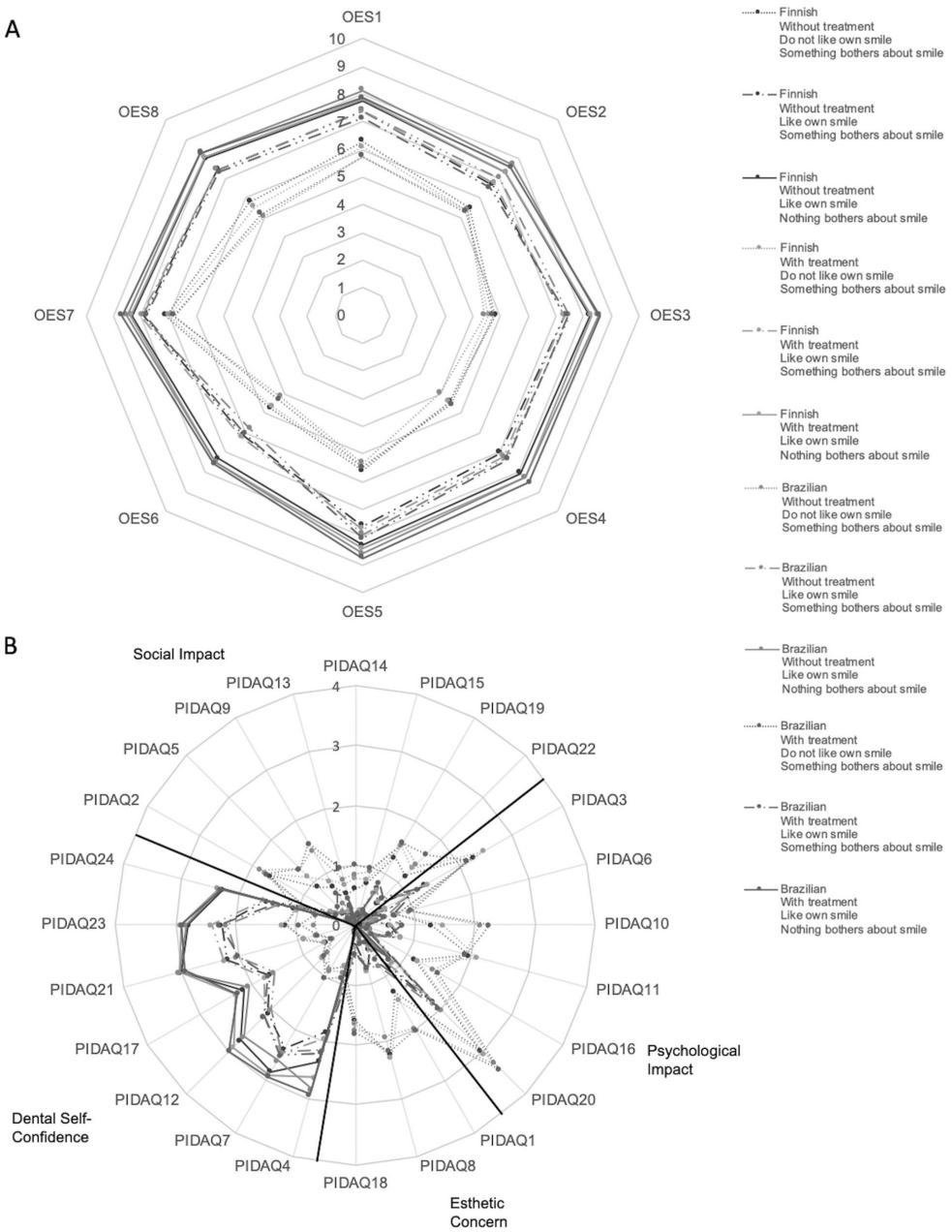

Figure 1. Mean scores given to the items of the Orofacial Aesthetic Questionnaire (OES) (A) and Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) (B) according to the interaction between the country, whether an individual has received any aesthetic dental treatment, whether the individuals like their own smile and whether something bothers the individuals about their smile.

of OES and PIDAQ. Thus, further investigations on the values of the aesthetic dental treatment in different social classes and cultures may be relevant.

Regarding the PIDAQ, configurational invariance was not observed. This finding shows that psychosocial impact of dental aesthetics is assessed differently in Brazil and Finland and points to a difference in how individuals perceive this impact on their lives. This could be because of the different social and cultural context between Brazil and Finland, in which physical aspects, including orofacial components, can

have different meanings in social interactions and ways of expressing the body for society. Thus, unlike the concept of satisfaction with OA, the hypothesis of cultural differences (culture-specific theory) [7] can be accepted for the psychosocial impact of dental aesthetics.

Responses to the OES and PIDAQ items were found to be influenced whether the individual did not like his/her own smile and whether the individual was bothered by any specific physical aspect. Therefore, if the dentist aims to elaborate on a patient-centred treatment plan considering the concepts of the OES and PIDAQ, it is relevant to establish a dentist-patient relationship with good communication [35]. Thereby, the dentist will be able to identify the patient's concerns related to physical aspects of their smile and assess the risk-benefit of an aesthetic treatment. In addition, with the establishment of open dialogue, the dentist can instigate changes in the patient so that they can take pleasure in seeing their appearance. It is also noteworthy that some patients may present symptoms or disorders, such as body dysmorphic disorder or anxiety, and neither an aesthetic treatment nor a dentist-patient dialogue sufficiently satisfy the patient or reduce the psychosocial impact of OA in their life [36]. It is important for the dentist to be able to suspect or identify such cases and verify how many previous aesthetic procedures the patient has had and deciding to refer the patient to a professional (such as psychologist or psychiatrist) who can properly assess and treat their emotional and mental status [36].

Analysing the responses to the PIDAQ items, all clusters showed a lower mean for items 13, 14 and 15 than the other items of the same factor (social impact factor). These items have content related to characteristics of social interaction. The low means may be related to the period of data collection that was performed in both countries during the Sars-Cov-2 pandemic and period of social isolation to control the spread of the virus. The difference in the pattern of responses in item 17 ('My teeth are attractive to others') of the dental self-confidence factor should be investigated since it is the only item in this factor that corresponds to external judgement. Two aspects can be considered to justify this difference: the individuals did not consider external judgement important or, conversely, the individuals' answers were low values in this item because they may be more sensitive to the way others view their appearance. However, it is not possible to speculate about this since additional information would be needed. The same aspects can be considered to explain the difference in item 24 ('I find my teeth colour to be very nice') since the colour of teeth is the main component of the smile in external evaluation. The high responses in item 20 ('I wish my teeth looked better') deserves attention since the excess of desire to improve appearance may be related to some symptoms or disorders (as previously discussed) and signs of addiction to aesthetic treatment [36]. Health professionals are responsible for verifying how many previous aesthetic procedures the patient has had and deciding to refer the patient to a professional who can properly assess and treat their emotional and mental status [36].

The convenience sample design was a limitation of the study, which may affect the generalizability of the results for the whole population in the countries. However, it should be noted that the measurement invariance of the OES and PIDAQ was observed between independent samples from both countries [10,15,16], supporting the stability of validity of the results obtained by these instruments. In addition, we sought to obtain a large sample in both countries in an attempt to obtain the results more comprehensive and to approximate to population variability. Online data collection can also be considered a limitation, especially in Brazil, since generally people who have access to the internet have a higher level of education and are at a higher socioeconomic level. As noted by Alhajj et al. [37], individuals with these characteristics tend to be more concerned with oral health, have greater access to treatments and better hygiene conditions, which leads to greater satisfaction with OA. Thus, the online data collection can hinder the generalization of the results for the whole population. It is noteworthy that data collection occurred during the pandemic and social isolation; therefore, the online data collection was a feasible strategy for that. Furthermore, the impossibility of comparing the results of this study with those of previous studies that used OES and PIDAQ in different countries is highlighted. This is due to methodological differences applied in the studies (e.g. score calculation, response scale, number of items) and, mainly, due to the impossibility of evaluating the measurement invariance between populations. The measurement invariance is a way of attesting that the latent phenomenon assessed by the psychometric instrument is similar between different populations, and therefore, scores can be directly compared [25,26]. Thus, we recommend that researchers join efforts to conduct cross-national studies following the recommendations for appropriate measurement invariance procedures in order to unveil cultural factors involved in the perception of OA.

Despite its limitations, this cross-national study provides evidence on the perceptions of OA in countries with large cultural differences, paving the way for a discussion about the values of aesthetic treatments in different cultures. It is also expected to contribute with dentists in Finland and Brazil so that they can use the OES and PIDAQ in clinical practice. Based on the mean scores of the general population provided by the study, they will be able to identify information related to the importance that OA has in their patients' lives and then to develop a patient-centred treatment plan. In addition, the study provides subsidies for dentists who practice aesthetic treatment to reflect on their social role as health professionals. This reflection extends to dentists around the world, since body aesthetics, including OA, can be considered a form of capital (aesthetic capital) [38].

Conclusion

There was no difference in satisfaction with OA between Brazil and Finland. Despite this, seeking and receiving aesthetic dental treatment is significantly greater for Brazilians

than Finns. In addition, although participants from both countries responded similarly to OES and PIDAQ items, the psychosocial impact of OA is perceived differently between them. It points to a cultural influence on the perception of this impact.

Disclosure statement

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PUBLICATION IV

Aesthetic dental treatment, orofacial appearance, and life satisfaction of Finnish and Brazilian adults

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RESEARCH ARTICLE

Aesthetic dental treatment, orofacial appearance, and life satisfaction of Finnish and Brazilian adults

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Abstract

Aims

To study the probability of seeking/undergoing aesthetic dental treatment (ADT) and compare self-perception of orofacial appearance (OA) based on sex, age, and monthly income; and to estimate the impact of OA on life satisfaction (LS) among Finnish and Brazilian adults, considering the indirect effect of receiving ADT and the moderating effects of those sociodemographic variables.

Methods

This was an online cross-sectional study. Orofacial Esthetic Scale (OES), Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) and Satisfaction with Life Scale (SWLS) were used. Probability of seeking/receiving ADT was calculated using logistic regression and odds ratio (OR). OA scores were compared according to sociodemographic characteristics (ANOVA, α = 5%). Structural equations models estimated the impact of OA on LS.

Results

3,614 Finns [75.1% female, 32.0 (SD = 11.6) years] and 3,979 Brazilians [69.9% female, 33.0 (SD = 11.3) years] participated in the study. Women were more likely to receive ADT than men in both countries (OR>1.3). However, no statistically or practical significant differences were observed in OA between sexes ($p>0.05$ or $p<0.05$, $\eta_p^2 = 0.00–0.02$). In Finland, demand for ADT (OR = 0.9–1.0) and OA scores ($p>0.05$) were the same among different ages and monthly income. In Brazil, younger individuals (OR>1.6) and those with higher monthly income (OR>2.7) were more likely to receive ADT, while those with lower income had a greater psychosocial impact of OA ($p<0.05$; $\eta_p^2>0.07$). Individuals who were more

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satisfied with their own OA and had less psychosocial impact from OA had higher levels of LS (β = 0.31–0.34; p<0.01; explained variance: 9.8–13.1%).

Conclusion

Demand for ADT is influenced by sociodemographic and cultural factors. Greater societal pressure on physical appearance is observed among women in Western countries. In countries with high socioeconomic inequalities, consumerism and social prestige are involved in this demand. Self-perception of orofacial appearance plays a significant role in individuals' subjective well-being. Therefore, the planning of aesthetic treatments in the orofacial region should consider the patient's perceptions and social context.

Introduction

Since ancient times, societies have valued physical appearance, which today remains to be an important characteristic that can affect various aspects of an individual's life [1, 2]. Orofacial appearance (teeth and face) is a notable feature of physical appearance and is strongly related to interpersonal relations [1]. This is because orofacial region plays a large role in the process of communication, identification, and self-identity construction [1, 3, 4]. From the orofacial appearance, impressions are also quickly formed regarding an individual's personality and moral and social characteristics [4, 5]. Despite their limited accuracy, these impressions have a place in social behavior and routine decision making, resulting in privileges or disadvantages based on orofacial appearance [5]. An individual who is aware of this can then adopt body-altering behaviors, aiming to obtain a good-looking appearance based on self-perception and socially established standards [1]. Undergoing aesthetic procedures [6], including aesthetic dental treatments, are among these behaviors.

With progress advancing in the field of aesthetic dental treatments, studies over the last two decades have stated a growing demand for these treatments [7–10]. Although this statement is widely recognized and reported in clinical dental practice, there are limited studies [9–12] that provide specific quantification of desire or demand for aesthetic dental treatments across different populations. Samorodnitzky-Naveh et al. [9] conducted a survey with 407 18-26-year-old dental patients in Israel, of whom 77.4% desired to improve their dental appearance. Wulfman et al. [10] found that 38.0% of French seniors sample (n = 3,868, age≥55 years) expressed a desire to change their smile, with women and younger part of the sample expressing a greater desire. In a study conducted on 31-year-old Brazilians (n = 536) in 2018, Silva et al. [11] found that 85.9% reported being interested in tooth whitening treatment.

This finding by Silva et al. [11] is similar to that by Campos et al. [12] in 2022, in which study 81.9% of a Brazilian general population sample (age≥18 years, n = 1,468) reported having sought aesthetic dental treatment. In the same study [12], a Finnish sample (n = 3,636, age ≥18 years) was also investigated: less than half (40.6%) reported having sought such a treatment. It seems that demand for aesthetic dental treatment is influenced by cultural [12] and sociodemographic factors [9, 10] such as sex, age, and economic level, and should be taken into account when the demand is scrutinized.

It is also important to consider that demand refers to a behavior adopted based on an individual's perspectives and perceptions. In dentistry, self-perception of orofacial appearance stands out [1, 12], being one of the main dimensions of oral health-related quality of life (OHRQoL) and can represent a reason why dental treatment is sought [13, 14]. Therefore,

including the self-perception of orofacial appearance in research on demand for aesthetic dental treatment is important. Because the dimensions of OHRQoL cannot be directly measured, the use of specific means, psychometric scales, are necessary [14, 15]. The Orofacial Esthetic Scale (OES) [15–17] and the Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) [15, 18, 19] are two scales that evaluate self-perception of orofacial appearance and have shown good indicators of validity and reliability in different populations.

Estimating the impact of the orofacial appearance dimension of OHRQoL on well-being of individuals with different cultural backgrounds is another important point to be considered. This information may be useful not only for advancing scientific evidence and contributing to the formation of professionals with a more holistic view of their patients [1], but also for fostering discussion about the social role of dentistry. Campos et al. [1] observed in a sample of Brazilian individuals aged 18 to 40 (n = 1,940) that orofacial appearance, measured by OES and PIDAQ, explained 9.9 to 14.3% of the variance in life satisfaction (cognitive aspect of subjective well-being). Although the orofacial appearance occupies a prominent space in an individual's life [1, 12–14], to the best of our knowledge no other studies have evaluated their direct contribution to subjective well-being in general populations, which would be relevant for the development of a patient-centered treatment plan [1].

Self-perception of orofacial appearance may vary according to different sociodemographic characteristics, such as sex, age, and socioeconomical level [16, 20, 21]. These characteristics may therefore also have an effect on how orofacial appearance impacts subjective well-being. Thus, it is relevant to investigate the differences in orofacial appearance according to sociodemographic characteristics and evaluate their moderating role on the relationship between orofacial appearance and well-being. Cultural and social values can also influence the role of these sociodemographic variables in the demand for aesthetic dental treatment and the perception of orofacial appearance, as well as its impact on well-being. Therefore, to identify coherences and specificities, it is worthwhile to extend this investigation to countries with significant sociocultural differences initially.

Finland and Brazil are examples of countries with such sociocultural discrepancies. Finland has one of the closest levels of gender equality [22], low inequality between different socioeconomic classes [23], and similar living conditions of its population. Brazil, on the other hand, has high inequality and different living conditions among different sociodemographic groups [22, 23], which affects access to health treatments, especially aesthetic dental treatment, since it is provided in the private sector. Moreover, the value attributed to physical appearance varies between these countries, with physical appearance carrying much more importance in social interactions and behaviors for Brazilians [12]. Thus, studying both countries simultaneously is a good starting point for cross-national comparisons.

The objectives of this study were 1. to study the probability of Finnish and Brazilian adults of seeking and undergoing aesthetic dental treatment according to sex, monthly income, and age, 2. to compare the self-perception of orofacial appearance in Finland and Brazil according to sex, monthly income, and age, and 3. to estimate the impact of self-perception of orofacial appearance on life satisfaction in Finnish and Brazilian adults, taking into consideration the indirect effect of receiving aesthetic dental treatment and the moderating effects of sex, monthly income, and age on this impact.

Methods

Study design and sampling

This was a cross-sectional study with snowball non-probability sample selection. Finnish and Brazilian individuals over the age of 18 years were invited to participate in the study. The

selection of Brazil and Finland for the study was based on their sociocultural differences, as well as the convenience of the researchers whose work is located in these countries. Initially the invitation was sent to students and staff from universities in Finland and Brazil. Then, snowball strategy was used to recruit more participants. Because the data were collected during the pandemic, this sampling strategy was the most feasible to address the aims of the study.

The minimum sample size was calculated following the proposal by Hair et al. [24], who recommend a minimum of 10 participants per parameter to be estimated in the structural model. In the present study, 28 parameters were considered a priori to be estimated in the model. Thus, the minimum sample size required for each country was 280 participants. However, a larger number of participants were recruited to increase the variability and coverage of the data for the study populations.

Demographic information was collected on sex (male, female, or other/not informed), age, marital status (single, married/common law/stable relationship, divorced, widower), monthly income, and whether the individual has sought or received any aesthetic dental treatment (no, yes). Although age was collected in years it was categorized according to the 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles when considering the samples from both countries simultaneously (1: $<$23 years, 2: 23 ⊢ 29 years, 3: 29 ⊢ 39 years, 4: 39 ⊢ 52 years, and 5: $\geq$52 years). The monthly income was collected based on information from Statistics Finland [25] and *Centro de Políticas Sociais*–FGV Social (Brazil) [26] and was stratified into the following categories: Finland– 1: $<$2,500 €, 2: 2,500 ⊢ 5,000 €, 3: 5,000 ⊢ 7,500 €, 4: 7,500 ⊢ 10,000 €, 5: $\geq$10,000 € Brazil– 1: $<$R$ 1,255, 2: R$ 1,255 ⊢ 2,005, 3: R$ 2,005 ⊢ 8,641, 4: R$ 8,641 ⊢ 11,262, 5: $\geq$R$ 11,262.

Procedures and ethical aspect

Invitation message was sent to individuals by institutional email. The message contained information regarding the aims of the study, ethical approval, and a link to the online survey which was created using the LimeSurvey software (LimeSurvey GmbH, Hamburg, Germany; URL http://www.limesurvey.org) on the server of Tampere University, Finland. To start the online survey, the participants were informed that the responses were anonymous and had to agree and give written informed consent. At first, the demographic questionnaire was presented followed by the measuring scales in random order. At the end of the survey, the participants were asked to forward the invitation message and survey link to their contacts via email or social media (snowball sampling). The data was collected between June and July 2020 in Finland and June 2020 and March 2021 in Brazil. In Brazil, the link had to remain open longer because the participants' adhesion to the survey was slower than in Finland. Initially, larger sample was planned in Brazil because of larger population than Finland. However, even after 9 months, we were only able to have a similar sample size in the two countries.

This study was approved by the Data Protection Officer at Tampere University, in accordance with the European Union's General Data Protection Regulation, and by the Research Ethics Committee of São Paulo State University (Unesp), School of Dentistry, Araraquara (CAAE: 88600318.3.0000.5416). In both countries, participation in the study was voluntary and anonymous, and participants did not receive any incentives to take part. The authors had no access to information that could identify individual participants during or after data collection.

Measuring scales

The self-perception of orofacial appearance was assessed using the Finnish and Portuguese versions of the Orofacial Esthetic Scale (OES) [15–17] and Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) [15, 18, 19]. The OES is a 7-item, one-dimension scale with an

11-point numerical response scale ranging from 0 (very dissatisfied) to 10 (very satisfied). This scale assesses the satisfaction with specific orofacial physic aspects. The OES also has an eighth item that assesses the satisfaction with the overall appearance. However, this item is not considered in the factor model nor for calculating the mean score as suggested by the authors proposing this scale [17].

Version of PIDAQ presented by Campos et al. [15, 20] was used in the present study. This version has 24 items with 5-point Likert-type response scale (0: I do not agree to 4: I totally agree) that assess 4 dimensions of the psychosocial impact of dental aesthetics (Dental Self-Confidence, Social Impact, Psychological Impact, and Aesthetic Concern). The need for exclusion of 4 items in Social Impact dimension for Finnish sample and 1 item in Social Impact dimension for Brazilian sample was observed in previous studies [12, 15] estimating the psychometric properties of PIDAQ. Therefore, these items were not considered in the factor model and for calculating the mean score for each sample in the present study.

The subjective well-being was assessed using the Satisfaction with Life Scale (SWLS) [27–29]. It consists of 5 items with 7-point Likert-type response scale (1: strongly disagree to 7: strongly agree) and measures one dimension related to the individual's overall life satisfaction.

Data validity and reliability

The validity of the data was verified using confirmatory factor analysis (CFA). To assess the psychometric sensitivity of the scales' items [30], the distribution of responses was estimated using measures of skewness (sk) and kurtosis (ku). Criteria for non-severe violations of univariate normality were defined as absolute values of $sk < 3.0$ and $ku < 10$ [31]. Multivariate normality for each scale's responses was assessed by calculating the ratio of multivariate kurtosis to critical ratios (ku_m/cr) [30]. Absolute values of ku_m/cr less than 3 indicated multivariate normality [30].

The maximum likelihood (for OES) or the robust weighted least squares mean and variance adjusted (for PIDAQ and SWLS) estimation methods were used. The fit of the factor models to the data was considered adequate when the comparative fit index (CFI) and the Tucker-Lewis index (TLI) were both greater than 0.90, the root mean square error of approximation (RMSEA) < 0.10, the standardized root mean square residual (SRMR) < 0.08, and standardized factor loadings (λ) > 0.50 [30, 31]. The reliability of the data was assessed using Cronbach's alpha coefficient (for OES) or ordinal alpha coefficient (for PIDAQ and SWLS) and values > 0.70 were considered adequate [30, 31]. Measurement invariance was tested to verify whether it would be possible to compare the mean scores obtained using the scales between subsamples according to variables of interest (sex, monthly income categories, and age categories) [32]. Multigroup analysis considering CFI difference (ΔCFI) between configural and metric models (metric invariance) and between metric and scalar models (scalar invariance) was performed between the subsamples of each country. Reductions in CFI smaller than 0.01 were indicative of measurement invariance. The analyses were conducted in the R program (R Core Team, 2022) using the "*lavaan*" [33] and "*semTools*" [34] packages.

The responses to the items within each scale demonstrated a distribution that closely approximated the normal distribution, as well as evidence of multivariate normality (Finland–OES: $|sk| \leq 1.2$, $|ku| \leq 1.9$, $ku_m/cr = 0.4$; PIDAQ: $|sk| \leq 2.6$, $|ku| \leq 6.5$, $ku_m/cr = 1.0$; SWLS: $|sk| \leq 1.1$, $|ku| \leq 1.0$, $ku_m/cr = 0.3$; Brazil–OES: $|sk| \leq 1.3$, $|ku| \leq 1.7$, $ku_m/cr = 0.4$; PIDAQ: $|sk| \leq 2.9$, $|ku| \leq 3.8$, $ku_m/cr = 1.1$; SWLS: $|sk| \leq 1.3$, $|ku| \leq 1.8$, $ku_m/cr = 0.3$). The fit of the factor models of the scales was adequate to the Finnish and Brazilian samples, attesting the validity and reliability of the data (S1 Table). The models also showed adequate fit to the subsamples data ($CFI \geq 0.94$, $TLI \geq 0.90$, $RMSEA \leq 0.13$, $SRMR \leq 0.06$, $\alpha \geq 0.82$). Metric or

scalar measurement invariance was observed among the subsamples of each country according to sex, monthly income categories, and age category (S1 Table) making it possible to directly compare the mean scores [32].

Data analysis

Descriptive analysis was performed to characterize the sample according to the country. The prevalence and 95% Confidence Interval (95%CI) of the participants who have sought and received aesthetic dental treatment were estimated and compared using z test ($\alpha = 5\%$) according to the sex, monthly income category, and age category. Logistic regression model was conducted separately according to the country and the odds ratio with 95%CI was calculated to verify the relationship of these sociodemographic variables with seeking and receiving aesthetic dental treatment. Sex (reference category (rc): male), monthly income category (rc: <2,500€/<R$1,255), and age category (rc: ≥52 years) were the independent variables. The reference category for the independent variables were established based on previous studies that identified the groups with the lowest prevalence of seeking/undergoing esthetic treatments [1, 9, 10, 12]. The dependent variable was having sought and received aesthetic dental treatment, separately.

The mean scores for the OES and PIDAQ factors were calculated for each participant considering the items that form the factorial model fitted to the sample data (S2 Table). The mean scores were compared according to sex, monthly income, and age category. The distribution of the scores in each group were estimated by skewness (Sk) and kurtosis (Ku). Absolute values of Sk and Ku lower than 3 and 10, respectively, were indicative of non-severe violation of normal distribution [31]. The scores showed no severe violation of the normal distribution ($Sk \leq |2.8|$; $Ku \leq |8.9|$). The data homoscedasticity was evaluated using Levene's test. If data showed homoscedasticity, the scores were compared using ANOVA followed by Tukey post-hoc test. If heteroscedasticity was observed, the scores were compared using Welch's ANOVA followed by Games-Howell post-hoc test. The effect size of the difference between the groups was calculated using partial eta squared (η_p^2), and a significance level of 5% was adopted. The analysis was performed using IBM SPSS Statistics 28 (IBM Corp., Armonk, NY, USA).

To address the third aim of the study, i.e. to estimate the impact of self-perception of orofacial appearance on life satisfaction, structural equation analysis was conducted. Initially, the possibility of forming a single Orofacial Appearance dimension composed of the mean scores of the OES and PIDAQ factors was tested using Principal Component Analysis (PCA) with Promin rotation. The assumption of sampling adequacy for factoring was estimated by measures of sampling adequacy (MSA), with values higher than 0.7 considered adequate [24]. Data from Finland and Brazil meet the assumptions for the PCA (S2 Table). The number of factors to be retained in the PCA was determined by Parallel Analysis with random permutations of the observed data [35]. PCA and Parallel Analysis retained one factor (S3 Table) and for this reason, additionally, the suggestion of the unidimensionality of the scores was evaluated to confirm the adequacy of this proposed model. For this, the following indices and reference values were considered: Unidimensional Congruence (UniCo) > 0.95, Explained Common Variance (ECV) > 0.85, and Mean of Item Residual Absolute Loadings (MIREAL) < 0.30 [36]. Values of UniCo > 0.98, ECV > 0.89, and MIREAL < 0.27 were observed in Finnish and Brazilian sample. Therefore, these results suggest and confirm the possibility of treating the OES and PIDAQ factors scores as one dimension called Orofacial Appearance. PCA was performed using program Factor 11.05 for Windows [37].

In the structural model, the Orofacial Appearance dimension was considered as independent variable and the dimension of life satisfaction assessed by SWLS was the dependent

variable. The variable 'received aesthetic dental treatment' was inserted in the model as intermediate variable (indirect effect) between orofacial appearance and life satisfaction. The criteria for indirect effect were verified [38, 39] and bootstrap simulation analysis for Sobel's test was used for the evaluation of indirect effect path estimates [31]. Moderation analysis was conducted to estimate the moderating role of sex (1 = male, 2 = female), monthly income (Finland: 1 = <2,500 €, 2 = 2,500 ⊢ 5,000 €, 3 = 5,000 ⊢ 7,500 €, 4 = 7,500 ⊢ 10,000 €, 5 = ≥10,000 €; Brazil: 1 = <R$ 1,255, 2 = R$ 1,255 ⊢ 2,005, 3 = R$ 2,005 ⊢ 8,641, 4 = R$ 8,641 ⊢ 11,262, 5 = ≥R$ 11,262), and age (years) between orofacial appearance and life satisfaction. First, CFA was conducted for the factor model of Orofacial Appearance, and factor scores were predicted from the factor score matrix obtained in the analysis [40]. Then, the interaction between factor scores and the moderation variables was added to the structural model. Also, following the theoretical rationale of the previous aims of the study, a direct path from sex, monthly income, and age to 'received aesthetic dental treatment' was added in the model.

The structural model elaborated is shown in Fig 1A and 1B. The fit of the model was considered adequate if CFI≥0.90, TLI≥0.90, RMSEA≤0.10 and SRMR≤0.08 [30, 31]. The significance of the hypothesized causal path estimates (β) was evaluated using the z-test (α = 5%), and the effect size was measured by the proportion of variance explained (r^2). The analysis was performed for each country separately in R program (R Core Team, 2020) using the "*lavaan*" [33] and "*semTools*" [34] packages.

Results

A total of 3,614 Finns and 3,979 Brazilians participated in the study. The mean age of the Finnish participants was 32.0 (95%CI = 31.6–32.4) years and of the Brazilian participants was 33.0 (95%CI = 32.6–33.4) years. Table 1 shows the characteristics of the participants according to the country. In both samples, most of participants were women and single. In the Finnish sample, the majority (67.5%) had a monthly income in the two lower categories (up to 5,000 €), while in Brazil, a large majority (83.2%) had an income in the three higher categories (≥ R$ 2,005). It may indicate differences in living conditions guarantees between the countries, with Brazil presenting greater inequalities in income distribution. In addition, it suggests that the income categories between the two countries are not directly comparable.

Most of the Finns have never sought or undergone a dental aesthetic treatment, while most of Brazilians have sought or undergone such treatment. Among those who sought aesthetic dental treatment, the prevalence of individuals who underwent such treatment was higher in the Finnish sample (94.8%, CI95% = 93.7–95.9%) than in the Brazilian sample (86.7%, CI95% = 85.5–87.9%), although both were high.

Table 2 and Fig 2 show the prevalence and probability, respectively, of seeking or receiving aesthetic dental treatment according to sex, monthly income, and age. For both countries, women were more prevalent and more likely to seek and receive this treatment than men. For Finland, no difference was found in seeking and receiving aesthetic dental treatment according to monthly income and age. For Brazil, younger people and those with higher monthly income had higher prevalence and chances of seeking and receiving such treatment. In general, differences between countries can be observed in Fig 2. While in Brazil, the OR is shifted to the left (OR>1.0) for different sociodemographic classes. In contrast, in Finland, the OR for age and economic level classes appears close to the alignment of the value 1.

The comparisons of dimensions scores of OES and PIDAQ according to sex, monthly income and age are presented in Table 3. For sex, although statistically significant differences were observed between men and women in the social and psychological impact dimensions (PIDAQ) in both countries, a low effect size was observed (η_p^2 = 0.002–0.022). This suggests

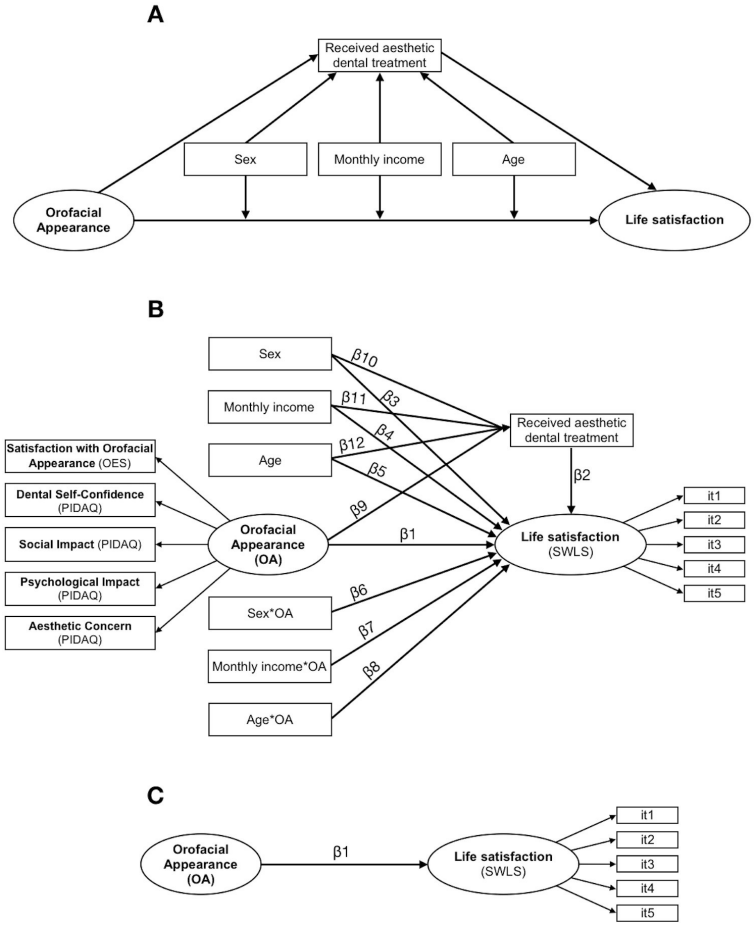

Fig 1. Structural model elaborated to estimate the impact of orofacial appearance on life satisfaction the moderation role of sex, monthly income, and age, and the indirect effect of have received aesthetic dental treatment on this impact. Note: **A:** Conceptual model. **B:** Statistical model. **C:** Refined model.

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that the statistical significance may have been found by an inflation of the type I error due to a high sample size. It causes the statistical test to find very small differences with no practical significance between groups.

The same issue is observed in the age and monthly income variables. For both countries, statistical differences point to older individuals and those with higher monthly income being more satisfied with their orofacial appearance and less psychosocially affected by dental aesthetics. However, for most dimensions, these differences in scores between the age and monthly income categories were low and with small practical significance ($\eta_p^2 = 0.007–0.042$). An exception to this was the comparison of the scores of the social and psychological impact dimensions (PIDAQ) between the monthly income categories in the Brazilian sample. In these

Table 1. Characteristics of the Finnish and Brazilian samples.

		Sample (% (95%Confidence Interval))	
Characteristic		**Finnish (n = 3,614)**	**Brazilian (n = 3,979)**
Sex			
Male		23.3 (21.9–24.7)	29.8 (28.4–31.2)
Female		75.1 (73.7–76.5)	69.9 (68.5–71.3)
Other/Not informed		1.6 (1.2–2.0)	0.3 (0.1–0.5)
Marital status			
Single		66.5 (65.0–68.0)	59.8 (58.3–61.3)
Married/Common law/Stable relationship		28.8 (27.3–30.3)	35.4 (33.9–36.9)
Divorced		4.5 (3.8–5.2)	4.3 (3.7–4.9)
Widower		0.2 (0.1–0.3)	0.5 (0.3–0.7)
Monthly income			
Finland (€)	Brazil (R$)		
<2,500	<1,255	44.6 (43.0–46.2)	6.4 (5.6–7.2)
2,500 ⊢ 5,000	1,255 ⊢ 2,005	22.9 (21.5–24.3)	10.4 (9.5–11.3)
5,000 ⊢ 7,500	2,005 ⊢ 8,641	14.3 (13.2–15.4)	45.7 (44.2–47.2)
7,500 ⊢ 10,000	8,641 ⊢ 11,262	8.7 (7.8–9.6)	16.3 (15.2–17.4)
≥10,000	≥11,262	9.5 (8.5–10.5)	21.2 (19.9–22.5)
Age category (years)			
<23		20.1 (18.8–21.4)	21.1 (19.8–22.4)
23 ⊢ 29		34.2 (32.7–35.7)	23.9 (22.6–25.2)
29 ⊢ 39		21.0 (19.7–22.3)	28.1 (26.7–29.5)
39 ⊢ 52		15.0 (13.8–16.2)	16.2 (15.1–17.3)
≥52		9.7 (8.7–10.7)	10.7 (9.7–11.7)
Have you ever sought any aesthetic dental treatment?			
No		59.4 (57.8–61.0)	22.1 (20.8–23.4)
Yes		40.6 (39.0–42.2)	77.9 (76.6–79.2)
Have you received any aesthetic dental treatment?			
No		61.6 (60.0–63.2)	32.5 (31.0–34.0)
Yes		38.2 (36.6–39.8)	67.5 (66.0–69.0)

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cases, the difference in score between the first and last category was approximately 1.0 point, and the practical significance was considered medium (η_p^2 = 0.070–0.077).

The analyses of the structural models elaborated to estimate the impact of orofacial appearance on life satisfaction, the moderation role of sex, monthly income, and age, and the indirect effect of have received aesthetic dental treatment on this impact are shown in Table 4. The models did not present adequate fit to the sample (CFI≤0.64, TLI≤0.56, RMSEA≥0.195, SRMR≥0.278) and none of the demographic variables presented moderating effect (p≥0.10). It was also observed that there was no indirect effect of having received aesthetic dental treatment on the impact of orofacial appearance on life satisfaction (p>0.17). Therefore, the models were refined by excluding this variable, as well as those sociodemographic variables. The refined model presented adequate fit to the samples (Finnish Sample: CFI = 0.97, TLI = 0.95, RMSEA = 0.087, SRMR = 0.068; Brazilian Sample: CFI = 0.97, TLI = 0.96, RMSEA = 0.076, SRMR = 0.047). The orofacial appearance presented a significant impact on life satisfaction in both countries (Table 4). Individuals who are more satisfied with their own orofacial appearance and who perceive less of a psychosocial impact of dental aesthetic have higher life

Table 2. Prevalence (% (95% Confidence Interval)) of the participants from Finland and Brazil who have sought and received aesthetic dental treatment in each category according to sex, monthly income, and age.

		Finland				Brazil			
		Sought aesthetic dental treatment		Received aesthetic dental treatment		Sought aesthetic dental treatment		Received aesthetic dental treatment	
Characteristic			z test		z test		z test		z test
		% (95%CI)	p-value[#]	% (95%CI)	p-value[#]	% (95%CI)	p-value[#]	% (95%CI)	p-value[#]
Sex									
Male		34.7 (31.5–37.9)	<0.001*	33.5 (30.3–36.7)	0.001*	70.6 (68.0–73.2)	<0.001*	60.2 (57.4–63.0)	<0.001*
Female		42.5 (40.6–44.4)		40.0 (38.1–41.9)		81.1 (79.5–82.7)		70.8 (70.3–71.3)	
Monthly income									
Finland (€)	Brazil (R$)								
<2,500	<1,255	41.6 (39.2–44.0)	0.218	39.4 (37.0–41.8)	0.246	73.2 (67.7–78.7)[a]	<0.001*	51.2 (45.0–57.4)[a]	<0.001*
2,500 ⊢ 5,000	1,255 ⊢ 2,005	39.0 (35.7–42.3)		37.3 (34.0–40.6)		76.8 (72.7–80.9)[ab]		60.9 (56.2–65.6)[b]	
5,000 ⊢ 7,500	2,005 ⊢ 8,641	39.6 (35.4–43.8)		37.7 (33.5–41.9)		79.6 (77.7–81.5)[b]		68.3 (66.2–70.4)[c]	
7,500 ⊢ 10,000	8,641 ⊢ 11,262	38.8 (33.5–44.1)		35.9 (30.6–41.2)		81.5 (78.5–84.5)[b]		75.7 (72.4–79.0)[d]	
≥10,000	≥11,262	41.9 (36.7–47.1)		39.6 (34.4–44.8)		73.6 (70.6–76.6)[a]		67.7 (64.5–70.9)[c]	
Age (years)									
<23		42.0 (38.4–45.6)	0.241	39.6 (36.0–43.2)	0.324	80.6 (77.9–83.3)[c]	<0.001*	68.4 (65.3–71.5)[b]	0.006*
23 ⊢ 29		41.4 (38.7–44.1)		38.7 (36.0–41.4)		79.9 (77.3–82.5)[bc]		67.9 (64.9–70.9)[b]	
29 ⊢ 39		39.0 (35.5–42.5)		37.1 (33.6–40.6)		79.0 (76.6–81.4)[bc]		69.2 (66.5–71.9)[b]	
39 ⊢ 52		39.8 (35.7–43.9)		37.7 (33.6–41.8)		75.8 (72.5–79.1)[b]		66.7 (63.1–70.3)[ab]	
≥52		39.2 (34.0–44.4)		38.0 (32.8–43.2)		68.7 (64.3–73.1)[a]		61.9 (57.3–66.5)[a]	

[#]the value presented is the lowest p-value found in pairwise comparison using z test (α = 5%) between the categories of the variable of interest.

*p<0.05.

[ab]different letters indicate significant statistical difference.

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satisfaction. The model showed an explained variance for life satisfaction of 9.8% in the Finnish sample and 13.1% for the Brazilian sample.

Discussion

This study presents a screening of the prevalence of individuals seeking and undergoing esthetic dental treatment according to sociodemographic characteristics in Finnish and Brazilian population. Although an increase in demand for this treatment has been pointed out [7–10], there is a lack of specific data that allows comparisons across populations and sociodemographic groups. We also compared the self-perception of orofacial appearance according to sociodemographic characteristics and estimated its impact on subjective well-being in both populations. The results call attention to the importance of dental and medical practitioners, educators, and policy makers to know and deal with the sociodemographic and cultural aspects involved in aesthetic dental treatments.

Women were more likely than men to seek and undergo aesthetic dental treatment in both samples. This is expected, since Western cultures are marked by patriarchy roots [41] and objectification of female body [42], resulting in more body-altering behaviors by women [42]. However, the scenarios in Brazil and Finland are different. Finland has strong and effective gender equality policies in different spheres of life, such as access to education and health, paid work, and political empowerment [43, 44] and it is the second most gender-equal country in the world [22]. Nevertheless, our results corroborate previous studies [44, 45] showing that

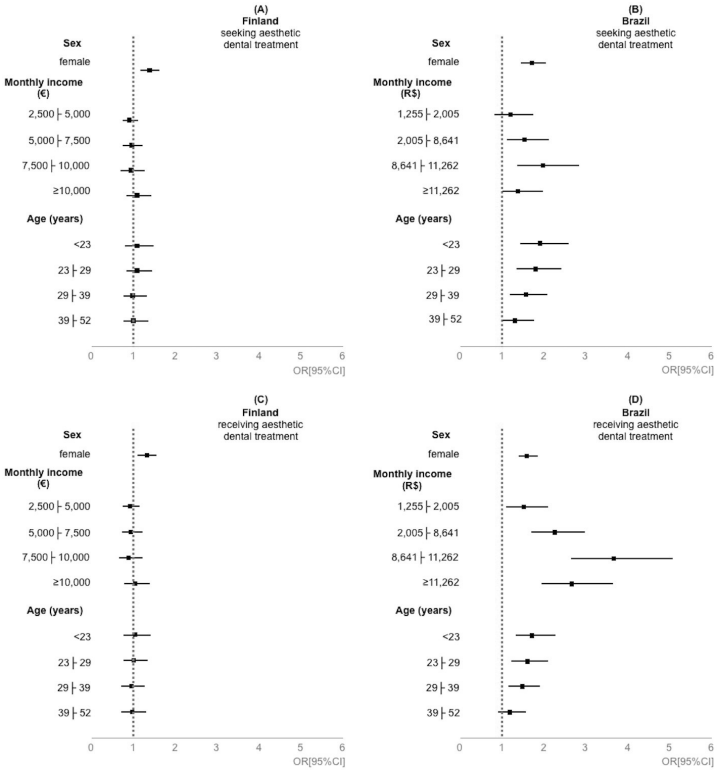

Fig 2. Odds ratio (OR) with 95% confidence Interval (95%CI) for seeking and receiving aesthetic dental treatment according to sex, monthly income, and age. Note. Reference category: sex = male; monthly income = <2,500€ / <R $1,255; and age = ≥52 years. Logistic Regression Models (y_1 = seeking aesthetic dental treatment; y_2 = receiving seeking aesthetic dental treatment; X_1 = sex; Monthly income (MI): X_{MI}, 2 = 2,500 ⊢5,000€/R$1,255 ⊢2,005; 3 = 5,000 ⊢7,500€/R$2,005 ⊢8,641; 4 = 7,500 ⊢10,000€/R$8,641 ⊢11,262; 5 = ≥10,000€/≥R$11,262; Age (years): X_A, 1 = <23; 2 = 23 ⊢29; 3 = 29 ⊢39; 4 = < 39 ⊢52): A: $y_1 = -0.668+0.332X_1-0.081X_{MI2}-0.037_{MI3}-0.051X_{MI4}+0.087X_{MI5}+0.092X_{A1}+0.093X_{A2}-0.004X_{A3}+0.011X_{A4}$, B: $y_1 = 0.049+0.551X_1+0.198X_{MI2}+0.444_{MI3}+0.688X_{MI4}+0.339X_{MI5}+0.655X_{A1}+0.596X_{A2}+0.463X_{A3}+0.288X_{A4}$, C: $y_2 = -0.669+0.285X_1-0.072X_{MI2}-0.045_{MI3}-0.106X_{MI4}+0.054X_{MI5}+0.049X_{A1}+0.017X_{A2}-0.038X_{A3}-0.020X_{A4}$, D: $y_2 = -0.780+0.472X_1+0.424X_{MI2}+0.816_{MI3}+1.303X_{MI4}+0.986X_{MI5}+0.547X_{A1}+0.480X_{A2}+0.399X_{A3}+0.180X_{A4}$.

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social norms evoking greater aesthetic pressure on women persist even in Finland. In future discussions and reform on gender equality policies in Finland [43] it is necessary to include agendas aimed at reconstructing the still-imposed social norms of physical appearance between the sexes.

In Brazil, with few and not so effective gender equality policies, there are social inequalities between the sexes [22], including low social representation of women in the society, wage gaps between the genders, and a high rate of violence against women [22, 46]. In this context, the greater physical appearance pressure on women, besides being considered a social norm, also becomes a tool for the men dominance and maintenance of inequalities [44]. Therefore, minimizing this pressure can be relevant, however, first and foremost, it is important that strong

Table 3. Comparison of the mean scores (standard deviation) for each dimension of the Orofacial Esthetic Scale (OES) and Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) according to sex, monthly income, and age in the Finnish and Brazilian samples.

		Dimension[#]				
		OES	PIDAQ			
Country	Characteristic	SOA	DSC	SI[‡]	PI[¶]	AC
Finland	**Sex**					
	Male	6.9 (1.6)	1.9 (1.0)	0.5 (0.8)	0.6 (0.7)	0.6 (0.9)
	Female	7.0 (1.6)	2.0 (1.0)	0.6 (0.8)	0.9 (0.9)	0.7 (1.0)
	Statistic test[†]	F = 2.31	F_W = 2.36	F_W = 11.34	F_W = 94.08	F_W = 3.97
	p-value	0.128	0.142	0.001*	<0.001*	0.047*
	η_p^2	0.001	0.001	0.003	0.022	0.001
	Monthly income (€)					
	<2,500	6.8 (1.6)^a	1.9 (1.0)	0.7 (0.9)^b	1.0 (0.9)^b	0.8 (1.0)^b
	2,500 ⊢ 5,000	7.1 (1.6)^b	2.0 (1.0)	0.5 (0.7)^a	0.8 (0.8)^a	0.7 (0.9)^a
	5,000 ⊢ 7,500	7.1 (1.6)^b	2.0 (1.1)	0.5 (0.7)^a	0.8 (0.8)^a	0.7 (0.9)^{ab}
	7,500 ⊢ 10,000	7.2 (1.4)^b	2.0 (1.0)	0.4 (0.6)^a	0.7 (0.7)^a	0.6 (0.8)^a
	≥10,000	7.4 (1.3)^b	2.1 (1.0)	0.4 (0.7)^a	0.7 (0.8)^a	0.5 (0.9)^a
	Statistic test[†]	F_W = 15.62	F = 2.15	F_W = 18.47	F_W = 16.06	F_W = 8.93
	p-value	<0.001*	0.072	0.001*	<0.001*	<0.001*
	η_p^2	0.016	0.002	0.020	0.017	0.009
	Age (years)					
	<23	6.9 (1.6)^a	2.0 (1.0)	0.7 (0.9)^b	1.0 (0.9)^b	0.7 (1.0)^b
	23 ⊢ 29	6.9 (1.6)^a	1.9 (1.0)	0.6 (0.9)^b	1.0 (0.9)^b	0.8 (1.0)^b
	29 ⊢39	7.0 (1.6)^{ab}	1.9 (1.0)	0.6 (0.8)^b	0.9 (0.9)^b	0.7 (0.9)^{ab}
	39 ⊢52	7.3 (1.5)^c	2.0 (1.1)	0.4 (0.7)^a	0.7 (0.7)^a	0.6 (0.8)^a
	≥52	7.2 (1.6)^{bc}	1.9 (1.1)	0.4 (0.6)^a	0.7 (0.7)^a	0.6 (0.8)^a
	Statistic test[†]	F = 7.03	F_W = 1.31	F_W = 18.07	F_W = 18.45	F_W = 7.22
	p-value	<0.001*	0.266	0.001*	<0.001*	<0.001*
	η_p^2	0.008	0.001	0.016	0.017	0.007
Brazil	**Sex**					
	Male	7.1 (1.7)	2.0 (1.0)	0.5 (0.7)	0.9 (0.9)	0.8 (1.0)
	Female	7.1 (1.7)	2.0 (1.1)	0.6 (0.8)	1.1 (1.0)	0.8 (1.0)
	Statistic test	F = 0.05	F = 3.30	F_W = 8.44	F_W = 11.46	F_W = 2.43
	p-value[†]	0.816	0.069	0.006*	0.001*	0.119
	η_p^2	<0.001	0.001	0.002	0.003	0.001
	Monthly income (R$)					
	<1,255	6.2 (2.1)^a	1.5 (1.1)^a	1.2 (1.1)^e	1.7 (1.2)^e	1.3 (1.2)^d
	1,255 ⊢ 2,005	6.7 (2.0)^b	1.8 (1.1)^b	0.9 (1.0)^d	1.4 (1.2)^d	1.1 (1.2)^c
	2,005 ⊢ 8,641	7.1 (1.7)^c	2.0 (1.1)^c	0.6 (0.8)^c	1.1 (1.0)^c	0.8 (1.0)^b
	8,641 ⊢ 11,262	7.3 (1.6)^d	2.1 (1.0)^d	0.4 (0.7)^b	0.8 (0.9)^b	0.7 (0.9)^{ab}
	≥11,262	7.5 (1.5)^d	2.2 (1.0)^d	0.3 (0.5)^a	0.7 (0.8)^a	0.6 (0.8)^a
	Statistic test[†]	F_W = 34.36	F = 28.47	F_W = 71.28	F_W = 67.60	F_W = 31.41
	p-value	0.001*	<0.001*	<0.001*	<0.001*	<0.001*
	η_p^2	0.039	0.028	0.077	0.070	0.035
	Age (years)					
	<23	6.8 (1.7)^a	1.8 (1.1)^a	0.9 (0.9)^d	1.4 (1.1)^c	1.0 (1.1)^b
	23 ⊢ 29	7.1 (1.7)^b	2.0 (1.1)^{b,c}	0.6 (0.8)^c	1.1 (1.0)^b	0.8 (1.0)^a
	29 ⊢39	7.3 (1.7)^b	2.1 (1.0)^c	0.5 (0.7)^b	0.9 (0.9)^a	0.7 (1.0)^a
	39 ⊢52	7.3 (1.8)^b	2.1 (1.1)^c	0.4 (0.7)^a	0.8 (0.9)^a	0.7 (0.9)^a

(*Continued*)

Table 3. (Continued)

		Dimension[#]				
		OES	PIDAQ			
Country	**Characteristic**	**SOA**	**DSC**	**SI[‡]**	**PI[¶]**	**AC**
	≥52	7.1 (1.9)[b]	1.9 (1.1)[a,b]	0.4 (0.7)[a,b]	0.9 (0.9)[a]	0.8 (1.0)[a]
	Statistic test[†]	F_W = 13.98	F = 10.92	F_W = 37.37	F_W = 39.20	F_W = 10.07
	p-value	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
	η_p^2	0.014	0.011	0.018	0.042	0.011

[#]SOA: Satisfaction with Orofacial Appearance; DSC: Dental Self-Confidence; SI: Social Impact; PI: Psychological Impact; AC: Aesthetic Concern.

[†]F: ANOVA; F_w: Welch's ANOVA.

*p<0.05.

[ab]different letters indicate significant statistical difference among groups according to dimension (Tukey or Games-Howell post hoc test, α = 5%).

[‡]For Finnish sample, items 9, 13, 14 and 15 were not considered for the calculation of the score.

[¶]For Brazilian sample, item 6 was not considered for the calculation of the score.

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and effective policies are developed and promoted to build a safe, fair, and representative society for Brazilian women as well.

No or very small differences without practical significance in the self-perception of the orofacial appearance (assessed by OES and PIDAQ) were observed between men and women.

Table 4. Path estimates of the structural models elaborated to assess the impact of orofacial appearance on life satisfaction, the moderation role of sex, monthly income, and age, and the indirect effect of have received aesthetic dental treatment on this impact.

	Finnish sample				Brazilian sample			
Path estimate	**B**	**β**	**SE**	**p-value**	**B**	**β**	**SE**	**p-value**
Completed model								
OA → LS (β1)	0.52	0.45	0.16	0.002	0.47	0.44	0.10	<0.001
ADT → LS (β2)	0.04	0.01	0.04	0.279	0.13	0.05	0.04	0.002
Sex → LS (β3)	0.33	0.11	0.05	<0.001	0.12	0.04	0.02	0.007
MI → LS (β4)	0.21	0.22	0.02	<0.001	0.37	0.30	0.02	<0.001
Age → LS (β5)	-0.01	-0.07	<0.01	<0.001	0.01	0.08	<0.01	<0.001
Sex*OA → LS (β6)	-0.12	-0.18	0.07	0.099	-0.07	-0.11	0.04	0.101
MI*OA → LS (β7)	-0.01	-0.03	0.02	0.523	-0.02	-0.06	0.02	0.159
Age*OA → LS (β8)	<0.01	0.03	<0.01	0.621	<0.01	-0.01	<0.02	0.790
OA → ADT (β9)	-0.01	-0.04	0.01	0.030	0.01	0.03	0.01	0.104
Sex → ADT (β10)	0.06	0.05	0.02	0.001	0.11	0.10	0.02	<0.001
MI → ADT (β11)	<0.01	<0.01	0.01	0.845	0.05	0.12	0.01	<0.001
Age → ADT (β12)	<0.01	<0.01	<0.01	0.995	<0.01	-0.08	<0.01	<0.001
Indirect effect[#]								
OA → ADT → LS (β9*β2)	<0.01	<0.01	<0.01	0.384	<0.01	<0.01	<0.01	0.166
Refined model[†]								
OA → LS (β1) [‡]	0.34	0.31	0.02	<0.001	0.38	0.36	0.02	<0.001

B: non-standardized path estimate; β: standardized path estimate; SE: standard error; OA: orofacial appearance dimension; ADT: have received aesthetic dental treatment; LS: life satisfaction; MI: monthly income. β1 to β12: path estimates corresponding to Fig 1B.

[#]Indirect effect assessed by Sobel's test with bootstrap simulation.

[†]Model refined by excluding the variables have received aesthetic dental treatment, sex, monthly income, and age (Fig 1C).

[‡]Explained variance for life satisfaction: Finnish sample = 0.098, Brazilian sample = 0.131.

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These results refute that the higher demand by women occurs because of a poorer self-perception of orofacial appearance than men. Rather, they support the idea that external factors and the internalization of social norms [41, 42, 44, 45], have a significant contribution in the difference in seeking aesthetic dental treatment between the sexes.

In agreement with previous studies [16, 20, 21], no differences with practical significance were found in the perception of orofacial appearance between the age groups. Despite this, in Brazil, young people have sought and undergone more aesthetic dental treatments. An explanation for this is that Brazilians place a high value on appearance and it becomes a key component of social interactions [1, 2] and can be considered as a capital (aesthetic capital) [47]. In this regard, good looks based on beauty standards have a strong influence on one's social acceptance and on obtaining job positions [2]. Therefore, young Brazilians may have a high demand for aesthetic dental treatment to fit into socially established beauty standards with the aim of achieving social insertion and even professional position.

In Finland, although physical appearance also has an influence on many aspects of life [44, 47, 48], no difference in the demand for aesthetic dental treatment was observed between the age groups. This difference in relation to Brazil can be interpreted by speculating three different, but not mutually exclusive, hypotheses: 1. a lower value attributed to physical appearance in Finland than in Brazil. It may result in lower demand for aesthetic dental treatment, even though the perception of orofacial appearance is similar to the Brazilians [12]. 2. different beauty standards related to physical traits between countries. In Brazil, the ideal beautiful smile is close to that of the USA [49], which includes straight and very white teeth and explains the greater demand for smile-improving treatments. And 3. in Finland there is a social norm of equal opportunity for the population [48], so that Finns may be aware of discriminatory issues that violate it, such as those related to physical appearance [48]. In this way, many Finns may avoid adopting behaviors, including undergoing aesthetic treatment, that contribute to these issues.

Despite the differences between Brazil and Finland, it is important to point out that aesthetic values, beauty standards, and behaviors to alter physical appearance have changed and become more similar among countries, especially Western ones, with increasing digitalization and the rise of social media [50]. Therefore, future cross-national studies in different age cohorts, including younger generations, are important for understanding attitudes toward orofacial appearance and aesthetic treatment. Our results may also not have captured the age-related consumption of aesthetic treatments for the rejuvenation purpose. This is because only intraoral treatments were considered as aesthetic dental treatment in the present study. Although some intraoral clinical features are associated with a more youthful appearance (e.g., gingival display and shape and length of incisors) [51], most treatments aiming at rejuvenation effect are extraoral, such as botulinum toxin and soft tissue filler injections [52]. Thus, we suggest that future studies investigate the relation of demand for different aesthetic treatments with self-perception of appearance in different populations and groups.

The results regarding monthly income were also different between Finland and Brazil. It supports the idea that health treatments, especially aesthetic ones, can be associated with consumerism and social prestige [12, 53]. Finland is classified as a low socioeconomic inequality country between socioeconomic classes [23] and most Finns have similar living conditions and a democratic access to health care, regardless of socioeconomic classes. Brazil, in turn, is classified as a high-inequality country with regard to socioeconomic factors [23], including differences in the access to healthcare. Still, treatments solely or primarily intended to improve physical appearance, such as aesthetic dental treatments, are not offer by the Brazilian public health system and can only be accessed in private clinics at high cost. Our results show that Brazilians in middle and upper socioeconomic classes had more access to aesthetic dental

treatment than the lower class, emphasizing the importance of income as a key factor in seeking and accessing dental treatments. Therefore, it is essential to consider economic conditions when studying the conditions that intervene in the search and undergoing of dental treatments.

The results also reinforce the hypothesis that these treatments have high social and consumption values in countries with large social inequalities, such as Brazil [12]. It is also difficult to disassociate these values from the other results, which show that lower-income Brazilians had a higher negative social and psychological impact of dental aesthetics on their life. The relation of this impact with not having undergone aesthetic dental treatment may be associated with a dissatisfaction with a physical characteristic, as well as with an unfulfilled desire to consume and a consequent feeling of not belonging to higher socioeconomic classes.

In accordance with previous studies [1, 54, 55], in which physical appearance was found to be an important contribution to one's subjective well-being, our results showed that self-perception of orofacial appearance had a significant impact on life satisfaction. This perception contributed approximately one tenth to the life satisfaction of Brazilian and Finnish individuals. Having received aesthetic dental treatment did not have an indirect effect on this impact.

Nevertheless, these results demonstrate how powerful the performance of the dentist can be in the re-establishment and/or promotion of their patient's well-being. In some cases, the aesthetic dental treatments are well indicated, with an improvement of physical aspects and, consequently, of the self-perception of orofacial appearance. This may, in turn, provide psychological benefits and positively impacts the patient's life satisfaction. However, this effect may not have been captured in our study since the sample consists of individuals from the general population, rather than patients with a specific orofacial condition. Thus, the results also suggest that the demand for aesthetic dental treatment is not always solely motivated by a desire to improve a single physical aspect, pointing to the potential risks that treatments carried out indiscriminately and without individualized planning may have. This is because, in some cases, the demand for aesthetic dental treatment may be associated with psychological symptoms or disorders (e.g., dysmorphic disorder) [56] or social pressures as discussed above. For these, performing the aesthetic treatment may not have a long-term benefit [1, 56] and may also contribute to worsening psychological symptoms or disorders and to the maintenance of social pressures and inequalities. As a result, no benefit, or even a negative impact on the patient's well-being, may be observed.

Present structural model analysis indicated that the impact of orofacial appearance on life satisfaction was similar between the countries and was not moderated by sociodemographic characteristics. This is comprehensible because orofacial region has peculiarities that transcend time, culture, and sociocultural characteristics [4]. Orofacial region not only serves as a tool for communication (both verbal and nonverbal) [1, 3], but also plays a crucial role in shaping one's sense of self-identity through unique physical features [1, 4]. Keeping in mind the importance of individual needs and characteristics, aesthetic treatments in the orofacial region should be patient-centered including a detailed anamnesis, patient's perceptions, and clinical examination identifying unique characteristics. In this way, the treatment can address physical issues that may enhance the sense of belonging and connect the patient to their social/cultural group [12, 53]. At the same time, the treatment will preserve their singularities, maintaining the sense of individuality and uniqueness [4]. Otherwise, the individual's singular characteristics are not taken into account in the aesthetic treatment, often being altered or disguised. This alteration may negatively affect the patient by removing their sense of self-identity and lead to a lack of recognition of themselves [4], subsequently causing dissatisfaction with the treatment.

The cross-sectional design was a limitation of the study since it does not allow for cause-and-effect inference of the structural model. The non-probability sampling and the online data collection can also be considered as a limitation [12], as they may hinder the generalizability of the results to the whole Finnish and Brazilian population. Trying to minimize these limitations, we used large sample sizes to obtain a comprehensive result that is close to the variability of the study population. We also attested to the validity and reliability of the data and used robust methods to elaborate the structural models. It is also noteworthy that the present study used life satisfaction as a measure of well-being. It deals only with the cognitive aspect of well-being from a hedonic perspective (focused on experiences of pleasure and enjoyment) [27–29]. However, well-being is a multidimensional concept, and other examples of its aspects are emotional well-being (hedonic perspective) and social and psychological well-being (eudaimonic perspective: focused on experiences of meaning and purpose) [55]. Therefore, it is important for future studies to examine the relationship between self-perception of physical appearance and other aspects of well-being in different cultures.

Despite its limitations, the present study provides evidence that contributes to research on social determinants of health, include those conducted in Latin America [57, 58]. It also highlights the need for discussion and further investigation of the psychological, social, cultural, economic, and political factors related to aesthetic dental treatments and their implications for health across different countries. These efforts can identify and provide key elements for a better understanding of social determinants of health, which is crucial for the development of effective and equitable health policies and programs. This can lead to improved health outcomes for individuals and communities.

Conclusion

The demand for aesthetic dental treatment is influenced by sociodemographic and cultural factors, not just by self-perception of orofacial appearance. The findings indicate greater societal pressure on physical appearance among women in Finland and Brazil. They also suggest that consumerism and social prestige are involved in this demand in countries with high socioeconomic inequalities, such as Brazil. Self-perception of orofacial appearance plays a significant role in individuals' subjective well-being. Therefore, to achieve success and promote well-being, the planning of aesthetic treatments in the orofacial region should also take into account the patient's perspectives, perceptions, unique characteristics, and social context.

Supporting information

S1 Table. Psychometric indicators related to the fit of the factor models of Orofacial Esthetic Scale (OES), Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ), and Satisfaction with Life Scale (SWLS) to the samples.
(DOCX)

S2 Table. Descriptive statistics of the scores of Orofacial Esthetic Scale (OES) and Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) dimensions and measures of sample adequacy (MSA) for principal component analysis (Finnish sample: n = 3,614; Brazilian sample: n = 3,979).
(DOCX)

S3 Table. Principal component analysis (PCA) and parallel analysis results for Finnish and Brazilian sample.
(DOCX)

S1 File. Data. Data underlying the finds described in this manuscript.
(XLSX)

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