Tampere University

ARTI SINGH

Tobacco Control in Ghana

Evidence from Qualitative and Cross-sectional Studies

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ACADEMIC DISSERTATION
To be presented, with the permission of
the Faculty of Social Sciences
of Tampere University,
for public discussion in the auditorium F114
of the Arvo Building, Arvo Ylpön katu 34, Tampere,
on 10 March 2023, at 12 o'clock.

ACADEMIC DISSERTATION
Tampere University, Faculty of Social Sciences
Finland

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The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

Cover design: Roihu Inc.

ISBN 978-952-03-2761-3 (print)
ISBN 978-952-03-2762-0 (pdf)
ISSN 2489-9860 (print)
ISSN 2490-0028 (pdf)
http://urn.fi/URN:ISBN:978-952-03-2762-0

Carbon dioxide emissions from printing Tampere University dissertations have been compensated.

PunaMusta Oy – Yliopistopaino
Joensuu 2023

To my loving family

ACKNOWLEDGEMENT

This research was carried out at Tampere University's Faculty of Social Sciences in Finland. First and foremost, I am grateful to and indebted to my wonderful supervisors, Professors Tarja Kinnunen and Ellis Owusu-Dabo, for their excellent guidance, involvement, and encouragement throughout my Ph.D. studies. Professor Kinnunen's scientific knowledge, expertise, and valuable feedback not only guided me to complete this piece of work, but also developed my ability to reflect critically and work independently as a researcher. Professor Owusu-Dabo has always encouraged and trusted me with opportunities to collaborate and greatly expand my research horizons beyond doctoral studies. I owe you my heartfelt and profound gratitude in this Ph.D. work and all future research progressions.

I sincerely appreciate Professor Pekka Puska from the Universities of Eastern Finland and Helsinki for accepting to be my opponent. Despite his unquestionably hectic schedule, I appreciate that he has been considerate of my situation and flexible with his schedule. I also sincerely thank Professor Tiina Laatikainen of the University of Eastern Finland and Professor Lekan Ayo-Yusuf of the Africa Center for Tobacco Industry Monitoring and Policy Research in South Africa, for consenting to pre-examine my thesis. Their insightful comments and suggestions have enabled me to greatly improve my thesis.

I also want to thank all faculty members, lecturers, and other staff of Tampere University who have directly and indirectly supported me in my studies. I am thankful to Professor Pekka Nuorti, Professor Anssi Auvinen, Head of the Study Affairs Leena Nikkari, Research Coordinator Kirsi Lumme-Sandt and to the Secretary of the Doctoral Program Tiina Kangasluoma. I am sincerely thankful to university lecturers namely Reija Autio, Jaakko Nevalainen, and Janne Pitkäniemi for their valuable statistical guidance. I am grateful for the support I have also recevied from the School of Public health (KNUST) and especially thankful to my dean, Professor Samuel Newton.

I am also grateful to Professor Linda Bauld, Professor Hana Ross, Dr. Fiona Dobbie and Professor John Bittion, for their immense support during different phases of my Ph.D. work and article feedback. Likewise, I am also grateful to all my other co-authors for their valuable contribution: Professor Sean Semple, Professor Ann McNeill, Professor Noreen Mdege, Dr. Laura Jones, Dr. Gabreil Okello, Dr. Allen Gallagher, Divine Logo and Dr. Olivia Boateng. I am also very thankful to the Tobacco Control Capacity Program which supported me throughout my Ph.D. program.

Furthermore, I want to extend my heartfelt thanks to all my friends from the Ph.D. program in Tampere, who have always welcomed me into their lives with warm hearts. My deepest gratitude goes to the nicest and closest friends such as Mark and Tripti Francis that I have made here in Finland, whom I prefer to call my family.

Above and beyond all, I am eternally grateful to the pillars of my life, my mother Baleena Singh, my Father Professor Keshaw Singh, my sisters Drs Bhavana and Neelum Singh, my wonderful children Ansh and Anshika Singh, Ananya Singh Chainani and Mansi Trivedi for their unconditional love, care, guidance, and support. Thank you for going beyond your limits in providing me with the best of everything, encouraging me to work hard, and make me who I am. You are everything to me! I would also like to thank my extended family and relatives in India, Ghana and Finland for all the best wishes, love, and support. Finally, to my husband, Dr. Sanjeev Singh, thank you so much for your support, care, respect, and most of all for encouraging me to work hard and remain focussed and for believing and picking me up at times when even I did not believe in myself.

ABSTRACT

Introduction: Tobacco remains one of the leading causes of premature death and disease globally. The prevalence of smoking in the African region continues to increase due to aggressive marketing strategies and increasing affordability of tobacco products. Nevertheless, research on tobacco control policy and its implementation in several African countries including Ghana remains low. Local evidence in order to increase awareness and effectively formulate a tailored response to curb the rising smoking prevalence in the region is needed. Ghana has ratified World Health Organisation's Framework Convention on Tobacco Control (WHO FCTC) and also has a national Tobacco Control Act. However, implementation and enforcement of tobacco control measures such as cigarette pack warnings, smokefree laws, and illicit cigarette market, remains a challenge.

Study aims: To assess the perception of smokers and non-smokers to pictorial and text-based warnings on cigarette packs; to evaluate the implementation of the smokefree policy (SFP) in hospitality venues, and to determine the extent and factors associated with the illicit cigarette market in Ghana.

Methods: Study I was a qualitative study with focus group discussions (n=12) among 50 smokers and 35 nonsmokers of age 15 years and above in Kumasi, Ghana. Studies II and III were cross-sectional studies using a structured observational checklist, air quality measurements, and face-to-face surveys among staff and owners within randomly selected hospitality venues (n=154) in three large cities in Ghana (Accra, Kumasi, and Tamale). Study IV was a cross-sectional study using empty cigarette packs from one day's single stick cigarette sales collected from cigarette vendors in five large cities and three border towns in Ghana.

Results: According to the results of Study I, health warnings with both a picture and text were thought to convey health messages more effectively than those with just a picture or just text, by both smokers and non-smokers. Due to smokers' poor literacy rates, text-based warnings were thought to be only partially effective. Smoking behavior was thought to be most affected by warnings about lung cancer, blindness, stroke, and throat and mouth cancer.

In Study II, smoking was seen in one-third of the locations visited. The average level of $PM_{2.5}$ (particulate matter 2.5) in indoor air was 14.6 $\mu g/m^3$ (range: 5.2–349). The $PM_{2.5}$ concentrations were higher (28.3 $\mu g/m^3$) in hospitality venues where smoking was observed than in venues where smoking was not observed (12.3 $\mu g/m^3$, p=0.001). Hospitality venues in Accra (Ghana's capital city) had the lowest rate of compliance with the current SFP, and poorer air quality than hospitality venues in the other two cities. In Study III, of the 142 staff/owners in hospitality venues, 27.5% knew about Ghana's Tobacco Control Act, 29% about smoking bans in public places, 22% about smokefree zones, and 6.3% about signs prohibiting smoking being displayed. The knowledge levels of the respondents were greater in Accra than in Tamale (OR=3.08; 95% CI: 1.10-8.60). Despite having 80% support, opinions in favor of SFPs were less favorable in Accra than in Tamale (OR=0.25; 95% CI: 0.08-0.71). With regards to compliance to SFP by the type of venue; hotels were three times more compliant as compared to bars and pubs (OR=3.16; 95% CI: 1.48-6.71).

Finally, in Study IV, illicit packs made up 19.5% (95% CI: 18.34-20.66) of the entire sample of packs (n=4461) collected across the eight cities in Ghana. Aflao (Ghana-Togo border) and Tamale (Ghana-Burkina Faso border) had the highest percentage of illicit cigarette sales (99% and 46%, respectively, p<0.001). A large proportion of the illicit packs originated from border countries including Togo (51%), Nigeria (14.8%), and Cote d'Ivoire (10.3 %). Unadjusted and adjusted logistic regression models indicated that convenience stores, border towns, lower pack prices, and the northern zone of the country had higher odds of sale of illicit cigarettes in Ghana than the respective reference groups (drinking bars, non-border towns, higher price pack and, middle and southern zones).

Conclusions: According to study findings, warning labels with both text and pictures may have a positive impact on smoking behavior. In addition, despite widespread support for limiting smoking in public areas, such as hospitality venues, it was found that the hospitality venue staff had little knowledge of and compliance with the SFPs. Finally, to combat the illegal cigarette trade, market monitoring, and tighter regulation of the cigarette supply chain, particularly in border towns and the northern part of the nation, are required.

TIIVISTELMÄ

Johdanto: Tupakka on edelleen yksi tärkeimmistä ennenaikaisen kuoleman ja sairauksien aiheuttajista maailmanlaajuisesti. Tupakoinnin yleisyys Afrikan alueella lisääntyy edelleen aggressiivisten markkinointistrategioiden ja tupakkatuotteiden yhä edullisemman saatavuuden vuoksi. Tupakanvalvontapolitiikkaa ja sen täytäntöönpanoa koskeva tutkimus on kuitenkin edelleen vähäistä useissa Afrikan maissa, kuten Ghanassa,. Tarvitaan paikallista näyttöä tietoisuuden lisäämiseksi ja räätälöityjen toimenpiteiden laatimiseksi, jotta voidaan tehokkaasti hillitä tupakoinnin yleistymistä alueella. Ghana on ratifioinut Maailman terveysjärjestön WHO:n tupakoinnin torjuntaa koskevan puitesopimuksen (WHO FCTC) ja sillä on myös kansallinen tupakoinnin torjuntaa koskeva laki, mutta tupakoinnin torjuntatoimenpiteiden, kuten savukepakkausten varoitusten, savuttomuuslakien ja laittomien savukemarkkinoiden, täytäntöönpano ja valvonta on edelleen haasteellista.

Tutkimuksen tavoitteet: Arvioida tupakoitsijoiden ja tupakoimattomien käsityksiä savukepakkausten kuvallisista ja tekstipohjaisista varoituksista, arvioida savuttomuuspolitiikan täytäntöönpanoa ravintola-alan yrityksissä ja määrittää laittomien savukemarkkinoiden laajuutta ja niihin liittyviä tekijöitä Ghanassa.

Menetelmät: Tutkimus I oli laadullinen tutkimus, jota varten toteutettiin fokusryhmäkeskusteluja (n=12), joihin osallistui 50 tupakoitsijaa ja 35 vähintään 15-vuotiasta tupakoimatonta henkilöä Kumasissa, Ghanassa. Tutkimukset II ja III olivat poikkileikkaustutkimuksia, joissa käytettiin strukturoitua havainnointitarkastuslistaa, ilmanlaadun mittauksia ja henkilökohtaisia kyselyitä satunnaisesti valittujen ravintola-alan yritysten henkilökunnan ja omistajien keskuudessa (n=154) kolmessa ghanalaisessa suurkaupungissa (Accra, Kumasi ja Tamale). Tutkimus IV oli poikkileikkaustutkimus, jossa kerättiin tyhjiä savukepakkauksia, jotka syntyivät yhtenä päivänä yksittäisten savukkeiden myynnistä ja jotka kerättiin savukkeiden myyjiltä viidessä ghanalaisessa suurkaupungissa ja kolmessa rajakaupungissa.

Tulokset: Tutkimuksen I tulokset osoittivat, että sekä tupakoitsijat että tupakoimattomat henkilöt pitivät kuvan ja tekstin yhdistäviä terveyvaroitusia tehokkaampina terveysviestien välittäjinä kuin pelkän kuvan tai pelkän tekstin varoituksia. Tekstipohjaisten varoitusten vaikutusten katsottiin olevan rajallisia tupakoitsijoiden heikon lukutaidon vuoksi. Keuhkosyöpää, sokeutta, aivohalvausta sekä kurkku- ja suusyöpää koskevien varoitusviestien koettiin vaikuttavan eniten tupakointikäyttäytymiseen.

Tutkimuksessa II havaittiin tupakointia kolmanneksessa käydyistä ravintola-alan yrityksistä. Sisäilman $PM_{2,5}$-hiukkasten pitoisuus oli keskimäärin 14,6 $\mu g/m^3$ (vaihteluväli: 5,2-349). $PM_{2,5}$-pitoisuudet olivat korkeammat yrityksissä, joissa tupakointia havaittiin (28,3 $\mu g/m^3$) kuin yrityksissä, joissa tupakointia ei havaittu (12,3 $\mu g/m^3$).. Savuttomuuspolitiikan noudattamisaste oli alhaisin (59,5%) ja ilmanlaatu huonompi ravintola-alan yrityksissä Ghanan pääkaupungissa Accrassa kuin kahdessa muussa kaupungissa. Tutkimuksessa III ravintola-alan yritysten 142 työntekijästä/omistajasta 27,5 prosenttia tiesi Ghanan tupakoinnin torjuntaa koskevasta laista, 29 prosenttia tupakointikiellosta julkisilla paikoilla, 22 prosenttia savuttomista vyöhykkeistä ja 6,3 prosenttia tupakoinnin kieltävistä merkeistä. Accran vastaajien tietämys oli suurempi kuin Tamanalen vastaajien (OR=3,08; 95 % luottamusväli, CI: 1,10-8,60). Vaikka 80 prosenttia vastaajista kannatti savuttomuuspolitiikkaa, mielipiteet olivat vähemmän myönteisiä Accrassa kuin Tamalessa (OR=0,25; 95 prosentin CI: 0,08-0,71). Mitä tulee savuttomuuspolitiikan noudattamiseen ravintola-alan yritysten tyyppien mukaan, hotellit noudattivat sitä kolme kertaa todennäköisemmin kuin baarit ja pubit (OR=3,16; 95 % CI: 1,48-6,71).

Tutkimuksessa IV laittomat pakkaukset muodostivat 19,5 prosenttia (95% CI: 18,34-20,66) kaikista kahdeksassa ghanalaisessa kaupungissa kerätyistä pakkauksista (n=4461). Aflaossa (Ghanan ja Togon rajalla) ja Tamalessa (Ghanan ja Burkina Fason rajalla) oli eniten laittomia savukkeita (99 % ja 46 %, $p<0,001$). Suuri osa laittomista askeista oli peräisin rajamaista, kuten Togosta (51 %), Nigeriasta (14,8 %) ja Norsunluurannikolta (10,3 %). Vakioimattomat ja vakioidut logistiset regressiomallit osoittivat, että Ghanassa lähikaupoissa, rajakaupungeissa ja maan pohjoisella vyöhykkeellä myydyt savukkeet sekä halvemmat savukkeet olivat todennäköisemmin laittomia savukkeita kuin vertailuryhmien savukkeet (juomabaarit, muut kuin rajakaupungit, korkeamman hintainen pakkaus sekä keskimmäinen ja eteläinen vyöhyke).

Päätelmät: Tutkimustulokset osoitttavat, että varoitusmerkinnöillä, joissa yhdistyvät kuvat ja teksti, voi olla mahdollista vaikuttaa myönteisesti tupakointikäyttäytymiseen. Vaikka tupakoinnin rajoittaminen julkisilla paikoilla, kuten ravintola-alan yrityksissä, saa vahvaa kannatusta, ravintola-alan henkilökunnan tietämys nykyisestä savuttomuuspolitiikasta on heikko ja sen noudattaminen on vähäistä. Markkinoiden ja savukkeiden toimitusketjun valvontaa tulee tehostaa etenkin rajakaupungeissa ja maan pohjoisosissa, jotta laittomat savukemarkkinat saadaan kuriin.

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ABBREVIATIONS

DSAs	designated smoking areas
DHS	demographic health surveys
EU	European Union
FCTC	Framework Convention on Tobacco Control
FDA	Food and Drugs Authority
GHC	Ghana cedis
GYTS	Global Youth Tobacco Survey
ITC	International Tobacco Control
LMICs	low and middle-income countries
MPOWER	acronym for six tobacco control measures
PHW	pictorial health warnings
$PM_{2.5}$	particulate matter 2.5
SFP	smoke free policy
SDG	Sustainable Development Goal
SHS	secondhand smoke
SSA	Sub-Saharan Africa
USD	United States dollars
WHO	World Health Organisation

LIST OF ORIGINAL PUBLICATIONS

I. **Singh, A**., Owusu-Dabo, E., Britton, J., Munafò, M. R., & Jones, L. L. (2014). "Pictures don't lie, seeing is believing": exploring attitudes to the introduction of pictorial warnings on cigarette packs in Ghana. Nicotine & tobacco research: official journal of the Society for Research on Nicotine and Tobacco, 16(12), 1613–1619. https://doi.org/10.1093/ntr/ntu127

II. **Singh, A**., Okello, G., Semple, S., Dobbie, F., Kinnunen, T. I., Lartey, K. F. ... Owusu-Dabo, E. (2020). Exposure to secondhand smoke in hospitality settings in Ghana: Evidence of changes since implementation of smokefree legislation. Tobacco Induced Diseases, *18*(May), 44. https://doi.org/10.18332/tid/120934

III. **Singh, A**., Dobbie, F., Kinnunen, T. I., Okello, G., Semple, S., Boakye Okyere, P. ... Owusu-Dabo, E. (2021). Adherence to smokefree policies in Ghana: Findings from a cross-sectional survey of hospitality venue owners and staff. Tobacco Prevention & Cessation, 7(January), 4. https://doi.org/10.18332/tpc/131058

IV. **Singh, A**., Ross, H., Dobbie, F., Gallagher, A., Kinnunen, T., Logo, D.D., …Owusu-Dabo, E. (2022). Extent of illicit cigarette market from Single Stick Sales in Ghana: findings from a cross sectional survey. BMJ Open (accepted).

Roman numbers are used in the text to identify the above-listed publications. Reprints of the original publications were made with the consent of the owner's of the copyright.

1 INTRODUCTION

Tobacco is the second leading risk factor globally (after high systolic blood pressure) for attributable deaths, accounting for 8.7 million deaths of all deaths in 2019 (Abbafati et al., 2020). According to recent estimates, 22.3% of the global population (aged 15 years and older) were current users of tobacco, down from approximately one-third (32.7%) in 2000 (World health statistics, 2022). The prevalence of tobacco use is also higher amongst men (49.3%) than women (16.2%) aged 15 years and older in 2000 (World health statistics, 2022). Similarly, current tobacco use among adolescents (11-17 years) stands at 19.1%, with more males (23.7%) than females (13.7%) (James et al., 2022).

It is estimated that by 2030, tobacco-attributable deaths will be doubled in low- and middle-income countries (LMICs), including countries in Africa (WHO-AFRO, 2021). Although Africa is less affected by the current tobacco epidemic, it is expected to experience a significant growth in tobacco consumption (Brathwaite et al., 2017). This has been attributed to factors such as urbanization, westernization, and changing demographics, as well as increasing penetration of the tobacco industry through its aggressive marketing campaigns targeting primarily young people (Vellios et al., 2018).

The World Health Organization's (WHO) Framework Convention on Tobacco Control (FCTC), adopted in 2003, is one of the most widely embraced treaties in United Nations history (WHO, 2021b). As of 2020, 182 countries (90% of the global population) are party to the convention. Despite many African countries have signed and ratified the WHO Framework Convention on Tobacco Control (WHO-FCTC), implementation of the FCTC remains a challenge and many have not fully implemented robust tobacco control policies as enshrined in the WHO-FCTC guidelines (WHO, 2021a). This has been attributed largely to the governments focusing on more immediate threats due to communicable diseases, the sustained attempts by the tobacco industry to undermine the enactments and implementation of robust laws, corruption, and resistance from the public in some countries as tobacco is considered their source

of livelihood (Chung-Hall et al., 2019). The tobacco industry continues to make substantial efforts to weaken policy creation and undermine implementation throughout the region, exploiting and aggravating a significant and acknowledged "implementation gap" in tobacco control (Egbe et al., 2022). Also, according to the Centre for Tobacco Control in Africa, the data on the tobacco situation in Africa is very scantly as compared to Europe and the Americas, and the region is referred to as a "research desert" that is in urgent need of more investment in tobacco control research and training (CTCA, 2020). Most tobacco control research is conducted in high-income nations, and it is not directly applicable to the African continent. The absence of policy-relevant research for efficient tobacco control measures is a significant issue contributing to the implementation gap of tobacco control policies in the African region (Dobbie et al., 2019). Given the differences in the population structure, availability of a diverse range of tobacco products; sociocultural determinants, and political environment, context-specific studies tailored to the needs are required within the region (Singh et al., 2021).

Ghana, an LMIC in West Africa has a current smoking prevalence rate below 10% (Tobacco Atlas, 2017). Recent surveys have found smoking prevalence to be higher among young adults (25–29 years old) as compared to older age groups (30–39 years old) (Ghana Statistical Service (GSS), Ghana Health Service (GHS), 2015). According to the findings of the 2017 Global Youth Tobacco Survey (GYTS), about 9% of students aged 13-15 years use tobacco products (Ghana Global Youth Tobacco Survey, 2017). The high prevalence of future tobacco use in many African countries including Ghana will be mainly a result of industry tactics that seek to target young people and provides access to cheap tobacco products (Boachie et al., 2022). Also, the projected relatively high smoking rate (including the use of shisha and e-cigarettes) (Logo et al., 2020) in Ghana is troubling since more than 5000 people currently die from tobacco-related diseases annually (WHO, 2018). Tobacco use in Ghana has also led to economic losses of around 668 million Ghana cedis (GHC) in 2019. These losses are equivalent to 0.2 percent of Ghana's gross domestic product.

Despite the early ratification of the WHO FCTC in 2004 by Ghana, there is a significant and recognized 'implementation gap' and poor enforcement within several FCTC articles including health warning labels, SFP, and illicit tobacco trade (WHO, 2021a). Ghana introduced pictorial warning labels on cigarette packs only in 2018

(Singh et al., 2019). No prior studies on the perception of the Ghanaian population on the introduction of pictorial warnings on cigarette packs existed. Also, compliance with the current smokefree policy (SFP) in Ghana has been sub-optimal according to the only study conducted pre and post-implementation of the SFP in 2012 (Agbenyikey et al., 2011, 2018). Further, in light of the tobacco industry's use of illicit trade to oppose tobacco control measures such as tax increases and the lack of studies on the illicit tobacco market, an understanding of the extent and nature of the illicit tobacco trade is needed. Most governments in sub-Saharan Africa (SSA) including Ghana do not measure the size of the illicit tobacco market nor analyze its features regularly (Egbe et al., 2022)

There is an urgent need for research performed in nations within the African region to help better inform policies and their implementation (Husain et al., 2016). This study aims to generate evidence to inform policy and practice and provide scientific support by addressing three broad knowledge gaps in the area of tobacco control in Ghana; cigarette pack warnings, SFP, and illicit tobacco trade. The results of these studies would fill in research gaps and add to the body of knowledge about tobacco control in Africa, arguing for improved FCTC implementation and a decrease in disease and mortality rates associated with tobacco use.

2 REVIEW OF LITERATURE

2.1 Global burden of tobacco use

Tobacco use imposes a significant economic burden all over the world, particularly in developed countries in Europe and North America, where the tobacco epidemic is most severe. Over 80% of tobacco users are cigarette smokers, though a diverse range of other combustible and non-combustible products (eg, snuff, chewing tobacco, cigars, waterpipe, pipes, bidis, and kreteks) is available (WHO, 2018). More recently, in 2007, electronic nicotine delivery systems (also called e-cigarettes or vaping products) were launched. This is a class of product that commonly contains a battery that powers a heating element to aerosolize a liquid typically containing nicotine, flavorings, and humectants.

Globally in 2019, an estimated 155 million individuals aged 15–24 years were tobacco smokers, with a prevalence of 20.1% among males and 4.95% among females (Reitsma et al., 2021). However, current tobacco use has been declining globally, with a prevalence of 33% in 2000 (WHO, 2018) In 2019, there were 1.14 billion current smokers who consumed 7.41 trillion cigarette-equivalents of tobacco according to the Global Burden of Disease Study (2019) (Reitsma et al., 2021). The prevalence of other forms of tobacco such as electronic nicotine delivery systems is however low; among children and adolescents (8-20 years) is 7.8% globally and just about 1% among adults (Pan et al., 2022; Yoong et al., 2021).

Tobacco smoking accounted for over 7.7 million deaths and 200 million disability-adjusted life years in 2019. About 6.7 million out of the total 7.7 million deaths attributable to smoking tobacco use were among current smokers (Abbafati et al., 2020). Tobacco also remains one of the leading risk factors for deaths among males

(20.2% of male deaths) (Reitsma et al., 2021) and 5.8% of all deaths among females (Abbafati et al., 2020).

Of the total number of smokers, around 80% reside in LMICs. About two-thirds of the global tobacco smoking population resides in China, India, Indonesia, the United States, Russia, Bangladesh, Japan, Turkey, Vietnam, and the Philippines in 2019. Also, China alone had 341 million (30%) of the world's 1.14 billion tobacco smokers in 2019 (Reitsma et al., 2021) Figure 1 (below) shows the prevalence of current daily smokers (age 15 years and above) in different countries.

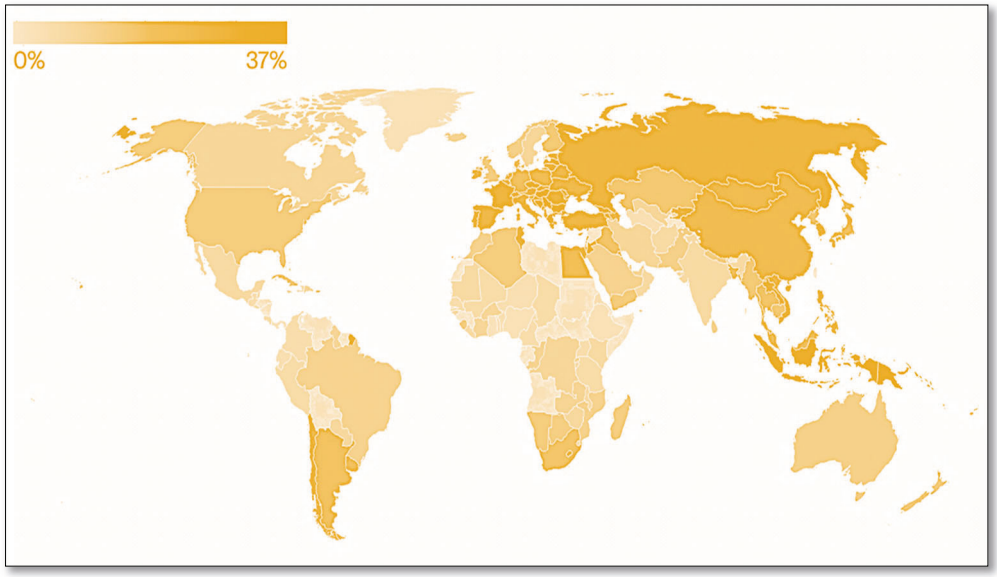

Figure 1. Current Smoking Prevalence: Percentage of daily smokers aged 15+ (2019). Source WHO GCTR 2021

The number of tobacco-related deaths is projected to increase from about 6 million to about 8 million deaths annually by 2030, with more than 80% of these occurring in LMICs (U.S. National Cancer Institute and World Health Organization., 2016). Projections also indicate that by 2030, approximately 26 million new cancer cases and 17 million cancer deaths per year will occur. This is almost twice the numbers in 2007;

12 million new cases and 7.6 million cancer deaths were estimated in 2007 (WHO, 2018).

Tobacco smoking among men aged 15–49 years is higher among the poorest and least educated subgroups according to demographic and Health Surveys conducted between 2010–2019 in 49 LMICs (World health statistics, 2022). Across these 49 countries, 25.6% of men with no education smoked any type of tobacco product compared to 9.1% of those with higher education levels. Similarly, smoking prevalence was highest among men in the poorest quintile, decreasing step-wise across the wealth quintiles (World health statistics, 2022)

These figures indicate a strong possibility that the global target of a 30% relative reduction in tobacco use by 2025 agreed to by WHO Member States will not be met (WHO, 2018). The amount of progress made in lowering the incidence of tobacco use and the dedication of various nations to tobacco control has also varied greatly. The fact that development has slowed down in many nations over the past ten years and yet the number of smokers around the world is still rising due to population expansion is alarming. To decrease the prevalence of current smoking and to prevent smoking initiation, particularly among adolescents and young people, it is been recommended that all governments urgently need to enact and execute a comprehensive package of evidence-based measures (Reitsma et al., 2021).

2.2 Regional and national burden of tobacco use

Smoking prevalence has been decreasing globally, although trends in smoking vary substantially across countries and by gender. Among men, smoking prevalence started to decrease in most high-income countries in the mid-1990s, followed by generally smaller decreases in some LMICs after 2010 (Abbafati et al., 2020). However, there has been no change, or there has even been an increase, in smoking prevalence in many other LMICs. Countries with the highest male smoking prevalence are located in East Asia, Southeast Asia, and Eastern Europe. Similar to the pattern observed among men, smoking prevalence for women has also been decreasing in most high-income countries and some LMICs, although the decrease began later and was slower than that for men

(Abbafati et al., 2020). Most countries with the highest smoking prevalence in women are in Europe. Countries that have implemented the best practices for tobacco control, including monitoring, smokefree policies, cessation programs, health warnings, advertising bans, and taxation, have been able to reduce smoking rates and related harms (WHO, 2018). However, the use of electronic cigarette use has rapidly increased since its introduction to the market (Islami et al., 2015).

Within SSA, evidence from a systematic review of 13 countries indicates that smoking prevalence varies widely ranging from 1.8% in Zambia to 25.8% in Sierra Leone (Brathwaite et al., 2017). Also, as observed in other parts of the world, the prevalence of smoking among women has been consistently lower than among men with the widest gender difference observed in Malawi (men 25.9%, women 2.9%). However, Rwanda has the highest prevalence of women smokers (12.6%). SSA is also considered to be in stage one of the tobacco epidemic continuum (Crosbie et al., 2021). One characteristic of this first stage is a predominantly higher prevalence of smoking among men than among women. In 2010, the estimated prevalence of smoking in SSA in 2010 was 14% in males and 2% in females, which supported this first stage criterion (The World Bank., 2010). However, among youth in Africa, smoking prevalence (9%) is slightly higher than in other developing regions such as South East Asia and Western Pacific region (8%) (The World Bank., 2010).

The number of smokers is projected to increase by over 60% in 2025 as compared to 2000 in the African region (WHO, 2018). Several factors have been indicated for this rise in the tobacco use burden; an increase in the affordability of tobacco products; the tobacco industry's aggressive marketing in Africa, the rising young population, and improved economic conditions in the continent (Crosbie et al., 2021). Further, the tobacco market in SSA is mostly unregulated, and tobacco control laws are weak or are not fully implemented and enforced even when present. There is also an existing poor health infrastructure and limited resources allocated to healthcare in the region (Husain et al., 2021).

Ghana, in West Africa, is situated on the Atlantic Ocean with neighboring countries including Togo, Cote d'Ivoire, and Burkina Faso. With a population of 31.7 million in 2020, Ghana became the first sub-Saharan nation in colonial Africa to achieve

independence in 1957 (Wikipedia, 2022). Adult male tobacco use prevalence in the nation has been under 10%, whereas adult female tobacco use prevalence is substantially lower (less than 1%) (Singh et al., 2020). Among youth aged 13 to 15 years, findings from the GYTS, 8.8% of students used tobacco products overall, and about 5.3% of students used other forms of tobacco such as water pipes (shisha) (Ghana Global Youth Tobacco Survey (2017) (Table 1).

Table 1. Tobacco use prevalence in Ghana (2003-2017)

Year (n)	Demographic Health Survey (Tobacco use prevalence) Male/female	Year (n)	GYTS (Current tobacco use among 13-15 years) Males/females
2003 (10505)	8.8/0.1	2000 (1088)	16.2/17.4
2008 (11913)	7.0/0.4	2006 (5185)	11.6/10.9
2014 (11835)	4.8/0.1	2009 (4171)	14.1/10.6
		2017 (5664)	8.8/8.1

Source: Singh et al (2021)

Tobacco usage in Ghana also varies by region in the nation, with a higher frequency among individuals residing in less developed areas (such as the northern region) than in the southern part of the nation. Even within the northern part of the nation, there are substantial differences in the prevalence of tobacco use: 31.2% in the Upper East, 22.5% in the Northern, and 7.9% in the Upper West (Yawson et al., 2013).

Cigarettes continue to be the most popular tobacco product in the nation. However, smokeless tobacco products (with less than 1% of tobacco use) are also used on the teeth and gums and chewed and sniffed. Evidence from the Demographic Health Survey data in 2014 indicates that men in lower socioeconomic categories (poor and low education) tend to have a higher likelihood to smoke as compared to well-educated categories; male smokers between the ages of 44 and 60 years with primary education have a higher likelihood to smoke greater quantities of cigarette daily (Nketiah-Amponsah et al., 2018). Also, regional differences exist within the country in terms of

tobacco use intensity; smokers residing in the Upper East and Upper West regions of the northern sector (socioeconomically deprived areas) of the country are reported to smoke more intensely than their counterparts in the Greater Accra region (Nketiah-Amponsah et al., 2018).

2.3 Tobacco control efforts

Significant international efforts have been made over the past 20 years to stop the tobacco epidemic, particularly following the approval of the WHO FCTC in 2003 and the MPOWER (an acronym for the first letters of the strategy) that followed. In 2015, the 2030 Agenda for Sustainable Development also added strengthened tobacco control as a global development goal in acknowledgment of the growing burden caused by tobacco usage.

2.3.1 Framework Convention on Tobacco Control (FCTC)

The WHO FCTC was established by the World Health Assembly in 2003 and came into effect in 2005 as a reaction to the globalization of the tobacco pandemic. As of May 2020, there were 182 Parties to the FCTC, making it one of the United Nation's (UN) Treaties that has been most broadly ratified. It lays out a comprehensive plan for Parties to address the tobacco epidemic and a wide variety of evidence-based actions to lessen tobacco demand (Articles 6–14) and supply (the rest of the document) (Articles 15–17) (WHO, 2021a).

The WHO defines the FCTC as "*an evidence-based treaty that reaffirms the right of all people to the highest standard of health*"(WHO, 2005).

The treaty deals with tobacco control measures such as demand and supply-side reduction measures, environmental protection, protection from tobacco industry interference, multi-sectoral tobacco control strategies implementation, nicotine addiction, and second-hand smoke exposure, public awareness, illicit tobacco trade, and measures such as tax increases or ban advertising (WHO 2005) (Table 2).

Table 2. Brief description of the Framework Convention on tobacco control (FCTC) Articles

FCTC Article	Description
Article 5.3	Protect tobacco control policies against industry interference.
Article 6	Price and tax measures to reduce tobacco consumption, including raising the price of tobacco products through taxation, prohibiting/restricting tobacco sales to international travellers and dedicating tobacco tax revenues to fund tobacco control.
Article 8*	Protection from exposure to tobacco smoke in indoor public places, workplaces, public transport and other public places.
Article 9	Regulation of tobacco product contents through testing and measuring contents and emissions of tobacco products.
Article 10	Regulation of tobacco product disclosures by requiring tobacco manufacturers and importers to disclose information about contents, toxic constituents and emissions of their products.
Article 11*	Require health warnings on tobacco product packaging and prohibit misleading tobacco packaging and labeling.
Article 12	Use all available communication tools to promote education, communication, training and public awareness of tobacco control issues.
Article 13	Enforce comprehensive bans on all forms of tobacco advertising, promotion and sponsorship.
Article 14	Promote tobacco cessation and provide treatment for dependence through healthcare providers, and accessible, low-cost interventions.
Article 15*	Eliminate all forms of illicit trade in tobacco products, including smuggling, illicit manufacturing and counterfeiting.
Article 16	Prohibit sales of tobacco products to and by minors, including a ban on the sale of tobacco products at point of sale, restrictions on accessibility to tobacco vending machines and ban on the sale of single cigarettes or small packs.
Article 17	Promote economically viable alternatives for tobacco workers, growers and individual sellers.
Article 18	Protect the environment and health of persons with respect to the cultivation and manufacturing of tobacco.
Article 19	Legislative action to deal with criminal and civil liability, including compensation where appropriate.
Article 20	Research, surveillance and exchange of information on tobacco control, including patterns of, determinants and outcomes of tobacco consumption.
Article 21	Require Parties to submit periodic reports on implementation of the Convention.
Article 22	International cooperation to promote the transfer of technical, scientific and legal expertise and technology to establish and strengthen national tobacco control strategies.

* Articles relevant to thesis

The FCTC has been reported to make contributions along the entire policy/regulation process of tobacco control including the development of a measure, building legislative and political support for a measure, and its implementation. Stakeholders in tobacco control report that the FCTC has played a pivotal role in accelerating and strengthening the implementation of tobacco control measures, although tobacco industry interference continues to be a significant obstacle to further advancement (Chung-Hall et al., 2019).

However, there exists a wide gap between the ideal type and the current situation. In most countries (particularly LMICs), that have signed the FCTC agreement, its implementation has been left to under-resourced health ministries (that compete with more powerful finance and trade ministries). Recommendations require that a country should have certain policy processes such as the department of health taking the policy lead; tobacco should be 'framed' as a public health problem; public health groups should be consulted at the expense of tobacco interests; socioeconomic conditions should be conducive to policy change; and, the scientific evidence is 'set in stone' within governments (Cairney & Mamudu, 2014).

In SSA, FCTC-ratified countries account for about 25% of all parties to the treaty globally (Egbe et al., 2022). Within the region, out of the 54 countries, 51 (including Ghana) have ratified the FCTC. Malawi, South Sudan, and Eritrea are the remaining countries yet to ratify the convention in the WHO African region (Walbeek, 2021). By ratifying the convention, countries are expected to commit to adopting effective and evidence-based measures to control tobacco use. However, this is not the case for many African countries as only a few countries meet the standards of the individual articles within the FCTC concerning effective implementation.

The implementation of the FCTC remains a major challenge in many African countries (WHO, 2021a). This has been attributed to governments prioritizing communicable diseases such as malaria and HIV/AIDS, the interference by the tobacco industry in the enactment of tobacco control laws (CTCA, 2020), corruption, and resistance from the public in some countries such as Zimbabwe and Uganda, as tobacco is considered their source of livelihood (Brathwaite et al., 2015). In addition, compared to other

international regions, Africa also has the lowest cigarette tax rates, ineffective smokefree laws, and few regulations on tobacco promotion (Walbeek, 2021). The FCTC remains fit for purpose, providing a flexible framework and example of best practices for global tobacco control. Countries that have poor tobacco control are not due to the inadequacy of the FCTC, but rather the failure of parties to implement in full its evidence-based measures. This has led to insufficient progress in delivering the targets of a 30% reduction in smoking prevalence by 2030, which is a crucial component of the WHO Global Action Plan for the prevention and control of non-communicable diseases (Arnott et al., 2022).

2.3.2 Measure to assist country-level implementation of tobacco control (the MPOWER measures)

In 2008, WHO introduced the MPOWER package of six highly effective and cost-effective measures: (M) monitoring tobacco use and prevention policies, (P) protecting people from tobacco smoke, (O) offering help to quit tobacco use, (W) warning about the dangers of tobacco, (E) enforcing bans on tobacco advertising, promotion and sponsorship, and (R) raising taxes on tobacco in order to assist the implementation of the WHO FCTC in party countries (WHO, 2022a) (Table 3).

Table 3. Brief description of the MPOWER measures

MPOWER measure	Description
Monitor tobacco use and prevention policies	Surveillance of the prevalence, determinants and impacts of tobacco use, and measuring the effects of tobacco control interventions (FCTC Article 20)
Protect people from tobacco smoke	Reduce secondhand smoke exposure through comprehensive smokefree legislation in public spaces, including all indoor workplaces (FCTC Article 8)
Offer help to quit tobacco use	Cessation support through advice from healthcare providers, telephone quit lines and easily-accessible or low cost medications (FCTC Article 14)
Warn about the dangers of tobacco	Warnings on tobacco packaging and anti-tobacco media campaigns to promote awareness on the health consequences of smoking (FCTC Article 11 and Article 12)
Enforce bans on tobacco advertising and sponsorship	Bans on direct (e.g., television advertisements, billboards) and indirect (e.g., industry-sponsored events) marketing of tobacco products (FCTC Article 13)
Raise taxes on tobacco	Increasing the price of tobacco products through taxation (FCTC Article 6)

These measures encompass a comprehensive set of policies that have been shown to reduce smoking and provide guidelines for countries where more actions are needed (WHO, 2008) (Table 3). According to recent reports, as of 2020, more than 5.3 billion people (69% of the world's population) are covered by at least one MPOWER measure adopted at the highest level (Hagen et al. 2022).

There have been several studies that show the effectiveness of implementing MPOWER measures at the country level; for instance in a study by Dubray et al., on the effects of six MPOWER scores on smoking prevalence, it was found that M and R scores significantly reduced smoking prevalence (Dubray et al., 2015); in another study examining the effect of MPOWER policies on smoking prevalence and cigarette consumption in a global context, it was observed that for every one-unit increase in the composite MPOWER score, the smoking prevalence reduces by 0.8% for both males and females and a reduction of 23 sticks of cigarette (one pack of cigarettes) in cigarette consumption per capita per year (Ngo et al., 2017). In another study using data from six rounds of the WHO Reports on the Global Tobacco Epidemic, a unit increase of the MPOWER score was associated with 0.39 and 0.50 percentage points decrease in adult daily smoking prevalence among high MPOWER-high prevalence and high MPOWER low prevalence countries respectively (Husain et al., 2021).

In recent times, despite the challenges brought on by the COVID-19 pandemic in 2020, progress in MPOWER implementation continues. According to an observational longitudinal study based on national reports from 2008-2018 from 195 countries, 76 out of 195 countries improved their MPOWER scores between 2008 and 2018, with only two achieving full implementation (Brazil and Turkey) (Hagen et al. 2022). The implementation of MPOWER has increased markedly between 2008 and 2018 in all seven WHO regions and countries representing all four World Bank income classifications. The WHO regions reporting the highest levels of implementation in 2018 in mean country scores in order of ranking were (1) North America (27.0 points); (2) Europe & Central Asia (26.6 points); (3) East Asia & Pacific (25.4 points); South Asia (25.3 points); the Middle East & North Africa (24.3 points); Latin America & Caribbean (23.1 points) and SSA (20.1 points) (Hagen et al., 2022). Some of the factors that have been attributed to the poor or slow implementation of MPOWER are low-income levels, compromised human development, reduced literacy rates, higher rates of

corruption, and autocratic political regimes (Hagen et al., 2022). Also, in many West African countries, despite the governments establishing some form of tobacco control policy, measures to counter rising tobacco industry activities remain a challenge (Winkler et al., 2015).

In the 2021 WHO MPOWER report, Ghana's rating for the various components was as follows when assessed on a scale of complete, moderate, minimal, and weak or no policies (from the highest to the lowest) (WHO, 2021c):

(M) Monitoring the use of tobacco and the impact of prevention policies (minimal)

(P) Protection of people from tobacco use (moderate)

(O) Offer support to quit tobacco use (moderate)

(W) Health warning policies and mass media policies (complete for both)

(E) Advertising, promotion, or sponsorship (complete)

(R) Raise taxes on tobacco (moderate).

The three studies conducted within this thesis have a clear link with the MPOWER components. For instance, illicit trade in cigarettes is a direct effect of a challenge from raising taxes (R of MPOWER). Secondly, cigarette pack warning if not following standard picture and text warnings influence advertising and promoting cigarettes and hence challenge eliminating E of MPOWER and, lastly if monitoring and evaluation of the impact of policies such as the SFP is lacking then this directly affects the M of MPOWER gaps in Ghana. Also, in the absence of programs to treat tobacco dependence, these interventions are meant to help smokers quit hence the graphic warning would be evaluated on the extent it could help smokers quit (O of MPOWER). Similarly, the elimination of the illicit markets and enforcement of SFP may also promote smoking cessation at a population level (Figure 2).

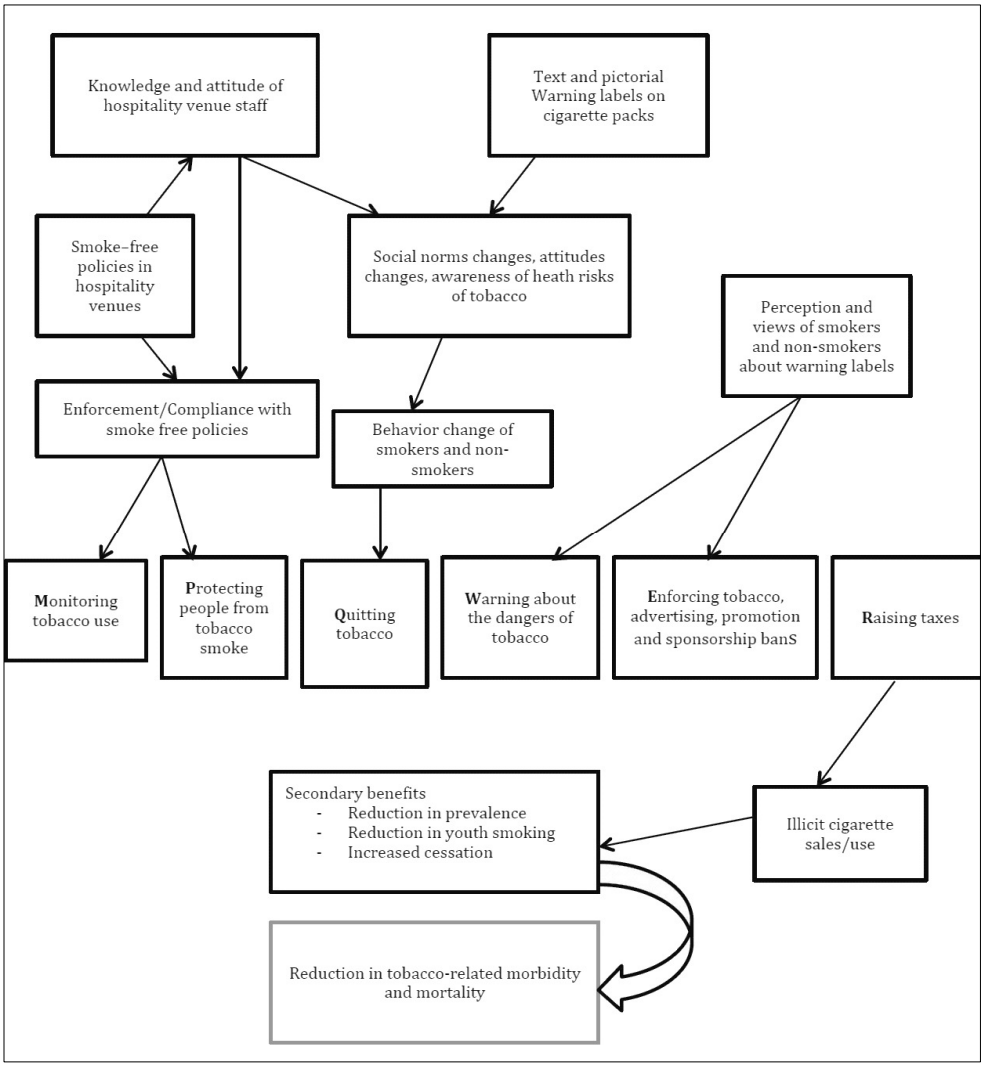

Figure 2. Conceptual framework of the study within the components of MPOWER

2.3.3 Sustainable Development Goals (SDGs)

In 2015, the magnitude of the tobacco epidemic was acknowledged in the 2030 Agenda for Sustainable Development encompassing 17 Sustainable Development Goals (SDGs). The need to strengthen tobacco control measures is directly referenced in SDG 3, but it is also highly relevant to the social, economic, and environmental dimensions of sustainable development encompassed in several other SDGs (World health statistics, 2022). The SDGs, which have 169 targets and 17 objectives, specifically mentions the value of tobacco control in SDG Target 3. a, which calls for the "strengthening of 'the implementation of the WHO FCTC' in all countries" (Matthes & Zatoński, 2019).

The integration of the FCTC in the SDG Agenda 2030 is important for national planning opportunities for governments to demonstrate fulfillment of their treaty obligations to implement tobacco supply measures including sales restrictions to minors, alternative livelihood support, and illicit trade controls. It is also important for achieving SDG 3 (Good Health and Well-Being), as well as the broader social, economic, and environmental aspects of sustainable development that are covered by several other SDGs (Matthes & Zatoński, 2019). As a result of these initiatives, smoking prevalence worldwide fell from 22.7% in 2007 (after FCTC implementation in 2005) to 19.6% in 2019 (after the introduction of SDGS in 2015) (WHO, 2021c).

2.3.4 Illicit Tobacco Trade Protocol

Illicit tobacco poses a significant threat to public health and undermines tobacco control efforts. Illicit tobacco trade increases access to cheap tobacco products causes substantial losses in government revenues and is also responsible for cross-border criminal activities (World Bank, 2019). In response to the threat posed by illicit tobacco, the WHO FCTC decided that a protocol (a new international treaty) was urgently needed to specifically address the illicit tobacco trade. The Protocol to Eliminate Illicit Trade in Tobacco Products (commonly referred to as the Illicit Tobacco Trade Protocol, is the FCTC's first protocol and a standalone new international agreement (Ross & Joossens, 2021).

The illicit tobacco protocol adds to and supplements FCTC Article 15, which deals with methods of preventing illicit trafficking in tobacco products. Through a series of actions that must be implemented by nations that ratify it, the illicit tobacco protocol seeks to end all types of illicit traffic in tobacco products. Countries that ratify the protocol agree to implement a range of actions, such as collaborating amongst international government agencies and deploying track-and-trace technologies to stop and combat illicit trade. By March 2022, 64 nations have approved the agreement (Paraje et al., 2022).

The African region is the continent with the highest proportion of countries (over 50%) that have ratified the protocol. Ghana completed the ratification of the protocol in 2021 after a long delay. One of the challenges faced in the implementation of the protocol in African countries including Ghana is the influence of the tobacco industries (Crosbie et al., 2021). The tobacco industry is well recognized for spreading false information about the illicit tobacco trade and exaggerating its scope to discourage governments from implementing tobacco control measures like higher tobacco taxes and visual health warning labels (Crosbie et al., 2021). According to reports analyzing internal British American Tobacco records, the business has engaged in smuggling in at least 40 of the 54 African nations (Legresley et al., 2008).

2.3.5 Global and regional implementation of tobacco control efforts

Although tobacco control policies have been adopted across the globe, effective implementation continues to be a major challenge, particularly in low-income and middle-income countries (LMICs). While the status of implementation has consistently improved since the entry of FCTC into force in 2005, progress towards complete implementation of its various articles remains uneven. According to a progress report on the implementation of the FCTC articles globally, the rates of implementation range from 13% to 85%. For most articles, a small increase in the average implementation rate has been observed between 2018 and 2020 (WHO, 2021a). Whilst, measures under Article 8 (protection from exposure to tobacco smoke) and 11 (health warning on tobacco packs) continue to be the most implemented articles, the implementation of

Article 13 (ban on tobacco advertising, promotion, and sponsorship) continues to lag well behind (WHO, 2021a).

Implementation of key measures within the WHO FCTC such as demand-reduction measures (WHO FCTC articles 6, 8, 11, 13, and 14) is significantly associated with lower smoking prevalence, with anticipated future reductions in tobacco-related morbidity and mortality. Evidence from data from 126 countries to examine the association between the number of highest-level implementations of key demand-reduction measures between 2007 and 2014 and smoking prevalence estimates between 2005 and 2015 indicates that there was a significant global increase in highest-level implementation of all key demand-reduction measures (Gravely et al., 2017). Geographical subregions varied in the number of key demand-reduction measures implemented at the highest level and thus in reductions in smoking prevalence. For example, Northern Europe, South America, and Australia engaged in strong WHO FCTC implementation over the first decade of the WHO FCTC and experienced corresponding large reductions in smoking prevalence (−7·11, −6·75, and −6·20 percentage points, respectively). By contrast, Western, Middle, and Northern African regions implemented very few WHO FCTC measures; these regions experienced increases in smoking prevalence (by 3·36, 12·60, and 4·60 percentage points, respectively) (Gravely et al., 2017).

Literature reviews of the FCTC's impact focus on the evaluation of key measures to reduce the demand for tobacco such as monitoring tobacco use; smokefree laws; tobacco cessation interventions; health warnings; tobacco advertising, promotion, and sponsorship bans; and tobacco tax increases exist for several implementing countries. A systematic review summarising over 1150 primary studies (up to May 2015) on the impact of FCTC policies on tobacco use, second-hand smoke (SHS) exposure, and primary health outcomes report that evidence is strongest for the effectiveness of smokefree and tobacco taxation policies, followed by mass media campaigns and health warnings on the harms of tobacco use, and affordable smoking cessation treatment interventions; limited for advertising restrictions; and unavailable for monitoring tobacco use (Hoffman & Tan, 2015). Another review reported that product-focused policies such as very low nicotine content have generated greater attention in terms of evidence thus moving consumers to reduced-risk products as compared to other product standards such as policies that target how tobacco products are supplied (user-

focused, supply-focused, or institutional structure-focused policies) (Puljević at al., 2022).

Although ratifying the FCTC is crucial for effective tobacco control, it is not enough for tobacco control efforts. To fully benefit from the FCTC, nations must domesticate the agreement by developing and putting into practice comprehensive and efficient tobacco control measures. However, inadequate investment in tobacco control is one of the key challenges in the implementation of effective tobacco control in SSA (Egbe et al., 2022). Another potential issue is the dearth of locally produced data and the inadequate mainstream media support for policy and advocacy efforts. Tobacco industries are also known to engage government representatives to fight FCTC provision and implementation in numerous SSA nations (Dobbie et al., 2019)

Ghana has been a global leader in enacting anti-tobacco and was one of the first nations to outlaw tobacco advertising through a government decree issued as early as 1982 (Wellington, 2017) (Table 4). Ghana was also one of the first five African nations to join the FCTC, and the 39th nation to ratify the FCTC in 2004 after signing it in 2003 (WHO FCTC, 2021). The Tobacco Control Act was included in the Public Health Act (851), which was passed in 2012. The Act includes measures on smoking in public places; tobacco advertising, promotion, and sponsorship; tobacco packaging and labeling and others (Campaign for Tobacco-Free Kids, 2022). After the Act was passed in 2012, a Tobacco Control Regulations (L.I. 2247) came into effect in 2017 and there were 18 months to ensure compliance with measures such as public smoking bans, and pictorial health warnings from the date of issue by the Food and Drugs Authority (FDA). (Campaign for Tobacco-Free Kids, 2022).

Table 4. Tobacco control efforts in Ghana (1982-2021)

1982	Tobacco advertising ban introduced
2000	Ghana joins the Global Tobacco Surveillance System. 1st Global Tobacco Youth Survey was conducted
2002	Ghana joins the Quit and Win International Smoking Cessation Program. Steering Committee on National Tobacco Control established.
2003.	1. National Tobacco Control Bill drafted
	2. A Demographic and Health Survey for assessing tobacco use among adults.
2004	Ghana signed and ratified the FCTC
2005	1. 2nd National Global Youth Tobacco Survey conducted.
	2. Tobacco Bill re-drafted to reflect FCTC provisions for approval.
2006	1. Directive to ban smoking in all Ministry of Health facilities issued by the Ministry of Health
	2. Directive to ban smoking in public and private commercial transport issued by the Ministry of Transportation
	3. British American Tobacco closed down manufacturing company in Ghana
2007	1. The Ministry of Health issued directive to compel importers of tobacco products to register their products and comply with the FDA regulatory requirements.
	2. The Ministry, the Ghana National Tobacco Control Steering Committee and the Ghana Tourist Board reached agreements with owners of hospitality areas to create smokefree areas for non-smokers.
2008	1. 2nd Ghana Demographic Health Survey conducted
	2. The Ghana National Tobacco Control Steering Committee reached an agreement with importers to disclose tobacco product contents
2009	1. GYTS conducted another survey.
	2. School Health Education Policy to prohibit tobacco use by children in educational settings developed by the Ministry of Education.
	3. FDA directed all tobacco products imported into Ghana to have approved health warnings.
2010	Ghana hosted the 2nd meeting of the Working Group of the FCTC Article 17 and 18
2011	The Ministry of Health issued an additional directive to mandate the posting of no-smoking signs on the premises of all health facilities.
2012	Ghana adopted a Public Health Act (Act 851 2012) with Tobacco Control in Part.6.
2014	Ghana Demographic Health Survey conducted in Ghana
2015	The parliament of Ghana approved an increase in tobacco taxes from 150% of the ex-factory to price to 175% passage of the Excise Duty (Amendment) Bill.
2016	Passage of the Tobacco Control Regulations 2016, on compliance with pictorial warnings and smokefree laws in Ghana
2018	Pictorial Health Warnings introduced
2021	Illicit tobacco Protocol ratified

Source: (Singh et al., 2020)

2.4 Cigarette pack warnings

2.4.1 Warning messages on cigarette packaging

One of the most cost-effective sources of health information among smokers has been health warnings on cigarette packs (WHO, 2021c). Health warnings on cigarette packs are an important means of communicating health risks aside from media sources such as television. Cigarette pack warning messages are warning messages that appear on the packaging of cigarettes to reinforce public awareness of the harms related to smoking habits. Cigarette pack health warnings were introduced between the 1960s and 1970s beginning in the United States of America in 1966 (Cunningham, 2022). Since then, there have been several phases of development of these warnings in countries limited to mainly, the United States of America, Canada, Australia, and the United Kingdom.

Over time, health warnings have grown in size, and graphic images have since been included. According to the FCTC (article 11) WHO. (2021b), cigarette packs must include health warnings that outline the negative effects of tobacco use or other pertinent messaging. Additionally, to retain impact and maintain saliency, Article 11 advises that there should be the frequent rotation of pictorial warnings that should cover not less than 50% of the front and rear sides of the pack (Cunningham, 2022). The FCTC also recognizes the fundamental importance of health warnings, with the FCTC's very first guiding principle stating in part as follows:

'Every person should be informed of the health consequences, addictive nature and mortal threat posed by tobacco consumption and exposure to tobacco smoke' (WHO, 2005).

Given their prominence, warning labels are an important and low-cost mechanism to communicate the dangers of tobacco use; pack-a-day smokers view health warning labels more than 7000 times a year (Borland et al., 2009). Cigarette packs with well-designed warnings reduce tobacco use and increase awareness of the health effects, and are an effective tobacco control measure by the government (Cunningham, 2022). As tobacco control measures such as advertising at points of sale, in magazines, on

television, and in other places in many nations become restricted, tobacco packaging remains a way for industries to lure new users and sustain current ones.

2.4.2 Introduction of pictorial health warnings

Health warnings featuring graphic images were first introduced in Canada in 2001. At least 134 nations will have finalized their requirements for picture warnings by October 2021 (WHO, 2021c). Additionally, pictorial warnings are probably more effective in groups with poor literacy rates, and they might be one of the few sources of knowledge about the dangers of smoking in LMICs (Tumwine, 2011). More and more nations are mandating the placement of pictures on the front and rear as well as the placement of warnings at the top of the front and back surfaces. In addition, more nations are mandating that health warnings be printed on sides besides the front and rear. By way of illustration, the European Union (EU) mandates that the words "Smoking kills" or "Smoking kills—quit today" appear on 50% of the lateral side. A series of rotational black or yellow text warnings are required in several nations, but Thailand mandates these on both lateral sides (Cunningham, 2022).

Nearly 4.7 billion individuals in 101 countries are subject to strong graphic package warnings, which account for 60% of the world's population and 55% of all nations (WHO, 2022a). More people are covered by this MPOWER strategy than by any other MPOWER measure. Close to 52% of countries, including 69% of high-income countries, 50% of middle-income countries, and 24% of low-income countries, have adopted the strongest graphic warning criteria (WHO, 2022a). However, 51 countries have warnings covering less than 50% of the package display areas (below the minimum required by the WHO FCTC), whilst 43 countries (six high-income, 24 middle-income, and 13 low-income) have warnings covering less than 30% of the pack or have non-existent warning labels (WHO, 2017b).

Within the African region, Mauritius was the first African country to implement large pictorial health warnings on cigarette packages in 2009. Ten African countries have pictorial health warnings: Chad, Kenya, Madagascar, Mauritius, Namibia, and Seychelles. Cameroon, Ghana, Gabon, and Togo (ATIM, 2020). South Africa is latest country to

consider graphic health warnings (ATIM, 2020). Currently, Chad has the largest picture warning in the region, covering 70% of the back and front of the cigarette pack. Togo, Mauritius, and Namibia all have picture warnings exceeding 50%.

In Ghana, a combined picture and text health warning is displayed in the lower half of the pack's front and back principal display area (Campaign for Tobacco-free Kids, 2022). A text-only health warning that covers 50% of the front and back surfaces and is positioned on the left is required on cartons and other exterior packaging. Currently, the FDA has approved at least seven visual health warnings that must be regularly cycled within a 24 months (Singh et al., 2020).

2.4.3 Effect of health warnings on smoking behavior

Pictorial health warnings as compared to text-only warnings have consistently been found to be effective in increasing quit intentions and perceptions of health risks. According to a review of 35 longitudinal studies on the impact of pictorial warnings on the perceived risk of tobacco use and quit intentions, combined text and picture warnings were found to be the most effective and affordable ways to raise public awareness of the serious health risks of tobacco use and discourage use (Pang et al., 2021). According to a special communication by Cunningham, warnings are found to be most effective if they are pictorial, comprehensive, and strongly worded (Cunningham, 2022). These types of warnings are also particularly effective in preventing youth and young adults from using cigarettes and smokeless tobacco (Pang et al., 2021). Health warnings have also been found to help in prompting smokers to think about quitting smoking habits resulting in decreased use (Hammond et al., 2006)

Most of the evidence on the effectiveness of pictorial over text-based warnings has been from high-income countries. In a large multi-country International Tobacco Control Policy Evaluation Survey (ITC Project) among adult smokers followed annually for five consecutive years (2002-2006) in four high-income countries (Canada, United States, UK, and Australia), the size of warnings increases warning effectiveness (measured by reading and noticing, thoughts of harm and quitting, forgoing cigarettes and avoiding the warnings) and pictorial graphic warnings were found to be superior as

compared to text-only warnings (Borland et al., 2009). In a similar ITC survey in Asia (Thailand and Malaysia) among adults, warnings that were large and more informative as in Thailand were associated with an increased effect on quitting and stronger associations with subsequent quitting as compared to text-only warnings in Malaysia (Fathelrahman et al., 2013). A meta-analysis of the experimental literature (n=37 studies) also reiterated that pictorial warnings are more effective than text-only warnings particularly in (1) supporting a cognitive and emotional reaction; (2) attracting and holding attention better; (3) showing more negative attitudes on cigarette packs and smoking and (4) in quitting and smoking initiation (Noar et al., 2016). Other studies have shown that visual health warnings are linked to improved cognitive function, emotional effects, and perceptions of salience (reading and perceiving the warning) and are more beneficial at deterring smoking and promoting quitting than text-only warnings (Ratih & Susanna, 2018).

The few studies on health warnings in the African region have shown similar findings as studies in high-income countries and other LMICs. According to evidence from quasi-experimental studies within the ITC project in Kenya and Zambia, pictorial health warnings cause increased salience, and cognitive and behavioral reactions compared with the text-only warning (Kaai et al., 2021). In the ITC project in Mauritius (the first African country to implement pictorial warnings in Africa), pictorial warnings were effective in improving behavioral reactions, and cognition and salience (Green et al., 2014). However, of note is the wearing-out effect of these warnings with time and the need to revise the pictorial warning messages over time (Cunningham, 2022).

The mechanism through which health warnings exert their effect is largely unknown and there is a dearth of theory-based research on this globally. Despite a gap, several theories such as health behavior theories and empirical models have been identified as mechanisms for the effect of warnings. Some of the oldest and most widely used theories based on behavior change are the Health Belief Model (Rosenstock, 1974) and the Theory of Planned Behavior Ajzen, 1991). These theories suggest that pictorial warnings exert their effects by changing risk perceptions and attitudes to the warnings on cigarette packs. Another theory known as the Extended Parallel Process Model (Witte, 1992) provides a theoretical framework for explaining the audience's responses to fear appeals. According to this model, persons who are exposed to fear appeals consider the severity of the threat and personal susceptibility to the threat and people

may change their behavior by eliciting fear and adaptive responding (Owusu et al., 2019). These psychological mechanisms share the insight that pictorial warnings generate deeper engagement with the messages. Contrary to the above theories, a recent study indicated that the warnings exert little influence through changes in beliefs and attitudes but rather the warnings increase quit attempts by eliciting aversive reactions and by keeping the message vividly in smokers' minds (Brewer et al., 2019).

These studies provide strong empirical support for African countries that still have text-only warnings and are thus obligated to implement pictorial warnings in line with FCTC. The majority of the studies in the region have been within the ITC project and there is a lack of qualitative studies (a methodological gap) and an in-depth understanding, particularly on the effect of pictorial warnings on smoking behavior and perceptions of smokers in the region.

2.4.4 Content of health warning messages

The visual component of health warnings plays a major role in establishing their overall relevance and impact. This feature also affects how emotionally charged and well-received they are (Cunningham, 2022). Images of health problems can be prominent and inevitable in pictures. Strong, graphic pictorial warnings are effective at deterring smoking and increasing impact, including risk perceptions and quit intentions. Fear has been linked to increases in critical outcomes like intents to stop, thinking about health concerns, and cessation behavior, and it has been postulated that it mediates the impact of health warnings (Pang et al., 2021).

Young adults in the United States who saw images that evoked fear-related reactions were more deterred from wanting to smoke than those who merely saw the text-only labels (Cameron et al., 2015). In a cross-sectional study in Thailand among tertiary-level students, out of the 21 warning graphic images presented, images that showed patients suffering from cancers (such as lung cancer) and images of body parts that have been damaged were perceived as the most ominous warnings (Yong et al., 2013). Thus the images with the scariest contents elicit greater levels of fear-related smoking harm.

Studies on the most effective individual images and message themes messages and their associated emotions within smokers and non-smokers are generally lacking in many LMICs, particularly the African region. As countries within the African region prepare to implement pictorial warnings, there is a need for more studies including qualitative studies on exploring the perception of pictorial warnings in different population groups within the African region, and studies on the most effective warning messages are required (ATIM, 2020).

2.5 Secondhand smoke exposure and smoke free policy

Secondhand smoke (SHS) is a combination of mainline smoke that is exhaled back into the air by an active smoker and side stream smoke that is emitted into the air by a lit tobacco product (such as a cigarette, pipe, or cigar) (Sureda et al., 2013). Only roughly 70 of the over 7000 compounds in SHS are known. The amount of tobacco smoked over time, the size of the room, the ventilation rate, and other activities that might eliminate pollutants all affect indoor SHS concentrations.

Exposure to SHS particularly in public settings continues to be a serious public health concern for both smokers and non-smokers around the world (WHO, 2021d). In most countries, an estimated 15%–50% of the population is exposed to SHS whilst in some countries SHS exposure affects as much as 70% of the population (U.S. National Cancer Institute and World Health Organization., 2016). Annually, around 6 million people die from diseases caused by tobacco use, including about 600,000 from SHS exposure. The burden of disease from tobacco is increasingly concentrated in LMICs (U.S. National Cancer Institute and World Health Organization., 2016).

According to GYTS data from 142 countries from 1999 to 2018, 62.9 percent of adolescents between the ages of 12 and 16 have experienced SHS exposure, the majority of which happened in public areas (Ma et al., 2021). The prevalence of SHS exposure in any location, and in particular in public areas, is still high across all WHO regions (Ma et al. 2021).

According to WHO, over 80% of the 1.3 billion tobacco users globally reside in LMICs, where the burden of tobacco-related disease and mortality is highest (WHO, 2021d). There is correlative evidence that exposure to SHS is responsible for the death of more than 880 000 individuals worldwide every year (Öberg et al., 2011). Also, children exposed to SHS, are at an increased risk of sudden infant death syndrome, acute respiratory infections, aural dysfunction, and the aggravation of asthma, compared with children with no SHS exposure (Simons et al., 2014). Exposure to SHS has also been associated with more extensive coronary artery disease and a 20% to 30% increase in cardiovascular events compared with individuals with no exposure (Barnoya & Glantz, 2005). A similar increase in lung cancer is reported among individuals exposed to SHS compared with those not exposed (Yousuf et al., 2020). Interestingly, as much as a 15% lower rate of myocardial infarction has been reported in a review of studies from Europe, America, Canada, and New Zealand, after the first year of enforcing smoking bans in public and workplaces (Lin et al., 2013).

Particular populations are more susceptible to SHS exposure and cigarette usage. Studies have revealed that compared to other workers, hospitality workers (i.e., those employed in bars, pubs, restaurants, and other establishments) are exposed to significantly greater amounts of SHS (Jones et al., 2013). For instance, smoking bans introduced in bars and restaurants in most countries have demonstrated health-related benefits (Lin et al., 2013).

In a recent cross-sectional assessment based on data from Our World in Data, the number of individuals who smoke in each country was compared with the number of premature deaths related to SHS in that country from 1990 to 2016 (Yousuf et al., 2020). Data were collected for the following World Bank regions: North America, Latin America and the Caribbean, Europe and Central Asia, the Middle East and North Africa, sub-Saharan Africa, South Asia, East Asia and the Pacific. The study showed that in regions where smoking bans have been widely adopted, such as North America, the SHS index (calculated as the number of individuals who smoked for 24 years (ie, the mean duration of smoking) associated with the death of 1 individual who does not smoke), was more favorable than in areas with minimal or no protection from SHS, such as the Middle East and North Africa (Yousuf et al., 2020). Therefore, protecting everyone from SHS exposure is a crucial strategy in lowering the burden of tobacco smoking-related illness and mortality (IARC, 2009). The creation of smokefree

environments is the sole practical scientific method for preventing the harmful effects of SHS exposure in populations as mandated by Article 8 of the WHO FCTC (WHO, 2017b).

2.5.1 Smokefree policy

The implementation of SFP measures are useful in protecting non-smokers from SHS, and can additionally increase cessation and reduce smoking initiation (Semple et al., 2022). The WHO also urges all nations to enact complete smokefree regulations, which are defined as smokefree regulations without exceptions for certain venue types or provisions for dedicated smoking spaces. Implementing SFPs has several of advantages, including a reduction in SHS exposure that results in a significant decrease in heart disease morbidity and respiratory symptoms in workers, a decrease in cigarette consumption among current smokers, an increase in successful quitting among workers, and a decrease in youth tobacco use (Byron et al. 2019; Semple et al. 2022).

SFPs have been enacted in different jurisdictions and their compliance with legislation also varies from country to country. For instance in Europe, Ireland is credited with implementing the first comprehensive national smokefree measures protecting non-smokers from SHS in enclosed public spaces in 2004. These measures included prohibiting smoking in pubs and bars and were influential in setting the direction of travel for many other European countries to follow suit. SFPs and restrictions in many states in the United States of America, Australia, and New Zealand are broadly similar and protect many people at work, on public transport, and in leisure settings including bars, restaurants, and nightclubs (Semple et al., 2022). Policymakers and regulators have also acknowledged that reducing SHS exposure is a significant public health concern, and smokers' behavior is impacted in part by their comprehension of smokefree legislation (Apsley & Semple, 2012).

Despite significant progress in implementing effective SFPs, there is a substantial difference in progress between nations with less developed nations benefiting less from the fight against SHS. Implementation challenges of this FCTC article according to the most recent report on FCTC implementation are the lack of financial resources, and the

most frequently mentioned barrier was the interference by the tobacco industry, including the industries producing novel and emerging tobacco products and nicotine products (WHO, 2021a). Additionally, there are significant differences between nations in how agreed-upon smoking bans are implemented in terms of compliance. One important factor that impedes effective SFPs includes poor political will to safeguard public health (Byron et al., 2019). As a result, especially in less developed nations, the level of enforcement and compliance is seen as being at least as important as the introduction of smokefree regulations. There has been little evidence of a drop in economic activity in hospitality venues where rules are enforced, such as restaurants or bars since the implementation of SFPs in several high-income nations over the past ten years (Jackson-Morris et al., 2016). More than 80% of the world's population, particularly in LMICs, is still not adequately protected by current restrictions, and much less has been done to decrease SHS exposure in many LMICs, including those in SSA (Byron et al., 2019).

Within the African region, there are only a few nations with effective SFPs. Additionally, the prevalence of efficient SFPs is lowest and weakest in Africa (Mamudu et al., 2020). Currently, Ghana has a partial smoking ban in enclosed public spaces, including places of hospitality, such as restaurants, bars, and nightclubs, but enables smoking in specified areas. A third of teenagers in Ghana are exposed to SHS, despite the country's general smoking prevalence being 10% for adolescents and 5% for adults (Ghana Global Youth Tobacco Survey (2017). An assessment via observational studies on air quality and SHS exposure in hospitality venues highlighted a lack of compliance with high levels of SHS exposure (Agbenyikey et al. 2011). A follow-up study after the adoption of the tobacco control act in 2012 also indicated poor compliance with the policy (Agbenyikey et al., 2018).

2.5.2 Air quality monitoring for measurement of secondhand smoke

Significant improvements in scientific techniques for evaluating and quantifying exposure to SHS have occurred in line with the growing awareness of the need to better understand the health implications of SHS. Smoking tobacco is typically the biggest source of indoor air pollution when smoking is allowed, even if other factors such as using biomass fuel and wood for cooking and heating and exposure to external air

pollution through open windows can also contribute to that (Semple et al., 2015). This is especially true in urban areas where electricity serves as the primary energy source. Evaluating the efficacy of SFPs using air quality monitoring can give unbiased scientific data on SHS and air quality levels in public places (Semple et al., 2007). However, high outdoor air pollution levels and equipment expenses have restricted the use of air quality monitoring to determine SHS exposure, especially in LMICs.

Currently, several methods exist for the measurement of SHS including real-time measurements of tobacco-generated concentrations of fine particulate matter ($PM_{2.5}$) (Semple, 2005), nicotine in air, or biomarkers of nicotine intake including salivary cotinine (IARC 2009). Currently, the most frequently used metric for assessing SHS is $PM_{2.5}$ (fine PM less than 2.5 $\mu g/m^3$) as the majority of tobacco smoke-related particles have a diameter of less than 1 μm (Semple et al., 2015). Measuring SHS exposures using biomarkers such as $PM_{2.5}$ is more advantageous compared to for instance nicotine measurement. Nicotine measurement involves lengthy sampling periods and expensive laboratory analysis. Currently, there is interest in more refined and lower-cost exposure assessment techniques have also increased as part of evaluations of policies to reduce SHS (Semple et al., 2013).

Measurement of SHS exposure has several benefits; policymakers and other stakeholders can receive objective scientific data on SHS and air quality levels in venues by using air quality monitoring equipment (Semple et al., 2022). It is also helpful in determining whether SFPs need to be better implemented or enforced. However, the use of certain instruments for measuring SHS presents several challenges including; the high cost of instrument, excessive noise levels produced by the equipment used during covert compliance checks in hospitality venues, the need for extensive training to use the equipment and data analysis, as compared to the observational survey method (Semple et al., 2022).

The availability of inexpensive air quality monitors, such as Dylos DC 1700 for measuring $PM_{2.5}$, has improved the type and volume of SHS data that can be gathered in low-income locations (Semple et al., 2015). Given that air quality measurement in developing countries (eg. Ghana) is rarely done in addition to it being costly and time-intensive, the low-cost Dylos monitors thus provide a cost-effective approach for

documenting information on SHS exposure and compliance to the SFP in public places including hospitality venues in LMICs (Jackson-Morris et al., 2016). The Dylos seems to be a reliable tool for calculating $PM_{2.5}$ in residential settings also, and it might be useful in interventions based on air quality aimed to change smokers' behavior to encourage quitting and/or smokefree homes (Semple et al., 2015).

It has been proven in numerous nations that complete smokefree legislation has been successful in preventing SHS exposure. For instance, in Scotland, the introduction of complete smokefree laws resulted in a significant improvement in the air quality in bars and pubs (Semple et al., 2007). Findings in the other parts of the United Kingdom and other high-income countries also show similar results (Abidin et al., 2013; Quansah et al., 2017; Semple et al., 2015). Studies in LMICs such as India, Chad, Mexico, Pakistan, Bangladesh, and Indonesia have indicated an average $PM_{2.5}$ of 34 $\mu g/m^3$ in venues where smoking was observed as compared to an average of 0 $\mu g/m^3$ in locations where smoking was not observed (Jackson-Morris et al., 2016).

There is limited evidence on the evaluation and compliance with the current SFP within SSA including Ghana (Dobbie et al., 2019). Only two studies on $PM_{2.5}$ measurements and compliance with SFP have been conducted in Ghana to date (Agbenyikey et al., 2011, 2018). In the 2011 study in Ghana, real-time $PM_{2.5}$ concentrations in hospitality venues were measured using TSI SidePak AM 510 Personal Aerosol Monitor. The study showed that SHS levels were unacceptably high (median $PM_{2.5}$=553 $\mu g/m^3$) in places where smoking was allowed. A follow-up study in 2015 using the same monitors for measurements showed similar findings (median $PM_{2.5}$ of 439 $\mu g/m^3$) (Agbenyikey et al., 2018). Both studies in Ghana used the Sidepak aerosol monitors for $PM_{2.5}$ measurements. Since Ghana passed the partial SFP more than 5 years ago, no research has been done to evaluate the present SFP. It is therefore timely to assess the present policy and provide comparisons to the two earlier studies in Ghana.

2.5.3 Knowledge and attitude of hospitality staff on smoke free policy

The only effective way to safeguard populations from SHS is to eliminate smoking from all indoor workplaces, including hospitality establishments (hotels, bars, pubs, etc.),

public transportation, and other areas that are open to the general public. The hospitality industry, workers and customers have traditionally been exposed to the highest levels of SHS compared with any other public place (Aherrera et al., 2017; Alkan & Ünver, 2022; Byron et al., 2019). Many countries around the world have enacted smokefree legislation to protect hospitality workers from tobacco smoke (IARC, 2009).

Despite the advantages of implementation of SFPs in hospitality venues in large reductions in workplace exposure to SHS among workers in hospitality venues, compliance with these policies is debatable (Semple et al., 2007). Knowledge and attitude of hospitality workers towards the SFPs are important to determine their level of compliance in hospitality venues. For instance, in Uganda, in a cross-sectional study in hospitality venues (bars, pubs, and restaurants) conducted two months post-implementation of the smokefree law, 97% of workers in hospitality venues were in agreement that the smoke free law protects the health of workers in these settings. Nevertheless, 32% of the respondent admitted that the law would result in financial losses at their facilities (Gravely et al., 2018). Similarly, in Nigeria, despite the high levels of awareness among hospitality venue staff about the dangers related to SHS exposure and their positive attitude to the law, exposure among workers to SHS was high (Onigbogi et al., 2015).

Studies from other parts of the world including Asia and Europe show a similar picture as above. For instance, within two states in India among workers (n=804) in hospitality venues, more than half of the workers knew of the smokefree law but compliance to the law was low (Gupta et al., 2013). In Turkey in the European Region, over one-third (37.3%) of hospitality owners and employees had adequate knowledge of the health effects of SHS and 71.3% had a positive attitude towards the law but less than 20% had personally enforced the law (Aherrera et al., 2017). The study reported the need to increase knowledge on the health effects of SHS and facilitate enforcement of the law in Turkey.

Ghana has a partial smokefree law, thus smoking in enclosed public spaces is not allowed, including eating establishments like hotels, bars, pubs, and nightclubs. However, smoking is allowed in places called designated smoking areas (DSAs).

Previous research in Ghana has emphasized the high levels of SHS and lack of compliance in hospitality venues (Agbenyikey et al., 2011). In light of the poor compliance to SFP in hospitality venues associated with increased exposure among workers in hospitality venues (Karimi et al., 2016), no previous studies have been conducted among these high-risk groups to identify the drivers of attitude towards enforcement of the SFP in Ghana. Such research has the potential to inform recommendations for the successful execution of SFP in hospitality venues in Ghana and SSA.

2.6 Illicit tobacco trade

One important threat to global tobacco control efforts is the illicit tobacco trade which refers to "*any practice or conduct prohibited by law and which relates to production, shipment, receipt, possession, distribution, sale or purchase including any practice or conduct intended to facilitate such activity*" (Tobacco Tactics, 2021). There are three categories of illicit trade products; those that are smuggled, counterfeits and illicit (also known as cheap whites) (World Bank, 2019). The illegal nature of these products makes the measurement of sales and consumption of illict cigarettes difficult (Vellios et al., 2021). Also the availability of public data on the topic is almost non-existent in many countries especially LMICs (Rossouw et al., 2019).

Comparisons of illicit trade markets in countries are challenging since different sources employ various methodologies and produce estimates that are greatly inconsistent. When compared to independent research, tobacco firms have been proven to overstate the scope of the illicit trade (World Bank, 2019). Nevertheless, tobacco businesses continue to utilize this information to support their claims about the illicit tobacco trade and its drivers notwithstanding the unreliability of industry measures (Rossouw et al., 2019).

Illegal tobacco trade has a number of detrimental effects and is linked to public health consequences, including the financial expenses of diseases related to tobacco use. Because of the increased availability of tobacco products due to illicit commerce, which lowers their price, younger and poorer persons are disproportionately affected by the

direct increases in harms (Ross, 2015). Illegal trade benefits the tobacco business in a number of ways. First, by supplying tobacco goods at inflated prices, illegal trading boosts tobacco consumption (Paraje et al., 2022). Second, the accessibility of illegal substances contributes to the widening of health disparities and directly undercuts tobacco control measures, including evading tax hikes and obnoxious health warnings intended to reduce demand for cigarette products (Ross, 2015). Last but not least, illegal cigarettes raise the rate of tobacco use and mortality caused by tobacco use while defrauding governments of astonishing quantities of money through tax evasion (World Bank, 2019).

2.6.1 Extent of illicit tobacco trade

The illicit cigarette market is estimated to account for 11.6% of the global cigarette market which accounts for close to 657 billion cigarettes a year and $40.5 billion in lost revenue (The World Bank, 2018). Recent data on the estimates of illicit trade in cigarettes from 36 countries indicates that it was about 11.2% of the total consumption in the 2010–2018 period (Goodchild et al., 2022). However, the burden of illicit cigarette trade falls mainly on LMICs; 9.8% in high-income countries and 16.8% in LMICs (World Bank, 2019). Also, the annual tax revenue lost to governments in LMICs far exceeds the tax revenue lost in high-income countries. According to Joosens et al. (2009), governments stand to benefit at least $31 billion and save close to 160,000 lives annually starting in 2030 if the illicit trade was completely eradicated.

Several techniques can be used to determine whether cigarettes are being sold illegally, for example, pack examinations (including littered packs, smoker survey, and vendor pack survey) and the gap method (estimates the difference between the total cigarette market and tax-paid and tax-unpaid) (Michal et al., 2020). Depending on the specific circumstances, researchers may want to employ the smoker pack examination approach or the littered pack collection method or use them both concomitantly. The smoker pack examination approach involves collecting data from the tobacco product pack during a survey of tobacco users. The survey can also ask smokers about their product, such as product price and place of purchase. In a littered pack collection, the data is collected from packs that were previously discarded on the ground in public places. In countries (mainly LMICs), where a large percentage of cigarettes are sold in the form of

single sticks, the vendor pack survey is used. In such cases, the littered pack collection method would miss the properly disposed of packs from single stick vendors. In the vendor pack survey, the vendor of loose cigarettes sets aside emptied cigarette packs for collection by enumerators at the end of the day. The vendor pack survey was first implemented in India, where 55 percent of cigarettes are sold as loose cigarettes (John & Ross, 2018).

The extent of illicit cigarette consumption varies between countries. For instance, in Poland using observational methods such as personal possession of packs by smokers, and collection of discarded packs on streets indicates a prevalence of 14.6% and 15.6% respectively (Stoklosa & Ross, 2014a). In another study in Argentina, using a similar methodology, of a total of 4,906 packs collected, illicit cigarette packs comprised 3.7% of the total (Pizarro et al., 2021). In LMICs such as India, using the empty pack survey methods, 2.73% of the packs collected from a total of 11063 empty cigarette packs were illicit (John & Ross, 2018a). Estimates from Pakistan, using littered packs and consumer surveys indicated that one out of six cigarette packs consumed in Pakistan were illicit (Khan et al., 2021). Despite a lack of estimates on the extent of illicit cigarette consumption in the African region, estimates within the region are higher than in other parts of the world. For instance, using the gap method in Nigeria, 26% of the tobacco products consumed were found to be illicit (Adeniran et al., 2020). Further, the size of the illicit cigarette market in South Africa using the gap method ranges from 30-35% (Vellios et al., 2021).

Despite the low prevalence of tobacco use in Ghana and the lack of an active tobacco industry, illicit cigarettes made up 39% of total cigarette volume sales in 2018 which was higher than 35% in 2017 (Euromonitor, 2019). Although Euromonitor obtains its data from annual reports and an online database, its estimates have been criticized for being unreliable and inconsistent, and for lacking independence due to the Euromonitor entering into business contracts with Philip Morris International (Blecher et al., 2015). Although Ghana was one of the first countries to ratify the FCTC in 2004, ratification of the illicit tobacco protocol was only completed in October 2021 (Myjoyonline, 2021). There is a lack of research on the illicit tobacco market in most parts of the African region and Ghana is not an exemption (Dobbie et al., 2019). Filling in this research gap and measuring the size of the illicit tobacco market using methods suitable for regions with single stick sales will produce a more comprehensive picture of the illicit tobacco trade in Ghana and also support tobacco control efforts.

2.6.2 Characteristics of illicit tobacco trade

Forcing market access into new and expanding regions, like Asia, Eastern Europe, and Latin America, has long been a strategy used by transnational cigarette businesses, most notably Philip Morris and British American Tobacco (Legresley et al., 2008). Tobacco firms deliberately exaggerate the scope of the illicit tobacco trade and disseminate false information about it to discourage governments from enacting tobacco control policies like higher tobacco taxes and visual health warning labels. British American Tobacco has been involved in smuggling in at least 40 of the 54 African countries, according to prior studies that analyzed internal tobacco business records from the corporation (Crosbie et al., 2021). Individual cigarettes are frequently sold in various African nations, including Benin, Ethiopia, Niger, Nigeria, Ghana, and Senegal, despite a ban on sales. Individual cigarettes are sold in pushcarts in grocery and convenience stores adjacent to schools in Benin, Burkina Faso, Cameroon, Nigeria, and Uganda (Crosbie et al., 2021).

Contrary to claims made by the tobacco industry, taxes and prices only have a small influence on the market share of illegal cigarettes at the national level. According to data, the illicit cigarette market is considerably bigger in nations with low cigarette taxes and prices while being relatively smaller in nations with higher cigarette taxes and prices (Ross et al., 2020). The availability of informal distribution networks, governance status, a lax regulatory environment, social acceptance of illicit trade, and other non-price characteristics appear to be significantly more significant determinants of the size of the illicit tobacco market (Paraje et al., 2022).

In Ghana, the sale of illicit cigarettes is linked mainly to Ghana's porous borders, especially its northern border with Burkina Faso and its eastern border with Togo (Euromonitor, 2019). Major source countries for illicit cigarettes include Burkina Faso and Nigeria, with Nigerian products smuggled in via Togo. Northern Ghana sees particularly strong illicit trade, with most smuggling from Burkina Faso finding their way to this region. Most products smuggled in from Togo originate from British American Tobacco's Nigerian operations, with lower taxes in Nigeria enabling these to be sold at a lower price in Ghana. This includes brands that are also legally available in Ghana, such as Rothmans and Pall Mall, further contributing to unwitting purchases by consumers (Euromonitor, 2019)

2.7 Justification for study

In comparison to other regions, smoking prevalence in much of the African region is relatively low; however, the aggressive marketing tactics used by the tobacco industry, economic growth, and the increasing young population all contribute to projections indicating an increase in tobacco use in the future. Despite this, a large number of studies on tobacco control are carried out in high-income nations that cannot be directly applied to the African context due to differences in population, sociocultural, product diversity, health, economic, and environmental dangers, as well as political situations. Many African nations, including Ghana, have made little headway in implementing the FCTC provisions. A key factor that is responsible for this implementation gap in the FCTC is the lack of policy-relevant research for efficient tobacco control interventions.

Given the projected increase in the tobacco burden in Africa due to increasing population and industry influence, there is an urgent need for evidence about the effectiveness of pictorial health warnings in the African context, where there are weaker systems of tobacco control and law enforcement, very low levels of literacy, as well as low awareness of the harms of using tobacco. Currently, evidence on the effectiveness of cigarette pack pictorial warnings on smoking behavior and initiation is lacking in Africa and Ghana. No prior studies to understand the perception and attitude of smokers and non-smokers towards the introduction of pictorial warning on cigarette packs and its effect on smoking behavior in Ghana has been conducted to date.

Additionally, article 8 of the FCTC requires protection against cigarette smoke exposure in all indoor workplaces, public transportation, and other public areas, including hospitality venues. The reduction of SHS exposure is a significant public health concern that regulators and policymakers have acknowledged. Despite the WHO's recommendation that all countries adopt comprehensive smokefree legislation, Ghana has a partial smokefree regulation that allows smoking in selected types of enclosed public areas. However, data regarding the evaluation of the implementation of the SFP and compliance levels is limited. More than 5 years after Ghana implemented its SFP, it is appropriate to assess the effectiveness of the current strategy given the use of other tobacco products (such as shisha), as well as to provide comparison information with

earlier studies conducted in Ghana. Evaluating the smokefree law in Ghana helps identify any enforcement issues and gauging compliance with the law's existing requirements.

Lastly, the trade of illicit tobacco poses several negative impacts and is associated with public health harms including economic costs of tobacco-related illness. The burden of illicit cigarette trade falls more on LMICs than high-income countries. Although, the illicit tobacco market is difficult to measure and multiple methods are usually employed to corroborate various estimates, current methods for estimating illicit cigarettes such as the empty pack survey have been unexplored in the African continent, where the sales of single sticks is a common practice. Measuring the size of the illicit tobacco market and its associated factors will produce a more comprehensive picture of the illicit tobacco trade in Ghana to inform public policies so that they are (better) tailored to the needs of tobacco control and the revenue generation goal of the government.

This thesis aims to fill both knowledge and methodological gaps in three main areas under tobacco control to bolster Ghana's FCTC implementation; cigarette packaging with pictorial warnings; smoke free policy assessment and illicit tobacco trade in Ghana.

3 AIMS OF THE STUDY

The primary goal of the study was to produce evidence to guide the implementation of efficient tobacco control strategies and to advance crucial development priorities in Ghana.

The specific objectives were:

1. To compare perceptions of textual and pictorial warning labels on cigarette packs among smokers and non-smokers in Ghana, and explore their views on the introduction of pictorial warnings in Ghana.
2. To evaluate the implementation of the SFP in hospitality venues in three cities in Ghana.
    I. To provide objective data on SHS by measuring fine particulate matter, $PM_{2.5}$ (a marker of SHS) in hospitality venues.
    II. To determine the level of compliance to the SFP at hospitality venues.
    III. To evaluate the knowledge, opinions and compliance related to the SFPs among staff of hospitality venues.
3. To characterize the extent, nature and factors associated with illicit cigarette sales in Ghana.

4 METHODS

4.1 Study design

This doctoral dissertation included four unique studies with different study designs and/or populations. Study I was a qualitative study among male and female smokers and nonsmokers, to explore the perception, acceptance, and potential use of pictorial warning labels in Ghana. Study II and III were cross-sectional studies in hospitality venues in three cities in Ghana to (i) assess the level of compliance to the requirements of the current SFP using air quality measurements for $PM_{2.5}$; (ii) covert observations of smoking-related behavior, signage, and compliance to the SFP in each venue; and (iii) to evaluate the knowledge, opinions, and self-compliance related to SFPs among owners and staff of hospitality venues by city, staff designation, and venue type. Study IV was a cross-sectional study using empty cigarette packs generated by single stick cigarette sales in one day to examine the characteristics, extent, and drivers of illicit cigarette sales in Ghana.

Table 5 below summarizes information on source population, study design and outcome variables used in Studies I –IV.

Table 5. Summary of study population and design

	Study I	Study II	Study III	Study IV
Study design	Qualitative study	Cross-sectional study	Cross-sectional study	Cross-sectional pack survey
Source population	Smokers and non-smokers in Ghana	Hospitality venues in Ghana	Hospitality venues staff in Ghana	Cigarette packs in Ghana
Study population	50 smokers and 35 nonsmokers aged 15 years and above in Kumasi, Ghana	152 hospitality venues from three large cities in Ghana.	142 owners and staff from hospitality venues in three large cities of Ghana.	Empty cigarette packs generated by one-day's single-cigarette sales collected from cigarette vendors in five large cities and three border towns in Ghana
Outcome variables	Perception, acceptance, and views of pictorial warning labels in Ghana	$PM_{2.5}$ values in hospitality venues	Knowledge, opinion and compliance scores	The number and characteristics of ilicit and licit packs

4.2 Recruitment, study participants, and sampling

4.2.1 Study I

Between October 2012 and June 2013, this qualitative study was conducted in Kumasi, an urban metropolis in Ghana's Ashanti region with a population of 1.7 million (Index-mundi, 2018). Smokers were purposively identified during clinical consultation and history taking during general practice clinics at Kwame Nkrumah University of Science and Technology hospital was used to initially enlist study participants. Snowball recruitment was used to ask respondents if they knew of any other individuals (smokers and non-smokers) who might be interested in taking part. A convenience sampling method was used to recruit non-smoking groups; direct approaches were also made to individuals at the selected locations, who were asked if they would be interested in participating in group discussions about cigarette warning labels. Participants were selected based on expert consultations from a variety of settings, including schools, hospitals, brothels, and abattoirs, to elicit a range of opinions from male and female

smokers and non-smokers. People who demonstrated interest were encouraged to bring other participants. Through convenience sampling, smoking groups were also found by approaching people at the chosen sites directly (brothels, abattoirs, and schools). According to discussions with important stakeholders like bar owners and students, brothels were determined to be an effective recruitment pathway due to the low smoking rates among women in Ghana (Brathwaite et al., 2017). Out of 97 smokers and non-smokers that were contacted, 85 (88%) comprising 50 smokers (34 males) and 35 non-smokers (27 males) responded and participated in the focus group discussions. A total of 12 focus groups, comprising seven of smokers (five of men and two of women, ages ranging from 15 to 64 years) and five of non-smokers (3 groups of men and 2 groups of women, ages ranging from 17 to 52 years) were conducted.

To find out whether there were any differences in the focus groups' opinions of the warning labels on cigarette packs, they were divided into groups based on smoking status and gender. Smokers comprised ever-smokers (those who reported smoking 100 cigarettes or more throughout their lifetime) and current smokers (those who reported smoking regularly at the time of the survey), and non-smokers those who did not smoke at the time of the survey, had not smoked in the six months prior and had no intention of smoking in the six months to come.

All interviews were conducted by the researcher (AS), under close supervision of LJ (qualitative researcher with over two decades of experience). All transcripts were also checked for accuracy against the audio recordings by a member of the research team with an MPH degree and more than three years of qualitative research experience (nonauthor).

4.2.2 Study II and III

Accra, Kumasi, and Tamale, Ghana's three largest cities, were chosen for the two studies because of their high population densities, ethnic variety, and smoking prevalence (Yawson et al., 2013). The Ghana tourist board provided a list of hospitality establishments (n=1532) including bars, pubs, restaurants, hotels, and nightclubs in the three cities. These venues were then stratified into the three major cities of the

southern, middle, and northern belts of Ghana, respectively; Kumasi (457), Accra (949), and Tamale (126). Using a margin of error of 5%, a confidence limit of 95%, and a probability that hospitality venues would not be compliant with the 100% smokefree legislation was set at 87% based on earlier studies (Agbenyikey et al., 2011), a total of 154 venues were required as the minimum sample size for the study. A proportionate allocation of the venues was then done for the three cities: Accra [(949/1532) × 154 = 95], Kumasi [(457/1532) × 154 = 46], and Tamale [(126/1532) × 154 = 13]. Simple random sampling using the random number generator (Minitab version 17) was then used to randomly select the planned number of venues within the three cities. The owners and staff from each of the selected venues were interviewed for study III; a total of 142 hospitality venue staff (77%) and owners (23%) were interviewed; hence a separate sample size for the staff and owners of the venues was not done but was based on the sample size for the selected hospitality venues All the venues approached agreed to participate but in cases where a venue was closed or non-functional, the venue next on the list was selected.

4.2.3 Study IV

Five major cities (Accra, Bolgatanga, Kumasi, Takoradi, and Tamale), and three border communities (Aflao, Paga/Hamele, and Elubo) were studied using a modified approach based on the collecting of empty cigarette packs from one-day single stick sales, directly from cigarette vendors. This method was adapted from similar studies in India and Bangladesh (Abdullah et al., 2020; John & Ross, 2018). This approach is particularly useful in countries where single stick sales are a common practice such as Ghana. Within each large city or border town, 10 smaller geographical areas were randomly selected using a list of available postcodes within each location in Ghana. A common point (such as market place, taxi station, or government building) was determined in each of them for retailer pack collection. A team of four research assistants and a coordinator walked 1 km along both sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point to identify tobacco retailers.

Following consent by the retailers, an empty bag with a unique identifier was given to any retailer who consented to participate to deposit all cigarette packs emptied throughout the day. These bags were then collected back from the retailers at the end of

24 hours. The retailers were given a monetary incentive of up to 10 United States Dollars (USD) commensurate with the number of packs provided. The sample size equation to obtain the minimum number of packs collected from each selected city/town was adapted from a toolkit for measuring illicit tobacco in LMICs (Michal et al., 2020). A minimum sample size of 2600 packs is needed, assuming a prevalence of illicit cigarette sales of 25%, with a 95% level of confidence and a margin of error of 0.15 (Michal et al., 2020).

4.3 Data collection, tools and study variables

4.3.1 Focus group discussions

The focus group approach was chosen as the most appropriate method for data collection in Study I. Focus group discussions are a useful method for bringing together (about six to ten) individuals with comparable backgrounds or experiences to explore a topic of interest (Kitzinger, 1995). A moderator leads the conversation, introduces themes for discussion, and encourages group participation in dynamic, natural conversation (Krueger & Casey, 2009). The most effective strategy for gathering attitudes, perceptions, and reactions from smokers and non-smokers in a way that would be challenging using other techniques, such as observation, one-on-one interviewing, or questionnaire surveys was a focus group discussion. These attitudes and beliefs are more likely to surface during social interactions and gatherings. Focus groups were used with to get smokers and nonsmokers to relate their personal stories and experiences with regards to cigarette pack warning labels.

Before each focus group discussion, the manager in each of the chosen locations (schools, abbatoirs, and brothels) was contacted and the study objectives were explained, and permission was obtained to use their facility. Following consent from the locations, people from the selected locations were informed of the study and invited to give consent to participate. Each focus group was arranged in a location provided by an administrator of the location and was conducted in a quiet setting. The researcher moderated the focus groups with the support of an observer (study assistant) who took notes of any non-verbal communication and additional field notes. A basic discussion

on consent, confidentiality, ground rules, and standards for group interviews were held before the start of each focus group. Additionally, all participants had to complete a brief profile questionnaire that asked them about their age, education, qualifications, and employment position. Discussions on perceptions of attitudes toward smoking cigarettes, opinions on warning labels, interpretations of the text and pictorial warnings, opinions on the influence of text and pictures on smoking behavior, and ratings/grading of various warning labels on their influence on smoking behavior in terms of starting to smoke and/or quitting were all held after that. Each focus group conversation was audio-recorded and lasted between 30 and 50 minutes.

The research team created cigarette packs based on the pack's design and color scheme (olive green) from the Australian packaging style (Hammond, 2009). Six warning messages, including "smoking destroys your teeth and gums," "smoking causes blindness," "smoking destroys your lungs," "smoking causes throat and mouth cancer," "smoking causes stroke," and "passive smoking causes severe asthma attacks," were used as visual discussion aids for the focus group discussions. These warnings were those already in use in the EU.

Participants were shown the first set of packs with text-only messages and allowed to interact with them (Figure 3b), then those with picture-only messages (Figure 3c), and then packs with text plus picture messages (Figure 3d). Participants saw a total of 18 different pack designs. They were asked how they felt about them, what they thought about the color, whether the packs made them feel differently about smoking, if they thought they were off-putting, how they would feel about using the packs and displaying them in public, how they thought people would react to them using the packs, whether they liked or disliked any of the packs and their opinions of the warnings. Time was given for comments to be made about the different pack features, with the moderator following up on these.

Figure 3. Warning messages used in focus group discussions (Singh et al. 2014)

4.3.2 Cross sectional study (Study II and III)

Data gathering took place over 10 weeks (July to September 2019) with a three-day pilot in Kumasi. A uniform observational checklist with all the compliance indicators, adopted from related studies (Gravely et al., 2018), was applied across all locations to enhance quality control. All field personnel received training on how to submit observational data. Due to the delays and difficulties associated with an open approach, a covert data collection approach was deemed appropriate for air quality measurements based on expert advice from experts and previous studies (Petticrew et al., 2007).

At each hospitality venue, the research team bought a drink before finding a seat or location that was as central as feasible and away from any doors, windows, or other environmental sources of $PM_{2.5}$ (such as open solid-fuel fireplaces or cooking areas). The Dylos monitor was positioned at seat or table level in each of the venues to ensure that sampling was done as close as possible to the breathing area, but not less than one metre from any smoking activity.

$PM_{2.5}$ measurement was conducted for a minimum of 30 minutes at each venue using the Dylos monitor. This device counts the number of particles in two particle size ranges (> 0.5 μm and > 2.5 μm). All data presented in this thesis relate to particles in the size range between 0.5 μm and 2.5 μm; and were generated as mass concentrations using equations specific to SHS aerosol as documented in earlier studies (Jackson-Morris et al., 2016; Semple et al., 2015). Each series of visits began with the Dylos devices turned on to begin the logging process, and they were left to measure and log 1-minute particle number concentrations throughout the sampling procedure. In addition to indoor air quality measurement, outside air was also sampled for at least 30 minutes to compare data on outdoor and indoor $PM_{2.5}$ concentrations each day. The outdoor air was measured about 10 metres away from the hospitality venue. Each venue's admission and exit times as well as the amount of time spent outside in the open air were noted.

At each hospitality venue, the owners and staff were approached for their consent to participate in a face-to-face interview at a time and venue suitable to them. Only one eligible staff that consented was interviewed at each venue. In cases where the venue owner was not available for an interview or there was more than one eligible and consenting staff, the owner's recommendation was sought for the staff to be interviewed. A pre-tested questionnaire was used for data collection (Gravely et al., 2018) in a private secure place within the hospitality venue to ensure confidentiality.

Knowledge, attitude, and practice scores were used to assess the knowledge, opinions, and compliance to SFP of hospitality venue owners and staff. Knowledge of Ghana's tobacco control act and SFP was assessed with a list of nine components related to the tobacco control act; such as components related to SFP (3), advertising and promotion (1), warnings on tobacco products (1), the ban on advertising and promotion (1),

government and tobacco industry interaction (1), sale and display of tobacco products (1), and sale of tobacco products to minors (1). The responses were coded as either '1=yes' or '0=no' according to whether or not they have heard of the components or not respectively. The mean score for each of the nine items (across all 142 participants) was calculated and then a mean of those item-specific means was calculated to get the overall mean score. The overall mean score was then used as a cut-off for 'more knowledge' (≥ 0.09) and 'less knowledge' (<0.09) on the tobacco control act.

Next, opinions on SFP were assessed by 10 questions using a 5-point Likert scale (options ranging from 'strongly agree' to 'strongly disagree'). Hospitality venues staff/owners were asked if they believed they knew enough about SFPs and what they thought of the following claims; smokefree bars make visits more comfortable; it is necessary for public bars; a smoking ban will motivate smokers to give up; it results in financial losses; harms business; it is an unfair restriction on smokers; it leads to unemployment; and protect the health of workers. To analyze opinion scores, dichotomous outcome variables were created with a score of 1 given for 'agree' (strongly agree/ agree) and 0 for 'disagree' (undecided/strongly disagree/disagree). Opinion scores for individual items were also computed in a similar way to knowledge scores. The overall mean score was used as a cut-off to categorize the opinions as 'agree/support' (≥0.54) and 'disagree/against' (<0.54).

Lastly, compliance with the SFP included five items with multiple-choice options related to the venue's smoking policy. These items included: the respondent's best description of the venue's smoking policy; actions taken if someone smoked at the venue; awareness of violation penalties; law prohibiting the sale and advertisements of tobacco products; and the importance of no-smoking signage. Each response was coded as compliance (score = 1) or non-compliance (score = 0). The mean score for each item (across all respondents) was calculated and then a mean of those item-specific means was calculated to get the overall mean score. The scale classified a score of ≥0.7 as 'more compliant' and a score of <0.7 as 'less compliant'.

4.3.3 Pack survey

For each empty cigarette pack, data were collected on city, country zone (northern, middle, and coastal zones) and retail shop type (drinking bars, convenience stores, and kiosks) where the cigarettes were sold. The cities and towns were categorized into border and non-border towns. The cigarette packs were also categorized by country of origin (based on the inscription on the packs on sale restricted to respective country eg. for sale in Togo only or Nigeria etc.). Packs were then finally classified as illicit and licit packs based on the pack classification of pack characteristics such as pictorial health warning (absent/present), textual health warning (absent/present), warning labels in English (absent/present), tax stamps (absent/present) and "for sale in Ghana" sign (absent/present). Packs were classified as illicit if at least one of the following attributes were present:

(a) Absence of authentic tax stamps (using an online tax stamp authenticator);

(b) Absence of textual and pictorial warnings;

(c) Absence of "FOR SALE IN GHANA ONLY" written on the side panel of the cigarette pack and

(d) Health warnings not in English

A summary of the variables in the quantitative studies (studies II-IV) are illustrated in the table below (Table 6)

Table 6. Summary of variables in studies II-IV

Study	Study variables	Variable categorisation
Study II (air quality monitoring and covert observation)	City	Accra Kumasi Tamale
	Venue type	Hotels Bars/pubs Restaurants
	Venue size	Small (for 1 – 15 people) Medium (for 16-30 people) Large (for > 30 people)
	No Smoking signs	Yes No
	Presence of designated smoking area	Yes No

	Smell of smoke	Yes No
	Cigarette butt/ends	Present Absent
	Active smoking	Present Absent
	Ashtrays	Present Absent
	$PM_{2.5}$ (outcome variable)	Continuous variables
Study III (knowledge, opinion and compliance survey)	Type of venue	Bar Hotel Nightclub Restaurant Pub
	Staff designation	Owner Manager Waiter Other
	Tobacco products sold	Yes No
	Nature of venue	Indoor Only outdoor Both indoor and outdoor
	Types of tobacco products sold at the venue	Manufactured cigarettes Hand-rolled cigarettes Pipes Cigars Shisha Electronic cigarettes Smokeless tobacco products
	Smoking allowed at venue	Yes No
	Sale of alcohol at venue	Yes No
	Presence of designated smoking area	Yes No
	Restriction to minors	Yes No
	Smoking status of staff	Smoker Non-smoker
	Knowledge scores	More knowledge (≥ 0.09) Less knowledge' (<0.09)
	Opinion scores	5-point Likert scale
	Compliance scores	Compliance

		Non-compliance
Study IV	Classification of cigarette packs (Outcome variable)	Licit Illicit
	City	Accra Kumasi Tamale Takoradi Aflao Elubu Bolgatanga Paga/Hamele
	Zone of the country	Upper Middle Coastal
	Border or non border towns	Border Non border
	Cigarette brands collected	555/London Brown/Pallmall Business Royal Fine Kingsize/Oris Rothmans Royals Others (Tusker, Fishers)
	Tax stamp	Yes No
	Warning labels	Yes No
	Warning label in English	Yes No
	"For sale in Ghana" sign	Yes No
	Cigarette pack price	2-7 GHC 8-14 GHC
	Country of origin of the packs	Ghana Togo Nigeria Niger Cote d'ivoire Others (England, Denmark etc)
	The type of retail shops	Drinking bars Kiosks Others (eg. grocery, petrol stations)
	Number of sticks per packs	20 sticks pack 10 sticks pack

4.4 Data Analysis

4.4.1 Qualitative data analysis

All audio files were translated (from Twi to English) and transcribed verbatim. The framework approach was the data analysis method used for the study (Ritchie & Spencer, 2010). This approach is an important tool for managing qualitative data. It also allows a step-by-step approach to analysis and explores the data in-depth whilst keeping an effective and transparent audit trail (Smith & Firth, 2011). The main attribute of the framework analysis that makes it different from many other qualitative analysis techniques such as content analysis is its use of a matrix output that enables researchers to systematically analyze data by participants and themes. Within the matrix, there are rows representing individual participants, and columns representing themes. The cell of each matrix is used to summarize the findings about the corresponding participant and theme. The use of the matrix enables the researcher to compare and contrast data contextually across the study participants and themes (Gale et al., 2013).

The data were analyzed in the five stages outlined below in the framework analysis method;

Stage 1. Familiarisation: Using this method, all transcripts (n=12) were first read several times with transcripts in a line-by-line way to identify codes and categories by two researchers.

Stage 2. Identifying themes: The researchers identified discussion points, issues, or themes that were buried within the transcripts. After which all themes and subthemes found in stage 1 were then written down. This step was done inductively.

Stage 3. Indexing: Codes were then assigned to all the themes and subthemes. Each line/phrase was then charted in a coding matrix using Microsoft Excel™. The codes and categories were then grouped into themes and subthemes, after which a coding

index was developed. L.J. (with more than two decades of experience) supervised the coding process and crosschecked a sample of 25% of the transcripts.

Stage 4. Charting and summarizing: The researcher read over each theme for every research participant and summarized the information into the corresponding cell in the matrix.

Stage 5. Interpretation and mapping: This allows the researcher to study the core themes and to make sure that interpretation of the developing notions remained based on the participants' descriptions. Each theme was then charted in a summary framework with direct extracts from the transcripts.

A subsection of the interview transcripts were discussed with the members of the focus groups (n=6) to enhance the credibility

An illustration of the coding index for the study is found in the table below (Table 7

Table 7. Coding index for health warning study

Main theme	Level 1	Level 2
1. Smoking rationale and awareness	1.1 addiction	1.1.1 desire to stop
		1.1.2 difficulties in stopping
		1.1.3 coping strategies
		1.1.4 relationship to alcohol
	1.2 influence	1.2.1 on health
		1.2.2 on quality of life
		1.2.3 of other (peers/identity)
	1.3 perceptions	1.3.1 of self
		1.3.2 of others
	1.4 knowledge	1.4.1 aware that it's negative
		1.4.2 specific diseases
		1.4.3 source of knowledge
2. Current Ghanaian warning labels	2.1 awareness	2.1.1 influence of literacy, language
		2.1.2 retained knowledge
		2.1.3 other influences (religion/peers)
	2.2 avoidance	2.2.1 habitualisation
		2.2.2 language/literacy
	2.3 influence on behaviour	2.3.1 apathy/acceptance/rationalisation

		2.3.2 dependent on type of purchase
		2.3.3 addiction, desires and pressures
		2.3.4 effectiveness and sustainability
		2.3.5 promote cutting down/quitting
		2.3.6 influence of others (religion/family)
3. New Ghanaian warning labels	3.1 text only	3.1.1 general views on text only
		3.1.2 influence on smoking behaviour (initiation/quitting)
		3.1.3 effectiveness (impact positive & negative)
	3.2 pictures only	3.2.1. general views on pictures only (language/literacy)
		3.2.2 influence on smoking behaviours
		3.2.3 effectiveness (impact positive & negative)
	3.3 text and picture	3.3.1. general views on text and pictures (language/literacy)
		3.3.2 influence on smoking behaviours
		3.3.3 effectiveness (impact positive & negative)
	3.4 overall views on best design	

4.4.2 Statistical methods

4.4.2.1 $PM_{2.5}$ measurements and covert observations

The Dylos logger software was used to download all air quality data. Each Dylos device had a specific calibration factor applied from a chamber experiment where measured concentrations of SHS $PM_{2.5}$ were compared with those reported from a calibrated Sidepak AM510 Personal Aerosol Monitor (TSI Inc, MN, USA) (Dobson & Semple, 2018). All Observational data obtained using a standardized checklist was also entered into Microsoft excel spreadsheet and were coded and analyzed using SPSS version 22. All data including $PM_{2.5}$ were recorded at three-time intervals (entry, +15 minutes, and +30 minutes) after which the mean of the three values was used for the analysis.

Descriptive statistics including percentages, median, 25,th and 75th percentile values for $PM_{2.5}$ were reported. The association between the exposure variables (city, venue type, and venue size) and $PM_{2.5}$ measurements (indoor, outdoor, indoor-outdoor $PM_{2.5}$) was

calculated using the Kruskal-Wallis test. A Kruskal-Wallis test is used to test whether or not a statistically significant difference between the medians of three or more independent groups is present. It is a nonparametric equivalent of the one-way ANOVA and does not assume normality in the data ($PM_{2.5}$). It is also suitable for a small sample size. Based on the results from the Kruskal-Wallis test, the Tukeys test was used for a pairwise comparison to assess group differences. The Tukey's test is for multiple comparisons when there are more than two means being compared. Typically, Tukey's test is utilized after an analysis of variance has shown that a significant difference exists and determines where the difference exists.

For the data from covert observation, descriptive statistics such as numbers and percentages above were conducted. The 'average compliance' to the smokefree law for all hospitality venues in the survey was calculated by summing up the values of 'individual compliance indicators' and dividing it by the total number of indicators measured.

4.4.2.2 Knowledge, compliance, and opinion survey

All data collected was checked in the field for any errors and inconsistencies after which it was exported onto STATA 12. The study participants were pseudoanonmysed for confidentiality. Descriptive statistics in the form of numbers and percentages were reported for variables such as city, type of venue, presence of DSAs, and types of tobacco products sold at the venue, smoking on the premises, and smoking status of the interviewee. The relationship between the exposure variables (city, venue type, and staff designation) and outcome variables (knowledge, opinions, and compliance to SFP) were first studied using χ^2 or Fisher's exact test (when the number in the table was <6), and then followed by a univariate logistic regression model. The results are presented as odds ratios (OR) with 95% confidence interval, with significance set at an alpha level of 5% ($p \leq 0.05$).

4.4.2.3 Pack Survey

All pack data were first entered into an excel spreadsheet, cleaned, and analyzed by R studio version 1.4.1717. The unit of analysis was each cigarette pack. For purposes of analyses, continuous variables such as price per pack for 10 or 20 stick packs were changed to categorical (low price category 2-7 GHC, high price category 8-14 GHC) (1USD=6GHC). The price variable was categorized for the measure of association but was maintained as a continuous variable for the regression part of the analysis (see below). The size of the pack was not taken into account as the majority of the packs (98.2%) belonged to the 20-stick packs.

Descriptive information was reported as numbers and percentages, and as means (sd) and minimum and maximum values for prices per pack based on the number of sticks per pack. The relationship between illicit tobacco and the categorical variables (country zone, border, and non-border town, city, shop type, price/packs, and cigarette brand) were first studied using χ^2 or Fisher's exact test (when the number in the table was <6). Due to the binary nature of the outcome variable (licit/illicit), bivariate and multiple logistic regression analyses were performed. The forward method was used to add covariates to evaluate the adjusted odds ratios for the explanatory variables for illicit cigarette sales. The relevant explanatory variables (based on previous literature) were country zone, border towns, shop type, and price/pack. The results are presented as odds ratios (OR) with 95% confidence interval, with significance set at an alpha level of 5% ($p \leq 0.05$). Coefficients are reported for the continuous price-per-pack variable in the regression analysis.

4.5 Ethical considerations

The Kwame Nkrumah University of Science and Technology Ethics Committee provided ethical approval for each of the four studies. Additionally, Study II and III received approval from the University of Stirling's Ethics Committee (Reference number: GUEP494). Both the Kwame Nkrumah University of Science and Technology Ethics Committee and REACH (EP 19/20 063) of the University of Bath gave their approval for Study IV's ethical conduct.

Informed consent (written and oral) was sought from each of the respondents that were interviewed for Studies I-III. All participants (including sex workers in the qualitative study) were assured of confidentiality and anonymity of their responses. The research team carried an official letter, with evidence of ethical approval and the contact details of the principal investigators at all times during data collection for Studies II-IV. All written and electronic data from the focus group interviews and surveys were securely stored in locked storage to be destroyed five years after the end of this study.

Informed consent was not obtained for covert data collection (observation and $PM_{2.5}$ measurements) in Study II, but researchers nonetheless carried an official letter out in the field outlining the investigation, along with documentation of its ethical approval and contact information. All of the sites where data collection took place were considered "public spaces," and both the precise locations and the people who used them are still protected by anonymity and confidentiality.

5 RESULTS

5.1 Exploration of pictorial and textual warning labels among smokers and non-smokers (Study I)

Concerning the 12 focus group discussions, the average age of the participants was 38 years. About 59% of the participants had primary-level education and about 80% belonged to low occupational status.

Three overarching themes emerged from the data: (1) smoking rationale and awareness, (2) views on current Ghanaian warnings, and (3) views on European Union warnings. Each of these themes and associated sub-themes is described below and illustrated with their respective quotes (Table 8).

1. Smoking rationale and awareness:

Young adult males, young adult females, and adult male smokers all cited addiction as the primary deterrent to quitting smoking, overriding their underlying desire to do so. Peer pressure was viewed as a major factor in both the initiation and maintenance of smoking among young adult male smokers, who underlined that smoking was an essential component of their identity that allowed them to fit in with their peer group.

2. Current Ghanaian warnings

Awareness: Although non-smokers were better able to recall the warnings, all smokers were aware of the current health precautions listed on Ghanaian cigarette packs. Female non-smokers believed that smokers were less likely to notice and comprehend the

warnings because they were less likely to be educated. Adult male nonsmokers believed that the warnings wouldn't stop them from starting to smoke. The phrases "smoking causes cancer" and "smoking kills" were the most frequently remembered current warnings.

Avoidance: Male smokers admitted that, to continue to justify their smoking behavior, they purposefully avoided reading the warnings on cigarette packs. Despite warnings, the smoker's mood at that particular time influenced their desire to smoke. Adult female smokers noticed the warnings but did not register their content.

Influence on behavior: Young adult male smokers said that current warnings had little effect on their smoking behavior since their cravings and need to smoke outweighed them. The majority of smokers will continue to smoke owing to addiction and coping methods, according to non-smokers, who believed that the current warnings were not effective. The habit of buying single sticks shielded many smokers from the warning signs.

3. Views on European Union warnings

Text-only: The text-only EU warnings were generally viewed as being comparable to those currently in use and having little chance of having an impact. The text-only messages about lung cancer, stroke, and blindness were deemed to be the most successful among male smokers. Because a dentist can always heal damaged teeth and the consequences of passive smoking were not seen to be significant, messages that focused on teeth, gums, and passive smoking were regarded to be the least successful.

Picture-only messages: All groups agreed that picture-only warnings were more potent; they were thought to be creative, serious, educational, emotive, and to demonstrate "real effect." They were also more likely to arouse dread. The mouth and throat cancer image had the biggest impact overall, with adult female non-smokers being the sole exception. Adult female non-smokers were more concerned about pictures related to dental problems, as they were more concerned with outward appearance compared to men. Adult female smokers believed that the warnings with only pictures were more persuasive regardless of reading levels. Adult male non-smokers stated that the packs

with visual warnings would not appear appropriate in public and that they would not want to be observed using such a pack.

Text and picture: The health warning on cigarette packs that combines text and an image was considered to be the most thorough. The majority of groups believed that smokers would be able to grasp the text or the image, if not both. The addition of graphics increased interest and attention even if the picture and text warnings repeated health issues that some participants were already aware of. Young adult male smokers asserted that text and image warnings would deter young adults from starting to smoke and would instead provide them the information they need to make an educated decision.

Overall views: Both smokers and nonsmokers thought combined picture and text warnings were likely to have the largest influence on behavior when it came to starting and stopping. Their introduction in Ghana was met with enthusiastic support. Adult male smokers indicated that as many smokers buy cigarettes singly, the images should be printed on the cigarettes, while adult male non-smokers suggested that pack inserts with additional graphics might also be useful.

Table 8. Summary of themes, sub-themes and illustrative quotes

Themes	Sub-themes	Quotes
Smoking rationale and awareness	Addiction	"Smoking is addictive and you will smoke if your friend's smoke, we all know it is bad and it can make you sick, the person who smokes is used to it and so they don't mind but if you don't smoke it can cause problems" (Adult male non-smoker)
	Influence	"We know it is bad, but you go to a funeral or party, people are smoking and you want to smoke also, it looks nice when you see them smoking so you just want to do some" (Young adult female smoker)
	Perception	"There is nothing good about it…I don't know why people even smoke. It makes you sick so why smoke?"(Adult male non-smoker)
	Knowledge	"I know there are many things it can cause such as cancer, bad breath, bad teeth" (Young adult male smoker)
Current Ghanaian warnings	Awareness	"For me when I smoke although I see them [warning label] I don't really read them, some are difficult to read so I don't bother, but I know the messages mean smoking is bad for your health" (Adult male smoker)
	Avoidance	"I also don't notice any of them so I don't know what it reads, I just don't look at them as long as I get what's inside" (adult male smoker)
	Influence on behaviour	"If these warnings could make me stop smoking I would have done this long time, the cigarette makes me happy so why would I stop smoking because I am reading something on the pack?" (Adult male smoker)
Views on European Union warnings	Text-only	"Messages like these [text-only warning] are already in the system but I don't know if they are helpful in smoking habits. I mean do they influence people at all?" (Adult male non-smoker)
	Picture-only	"Seeing is believing. I think this is more serious, they make me now wonder more about my smoking habit" (Adult male smoker)
	Text and pictures	"These packs [text and picture warning] are the best they give you the complete information, those who have gone to school and those who have not can all understand it" (young adult male smoker)
	Overall views	"These are good ideas already, maybe putting the picture on the cigarette sticks would also help?" (Adult male smoker)

5.2 Evaluation of air quality in hospitality venues (study II)

5.2.1 Description of venues

The sample consisted of 154 locations altogether from three cities (2 venues with missing values during data entry). Of the venues with complete data, 62% (n=94) were in Accra, 30% (n=45) in Kumasi, and 9% (n=13) in Tamale. The majority of the venues (65%, n=94) were hotels, 15% (n=22) were bars/pubs, and 20% (n=29) were restaurants. The majority of the venues (80%, n=106) were substantial, permanent buildings that could hold more than 30 people at once.

5.2.2 Compliance with smokefree laws

All 152 locations were evaluated for the presence of the indicators of compliance (DSAs and no-smoking signs, lack of smoke smell, cigarette butts, ashtrays, and any active smoking). Venues were considered compliant with the composite indicator assessing "no evidence of smoking" if it met one or more of the following criteria:

1. Presence of no-smoking signage;
2. Presence of DSA;
3. Absence of smell smoke
4. Absence of active smoking
5. Absence of ashtrays

With significant variations by city, there were NO SMOKING signs in 49.5% of the venues (n=75), in Accra (54.3%, n=51), Kumasi (35.6%, n=16), and Tamale (61.5%, n=8) (p=0.007). DSAs were present in fewer than 10% of the venues (6.6%, n=10) (Figure 4). Tobacco smell was absent in 101 (66.4%) venues; Accra

(53.8%, n=50), Kumasi (86.7%, n=39) and Tamale (84.6%, n=11) (p<0.001). Smoking was not observed in over 80% (n=125) of the venues with a significant difference in the three cities; Accra (75.3%, n=70); Kumasi (95.6%, n=43) and Tamale (92.3%, n=12) (p=0.004). In 19 (12.5%) locations, cigarette butts were discovered on the floor. Also, only one location, a hotel in Kumasi, was "completely compliant" with all of the indicators of compliance measures (Figure 4). In more than 90% of the places we visited, there were no displays of cigarettes or other tobacco products for sale. The overall average compliance for all venues was 63.1%; Tamale (73.2%); Kumasi (67.8%) and Accra (59.5%).

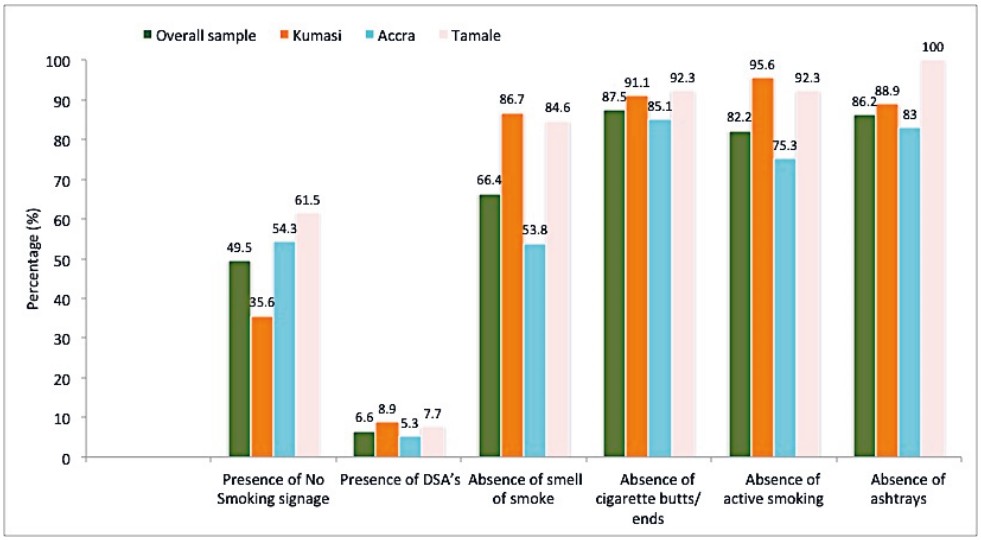

Figure 4. Compliance with indicators of smokefree policy in Accra, Kumasi and Tamale in Ghana

As compared to hotels and restaurants, bars and pubs were found to be less compliant with SFP indicators (Figure 5).

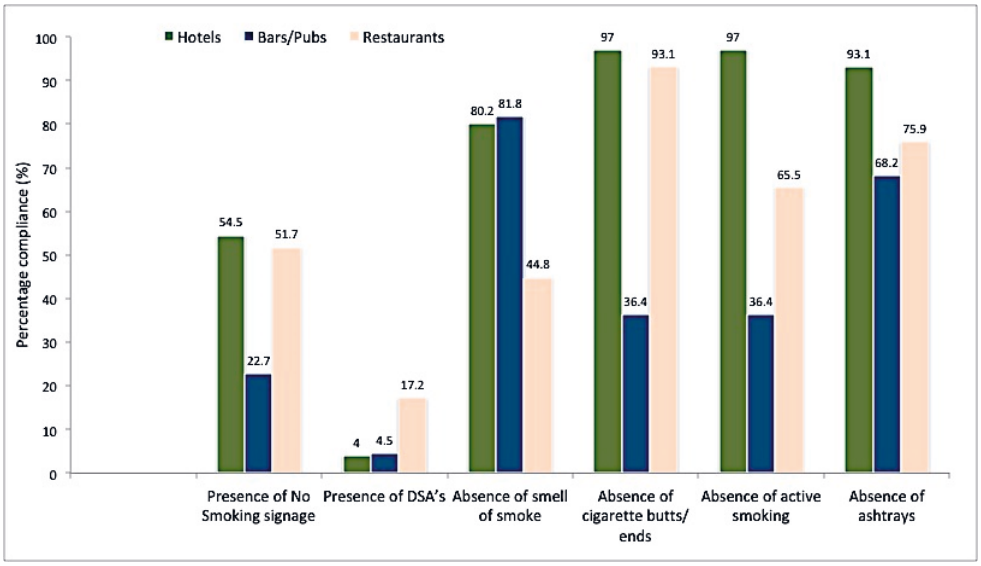

Figure 5. Compliance with indicators of smokefree policy in hotels, bars/pubs and restaurants

5.2.3 $PM_{2.5}$ measurements

Table 9 below shows the indoor, outdoor and indoor-outdoor difference in $PM_{2.5}$ levels across the three cities, venue types and sizes. The overall median indoor $PM_{2.5}$ level in all three cities was 14.6 μg/m^3 with a minimum level of 5.26 μg/m^3 and maximum of 349 μg/m^3. The overall median outdoor $PM_{2.5}$ was 12.4 μg/m^3 with a minimum level of 3.8 μg/m^3 and maximum 81.7μg/m^3. The indoor $PM_{2.5}$ concentrations in Accra were higher as compared to Kumasi and Tamale (p=0.003). A quarter of the venues in Accra had indoor $PM_{2.5}$ above 28.9μg/m^3. Outdoor $PM_{2.5}$ was also high in Accra as compared to the two other cities (Table 9).

For the venue types, the median $PM_{2.5}$ levels for bar/pubs and restaurants were almost similar, but a quarter of the bar/pubs had indoor $PM_{2.5}$ above 62.2μg/m^3. However, as compared to bars/pubs and restaurants, indoor and outdoor $PM_{2.5}$ levels in hotels were the lowest.

Table 9 also shows for each city the difference between indoor and outdoor $PM_{2.5}$ concentrations as measured on the same day. Positive results indicated the presence of interior sources of $PM_{2.5}$ emissions since indoor air $PM_{2.5}$ levels were higher than those measured outdoors.

Table 9. Indoor, outdoor and indoor-outdoor difference in $PM_{2.5}$ measurements by city, venue type and size

		$PM_{2.5}$ Indoor ($\mu g/m^3$)			**$PM_{2.5}$ Outdoor ($\mu g/m^3$)**			**Indoor-outdoor difference in $PM_{2.5}$ ($\mu g/m^3$)**		
	n	Median	25th Percentile	75th Percentile	Median	25th Percentile	75th Percentile	Median	25th Percentile	75th Percentile
City										
Kumasi	45	13.0	8.95	17.6	9.80	8.30	15.89	0.50	-2.80	5.30
Accra	94	15.9	11.7	28.9	14.6	10.5	20.4	2.75	-8.50	11.7
Tamale	13	12.5	7.20	13.7	5.90	5.70	11.7	1.70	1.20	7.70
		*0.003			*P<0.001			*0.241		
Venue type										
Hotels	101	13.3	9.85	19.3	11.7	9.2	16.2	1.5	-2.1	5.5
Bars/pubs	22	21.9	13.8	62.2	18.0	11.2	30.7	5.2	0.8	25.1
Restaurants	29	22.0	12.0	28.6	13.5	10.5	21.2	4.0	-0.6	14.9
Venue size**		*0.005				*0.006			*0.029	
Small	13	12.6	10.2	17.5	11.0	10.0	18.7	0.7	-3.1	4.8
Medium	25	22.7	13.2	43.9	15.2	10.5	27.9	4.5	-2.2	16
Large	114	13.9	10.2	20.8	12.1	9.4	17.9	1.8	-0.7	6.6
		0.092				0.118		0.359		

*p values obtained from comparing groups using Kruskal-Wallis test.

**Measured by how many people can be acommodated in this establishment: 1 – 15 = Small, 16 – 30 = Medium, More than 30 = Large

As shown in Table 9 above, a significant difference is found between the indoor and outdoor $PM_{2.5}$ levels and the three cities and venues. Indoor-outdoor difference in $PM_{2.5}$ levels is also significantly different between the three venue types (p=0.029).

Table 10 below shows the results obtained from a pairwise comparison of the groups to identify which groups are significantly different. It is observed from Table 8 that there is a significant difference in the mean indoor (p=0.038) and outdoor (p=0.025) $PM_{2.5}$ level between Accra and Kumasi as compared to the other groups. Similarly, there is a significant difference in the mean indoor (p=0.004) and outdoor (p=0.009) $PM_{2.5}$ levels between bars/pubs and hotels as compared to the other groups. Also, the mean indoor-outdoor difference in $PM_{2.5}$ levels is significantly different between hotels and bar/pubs (p=0.016).

Table 10. *Pairwise comparison of mean $PM_{2.5}$ and hospitality venue characteristics

Groups	Contrast	SD	P-value	95% Confidence interval
Indoor $PM_{2.5}$				
City				
Accra vs. Kumasi	24.229	9.793	0.038	1.043 - 47.415
Tamale vs. Kumasi	-3.856	16.981	0.972	- 44.059 - 36.348
Tamale vs. Accra	-28.085	15.969	0.187	-65.891 - 9.721
Venue type				
Bars/pubs vs. Hotel	40.499	12.573	0.004	10.733-70.266
Restaurant vs. Hotel	15.67	11.260	0.348	-10.987- 42.333
Restaurant vs. Bars/pubs	-24.827	15.095	0.230	-60.565 - 10.911
Outdoor $PM_{2.5}$				
City				
Accra vs. Kumasi	5.409	2.0476	0.025	0.562 - 10.257
Tamale vs. Kumasi	-5.244	3.551	0.305	-13.649- 3.162
Tamale vs. Accra	-10.653	3.339	0.005	-18.558- (-2.748)

Venue type				
Bars/pubs vs. Hotel	8.109	2.696	0.009	1.725 - 14.493
Restaurant vs. Hotel	2.292	2.448	0.618	-3.504 - 8.086
Restaurant vs. Bars/pubs	-5.818	3.265	0.179	-13.548 - 1.913
Indoor-outdoor $PM_{2.5}$ difference				
Venue type				
Bars/pubs vs. Hotel	32.604	11.689	0.016	4.933 - 60.275
Restaurant vs. Hotel	14.183	10.466	0.367	-10.595 - 38.960
Restaurant vs. Bars/pub	-18.421	14.046	0.391	-51.674 - 14.831

*Tukeys pairwise comparision test for ≥ 3 group means

$PM_{2.5}$ concentrations in areas where smoking was noticed (staff/customer smoking, smell of tobacco smoke, presence of cigarette butts and ashtrays) are shown in Table 11 below. When compared to outside, the air quality in places where smoking was observed was worse, while the air quality in places where smoking was not observed was comparable to that measured outside. Differences in indoor and outdoor $PM_{2.5}$ concentrations (indoor-outdoor difference) were higher in locations where smoking was observed (6 $\mu g/m^3$) compared to locations where smoking was not observed (1 $\mu g/m^3$, $P<0.001$). In a quarter of the hospitality venues where smoking was observed, indoor $PM_{2.5}$ concentration was at least 25 $\mu g/m^3$ greater than outdoor measurements in that city on the same day.

Table 11. Measurements of $PM_{2.5}$ in venues where smoking was observed versus venues where smoking was not observed

		Indoor $PM_{2.5}$ ($\mu g/m^3$)			Outdoor $PM_{2.5}$ ($\mu g/m^3$)			Indoor-Outdoor difference in $PM_{2.5}$ (ug/m^3)		
Smoking observed	Count	Median	25th Percentile	75th Percentile	Median	25th Percentile	75th Percentile	Median	25th Percentile	75th Percentile
Yes	57	23.80	15.7	61.1	18.2	12.7	30.7	6.00	1.20	25.1
No	95	12.30	9.00	16.0	10.8	8.30	14.0	1.00	-2.80	4.80
*P-value	P<0.001			P<0.001			P<0.001			

*P-value based on Independent Sample T-test

5.3 Knowledge, opinion and compliance of hospitality venues staff (study III)

Out of a total of 154 venues visited, 142 were analyzed and 12 (7.8%) of them had incomplete data. Almost half of the venues were in Accra (47.2%), followed by Kumasi (38.0%) and Tamale (14.9%). Close to 70% of the venues visited were hotels (69%), and about two-thirds of the participants interviewed were waiters or receptionists (76.8%). Only about 10% of the venues were selling tobacco products. The tobacco products commonly sold at these venues were manufactured cigarettes (in 15 venues), smokeless tobacco (in 18 venues), and shisha (in 10 venues). A third of the venues (31%) allowed smoking in their facility and about 14% of the venues had a DSA. Over 90% of the venues had indoor or both indoor and outdoor facilities. Also, about 90% of the staff interviewed were non-smokers.

5.3.1 Knowledge of hospitality staff on Ghana's tobacco control act and smokefree policy

Of the total 142 respondents, 27% had heard of the tobacco control act (2012). About 29% of the staff/owners were aware of smoking restrictions in public places, and about a fifth (22%) were aware of smoke free places. Less than 10% of the staff/owners were aware of the display of 'no smoking' signage (6.3%) and the ban on tobacco advertising

and promotion (8.5%) as a component of the tobacco control act. Only about 5% of the staff was aware of the components on sale of tobacco and tobacco products.

Table 12 below provides the findings of the knowledge related to the tobacco control act stratified by the three cities (Accra, Kumasi, and Tamale), staff designation (owners and others), and venue type (hotels and bars/pubs). As compared to Accra and Kumasi, hospitality staff in Tamale had more knowledge of all the components of the tobacco control act except for awareness on the restriction of smoking in public places (Kumasi 29.6%, Accra 35.8%, and Tamale 4.8%, $p=0.014$).

The knowledge of staff were found to be low in almost all components of the tobacco control act (Table 12). The mean knowledge score levels were higher for hospitality staff in Tamale (0.13) as compared to those in Kumasi (0.05) and in Accra (0.10). The mean knowledge scores were highest for "smokefree places" (0.22) and "restriction of smoking in public places" (0.29) and were significantly different in the three cities ($p<0.05$). The lowest mean knowledge scores were observed for "regulation of tobacco products" (0.04) and "prohibition of supply of tobacco products to minors" (0.05) and "sale & display of tobacco & tobacco products" (0.05). The mean knowledge scores for "display of no smoking signs" was also low (0.06) but it was significantly different across the three cities ($p=0.001$). All hospitality staffs were completely unaware of "warning labels on tobacco products" and "limiting Government interaction with the tobacco industry" as part of the tobacco control act in Ghana.

Table 12. Knowledge of staff on Tobacco Control Act and smokefree policy

Tobacco Control Act knowledge Items	City n (%)				Venue type n (%)			Staff designation n (%)			Mean KAP scores
	Kumasi (n=54)	Accra (n=67)	Tamale (n=21)	p-value	Hotels (n=98)	Others* (n=44)	p-value	Owners (n=31)	Others** (n=111)	p-value	
Ban on tobacco advertising and promotion											0.08
Yes	0 (0)	7 (10.5)	5 (23.8)	0.001	9 (9.2)	3 (6.8)	0.754	3 (9.7)	9 (8.1)	0.725	
Smokefree places (public, work & transport)											0.22
Yes	5 (9.3)	19 (28.4)	7 (33.3)	0.011	23 (23.5)	8 (18.2)	0.481	4 (12.9)	27 (24.3)	0.223	
Display of no-smoking signs											0.06
Yes	1 (1.9)	2 (3.0)	6 (28.6)	0.001	8 (8.2)	1 (2.3)	0.274	1 (3.2)	8 (7.2)	0.684	
Warnings on tobacco products											0
Yes	0	0	0		0	0		0	0		
Sale & display of tobacco & tobacco products											0.05
Yes	0 (0)	5 (7.5)	2 (9.5)	0.047	5 (5.1)	2 (9.1)	1.000	3 (9.7)	4 (3.6)	0.176	
Prohibition of supply of tobacco to minors											0.05

Yes	1 (1.8)	3 (4.5)	3 (14.3)	0.086	6 (6.1)	1 (2.3)	0.436	0	7 (6.3)	0.347	
Regulation of tobacco products											0.04
Yes	2 (3.7)	3 (4.5)	0 (0)	1.000	4 (4.1)	1 (2.3)	1.000	3 (9.7)	2 (1.8)	0.069	
Limiting Gov't interaction with tobacco industry											0
Yes	0	0	0		0	0		0	0		
Restriction of smoking in public places											0.29
Yes	16 (29.6)	24 (35.8)	1 (4.8)	0.014	26 (26.5)	15 (34.1)	0.358	8 (25.8)	33 (29.7)	0.670	
Overall Mean KAP scores											
	0.05	0.10	0.13		0.09	0.08		0.08	0.09		0.09

Note: Knowledge scores assessed by allocating 1 to "yes"answer and 0 to "no" answer. Overall mean scores ≥ 0.09 were taken as more knowledge and <0.09 as less knowledge on Tobacco Control Act; P-values base on chi-square or Fisher's exact

Others* includes bars, pubs, nightclubs and restaurants, Others** includes waiters and receptionists

5.3.2 Opinion of the hospitality staff on the SFP

Table 13 below shows the responses to the opinions of hospitality staff/owners towards SFP stratified by city, venue, and staff designation. The highest opinion scores were for the statement "smoking ban protects the health of workers" (0.96) and all respondents from Kumasi (100%) and over 80% from Accra and Tamale agreed with that statement (p=0.016). Scores for opinion were also high for the statement "prohibition of indoor smoking in public places" (0.89) and this was also significantly associated with the city; over 90% of hospitality staff and Accra agreed with the statement as compared to Kumasi (87%) and Tamale (76%) (p=0.028). Similarly, 89% of all respondents supported the statement "smoking ban is necessary in hospitality venues" and a higher percentage of hotel staff (92%) supported this ban as compared to staff from other bars/pubs (81%) (p=0.048).

Over half of all respondents disagreed with the statement that "smoking ban will have a negative effect on business" and was significantly associated with the city; Kumasi (61.1%), Accra (86.8%), and Tamale (52.4%) (p<0.001). In general, hospitality staff had a positive attitude toward supporting SFP with an overall mean score of 0.54. Interestingly, the lowest opinion scores were found for the statement "public smoking ban will cause financial losses" (0.13), but this was not significantly associated with the type of city; venues, or staff designation. Also, over 50% of the staff in Kumasi and Tamale agreed that "smoking ban will result in joblessness" as compared to about a quarter of them in Accra (p=0.001).

The primary obstacles to implementing a SFP in hospitality venues were determined to be inadequate enforcement authority support (n=97, 68.3%) and revenue loss from smokers (n=44, 31.0%).

Table 13. Opinions related to smokefree law in Ghana

Items on opinions of hospitality staff to the SFP	City n (%)				Venue type n (%)			Staff designation n (%)			Mean Opinion scores
	Kumasi (n=54)	Accra (n=67)	Tamale (n=21)	p-value	Hotels (n=98)	Others* (n=44)	p-value	Owners (n=31)	Other** (n=111)	p-value	
Adequately informed about Ghana's SFP											0.17
Agree	8 (14.8)	13 (19.4)	3 (14.3)	0.787	18 (18.4)	6 (13.6)	0.487	5 (16.1)	19 (17.1)	1.000	
Public smoking ban will have a negative effect on business											0.28
Agree	21 (38.9)	9 (13.4)	10 (47.6)	<0.001	27 (27.6)	13 (29.5)	0.807	8 (25.8)	23 (20.7)	0.741	
Public smoking ban will cause financial losses											0.13
Agree	8 (14.8)	6 (9.0)	5 (23.8)	0.199	10 (10.2)	9 (20.5)	0.097	2 (6.5)	17 (15.3)	0.247	
Public smoking ban is an unfair restriction on smokers											0.30
Agree	14 (25.9)	17 (25.4)	12 (57.1)	0.015	30 (30.6)	13 (29.5)	0.898	9 (29.0)	34 (30.6)	0.864	
Smoking ban will result in joblessness											0.40
Agree	29 (53.7)	16 (23.9)	12 (57.1`)	0.001	36 (36.7)	21 (47.7)	0.217	14 (45.2)	43 (38.7)	0.519	
Smokefree bars make visits more comfortable											0.82
Agree	41 (75.9)	56 (83.6)	19 (90.5)	0.451	83 (84.7)	33 (75.0)	0.128	27 (87.1)	89 (80.2)	0.596	
Smoking ban will encourage smokers to quit											0.56
Agree	32 (59.3)	37	11 (52.4)	0.837	61 (62.2)	19 (43.2)		19	61 (55.0)	0.529	

		(55.2)					0.034	(61.3)			
Smoking ban protects the health of workers											0.96
Agree	54 (100)	64 (95.5)	18 (85.7)	0.016	94 (95.9)	42 (95.5)	1.000	30 (96.8)	106 (95.5)	1.000	
Smoking ban is necessary in public bars											0.89
Agree	48 (88.9)	61 (91.0)	18 (85.7)	0.708	91 (92.9)	36 (81.8)	0.048	29 (93.5)	98 (88.3)	0.523	
Prohibition of indoor smoking in all public places											0.89
Support	47 (87.0)	64 (95.5)	16 (76.2)	0.028	89 (90.8)	38 (86.4)	0.425	27 (87.1)	100 (90.1)	0.741	
Overall Mean KAP scores											
	0.59	0.66	0.71		0.72	0.45		0.71	0.62		0.54

Note: Opinion was assessed as a score of 1 for agree/support and 0 to disagree/do not support. The scale classified opinion as agree/support with scores ≥0.54 and disagree/against < 0.54; P-values based on chi-square or Fisher's exact as appropriate set at p≤0.05. Others* includes bars, pubs, nightclubs and restaurants, Others** includes waiters and receptionist

5.3.3 Compliance to the smokefree laws at the hospitality venues

In response to questions related to compliance, over 80% of hotels had an existing indoor SFP policy that does not allow smoking in any indoor area as compared to 50% of bars and pubs (54.5%) ($p<0.001$) (Table 14). A third of staff in Kumasi as compared to a fifth in Tamale and less than 10% in Accra were aware of "violation penalties on smoking in public places" ($p=0.002$). Also, over 70% of hotels were more likely to have 'no smoking' signs as compared to 40% of bars and pubs ($p=0.001$). Hospitality venues in Tamale had higher compliance scores (0.71) as compared to Kumasi (0.70) and Accra (0.68).

Table 14. Compliance towards Ghana's smokefree policy

Compliance Items on SFP	City n (%)				Venue type n (%)			Staff designation n (%)			Mean KAP scores
	Kumasi (n=54)	Accra (n=67)	Tamale (n=21)	p-value	Hotels (n=98)	Others* (n=44)	p-value	Owners (n=31)	Others** (n=111)	p-value	
Best description of indoor SFP at your establishment											0.9
Smoking is allowed anywhere											
	2 (3.7)	4 (6.0)	1 (4.8)		1 (1.0)	6 (13.6)		1 (3.2)	6 (5.4)		
Smoking is allowed only in some indoor areas											
	3 (5.6)	9 (13.4)	3 (14.3)	0.603	6 (6.1)	9 (20.1)	<0.001	1 (3.2)	14 (12.6)	0.254	
Smoking is not allowed in any indoor areas											
	42 (77.8)	50 (74.6)	15 (71.4)		83 (84.7)	24 (54.5)		28 (90.3)	79 (71.2)		
There is no policy/Don't know											
	7 (12.9)	4 (6.0)	2 (9.5)		8 (8.2)	5 (23.8)		1 (3.2)	12 (10.8)		
Action taken incase someone smokes in premises											0.9
Nothing, smoking is allowed											
	2	6	3	0.134	3	8	0.007	2	9	0.967	

	(3.7)	(8.9)	(14.3)		(3.1)	(18.2)		(6.5)	(8.1)	
Ask the person to go to a designated smoking area										
	11 (20.4)	9 (13.4)	0 (0)		11 (11.2)	9 (20.5)		4 (12.9)	16 (14.4)	
Ask the person to stop smoking										
	20 (37.0)	20 (29.7)	5 (23.8)		32 (32.7)	13 (29.5)		10 (32.3)	35 (31.5)	
Ask the person to leave the premises										
	19 (35.2)	31 (46.3)	12 (57.1)		48 (49.0)	13 (29.5)		15 (48.4)	47 (42.3)	
Don't know	2 (3.7)	1 (1.5)	1 (4.6)		4 (4.1)	0 (0)		0 (0)	4 (3.7)	
Aware of violation penalties on smoking in public places										0.2
Yes	16 (29.6)	4 (6.0)	4 (19.0)	0.002	18 (18.4)	6 (13.6)	0.487	3 (9.7)	21 (90.1)	0.286
No	38 (70.4)	63 (94.0)	17 (81.0)		80 (81.6)	38 (86.4)		28 (90.3)	90 (9.9)	
Law prohibiting all advertisements for tobacco products										0.9
Approve	48 (88.9)	60 (89.6)	20 (95.2)	0.798	92 (93.9)	36 (81.8)	0.076	29 (93.5)	99 (89.2)	0.756
Disapprove	4 (7.4)	5 (7.5)	0 (0)		4 (4.1)	5 (1.4)		2 (6.5)	7 (6.3)	
Refused	2 (3.7)	2 (2.9)	1 (4.8)		2 (2.0)	3 (6.8)		0 (0)	5 (4.5)	
Importance of no-smoking signs at premises										0.6
The smoking signs already present										
	30 (55.6)	46 (68.7)	16 (76.2)		73 (79.6)	19 (43.2)		21 (67.7)	71 (64.0)	
Yes, but we don't have signs										
	20 (37.0)	14 (20.9)	2 (9.5)	1.000	19 (19.5)	17 (38.6)	0.001	8 (11.9)	28 (25.2)	0.904
No, they are not necessary										
	4 (7.4)	7 (10.4)	3 (14.3)		6 (6.1)	8 (18.2)		2 (6.5)	12 (10.8)	
Overall Mean KAP scores										0.7
	0.70	0.68	0.71		0.74	0.59		0.72	0.67	

Note: Compliance assessed by giving a score of 1 to compliance and 0 to non-compliance. The scale classified less compliant as a overall mean score < 0.7 and more compliant ≥ 0.7. P-values based on chi-square or Fisher's exact as appropriate set at p≤0.05. Others* includes bars, pubs, nightclubs and restaurants, others** includes waiters and receptionists

As shown in Table 15, hospitality staff in Accra had higher levels of knowledge of the tobacco control act (OR 3.08, 95% CI 1.10-8.60) as compared to Tamale. However, the odds of opinion in support of SFP were lower in Accra (OR 0.25 95% CI 0.08-0.71) as compared to Tamale. Also, the odds of compliance were higher in hotels (OR 3.16, 95% C.I. 1.48-6.71) as compared to bars/pubs

Table 15. Knowledge, opinion and compliance by city, the type of venues and role of the interviewee using Univariate logistic regression analysis

	More knowledge		Agree/support		More compliance	
Variables	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Cities						
Tamale	1		1		1	
Kumasi	0.76 (0.27-2.11)	0.596	0.46 (0.15-1.32)	0.148	0.65 (0.21-2.00)	0.452
Accra	3.08 (1.10-8.60)	0.031	0.25 (0.08-0.71)	0.010	0.94 (0.30-2.87)	0.915
Venue types						
Others*	1		1		1	
Hotels	1.18 (0.54-2.55)	0.672	2.01 (0.91-4.37)	0.080	3.16 (1.48-6.71)	0.003
Staff designation						
Others**	1		1		1	
Owners	0.70 (0.30-1.64)	0.417	0.94 (0.40-2.18)	0.887	1.40 (0.56-3.44)	0.464

Statistical significance set at 0.05 (p≤0.05); OR: Odds Ratio; CI: 95% Confidence Interval.

Others* includes bars, pubs, nightclubs and restaurants, Others** includes waiters and receptionists

5.4 Characteristics and associated factors of illicit cigarette sales (study IV)

A total of 425 retailers were approached for the study, out of which 384 (90%) consented to collect packs and participate in the survey. Each retailer provided an average of 12 packs of cigarettes within 24 hours of single stick sales. A total of 4461 packs were collected from the 384 retailers in the selected cities and towns. All retailers (100%) in the study sold single sticks. A total of 871 out of 4461 (19.5%) packs were classified as illicit based on the criteria for classification approved by the FDA (Table 16).

A third (30.6%) of the packs collected from the northern zone of Ghana and two-thirds (68.5%) of the packs from the border towns were illicit. Almost all the packs collected from Aflao (Ghana-Togo border) were illicit (98.6%), followed by Tamale (45.8%) and Paga/Hamele (Ghana-Burkina Faso border) (26.6%) and Elubu (21.1%) (Ghana - Cote d'Ivoire border). In terms of the retail selling points, a higher percentage of the packs collected from provision stores (29.0%) and drinking bars (18.2%) were illicit than packs collected from kiosks (5.2%) ($p<0.001$). Over 60% of the packs collected within the price category of 2-7 GHC were illicit (Table 16). The most common illicit packs were Gold Seal (91.4%), Rothmans Royal (86.1%), and Oris (81.1%). All 555 and London Brown/White packs were found to be licit (100%).

Table 16. Determinants of illicit cigarette sale in Ghana (%)

	Total (n=4461)	Illicit cigarette packs (n=871) (%)
Country zone		
Northern	1203	368 (30.6)
Coastal (south)	2594	495 (19.1)
Middle	664	8 (1.2)
P-value*	<0.001	
Border/non-border		
Border	720	493 (68.5)
Non-border	3741	378 (10.1)
P-value*	<0.001	
City/town		
Aflao	453	433 (98.6)
Tamale	753	345 (45.8)
Paga/Hamele	58	16 (26.6)
Elubu	209	44 (21.1)
Accra	1164	17 (1.5)
Kumasi	659	8 (1.2)
Bolgatanga	397	7 (1.8)
Takoradi	768	1 (0.1)
P-value*	<0.001	
Shop type		
Provision/grocery stores	1251	363 (29.0)
Drinking bar	2616	477 (18.2)
Kiosks	594	31 (5.2)
P-value*	<0.001	

Price/pack (GHC)		
Low price (2-7)	1272	778 (61.2)
High price (8-14)	3189	93 (2.9)
P-value*	<0.001	
Cigarette brand		
Gold Seal	93	85 (91.4)
Rothmans Royals	115	99 (86.1)
Oris	132	107 (81.1)
Fine	231	181 (78.3)
Business Royal	300	210 (70.0)
Others (Tusker, Fisher, menthol, Cherry etc.)	151	90 (60.0)
Pall Mall White	494	70 (14.2)
Kingsize	1827	29 (1.6)
555	190	0 (0)
London Brown/White	928	0 (0)
P-value*	<0.001	

*P-value based on $\chi 2$ or Fisher's exact test

Majority of the illicit packs were characterized by absence of tax stamps (94.3%), 'for sale in Ghana' sign (92.2%) and warning labels in English (77.3%). The most common brand of cigarettes sold was Kingsize, London Brown/White and Pall Mall (Figure 6).

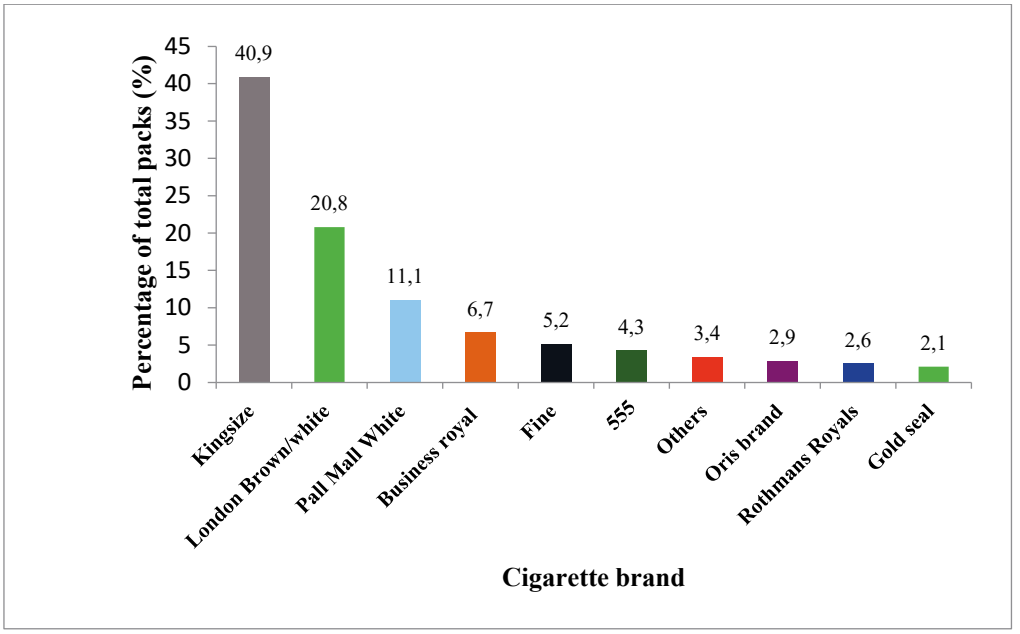

Figure 6. Brands of cigarette packs collected in the study

The majority of the packs collected were the 20-stick pack (98.2%) and the remaining was the 10-stick pack. The 20-stick packs had an average price of 8.5 GHC and the 10-stick packs had an average price of 3.3 GHC. Illicit packs had an average price/pack of 5.4 GHC (SD 1.5, range 2-12 GHC) whilst licit pack was 9.1 GHC (SD 2.1, range 2-14 GHC). Close to half of the illicit packs originated from Togo (51%), followed by Nigeria (14.8%) and then Cote d'Ivoire (10.3 %).

Table 17 below shows the results from unadjusted and adjusted logistic regression of the factors associated with illicit cigarette sales in Ghana. The odds of illicit cigarette sales were 1.8-fold and 3.5-fold in convenience stores as compared to drinking bars in the unadjusted and adjusted models respectively (Table 17). Also, the odds of illicit cigarette sales were 19.3 and 67.2-fold in border towns as compared to non-border towns in both the adjusted and unadjusted models respectively. The middle and coastal country zones had lower odds of illicit cigarette sales than the northern zones in both the unadjusted and adjusted regression models. Also, for every unit increase in price/pack, the odds of illicit cigarette consumption were reduced by almost 60% (Table 17).

Table 17. Unadjusted and adjusted odd ratios (95% confidence intervals, CI) for illicit cigarette sales by type of shop, country zone, border/non border and pack price.

Variable	Unadjusted OR	95% CI	Adjusted OR	95% CI
Retail shop type				
Drinking bars	1		1	
Kiosks	0.25	0.17 - 0.35	0.52	0.28-0.96
Convenience stores	1.83	1.57-2.15	3.47	1.92-6.26
Country Zone				
Northern	1		1	
Middle	0.03	0.01-0.05	0.42	0.16 -1.08
Coastal	0.54	0.46-0.63	0.70	0.39-1.25
Border/non border towns				
Non-border town	1		1	
Border town	19.3	16.0-23.4	67.2	(44.2-102.2)
Pack price	0.39 (*coef= -0.94)	(0.37-0.42) (-0.99 to -0.88)	0.39 (*coef=-0.95)	(0.36 -0.42) (-1.03 to -0.88)

*Price variable used a continuous predictor in the logistic regression model. The exponentiated coefficient represents the odds ratio for one unit change in the pack price.

6 DISCUSSION

6.1 Discussion of major findings

6.1.1 Summary of main findings

The results of the qualitative analysis show that the text-only warnings currently used in Ghana are thought to be poor at conveying the health risks of smoking, and there is substantial public support for the introduction of visual warnings. The effectiveness of text-only warnings is limited by low reading rates and single stick sales. The warning messages with lung cancer, blindness, stroke, and throat/mouth cancer messages were found to have the most influence on smoking behavior, uptake, and attempts to quit among the six health warnings studied.

From the air quality measurements and covert observations in hospitality venues, a third of the hospitality venues visited had observed smoking activity. The median indoor $PM_{2.5}$ concentration was 14.6 $\mu g/m^3$ and was higher in venues where smoking was observed (28.3 $\mu g/m^3$) as compared to venues where smoking was not observed (12.3 $\mu g/m^3$). Accra (Ghana's capital city) had lower compliance levels to SFPs (59.5%) and poorer air quality as compared with Kumasi and Tamale. Knowledge levels of the SFP were found to be very low in all three cities as observed from the survey of hospitality venues staff. Compared to Tamale, the odds of having high knowledge scores were three times higher in Accra but lower in Kumasi. Scores for opinions were high for 'support for the prohibition of indoor smoking', 'smoking ban is necessary in public bars', 'smoking ban protects the health of workers', and 'smokefree bars make visits more comfortable'. Tamale had higher compliance with the SFP compared to Accra and Kumasi. Likewise, hotels were found to be more compliant as compared to bars and pubs.

The empty pack survey from one-day single stick sales recorded about 20% of the packs being illicit. A majority of the packs from Aflao (Ghana-Togo border) (99%) and Tamale (Ghana-Burkina Faso border) (46%) were illicit. The country of origin of the majority of the illicit packs was Togo with a few from Nigeria, Cote d'Ivoire, and other countries. The cigarettes sold in convenience stores, border towns, and the northern zone of the country, and cheaper cigarettes were more likely to be illicit compared with the relevant reference groups.

6.1.2 Perceptions and views on pictorial warnings warning labels on cigarette packs

The study revealed that pictorial warnings on cigarette packs are more effective in promoting unfavorable views about smoking. Whilst smokers in the study used words like "serious" and "showing the real effect" to describe the pictorial pack designs, nonsmokers were not in favor of being seen in public with packs bearing health warnings. Pictorial health warnings have repeatedly been proven to be more effective (in terms of smoking behavior, strong cognitive reactions, and quitting behavior) as opposed to text-only warnings within high-income countries (Noar et al., 2016). Cigarette packs bearing pictorial health warnings have also been associated with causing greater impact and recall as compared to text-only warnings (Borland et al., 2009). Graphical warnings may be more beneficial in LMICs due to lower levels of literacy making text-only warnings less effective.

Findings from intervention studies (as part of the ITC project) within countries in Asia such as Thailand and Malaysia (Fathelrahman et al., 2013) and systematic reviews (Ratih & Susanna, 2018) also reiterate the effectiveness of the pictorial warnings over text-only. Despite the lack of studies within the African region, available literature on intervention studies in Kenya and Mauritius within the International Tobacco Control Project, has also reiterated that health warnings in the form of pictures are effective in terms of salience, thinking about health risks and thinking about quitting among smokers (Green et al., 2014). In our study, visual warnings were deemed useful in helping established smokers quit and reduce their cigarette consumption by both smokers and non-smokers. These results encourage ongoing efforts to implement visual warnings in other African

nations, including South Africa, Kenya, Niger, Burkina Faso, and Chad (Brathwaite et al., 2015).

In Ghana, pictorial health warnings are used to explain the negative health impacts of smoking to both present and potential smokers. Given that tobacco use in Ghana often begins in adolescence, this is especially helpful when communicating with vulnerable young people (Mamudu et al., 2018). In Ghana, about 15% of students have either purchased tobacco-branded goods or have received free cigarettes, demonstrating the power of the tobacco industry to influence smoking among Ghanaian youth. Findings among Australian school-aged youth show that after the introduction of pictorial warnings in 2006, they were more likely to read, pay attention to, consider, and discuss health warnings (White et al., 2008). Similar to this, pictorial representations on the rear of cigarette packaging in the United Kingdom increased the persuasiveness of warnings among 11–16 year old never and experimental smokers (those that have tried smoking, used to smoke, or smoked less than one cigarette a week) (Moodie et al., 2015).

Among low literacy groups, pictorial warnings have been found to be particularly important in communicating health information (Yong et al., 2013) The literacy rates in many countries within the African region range from 27 to 65% (Geck, 2017) In Ghana, the literacy rate is currently about 72% and smoking is concentrated among those with low levels of education (Yawson et al., 2013) and poverty, being a parent and having higher alcohol use (Rijo et al., 2012). Smokers in Ghana are thus more likely to be unable to read and understand text warnings on cigarette packs. Thus, a combination of pictures and text facilitates understanding of the warning messages regardless of literacy level.

However, one challenge that continues to persist in several low-income countries including Ghana is the rampant practice of single sticks-sales (Crosbie et al., 2021) This practice undermines the effect of health warnings on cigarette packs, regardless of the type of warning. In our study, male smokers recommended the printing of health warnings on individual cigarettes to address the challenges related to single stick purchases. Studies among smokers in Australia, Canada, the United Kingdom, and the United States also made similar recommendations about messages on individual cigarette sticks and that they present a novel and effective method for addressing tobacco use (Drovandi et al., 2019).

Six different warning labels were utilized in the focus groups for this study, and the majority of smokers and non-smokers thought the visuals of throat and mouth cancer, blindness, and lung cancer were the most effective. These findings were consistent across all categories. Smokers and non-smokers assess the appearance of graphic, upsetting visuals with frightening content as having a greater detrimental impact on smoking behavior (Cunningham, 2022). Fear has been linked to increases in important outcomes, including intentions to stop, thinking about health concerns, and cessation behavior. It has been postulated that fear mediates the impact of health warnings (Pang et al., 2021).

With regards to specific warning messages, throat and mouth cancer, blindness, and stroke messages in our study elicited a "fear" response among study participants. However, similar to our study findings, pictures with fear-related reactions discouraged respondents from wanting to smoke more than the corresponding text-only labels did among young adults in the United States (Cameron et al., 2015). Interestingly, related studies in LMICs also show that graphic warning images exhibiting patients suffering from cancers (e.g., lung cancer or laryngeal cancer) and images of damaged body parts are perceived as the scariest warning images (Chudech & Janmaimool, 2021). Nevertheless, studies on the most effective individual images and message themes and their associated emotions among smokers and non-smokers are generally lacking.

According to the participants in our study, picture and text warnings intended for usage in Ghana should be locale- and context-specific. The most significant factor in determining the general salience and impact of health warnings is their visual component, which also determines how emotionally charged and well-received they are (Cunningham, 2022). The recommended set of warning labels assessed in the current study, of which four stood out, may serve as the foundation for visual warning labels that Ghanaian cigarette packaging may eventually adopt.

6.1.3 Air quality measurements and secondhand smoke exposure in hospitality venues

One of the central elements of tobacco control is the adoption of smokefree policies over the last three decades. The study's findings show that around 60% of the venues in the three cities complied with the law against smoking at least in part, and did not have evidence of active smoking when we visited. Similar methodologies used by LMICs like India, where smoking prevalence is substantially higher, to assess compliance with smokefree laws, revealed higher levels of compliance (>80%) in hospitality sites than in our study (Goel et al., 2014). This could be attributed to the tobacco control laws with strong enforcement at the district and state levels. Less than 10% of the hospitality venues in our study had DSAs, and only about 50% of the hospitality venues had a no-smoking signage. However, we did find active smoking in roughly a third of the venues (in sections that were supposed to be smokefree). Less than 10% of the locations did, however, sell tobacco products.

Several years after Ghana's tobacco control act (2012) and the ratification of the FCTC (2004), our study's findings unmistakably show that hospitality venues, especially in Accra, are not fully compliant with current smokefree regulations. In other countries in SSA such as Kenya, active smoking was found at about 85% of hospitality sites, despite having a comparable smokefree ordinance to Ghana (Karimi et al., 2016). However, in Uganda (with a comprehensive smokefree law since 2016), active smoking was observed in less than 20% of hospitality locations (Robertson et al., 2018). Our study found active smoking in about 30% of the hospitality venues, which could be attributed to the low prevalence of smoking in Ghana.

The WHO urges all nations to implement comprehensive SFP, which it defines as SFPs without any exceptions for certain venue types or provisions for DSAs because these do not safeguard against the health risks of SHS (WHO 2021). Reviews within the African region emphasize the lack of implementation and enforcement of SFPs in addition to policy fatigue and limited resources (Mamudu et al., 2020) There are difficulties in SFP enforcement in a sizable number of African nations, including Ghana, with persistent legal violations. One country, Seychelles, demonstrates a good example, where compliance with smokefree laws was impressively high in bars and restaurants after only nine months of the enactment of the smokefree law (Viswanathan et al., 2011). Some positive aspects of the situation in Seychelles included the small country size (thus requiring fewer resources for implementation), high awareness and knowledge of

hospitality staff, training of hospitality staff on how to enforce the ban, and active enforcement of the ban by venue workers.

An objective assessement of SHS exposure by measuring $PM_{2.5}$ concentrations in the hospitality venues in the three cities was also studied. Air quality measurements for SHS exposure are rarely conducted in the African region due to its resource-intensive and time-consuming feature (Byron et al., 2019). The availability of low-cost air quality monitors, like the Dylos DC 1700 for measuring $PM_{2.5}$, has improved the quality and amount of SHS data that can be gathered and supplied the proof required to reinforce smokefree protection, especially in low-income settings (Jackson-Morris et al., 2016).

In our study, the median $PM_{2.5}$ measured in smoking venues was higher as compared to nonsmoking venues (23.8 $\mu g/m^3$ and 12.4 $\mu g/m^3$ respectively). Bars/pubs and restaurants were also found to have higher indoor $PM_{2.5}$ than hotels. The earlier study in Ghana in 2010 indicated markedly higher $PM_{2.5}$ in smoking venues than in non-smoking venues (Agbenyikey et al., 2011). As compared to earlier $PM_{2.5}$ concentrations in hospitality venues in 2010, our results show marked improvement in air quality with $PM_{2.5}$ concentrations having decreased from a median of 553 (pre-law) to 14.6 $\mu g/m^3$ in our current study (97% reduction). We used the WHO-recommended 24-h average limit in outdoor air quality ($PM_{2.5}$ of 25 $\mu g/m^3$) as a benchmark in our study (WHO, 2006).

The WHO FCTC Article 8 standards are not fully met by Ghana's public smokefree regulations, despite substantial improvements in air quality measures in hospitality venues. SHS has no risk-free level, and even brief or minor exposure can have rapid negative effects (McGhee & Hedley, 2016).

6.1.4 Knowledge, opinion and compliance of hospitality venue staff/owners towards smoke free policy

The study's findings show that the staff knowledge levels for the SFP in the three cities were extremely poor. Knowledge scores varied significantly between the three cities, with Accra notably outperforming Kumasi and Tamale in terms of knowledge. Other research

utilizing comparable instruments in Middle Eastern countries like Lebanon (Alaaeddine et al., 2013) and African nations like Nigeria (Odukoya et al., 2016) and Uganda (Gravely et al., 2018) show higher levels of awareness of their respective national laws (>50%) than in our study. In Uganda and Lebanon, most of the respondents were managers, however, in our study, more than 70% of the respondents were waiters or receptionists. The differences in the educational background of the respondents in these studies could explain the varying knowledge scores. The level of education was found, for instance in Kenya (Mamudu et al., 2020) and Turkey (Alkan & Ünver, 2022), to also influence the presence and enforcement of a work SFP. Although, respondents in all three cities scored poorly on the tobacco control act and SFP, Accra respondents were three times more likely to score well than Tamale respondents.

The literacy level distribution in the country, which is highest in Accra (86%), the capital city of Ghana, with Tamale at 43% and Kumasi at 50%, may help to explain some of the variations between the three cities (Yen news, 2018). In addition, hotels were twice as likely as bars and pubs to sponsor SFPs, but this difference was not statistically significant. Additionally, the difference between hotel workers and staff at other establishments like bars and pubs may be due to literacy levels; hotel staff may be more educated than the staff at bars and pubs. Because hospitality industry workers have a higher risk of exposure to SHS, the public health community and tobacco control advocates must launch educational efforts to inform and sensitize them about the tobacco control act and its SFP components. This is especially critical in Tamale and Kumasi.

Compared with earlier studies in Ghana among adults (Owusu-Dabo et al., 2011) and the youth (WHO, 2017a), our study highlights the support of SFPs by the staff of hospitality venues. Comparatively, strong support (>80%) for a ban on smoking in hospitality venues has also been observed in other countries in Africa (Odukoya et al., 2016) and Europe (Aherrera et al., 2017b). Findings from four countries in SSA (Nigeria, Cameroon, Kenya, and Uganda) also indicate strong support (>90%) for the prohibition of smoking in public places (Mamudu et al., 2020). The staff at hospitality venues did not think that implementing effective SFP would have a significant negative economic impact. The fundamental defense of advocates of comprehensive SFPs has been that SFPs do not decrease the sales, earnings, or staffing needs of pubs and restaurants. In our study, Accra had a lower likelihood of having a favorable view toward SFPs than Tamale.

This could be attributed to the growing economy and level of international connectedness in Accra as compared to Kumasi and Tamale.

Respondents believed that SFPs improved the comfort of hospitality venues and shielded their health from the negative impacts of SHS. These findings drive those who support tobacco control to urge for a review of the current partial SFP in favor of a comprehensive SFP (100 percent smokefree environment). Implementing smokefree environments has been shown to decrease the levels of dangerous biomarkers, such as nicotine and cotinine, in biological samples by 90% and 50% to 89%, respectively (Fu et al., 2013). However, to accomplish this, a strong enforcement system with clear regulations is necessary.

Self-reported compliance by hospitality venue staff did not differ considerably between the three cities. Similar to earlier studies, our study also demonstrates that establishments like bars and pubs had lower SFP compliance rates than hotels (Aherrera et al., 2017). This may be partially explained by (1) bar and pub personnel may be less inclined to enforce SFPs out of concern about losing customers and thereby reducing earnings and (2) the clientele that visits hotels may belong to a higher socio-economic class (with a low smoking prevalence) as compared to clients visiting bars and pubs. Therefore staff at hotels may be more likely to enforce SFPs. A coordinated enforcement framework is necessary to ensure compliance with SFPs. Our study findings also indicate that one of the main challenges in ensuirng a smokefree establishment in hospitality venues was poor assistance from enforcement authorities.

In our study, staff designation was not found to have any influence on the compliance level of the hospitality venues, however, studies have shown that managers of hospitality venues have conflicts about enforcing a policy among their customers on whom their livelihood depends on. A few solutions to this could be actions by civil society organizations to show public support for smokefree venues, engagement of stakeholder, and advocacy based on evidence as in Uganda (Robertson et al., 2018).

6.1.5 Sale of illicit cigarettes in Ghana

Data on illicit tobacco use is generally lacking in SSA and this study provides an objective measure of the extent and also describes the nature of the illicit cigarette market. This plays a critical role in developing comprehensive and effective tobacco control policies in the region. Our illicit cigarette estimates from single stick sales of 20% are, however, lower than the estimates of the Euromonitor (37% in 2018) (Euromonitor, 2019), which was the only available estimate on the illicit cigarettes market in Ghana. Nevertheless, the Euromonitor data is criticized for lack of transparency and their funding source from the tobacco industry (Stoklosa & Ross, 2014). The industry is known for quoting high estimates of the illicit market as a means of deterring governments from imposing tobacco tax increases, which contributes to ineffective tobacco control and lost opportunities for the governments to collect more revenue. Therefore, the earlier estimate of the Euromonitor International may be an overestimation.

Several methods of estimating the extent of illicit tobacco exist such as the gap analysis methods (measuring the difference between consumption and tax-paid sales), smoker's interviews, littered pack survey, and econometric modeling (Michal et al., 2020). For this study, the empty-pack survey method was used due to the common practice of single stick sales. This is similar to methods used in other LMICs with single stick sales such as India (John & Ross, 2018), Pakistan (Khan et al., 2021), and Bangladesh (Abdullah et al., 2020). Despite a ban on single stick sales, all retailers (100%) sold single sticks, calling for enforcement of the ban. Our estimates of illicit cigarette sales (20%) are also similar to countries with a higher tobacco use prevalence such as Pakistan (18%) and Argentina (14%) that used a similar methodology (Khan et al., 2021; Pizarro et al., 2021). Despite the lack of estimates of illicit cigarettes from many countries in the African region, countries such as South Africa, Kenya, The Gambia and Nigeria have available estimates of their illicit market using different methods of estimation. Our estimates were found to be lower than South Africa (with over 30% of the total market being illicit) (Vellios et al., 2021), Nigeria (26%) (Adeniran et al., 2020), and Kenya (26%) (Ross, 2017) but higher than The Gambia (8.6%) (Chisha et al., 2019). With the recent ratification of the illicit tobacco protocol in Ghana, and estimates suggesting one out of five cigarette packs to be illicit, there is an urgent need for the government in Ghana to address this by fully implementing ratified protocol (which has specific requirements to improve traceability of tobacco products and increase tobacco industry accountability).

The majority of the cigarette brands (Rothmans Kingsize, London Brown/White, and Pall Mall) collected in our study belonged to British American Tobacco. This could be attributed to the company's long history in Ghana (Owusu-Dabo, 2011). While the company ceased domestic production in 2006, it remains the dominant importer of cigarettes in the country. There are also very low-priced brands available, such as British American Tobacco's Tusker brand (of which all packs were illicit). While, all packs from London Brown/White were found to be licit, about 14% of Pall Mall and 1.6% of Rothmans Kingsize were illicit, suggesting the possibility of the industry's involvement in illicit trade.

According to recent findings from internal industry documents and insiders, British American Tobacco has used informants in West Africa to keep abreast of the illicit trade and also started to oversupply the West African country, Mali, with clean-labeled cigarettes (Morris, 2021). Further, small-scale convenience stores were found to be a major selling point for illicit cigarettes. These are legally operating, widely available settings to the low-income Ghanaian smoker (who prefers to buy single sticks) widely available in both rural and urban locations. Convenience stores were also found to have higher odds of illicit cigarette consumption as compared to drinking bars indicating that the situation may be the same else where in the country.

Geography was found to play an important role in the illicit cigarette market in Ghana. A third of the packs collected from the northern zone of the country were found to be illicit. Similar to findings of the Euromonitor (Euromonitor, 2019), the sale of illicit cigarettes is high in the north of Ghana, with most smuggling from Burkina Faso finding their way to this region into Tamale. The high smoking prevalence and lower-income population in the region could partly explain this (Yawson et al., 2013). Similarly, border towns were also found to be strong predictors of illicit cigarette sales. Six out of 10 packs collected from border towns were illicit and almost 100% of the packs collected from Aflao (Ghana-Togo border), and close to half of the packs from Tamale (a large city in Northern Ghana linked to Burkina Faso) were found to be illicit. Border towns are more vulnerable to the trade of illicit cigarette and tobacco products in Vietnam (Nguyen et al., 2020) and Georgia (Little et al., 2020).

Our findings reinforce the need for strengthening patrolling and border control in addition to building capacity and training for authorities belonging to customs, police, and immigration. The majority of the illicit cigarettes in our study originated from Togo, Nigeria, and Burkina Faso. According to Euromonitor (Euromonitor, 2015), Nigerian products are mostly smuggled in via Togo and most products smuggled in from Togo originate from British American Tobacco Nigerian operations, with lower taxes in Nigeria enabling these to be sold at a lower price in Ghana.

In terms of the pricing of cigarettes, illicit packs were found to be almost 50% cheaper than licit packs. Africa in general lags behind other regions (such as European and the Americas) in implementing strong tobacco tax policies. Close to 90% of the illicit packs belonged to the low-price category (2-7 GHC). Currently, the total excise tax on tobacco products in Ghana accounts for only 31.8% of the average retail price (WHO, 2021c). Also, over half of the smuggled cigarettes in the study originated from Togo where a pack of cigarettes is priced at about one USD and is about 0.50 USD in Ghana (WHO, 2021c). The link between tobacco taxation and smuggling has been doubtful and inconsistent. Contrary to claims made by the tobacco industry, a World Bank analysis (World Bank, 2019) finds that taxes and prices have a relatively small impact on the market share of illicit cigarettes at the national level. This insight is well illustrated by the African continent, which has high levels of smuggling and low prices and taxes on tobacco goods. This calls for more research to understand the relationship between tobacco taxation and smuggling in Africa.

6.2 Methodological considerations

6.2.1 Study design

Three observational studies and qualitative research are included in this dissertation. A qualitative approach was the best choice for examining smokers' and non-smokers' perspectives on the adoption of pictorial warnings in Ghana based on the study objectives of Study I. According to Ritchie and Spencer (Ritchie & Spencer, 2010), a naturalistic, interpretive approach to qualitative research is concerned with understanding

the meanings that people attach to actions, decisions, beliefs, values, and the like within their social world as well as the mind mapping process that respondents use to make sense of and interpret the world around them. Although focus groups have received criticism for their dynamics, which include social pressures and desirability bias, it is asserted that these dynamics are similar to those brought on by regular everyday talks (Hollander, 2004). To get smokers and nonsmokers to share their account and experiences regarding warning labels on cigarette packs, focus groups were found to be most appropriate.

Studies II-IV were cross-sectional studies. A cross-sectional study is a type of observational study design involving data from a population at one specific point in time. In this type of study, investigators measure both outcomes and exposures of the study subjects at the same time. They are the best way to determine the prevalence and can study the associations of multiple exposures and outcomes as observed in the pack survey and knowledge of hospitality staff on Ghana's tobacco control act and SFP and air quality measurement study.

6.2.2 Strengths of the study

The qualitative exploration of health warning labels on cigarette packs among smokers and non-smokers (Study I), to the best of my knowledge, was the first qualitative study on views and perceptions of text and pictorial health warnings in Ghana. Investigating difficult, novel, or comparatively neglected topics, like the adoption of warning labels in Ghana, can be done effectively and efficiently using qualitative research. It provides insightful information about the subject of interest. A qualitative approach is also appropriate to uncover aspects that may not be possible using a quantitative technique, such as societal norms, socioeconomic position, gender roles, ethnicity, and religion. Given the lower literacy rates and generally lower levels of publicly available health information on the harms of smoking, the conclusion from our study gives strong support for the introduction of pictorial warning labels in LMICs, where the advantages may be even higher. For the implementation of visual warnings in Ghana and to identify the most effective warning labels influencing smoking patterns, this study offers policymakers and tobacco control activists first-hand information.

The data from the qualitative study were analyzed using the framework analysis technique. The framework analysis method's usage of a matrix output, which enables researchers to systematically evaluate data by participants and topics, is one of its key features. I was able to meaningfully compare and contrast data across the several participant groups (smokers and non-smokers) and themes using the matrix I designed for this study.

In contrast to the earlier study in Ghana and several other studies worldwide that relied on convenience sampling and thus introduced selection bias, Studies II and III adopt a random technique to sample hospitality venues. Additionally, using both an objective ($PM_{2.5}$ measurement) and subjective SHS evaluation yields a more thorough estimation of SHS exposure in this context. Using a validated questionnaire, Study III presents compelling data regarding the understanding, attitudes, and compliance of staff to the SFP in Ghana, which has not been explored to date.

Using a novel technique appropriate for markets with a high prevalence of single-cigarette sales, the pack survey study (Study IV) offers the first impartial and empirically valid estimates of the illicit cigarette trade in Ghana. The empty pack survey method is a time and resource-efficient, cost-effective tool for assessing illegal cigarette sales, especially in low-income countries like Ghana.

6.2.3 Limitations of the study

Given the qualitative approach of study I with purposeful sampling technique of participants from locations such as brothels, abbatoirs, and schools, the results of the study may not be generalizable (transferability) to the smokers and non-smokers population in Ghana. Also, participants in this study were required to rate a series of warnings after viewing the warnings for a brief amount of time. Though it is necessary for an experimental design, "real-life" exposure to warnings is more repeated and sustained, and we are not able to determine in our study whether our findings are a true reflection of sustained exposure. Further, despite the heterogeneity of the focus groups, an increase in the number of focus groups (especially adult female smokers) and the inclusion of a

youth group (given that smoking begins during adolescence or young adulthood) would have facilitated a richer and thicker qualitative dataset.

Studies II and III have several limitations that need to be noted when considering the study results. Firstly, in study II, $PM_{2.5}$ is not a specific marker to SHS and may also be generated by other sources including combustion of fuel and traffic pollution. In our study, we were able to overcome this limitation by measuring outdoor $PM_{2.5}$ in addition to indoor $PM_{2.5}$ to provide comparative data and we also presented the difference between outdoor and indoor $PM_{2.5}$ concentrations. It was observed that $PM_{2.5}$ concentrations were higher in venues where smoking was observed, which partly validates the use of $PM_{2.5}$ as a marker. Previous work has also shown high a correlation between $PM_{2.5}$ and airborne nicotine in settings where smoking takes place (Fu et al., 2013).

Secondly, Study II and III use a cross-sectional study design hence a causal relationship between the exposures and outcomes cannot be implied. However, $PM_{2.5}$ is a well-established marker for SHS and highly correlates with air nicotine. Thirdly, the timing of the data collection for Study II was from 16:00 to midnight between July and September. It may be possible that smoking behavior may differ at different times of the day, the week, month, or year (seasonal and holidays). For both studies II and III, the study sites are limited to the three large urban cities in Ghana and findings may not be representative of all hospitality venues in Ghana.

Limitations that are peculiar to Study III include firstly, the exclusion of the 12 venues that had missing data. This may have to some extent reduced the generalizability of our findings. Secondly, Study III was based on self-reports thus the possibility of social desirability bias by the respondents. However, all respondents were, assured by the researcher of their responses being kept anonymous to reduce this bias. Third, the sample size of the study was small, which also reduced the power of the study to observe statistically significant differences between the study groups. Lastly, the majority of our respondents belonged to the waiters and receptionists category instead of managers and owners (who were not available during the interviews), which has to be kept in mind when interpreting the results although the staff designation was not significantly associated with knowledge, opinions, and compliance of the SFP.

In study IV, despite the wide geographical dispersion in the three zones of the country (northern, middle, and coastal), the representativeness of the country is limited as the study was conducted in five large cities and three border towns only. Also, as data was collected during the COVID-19 lockdown period in Ghana and other border towns could not be explored as planned due to pertaining restrictions at the time. Further, the empty pack collection relies on retailers to provide us with all the empty packs from the previous day's single stick sales. It could be possible that some retailers would want to hide the illegal packs, which could underestimate our findings. Nevertheless, retailers were motivated with a monetary incentive, which, to an extent, mitigated this issue. Another limitation was the lack of adjustment for possible clustering by retailers, however, the packs in this study were collected based on different cities (border and non-border) and not by the vendor as informed by a previous study that was conducted in a similar LMIC setting (John & Ross, 2018).

6.2.4 Future implications

The current study contributes fresh information and data on three main tobacco control-related topics; cigarette pack warning labels, SHS exposure, and illegal cigarette sales in Ghana. Future research on graphic health warnings in Ghana should make use of high-quality randomized trials to examine the effectiveness of health warning message content among Ghanaians with greater use and explication of the theoretical and conceptual underpinnings surrounding health warnings. Further, discussions about creating policies to safeguard customers and employees of such establishments as well as putting enforcement measures in place to increase compliance are built on the findings and conclusions from Studies II and III. Future studies are needed to better understand the problems and opportunities related to the implementation of the smokefree law in Ghana from the perspective of civil society organizations and policymakers. Additionally, there is a need for policymakers and supporters of civil society organizations to allocate more funds to develop media and educational initiatives to enlighten the general public and employees of hospitality venues about the health risks of SHS. To assist the adoption and implementation of complete SFPs as required by the FCTC, a review of the current partial SFP is necessary.

The empty-pack survey has two major implications for policy. First, the regulatory body and focal point for tobacco control in Ghana (FDA) should improve supply chain control and market surveillance at retail locations in towns and cities, particularly those close to the border towns, in addition to border monitoring and transportation tracing. This requires collaboration with customs, police, and immigration. To successfully monitor the black market, Ghana should also take into account putting in place a supply chain control in the form of a track-and-trace system that is free from any industry interference.

Therefore, it is anticipated that these research results will direct future studies on tobacco control and serve as a baseline for future research. The findings also have significance for bolstering and expediting the implementation of the following: 1) WHO FCTC to attain the universal right to health aims; 2) UN Sustainable Development Goals; and 3) non-communicable disease targets (WHO, 2022b).

7 CONCLUSIONS

In terms of tobacco control, the African continent has a substantial and well-known "implementation gap" that is made worse by the tobacco industry. The purpose of this dissertation was to conduct studies focusing on four key areas of tobacco control: pictorial health warning labels on cigarette packs; SHS exposure, knowledge, opinion, and compliance with the SFP among hospitality venue workers; and the illegal tobacco trade in Ghana, which will inform the implementation of the WHO FCTC. The FCTC is central to the achievement of UN SDG target 3.a, which highlights the strengthening of the implementation of the WHO FCTC in all countries.

The research on visual health warnings in Ghana was the country's first of its kind. The study's results help us better understand how effective visual warning labels are regarded to be. In Ghana, graphic warnings on cigarette packages can discourage adult and young adult smokers and non-smokers from starting to smoke increase attempts to quit and lessen the allure of smoking. The inclusion of visual warnings on cigarette packs is strongly advised in the area due to the poor literacy rates of smokers.

Following the implementation of the smokefree regulation, the assessment of SHS exposure in hospitality venues in Ghana's three largest cities revealed a noticeable improvement in air quality compared to earlier studies. However, there was little adherence to the law, and smoking was observed in one-third of the locations (based on the number of active smokers, the smell of smoke, and the presence of cigarette butts). There was substantial support for the ban on smoking in public areas, including hospitality venues, notwithstanding inadequate knowledge and low compliance levels with the present SFPs among hospitality personnel. Thus, initiatives are required to create an action plan to build on advancements made in the direction of changing societal norms toward smoking in hospitality venues. There is also a need to review the current SFP and facilitate the adoption and implementation of comprehensive SFPs that is in line with FCTC.

Finally, close to 20% of all packs collected during the empty pack survey from single stick sales in border and non-border towns in Ghana were found to be illicit packs. Border towns such as Aflao and Tamale had the highest percentage of illicit cigarette sales and a large proportion of the illicit packs originated from Togo followed by Nigeria, and Cote d'Ivoire among other countries. Convenience stores, border towns, pack prices, and the northern zone of the country were associated with the sale of illicit cigarettes in Ghana.

Implementation of the recently ratified illicit tobacco protocol is imperative for reducing the availability and affordability of cheap tobacco in addition to improving revenue generation for the government in Ghana. Successful implementation of the Protocol requires parties to modify their legal, administrative, and enforcement structures, and for which specialized technical assistance will be needed to build domestic capacities to a level that they can fully implement the protocol.

In a nutshell, this thesis provides a backbone to make a case for better implementation of the FCTC with an overall goal of reductions in tobacco-related morbidity and mortality in Ghana.

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PUBLICATION 1

"Pictures don't lie, seeing is believing": exploring attitudes to the introduction of pictorial warnings on cigarette packs in Ghana

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Nicotine & Tobacco Research, Volume 16, Number 12 (December 2014) 1613–1619
doi:10.1093/ntr/ntu127

Nicotine & Tobacco Research, Volume 16, Number 12 (December 2014) *1613–1619*

ORIGINAL INVESTIGATION

"Pictures Don't Lie, Seeing Is Believing": Exploring Attitudes to the Introduction of Pictorial Warnings on Cigarette Packs in Ghana

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Received February 6, 2014; accepted June 14, 2014

ABSTRACT

Purpose: To compare perceptions of text and pictorial warning labels on cigarette packs among Ghanaian smokers and nonsmokers and to explore their views on the introduction of pictorial warnings in Ghana.

Methods: Qualitative study involving 12 focus group discussions with 50 smokers and 35 nonsmokers aged 15 years and older in Kumasi, Ghana. Semistructured discussion guides along with visual discussant aids were used to explore the perception, acceptance, and potential use of pictorial warning labels in Ghana.

Results: Health warnings combining text and a picture were perceived by both smokers and nonsmokers to communicate health messages more effectively than text-only or picture-only warnings. The effect of text-only warnings was considered limited by low levels of literacy and by the common practice of single stick sales rather than sales of packs. Of the 6 health warnings tested, lung cancer, blindness, stroke, and throat/mouth cancer messages were perceived to have the most impact on smoking behavior, including uptake and quit attempts.

Conclusions: Warning labels combining pictures and text have the potential to reduce smoking uptake, increase quit attempts, and reduce smoking appeal among smokers and nonsmokers in Ghana. Measures to prevent single stick sales, or to promote health messages to purchasers of single sticks, are required.

INTRODUCTION

Tobacco smoking is the global leading cause of preventable death and the largest long-term challenge to public health in developing countries (WHO, 2013). Smoking currently kills 6 million people annually and is projected to kill 1 billion people by the end of the 21st century (WHO, 2013). Most of this disease burden will occur in low- and middle-income countries (WHO, 2013) such as those in Sub-Saharan Africa, where smoking prevalence is currently rising (Gilmore, Mckee, Sim, & Pomerleau, 2011), particularly among young people (GTYS, 2002), and is likely the result of intensive efforts by tobacco industries to expand into rapidly growing African markets (Twumwine, 2011).

Health warnings on cigarette packs have emerged as an important means of communicating the health risks of tobacco use to the consumer (Hammond, Reid, Dreizen, & Boudreau, 2012) and are now required in more than 56 countries (Cunningham, 2012). Pictorial warnings (including both text and a picture) covering more than 30% of the pack surface are more likely to be noticed than text-only warnings (Hammond et al., 2006; Hammond, Fong, McDonald, Cameron, & Brown, 2003) and are more effective at communicating the health risks, increasing thoughts about health risks (Li & Grigg, 2009; Thrasher, Hammond, Fong, & Arillo-Santillan, 2007) and motivating smokers to quit smoking (Hammond et al., 2012). Several population-based surveys in Canada, the United Kingdom, and Australia have also emphasized the importance of pictorial warnings in preventing smoking initiation among young people (O'Hegarty et al., 2006; Thrasher et al., 2007; White, Webster, & Wakefield, 2008). Pictorial warnings are also likely to be more effective in populations with low literacy rates (FCTC Article 11, 2009; Yong et al., 2013), and

doi:10.1093/ntr/ntu127
Advance Access publication August 11, 2014

low- and middle-income countries may represent one of the few sources of information about the health risks of smoking (Yong et al., 2013).

The West African country of Ghana has a population of 25 million, a rapidly growing economy (Central Intelligence Agency, 2013), low literacy rates, and rising smoking prevalence among young adults (6.7% for males vs. 4.4% for females—John, Mamudu, & Liber, 2012; Mamudu, Veeranki, & John, 2013—and 7.6% in older adults; Yawson et al. 2013). Cigarette packs in Ghana currently carry text-only health warnings, in English (Figure 1) (Owusu-Dabo, McNeill, Lewis, Gilmore, & Britton, 2010) and as far as the authors are aware, there are no studies that have explored views on the introduction of pictorial warnings in Ghana. The aims of this study were, therefore, to qualitatively explore (a) the perception and acceptance of text-only, picture-only, and pictorial warning labels and (b) the likely influence of text-only, picture-only, and pictorial warning labels on initiation and quitting behaviors of Ghanaian smokers and nonsmokers.

METHODS

Study Design and Participants

This qualitative focus group study was carried out in Kumasi, an urban city in the Ashanti region of Ghana with a population of 1.7 million (Ghana Demographic Profile, 2013) between October 2012 and June 2013. To elicit a range of views of male and female smokers and nonsmokers, participants were recruited from different locations including schools, hospitals, brothels, and abattoirs. Ever-smokers were defined as those who had smoked 100 cigarettes in their lifetime, current smokers as those who reported current regular smoking, and nonsmokers as those who did not currently smoke, had not smoked in the last 6 months, and did not intend to smoke in the next 6 months. Due to the low smoking rates among women in Ghana, brothels were identified as an appropriate recruitment pathway based on communication with key stakeholders such as bar owners and students. A total of 12 focus groups were conducted.

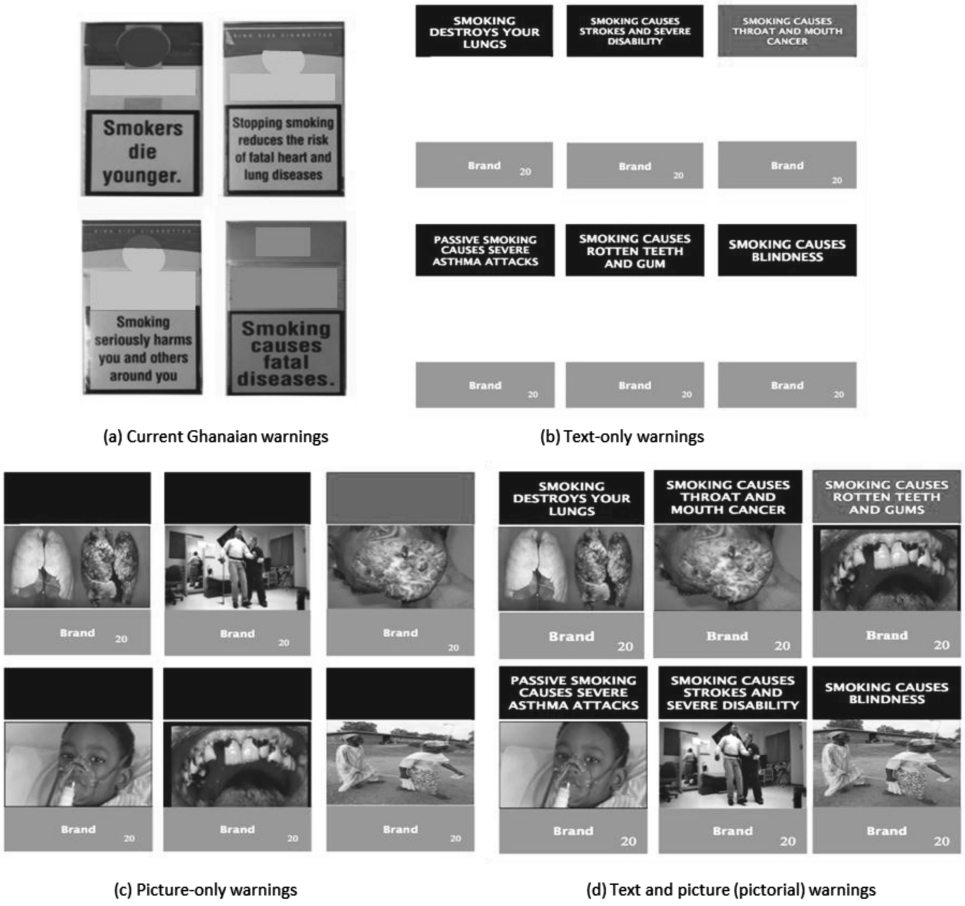

Figure 1. (a) Current Ghanaian warnings, (b) text-only warnings, (c) picture-only warnings, and (d) text and picture warnings. Photographs taken by AS.

Participants were initially recruited through purposive sampling of smokers and nonsmokers identified during consultation and history taking in general practice clinics run at Kwame Nkrumah University of Science and Technology Hospital by AS, with further snowball recruitment through asking respondents if they knew other people (smokers and nonsmokers) who may wish to participate. Nonsmoking groups were mainly identified by a convenience method; direct approaches by AS were also made to individuals at the selected locations (brothels, abattoirs, and schools) who were asked if they would be interested in participating in group discussions about cigarette warning labels. Those who expressed an interest were asked to bring others who would also be willing to participate. The focus groups were split by gender and smoking status to assess similarities and differences in their perceptions of cigarette warning labels. Those who agreed to participate were given an inconvenience allowance of GHC20 (GBP5) to cover travel and other minor expenses. We included individuals aged 15 and above.

Procedure

The authority in charge of the chosen focus group locations was contacted, the study objectives explained, and permission to use their facility requested. Each focus group was arranged by an administrator and took place in a quiet setting at the different chosen locations. The focus groups were moderated by AS with the support of an observer who took note of nonverbal communication and any additional field notes relevant to the study. Demographic data including age, education, qualifications, and employment status were collected by questionnaire prior to the start of the discussion. Each focus group began with a general discussion on consent, confidentiality, and guidelines for group interviews and then moved on to explore perceptions of general attitudes toward cigarette smoking, views about warning labels, interpretations of text and pictorial warnings, views on impact of text and pictures on smoking behavior, and the rating/grading of different warning labels on their impact on smoking behavior in terms of smoking uptake and/or quitting. Focus group discussions typically lasted between 30 and 50 min and were audio-recorded.

To help facilitate the discussion, cigarette packs were designed by the research team using the color (olive green) and design format of the Australian pack (Hammond, 2009) and used as visual discussant aids. A total of six different warning messages based on designs already used in the European Union (EU): smoking destroys your lungs, smoking causes throat and mouth cancer, smoking causes blindness, smoking causes stroke, passive smoking causes severe asthma attacks, and smoking destroys your teeth and gums were used. Participants were shown these six messages in a text-only format (Figure 1b), then in a picture-only format (Figure 1c), and then finally in a combination of text and picture (Figure 1d). Participants were shown a total of 18 different pack designs.

Ethics Approval

Ethics approval was obtained from the Kwame Nkrumah University of Science and Technology Ethics Committee (CHRPE/AP/219/12).

Analysis

Audio files were transcribed verbatim by AS in the language of the discussion (a mixture of Twi, a local Ghanaian dialect, and English) and then translated to English with support from native Twi speakers, using back translation where necessary to ensure that meaning and content were accurately reflected. Data were analyzed using the framework approach (Ritchie & Spencer, 1994) and following the methods suggested by Smith and Fith (2011). This approach allowed the different phenomena within these cross-sectional descriptive data to be captured and facilitated the exploration of potential differences in views between smokers and nonsmokers and between genders. To aid familiarization, all 12 transcripts were read and reread by AS and LLJ, with printed transcripts being annotated line-by-line where codes and categories were identified. Each line/phrase was then charted in a coding matrix using Microsoft Excel™. Transcripts were then revisited and the codes and categories grouped into appropriate themes and subthemes, from which a coding index was developed to synthesize and organize the dataset and to aid interpretation. Finally, each theme was charted in a summary framework, with direct extracts included to allow exploration of the core themes and to ensure that interpretation of the emerging concepts remained grounded in the participants' descriptions. Disagreements in coding and theme interpretation were resolved via discussion between the researchers.

RESULTS

From a total of 97 smokers and nonsmokers who were identified and contacted, 85 (88%) comprising 50 smokers (34 males) and 35 nonsmokers (27 males) with an average age of 38 years participated in a group discussion. We carried out 12 focus groups, comprising seven of smokers and five of nonsmokers (Table 1). The majority (59%) of participants had primary level education and were of low occupational status including butchers, street vendors, and sex workers (82%).

Three overarching themes were identified and interpreted within the data: (a) smoking rationale and awareness, (b) views

Table 1. Focus Group Participant Summary

Smoking status/gender	Number of potential participants approached	Number of participants recruited (%)	Mean age (range, years)	Number of focus groups/location
Adult male smokers	24	20 (83)	38 (22–64)	3 (abattoirs, hospitals)
Young adult male smokers	15	14 (93)	17 (15–21)	2 (schools)
Adult male nonsmokers	23	21 (91)	35 (22–52)	3 (hospitals, schools)
Adult female smokers	18	16 (89)	21 (18–25)	2 (brothels)
Adult female nonsmokers	17	14 (82)	38 (25–39)	2 (hospitals, schools)

on current Ghanaian warnings, and (c) views on EU warnings. Each of these themes and associated subthemes are described below and illustrated with quotes in Boxes 1–3.

Smoking Rationale and Awareness

All groups of smokers, irrespective of age and gender, recognized addiction as the main reason for continuing to smoke, overriding their underlying desire to quit smoking. The influence of peers was considered an important driver for the initiation and maintenance of smoking, and young adult male smokers highlighted that smoking was an important part of their identity that allowed them to be an accepted member of their peer group (see Box 1 for illustrative quotes).

Views on Current Ghanaian Warnings

Awareness

All smokers were aware of current health warnings on Ghanaian cigarette packs, though nonsmokers were more able to recall the warnings (see Box 2 for illustrative quotes). Female nonsmokers perceived smokers to be poorly educated, with low literacy and hence unlikely to notice and understand the warnings. Adult male nonsmokers thought that the warnings would not prevent initiation of smoking. The most commonly recalled current warning messages were "smoking causes cancer" and "smoking kills."

Avoidance

Male smokers reported that they actively avoided taking notice of the warnings on cigarette packs so as to continue to rationalize their smoking behavior. Desire to smoke was influenced by the smoker's mood at that specific time, regardless of warnings. Adult female smokers noticed the warnings but did not register their content.

Influence on Behavior

Young adult male smokers reported that current warnings did not influence their smoking habit, being overridden by cravings and desire to smoke. Nonsmokers were of the view that current warnings were not effective enough and that most smokers would smoke regardless due to addiction and coping mechanisms. For many smokers, the common practice of single stick purchases prevented contact with the warning messages.

Views on EU Warnings

Text-Only Warnings

General perceptions of the text-only EU warnings were that they were similar to those already in use in Ghana and unlikely to have an impact, particularly for those with low literacy (see Box 3 for illustrative quotes). Among male smokers, the lung cancer, stroke, and blindness text-only messages were considered the most effective. Messages featuring teeth and gums and passive smoking were considered least effective because a dentist could always fix affected teeth, and effects of passive smoking were not considered to be important.

Picture-Only Messages

Picture-only warnings were regarded by all groups to be more effective; considered to be novel, serious, informative, emotive, and to show "real effect"; and often provoking fear and disbelief. The throat and mouth cancer image had the greatest impact, and with the exception of adult female nonsmokers, the teeth and gums image the least. Adult female smokers saw the picture-only warnings as more effective across all literacy levels. Adult male nonsmokers felt that the packs carrying picture

Box 1. Smoking Rationale and Awareness

Addiction

"Smoking is addictive and you will smoke if your friend's smoke, we all know it is bad and it can make you sick, the person who smokes is used to it and so they don't mind but if you don't smoke it can cause problems" (adult male nonsmoker).

Influence

"We know it is bad, but you go to a funeral or party, people are smoking and you want to smoke also, it looks nice when you see them smoking so you just want to do some" (young adult female smoker).

Perceptions

"There is nothing good about it…I don't know why people even smoke. It makes you sick so why smoke?" (adult male nonsmoker).

Knowledge

"I know there are many things it can cause such as cancer, bad breath, bad teeth" (young adult male smoker).

Box 2. Current Ghanaian Warnings

Awareness

"For me when I smoke although I see them [warning label] I don't really read them, some are difficult to read so I don't bother, but I know the messages mean smoking is bad for your health" (adult male smoker).

Avoidance

"I also don't notice any of them so I don't know what it reads, I just don't look at them as long as I get what's inside" (adult male smoker).

Influence on Behavior

"If these warnings could make me stop smoking I would have done this long time, the cigarette makes me happy so why would I stop smoking because I am reading something on the pack?" (adult male smoker).

"I sometimes don't buy the packs…only the sticks so I don't see them anyways!" (young adult male smoker).

Box 3. Views on EU Warnings

Text-Only Warnings

"Messages like these [text-only warning] are already in the system but I don't know if they are helpful in smoking habits. I mean do they influence people at all?" (adult male nonsmoker).

Picture-Only Warnings

"Seeing is believing. I think this is more serious, they make me now wonder more about my smoking habit" (adult male smoker).
"I think if they did pictures like this on the pack here [in Ghana] I don't think anyone would buy cigarettes to smoke because it would make you think more. Look at the picture and you can see the actual thing yourself so you will believe it more than when it is just written so why would you buy it with such a picture on it?" (adult male nonsmoker).

Text and Pictures

"These packs [text and picture warning] are the best they give you the complete information, those who have gone to school and those who have not can all understand it" (young adult male smoker).

Overall Views

"These are good ideas already, maybe putting the picture on the cigarette sticks would also help?" (adult male smoker).

warnings would not look good in public and, therefore, that they would not want to be seen using such a pack.

Text and Pictures
The combination of text and picture into one health warning was felt to be the most comprehensive warning message on packs, regardless of literacy level. Most groups were of the view that smokers, particularly those with low literacy, would understand either the text or the picture, if not both. Although the picture and text warnings reiterated health messages that some participants were already aware of, the addition of pictures bolstered interest, attention, and clarity of the health message. Young adult male smokers suggested that text and picture warnings would prevent young adults from smoking initiation and would enable them to make a conscious and informed choice about smoking.

Overall Views
Smokers and nonsmokers believed that combined picture and text warnings were likely to have the biggest impact on initiation and quitting behavior and perceived that they may be particularly effective for those with low literacy. There was strong support for their introduction in Ghana. Adult male nonsmokers suggested that pack inserts with additional pictures might also be helpful, while adult male smokers suggested that since many smokers purchase cigarettes singly, the images should be printed on the cigarettes.

DISCUSSION

This study is one of the first to explore views on the introduction of pictorial warning labels among smokers and nonsmokers in a developing country. The results demonstrate that current Ghanaian text-only warnings alone are considered ineffective in communicating the health risks of smoking and that there was strong support for the introduction of pictorial warnings in Ghana. Our study suggests that pictorial warnings on cigarette packs may be effective in reinforcing negative perceptions of smoking as participants referred to these pack designs using language such as "serious" and showing the "real effect," and nonsmokers were reluctant to be seen in public with packs carrying health warnings. Pictorial warnings were also felt to be more effective among smokers with low literacy. However, the effect of health warnings was acknowledged to be diminished by the common practice of selling and purchasing cigarettes as single sticks.

Mauritius was the first African country to introduce pictorial warnings, and it did so in 2009 (ITC Project, 2012). Their experience indicates that pictorial warnings are more effective than text-only warnings in communicating the health effects of smoking (ITC Project, 2012). Our findings were similar for both smokers and nonsmokers who reported that pictorial warnings influenced thoughts about quitting and cutting down the number of cigarettes among established smokers. Our findings are also consistent with other qualitative studies (BRC Marketing and Social Research, 2004; Decima Research, 2009; Les Etudes de Marche Createc, 2006) demonstrating that pictorial warnings on cigarette packs are perceived by adult smokers and nonsmokers to be more effective and associated with greater impact than text-only warnings. Evidence for the greater potential impact of pictorial warnings has also been shown in experimental studies, including a U.S. study that found that pictorial warnings were associated with greater negative emotions and that these emotions were associated with more negative attitudes toward smoking (Peters et al., 2007).

Pictorial warnings are a potential key medium for communicating the health effects of smoking to existing and new smokers in Ghana. Communication with vulnerable young people is particularly important as tobacco use is typically initiated in adolescence in Ghana (Mamudu et al., 2013) and similar to many other developing countries, the tobacco industry has targeted adolescents with various marketing and promotional activities (WHO, 1999). According to Mamudu et al. (2013), approximately 15% of Ghanaian students have either acquired tobacco-branded merchandise or been offered a free cigarette, suggesting that the tobacco industry is trying to influence and encourage uptake of smoking in young people in Ghana. Young adult smokers in our study highlighted the influence of peers as an important driver for smoking initiation as it gave them a sense of belonging. Evidence from a longitudinal evaluation of pictorial warnings among Australian school children found that students were more likely to read, attend to, think about, and talk about health warnings after the implementation of pictorial warnings in 2006 (White et al., 2008). Findings from national surveys of Canadian youth also suggest similar levels of support for pictorial warnings and self-reported impact (Koval, Aubut, Pederson, O'Hegarty, & Chan, 2005).

Pictorial warnings may be particularly important in communicating health information to populations with lower literacy rates (Yong et al., 2013). Most African countries have literacy rates between 27% and 65% (World Factsheet, 2013), and in Ghana, it is higher than average at 72% (World Factsheet, 2013). In addition, smoking in many developing nations is concentrated in groups with low levels of education (World Factsheet, 2013). According to a recent study by John et al. (2012), tobacco use in Ghana was significantly associated with poverty, low education, being a parent, and alcohol use. Smokers in Ghana are thus particularly unlikely to be able to read and understand written health warnings. It was clear that combining pictures and text facilitated understanding of the key health messages even when literacy was low. However, there is a common practice in Ghana of purchasing single sticks, rather than pack of cigarettes, thus many smokers who are poor and with low literacy skills will not be exposed to the health warning label on packs, irrespective of whether they are text or pictorial in nature. Male smokers in our study suggested that the solution to this problem was to print health warnings on individual cigarettes.

Of the six different warning labels presented as visual aids in the focus group discussions for the current study (Figure 1), those depicting lung cancer, blindness, stroke, and throat and mouth cancer were rated as most effective by most groups of smokers and nonsmokers. These findings were consistent across all groups especially among male smokers and female nonsmokers. Some of these warnings were also associated with fear and disbelief among participants who sought clarification from the moderator as to the authenticity of the association between smoking and its effects especially blindness and stroke. Research has consistently demonstrated that warnings with fear-arousing content are rated more highly by smokers and nonsmokers (Sweet, Willis, Ashida, & Westman, 2003). Negative emotions, such as fear, have been hypothesized to mediate the effectiveness of health warnings (Sweet et al., 2003) and have been associated with increases in key outcomes, such as intentions to quit, thinking about health risks, and cessation behavior (Kees, Burton, Andrews, & Kozup, 2010). In our study, a "fear" response was articulated on a number of occasions, particularly in relation to warning messages with blindness, stroke, and throat and mouth cancer. In contrast with the substantial evidence based on the general effectiveness of pictorial warning labels, there is a paucity of research on the most effective individual images and message themes. Our study participants were of the view that picture and text warnings for use in Ghana need to be context and country specific. The pictorial component of health warnings is the most important determinant of the general salience and impact of health warnings and is responsible for the emotional reactions and positive evaluations of health warnings (Hammond, 2011). The proposed set of warning labels tested in the current study, of which four were salient, have the potential to be the starting point from which pictorial warning labels could be considered for implementation on cigarette packs in Ghana.

LIMITATIONS

Limitations of the study include our requirement for participants to rate a series of warnings after viewing the warnings for only a brief amount of time. Although necessary for the experimental design, "real-life" exposure to warnings is more repeated and sustained, and we are unable to determine whether our findings reflect the impact of this more sustained exposure. In addition, although the focus groups were heterogeneous, an increase in the number of focus groups, particularly for adult female smokers, would have facilitated a thicker and richer qualitative dataset.

CONCLUSIONS AND RECOMMENDATIONS

This study extends our understanding of the perceived effectiveness of pictorial warnings labels. Our study population recommends the use of pictorial warnings on cigarette packs in Ghana given the low literacy rates of smokers and their effectiveness compared to text-only warnings. Pictorial warnings have the potential to reduce smoking uptake, increase quit attempts, and reduce the appeal to smoking among adult and young adult smokers and nonsmokers. Given the significant health consequences of smoking among young people, the most vulnerable group in Ghana, it is timely to examine whether more diverse warnings could deter initiation of smoking and prompt cessation more effectively among this demographic population. The study also finds that the effect of all health warnings is significantly undermined by the practice of selling cigarettes as single sticks, and as this is likely in practice to be difficult to prevent in low income populations, it raises the need to consider printing health warnings on individual cigarettes.

FUNDING

This work was supported by a grant from the Association of Physicians of Great Britain and Ireland: Links with Developing Countries Scheme (Registered Charity No. 207530). JB, MRM, and LLJ are members of the UK Centre for Tobacco and Alcohol Studies (UKCTAS), a UK Centre for Public Health Excellence. Funding to UKCTAS from the British Heart Foundation, Cancer Research UK, the Economic and Social Research Council, the Medical Research Council, and the National Institute of Health Research, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged.

DECLARATION OF INTERESTS

None declared.

ACKNOWLEDGMENTS

The participation of our focus group participants is deeply appreciated, as well as the assistance of the observer for the focus groups, Isaac Nkrumah. The support and assistance provided by individuals who helped set up the focus groups are also recognized and appreciated.

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PUBLICATION 2

Exposure to secondhand smoke in hospitality settings in Ghana: Evidence of changes since implementation of smokefree legislation

Arti Singh, Gabriel Okello, Sean Semple, Fiona Dobbie, Tarja I. Kinnunen, Kwabena F. Lartey, Divine D. Logo, Linda Bauld, Sampson T. Ankrah, Ann McNeill, Ellis Owusu-Dabo

Tobacco Induced Diseases 2020;18(May):44
https://doi.org/10.18332/tid/120934

Tobacco Induced Diseases

Research Paper

Exposure to secondhand smoke in hospitality settings in Ghana: Evidence of changes since implementation of smoke-free legislation

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ABSTRACT

INTRODUCTION Ghana has a partial smoking ban with smoking allowed in designated smoking areas. Studies evaluating smoke-free laws are scarce in Sub-Saharan Africa. Evaluation of smoke-free laws is an effective means of measuring progress towards a smoke-free society. This study assessed the level of compliance to the provisions of the current smoke-free policy using air quality measurements for fine particulate matter ($PM_{2.5}$) in hospitality venues in Ghana.

METHODS This was a cross-sectional observational study conducted in 2019 using a structured observational checklist complemented with air quality measurements using Dylos monitors across 152 randomly selected hospitality venues in three large cities in Ghana.

RESULTS Smoking was observed in a third of the venues visited. The median indoor $PM_{2.5}$ concentration was 14.6 µg/m^3 (range: 5.2–349). $PM_{2.5}$ concentrations were higher in venues where smoking was observed (28.3 µg/m^3) compared to venues where smoking was not observed (12.3 µg/m^3) ($p<0.001$). Hospitality locations in Accra, Ghana's capital city, had the lowest compliance levels (59.5%) and poorer air quality compared to the cities of Kumasi and Tamale.

CONCLUSIONS The study shows that while smoking and SHS exposure continues in a substantial number of hospitality venues, there is a marked improvement in $PM_{2.5}$ concentrations compared to earlier studies in Ghana. There is still a considerable way to go to increase compliance with the law. Efforts are needed to develop an action plan to build upon recent progress in providing smoke-free public spaces in Ghana.

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KEYWORDS
observation, hospitality venues, Ghana, air quality monitoring, particulate matter

Received: 8 February 2020
Revised: 8 April 2020
Accepted: 21 April 2020

Tob. Induc. Dis. 2020;18(May):44 https://doi.org/10.18332/tid/120934

INTRODUCTION

Implementing smoke-free legislation remains a challenge in many low- and middle-income countries (LMICs). However, with 77% of all smoking-related deaths and 89% of secondhand smoke (SHS) related-deaths occurring in low- and middle-income countries, it is clear that the burden of the tobacco epidemic has moved from high-income countries (HICs) to LMICs[1]. This means that implementation of smoke-free laws in LMICs is paramount[2]. Article 8 of the World Health

Organization (WHO) Framework Convention on Tobacco Control (FCTC)[3] and its guidelines including other evidence-based policies such as MPOWER (the WHO's technical assistance package of evidence-based policies, for more information please see https://www.who.int/tobacco/mpower/mpower_report_six_policies_2008.pdf)[4] mandate protection from exposure to secondhand smoke (SHS). The WHO African Region also advocates that all countries be compliant with the requirements of FCTC Article 8 guidelines, and that 100% smoke-free environments should become the *status quo* in all societies. This includes hospitality venues (such as bars, hotels, restaurants, night clubs, and pubs) where workers have traditionally been exposed to the highest levels of SHS[5]. While smoke-free policies are becoming more common, more than 80% of the world's population (particularly in LMICS) is not yet protected by these policies[6,7]. This is the scenario in several countries in Sub-Saharan Africa (SSA) where smoke-free policies either do not exist or are in the inceptive stages and studies on the magnitude of SHS-related air quality are poorly described and inadequate[7].

Ghana, being one of the first countries to ratify the WHO FCTC in 2004, passed a Tobacco Control Act in 2012 as part of its legal obligation[8]. Section 58 (1) of the Tobacco Control Act prohibits smoking in 'an enclosed or indoor area of a workplace, or any other public place except in a designated area'. This was later followed by a legislative instrument in 2016 (L.I.2247) that further reiterated smoke-free policies in furtherance to provisions in the tobacco control act and had specific guidelines for setting up designated smoking areas and display of appropriate 'NO SMOKING' signage[9]. Thus, Ghana has a partial smoke-free law as smoking is prohibited in enclosed or indoor areas of the workplace or any other public place, with the display of adequate 'NO SMOKING' signages posted and ashtrays not displayed, except in a designated smoking area (DSA)[10]. Despite these binding principles, smoking prevalence among the youth (aged 11–17 years) continues to rise (up to 7%) and close to 50% of students are unaware of the harmful effect of SHS[11]. Furthermore, 1 in 10 children are exposed daily to SHS in homes[12].

Reducing the exposure to SHS is an important public health challenge that has been recognized by policymakers and regulators, and smokers' behaviour is influenced in part by their understanding of smoke-free legislation. Though the WHO recommends that all countries implement comprehensive smoke-free policies, defined as smoke-free policies with no exemptions for particular venue types or allowances for designated smoking areas, Ghana has a partial smoke-free policy that allows smoking to continue in certain types of enclosed public venues[13]. Effectiveness of comprehensive smoke-free laws have been demonstrated in many countries. For example, in Scotland air quality in bars and pubs was shown to have improved markedly after the introduction of comprehensive smoke-free laws[14]. Similar findings have been demonstrated in England, Wales, Ireland and other HICs[15,16].

There is limited evidence relating to the evaluation of the current smoke-free law and compliance levels in Ghana. Studies conducted in Ghana pre law (2007) indicated very high levels of SHS exposure (median $PM_{2.5}$ = 553 μg/m^3) in hospitality venues located in the urban cities of Ghana[17]. A follow up study conducted in 2015 showed similar findings (median $PM_{2.5}$ = 439 μg/m^3)[18]. Now, more than 5 years into Ghana's smoke-free policy, it is timely to evaluate the current policy given the rising smoking rates among young people and the use of other tobacco products (such as shisha), in addition to providing comparative data to the previous studies in Ghana[10,19]. Evaluating the law is also useful to identify gaps and check compliance with existing regulations, and in the identification of areas requiring more effective enforcement. This study, therefore, aimed to determine the compliance to the provisions of the current smoke-free policies as identified in the Tobacco Control Act (2012) and L.I (2016) and provide objective data on SHS (by measuring fine particulate matter, $PM_{2.5}$, as a marker of SHS) in hospitality venues.

METHODS

Study design

This was a cross-sectional study comprising objective measurements of airborne fine particulate matter ($PM_{2.5}$) in hospitality venues across three cities in Ghana. The measurements were complemented with covert observations of smoking related behavior, signage and compliance with local laws in each venue.

Training

A team comprising the researcher and four research

assistants received training on air-quality monitoring using a low-cost monitor and compliance studies involving observational data collection. Training involved: how to operate a Dylos DC1700 (Dylos Inc, CA, USA) air quality monitor; how to download acquired data; and how to collect data in hospitality venues using an observation checklist protocol similar to that used in studies in similar settings over the past decade[20,21]. The protocol included details on venue selection, visit duration, researcher safety, inside/outside air monitoring duration, logging data, assessment sheet instructions, and data transferring.

Site selection

The study was conducted in the three largest cities in Ghana; Accra, Kumasi and Tamale (due to their large population density, diversity, and high smoking prevalence). A list of 1532 hospitality venues of bars/pubs/restaurants/hotels and nightclubs in the three cities was obtained from the Ghana tourist authority. These venues were then stratified into the 3 major cities of the southern, middle and northern belts of Ghana, respectively; Kumasi (457), Accra (949), and Tamale (126). Using a margin of error of 5%, confidence limit of 95% and a no-response rate of 87.7%, a total of 154 venues were obtained as the sample size of the study. A proportionate allocation was then done for each of the three cities to gather a convenience sample of 150 venues across the country. A random number generator (Minitab version 17) was then used to randomly select 150 venues from each city. Visits took place during peak working hours (from 16:00 to midnight) in each of the selected cities. In cases where the venue was closed or no longer in operation, the venue next on the list was visited.

Data collection

A total of 154 venues were visited from the three cities. Data were collected over a 10-week period from July to September 2019 including a three-day pilot data collection in Kumasi. All data collection at the hospitality venues was done in pairs (the researcher and an assistant) on any particular day.

Covert observations

Observational methods such as visual inspection of a venue (e.g. surveying rooms for the posting of 'No Smoking' signs, staff/customer smoking, presence of DSAs, evidence of ashtrays and cigarette butts) and semi-subjective assessment of the presence of recent smoking through self-reported smell of smoke from the researcher are a relatively simple and inexpensive methods of assessing SHS exposure[20]. These methods provide an easy tool to provide a snapshot of an environment at a specific point in time. A standardized observational checklist, comprising all the compliance indicators, was adapted from similar studies and was implemented across all venues to improve quality control[20]. The standard indicators of compliance include observed smoking, presence of DSAs, presence of ashtrays and presence of NO SMOKING signs. Additional indicators of compliance such as presence of cigarette butts and the smell of smoke at the venues were also observed in this study. All field workers were trained in entering observation data. Covert data collection was agreed upon based on advice from experts and previous studies on air quality measurement that highlighted the delays and difficulties that an open approach to owners can present[22]. The study protocol was approved by the Ethics Committee of the University of Stirling (Reference number: GUEP494) and KNUST (Reference number: CHRPE/AP/441/18). Data collection was conducted covertly (observation and $PM_{2.5}$ measurements) hence informed consent was not taken, however, researchers carried an official letter during field work describing the study plus evidence of ethical approval and contact details. All the places in which data collection occurred were 'public places' and the individuals and the specific locations remain protected by anonymity and confidentiality.

$PM_{2.5}$ measurements

On entry to each establishment, the researchers purchased a beverage before proceeding to a seat or area as central as possible and away from any doors, windows or obvious potential sources of $PM_{2.5}$ such as open solid-fuel fires or kitchen areas. The researchers aimed to place the monitor on the seat or table level to ensure that sampling was as close as possible to the breathing zone and also tried to ensure that they were not within 1 m of anyone smoking. Air sampling was carried out for a minimum of 30 minutes. This instrument uses a light scattering technique to measure the number of particles in two particle size ranges: more than 0.5 µm and more than 2.5 µm. All

data presented in this article relate to particles in the size range between 0.5 µm and 2.5 µm; and were generated as mass concentrations using equations specific to SHS aerosol presented in Semple et al.[23-25]. The Dylos devices were switched on to start the logging process at the beginning of each series of visits and were left to measure and log 1-minute particle number concentrations for the duration of the sampling process. SHS assessment was conducted continuously for a period of 30 minutes inside each venue and the device left running between venues to allow $PM_{2.5}$ measurement in outdoor air to provide comparative data. A minimum of 30 minutes of outside air sampling was also undertaken each day in order to provide comparative data on outdoor $PM_{2.5}$ concentrations. Exact entry and exit time for each venue and time spent outside in ambient air were also recorded.

Data analysis

Study team staff downloaded the air quality data using Dylos Logger software. The Dylos DC1700 measures and records the concentration of particles as described above. Each Dylos device had a specific calibration factor applied from a chamber experiment where measured concentrations of SHS $PM_{2.5}$ were compared with those reported from a calibrated Sidepak AM510 Personal Aerosol Monitor (TSI Inc, MN, USA)[24-26]. Descriptive statistics including the geometric and arithmetic means, standard deviation, minimum, maximum and median were generated for the $PM_{2.5}$ levels across the whole dataset and then subdivided by city, venue type and size of venue using SPSS version 22. Observation data from the standardized checklist were also entered onto an excel sheet, coded and analysed using SPSS version 22. The data were recorded at three time intervals (entry, +15 minutes and +30 minutes) and the mean of the three values was used for the analysis. Descriptive statistics including percentages, proportions, means, standard deviation and medians were generated. The 'average compliance' to the smoke-free law was calculated by adding up the values of 'individual compliance indicators' and dividing it by the total number of indicators measured.

RESULTS

Description of venues

As noted above, a total of 154 venues from three cities were included in the sample. However, two of the venues from Accra and Kumasi had incomplete information, thus 152 venues were included in the final analysis. Out of the 152 venues visited, 62% (n=94) were in Accra, 30% (n=45) in Kumasi and 9% (n=13) in Tamale. About two-thirds (65%, n=94) of the venues were hotels, 15% (n=22) were bars/pubs and 20% (n=29) restaurants. Most of the venues (70%, n=106) were large and permanent structures and could accommodate more than 30 people at a time.

Compliance with smoke-free laws

The indicators of compliance (presence of DSAs and no-smoking signs, absence of smell of smoke, cigarette butts, ashtrays and any active smoking) were assessed in all 152 venues. NO SMOKING signs were evident in half of the venues (49.5%, n=75) with considerable variations by city: Accra (54.3%, n=51), Kumasi (35.6%, n=16), and Tamale (61.5%, n=8), with DSAs present in less than 10% of

Table 1. Compliance with specific indicators of smoke-free law in three cities, Ghana

Indicator		Cities			p*
	Overall sample (N=152) n (%)	Kumasi [a] (N=45) n (%)	Accra (N=94) n (%)	Tamale (N=13) n (%)	
Presence of no-smoking signage	75 (49.5)	16 (35.6)	51 (54.3)	8 (61.5)	0.007
Presence of DSAs	10 (6.6)	4 (8.9)	5 (5.3)	1 (7.7)	0.509
Absence of smell of smoke	101 (66.4)	39 (86.7)	50 (53.8)	11 (84.6)	0.000
Absence of cigarette butts/ends	133 (87.5)	41 (91.1)	80 (85.1)	12 (92.3)	0.636
Absence of active smoking	125 (82.2)	43 (95.6)	70 (75.3)	12 (92.3)	0.004
Absence of ashtrays	131 (86.2)	40 (88.9)	78 (83.0)	13 (100)	0.567

*p-value based on Fisher's exact test. a Only one venue in Kumasi was fully compliant with all the indicators.

the venues (6.6%, n=10) (Table 1). Tobacco smell was recorded in 51 venues (33.6%), and cigarette butts were found on the floor in 19 (12.5%) venues. Only one venue (a hotel in Kumasi) was found to be 'fully compliant' with all the indicators of compliance measure in the study (Table 1). More than 90% of the venues visited did not have cigarette or other tobacco products displayed for sale. The total average compliance for all the venues was 63.1% with Accra being the least compliant (59.5%).

Bars and pubs were found to be the least compliant with indicators of smoke-free legislation compared to hotels and restaurants (Table 2).

Subjective assessment of SHS

The field observers also rated SHS exposure in all the venues as low or zero, medium and high during covert observations and these were converted to binary variables (as present or absent) for analysis. Close to half of the venues in Accra had evidence of SHS exposure, and bars and pubs were more likely to have SHS exposure compared to hotels and restaurants (Figure 1).

$PM_{2.5}$ measurements

Table 3 shows the $PM_{2.5}$ levels across the different cities, venue type and size. The overall $PM_{2.5}$ concentration (indoors) in all 3 cities was 14.6 µg/m^3 (median) (Min 5.2, Max 349, IQR 12.9). Overall $PM_{2.5}$ (outdoors) was 12.4 µg/m^3 (median) (Min 3.8, Max 81.7, IQR 9.4). $PM_{2.5}$ concentrations were higher in Accra compared to Kumasi and Tamale, with bars and pubs having higher indoor $PM_{2.5}$ concentrations than hotels.

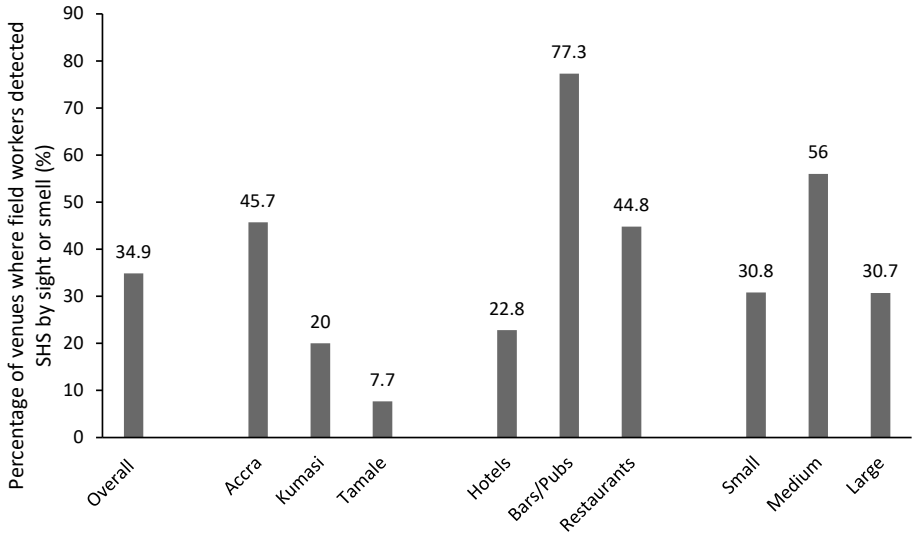
Table 4 shows the median and IQR of $PM_{2.5}$ inside, outside and indoor–outdoor grouped by city. The median values in all three cities were below the WHO

Table 2. Compliance with specific indicators in hotels, bars/pubs and restaurants

Indicators	Type of venue		
	Hotels [a] (N=101) n (%)	Bars/Pubs (N=22) n (%)	Restaurants (N=29) n (%)
Presence of no-smoking signage	55 (54.5)	5 (22.7)	15 (51.7)
Presence of DSAs	4 (4.0)	1 (4.5)	5 (17.2)
Absence of smell of smoke	81 (80.2)	18 (81.8)	13 (44.8)
Absence of cigarette butts/ ends	98 (97.0)	8 (36.4)	27 (93.1)
Absence of staff/ customer smoking	98 (97.0)	8 (36.4)	19 (65.5)
Absence of ashtrays	94 (93.1)	15 (68.2)	22 (75.9)

a Only one hotel in Kumasi was compliant with all indicators.

Figure 1. Subjective assessment of SHS by location, venue type and size



24-hour air quality guidance for $PM_{2.5}$ (25 µg/m^3). It also shows for each city the difference between inside and outside $PM_{2.5}$ concentrations as measured on the day. Positive values indicate that indoor air $PM_{2.5}$ was higher than measured outdoors suggesting the presence of indoor sources of $PM_{2.5}$ emissions.

Table 5 shows results of $PM_{2.5}$ concentrations in locations where smoking was observed (presence of staff/customer smoking, presence of smell of tobacco smoke, cigarette butts, and ashtrays). Venues where smoking was observed had poorer air quality compared to outside, and venues where smoking was not observed had air quality similar to that measured outdoors. Indoor–outdoor concentrations were higher in locations where smoking was observed (6 µg/m^3) compared to 1 µg/m^3 where smoking was not observed (p<0.001). In one-quarter of establishments where smoking was observed the indoor $PM_{2.5}$ concentration was at least 25 µg/m^3 greater than that measured outdoors in that city on the same day.

Table 3. Indoor $PM_{2.5}$ concentrations (µg/m^3) by city, venue type and size

	Indoor $PM_{2.5}$			
	Median	Minimum	Maximum	IQR
City				
Accra (n=94)	15.8	6.0	349	17.2
Kumasi (n=45)	13.0	5.2	51.3	10.7
Tamale (n=13)	12.5	6.5	23.8	6.5
Venue type				
Hotels (n=101)	13.3	5.2	276	9.7
Bars/Pubs (n=22)	21.9	9.0	349	53.4
Restaurants (n=29)	22.0	6.5	335	19.9
Venue size*				
Small	12.6	7.0	66.6	13.1
Medium	22.7	6.1	81.6	31.0
Large	13.9	5.2	349	10.7

*Measurement by how many people can sit in this establishment: 1 – 15 = Small, 16 – 30 = Medium, >30 = Large. IQR: interquartile range.

Table 4. $PM_{2.5}$ concentrations (µg/m^3) measured at indoor and outdoor venues by city

		Indoor			Outdoor			Indoor–Outdoor		
	Count	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
City										
Kumasi	45	13.0	8.95	17.6	9.80	8.30	15.89	0.50	-2.80	5.30
Accra	94	15.0	11.7	28.9	14.6	10.5	20.4	2.75	-8.50	11.7
Tamale	13	12.5	7.20	13.7	5.90	5.70	11.7	1.70	1.20	7.70

Table 5. $PM_{2.5}$ concentrations (µg/m^3) in smoking-observed versus smoking-not-observed venues

Smoking observed		Indoor			Outdoor			Indoor–Outdoor		
	Count	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Yes	57	23.80	15.7	61.1	18.2	12.7	30.7	6.00	1.20	25.1
No	95	12.30	9.00	16.0	10.8	8.30	14.0	1.00	-2.80	4.80
*p-value			<0.001			<0.001			<0.001	

*p-value based on multiple linear regression.

DISCUSSION

The study results demonstrate that close to 60% of the hospitality locations in the three cities were at least partially compliant with the current smoke-free legislation and had no observed smoking during our visit. Findings from other LMICs such as India (where smoking prevalence is much higher) using similar methods for assessing compliance to smoke-free

laws recorded higher levels of compliance (>80%) in hospitality locations[27]. This may partly be explained by the development of state- and district-level tobacco control laws alongside strong enforcement of the law in India, which may account for the higher compliance levels. In our study, smoking was observed in about a third of the venues (in areas meant to be smoke-free) and less than 1% of the hospitality locations had DSAs and about 50% of the venues had NO SMOKING signage. Interestingly, less than 10% of the venues had tobacco products for sale. Findings from our study clearly indicate that hospitality locations (particularly in Accra) are not fully compliant with current smoke-free legislation several years after the ratification of the FCTC (2004) and passage of the National Tobacco Control Act (2012).

Findings from other countries in Africa such as Kenya with a similar smoke-free policy like Ghana, indicated that smoking occurred in about 85% of hospitality locations[28]. Whereas in Uganda (which has a comprehensive smoke-free law introduced in 2016), observed smoking was present in less than 20% of hospitality locations[29]. The WHO recommends that all countries implement comprehensive smoke-free policies, defined as smoke-free policies with no exemptions for particular venue types or allowances for designated smoking areas as these do not protect against the health harms of secondhand smoke[13]. Reviews in the African region strongly emphasize that the struggle in smoke-free policies in the region are mainly in the areas of implementation and enforcement in addition to other factors such as policy fatigue and limited resources[6,7]. A considerable number of countries in the African region including Ghana have challenges with the enforcement of their smoke-free polices and that the law is continuously breached. Lessons could be learnt from Seychelles, a similar country in Africa, where the compliance to smoke-free laws was impressively high in bars and restaurants after only nine months of the enactment of the smoke-free law[30]. Contributing factors for the situation in Seychelles included a smaller country size (thus requiring fewer resources for implementation), high awareness and knowledge of the smoking ban among hospitality staff, training of hospitality staff on how to enforce the ban, and active enforcement of the ban by venue workers[31].

The second part of our study objectively assessed SHS exposure by measuring $PM_{2.5}$ concentrations in the hospitality locations within the three cities. Air quality measurement in resource-limited countries in the African Region are rarely carried out and can be expensive and time-consuming[6]. Introduction of low-cost air quality monitors such as the Dylos DC 1700 for measurement of $PM_{2.5}$ has enhanced the quality and quantity of SHS data that are possible to collect and provided evidence needed to strengthen smoke-free protection in low-income settings[21]. In our study, $PM_{2.5}$ measurements in the three cities indicated that venues where smoking was observed had statistically higher $PM_{2.5}$ concentrations compared to those where smoking was not observed. The overall $PM_{2.5}$ concentrations (indoors) in the three cities was 14.6 $\mu g/m^3$ (range: 5.2–348.8) with similar levels in the three cities: Accra (15.5 $\mu g/m^3$), Kumasi (13.0 $\mu g/m^3$), and Tamale (12.5 $\mu g/m^3$). Differences were also observed between the different hospitality venues visited with bars/pubs and restaurants having higher indoor $PM_{2.5}$ than hotels. For this study, we used the WHO recommended 24-h average limit in outdoor air quality of $PM_{2.5}$ of 25 $\mu g/m^3$ as a bench mark[32]. The previous study in Ghana on SHS in 2010 indicated markedly elevated $PM_{2.5}$ (median 553 $\mu g/m^3$; IQR: 259–1038) in smoking venues than in non-smoking venues (median 16.0 $\mu g/m^3$; IQR: 14.0–17.0)[17]. In our study, the median $PM_{2.5}$ measured in smoking venues was higher (23.8 $\mu g/m^3$) compared to non-smoking venues (12.4 $\mu g/m^3$) ($p<0.001$). Comparing $PM_{2.5}$ concentrations in hospitality venues in Ghana from 2010 with our results suggests that air quality has markedly improved with $PM_{2.5}$ concentrations having decreased from a median of 553 (pre law) to 14.6 $\mu g/m^3$ in the current study, an almost 97% reduction.

Ghana has made significant progress in terms of improved air quality measurements in hospitality settings. However, public smoke-free law does not fully meet the standards of the WHO FCTC Article 8 (to which Ghana is a Party to); thus, both smokers and non-smokers continue to remain unprotected against SHS in many hospitality locations. There is no risk-free level of SHS and even brief/minimal exposure can cause immediate harm[2,33]. Non-compliance with smoke-free laws among hospitality venues has also been found in other LMICs including those of Africa[21,31]. The results and outcome of this research

serve as a basis for discussions on the need to develop specific policies to protect consumers and employees of such premises, and also implement enforcement measures to improve compliance.

Strengths and limitations

The study's major strength is the use of a random strategy to sample hospitality venues compared to the previous study in Ghana and several other studies elsewhere that have relied on convenience sampling thus introducing selection bias. Also, the inclusion of a large number of hospitality venues in the three largest cities in Ghana including the use of an objective and subjective assessment of SHS provides a more detailed estimation of SHS exposure in this setting. However, the study has several limitations that need to be noted when considering the study results. First, $PM_{2.5}$ is not specific to SHS and may be generated by other non-smoking sources such as combustion of fuel and traffic pollution, however, our methodology sought to overcome this weakness by measuring outdoor $PM_{2.5}$ to provide comparative data and by presenting the difference between outdoor and indoor concentrations. The results of greater $PM_{2.5}$ concentrations in venues where smoking was observed validate the use of $PM_{2.5}$ as a marker and previous work has also shown high correlation between $PM_{2.5}$ and airborne nicotine in settings where smoking takes place[33]. Other limitations include the study sites limited to the three large urban cities in Ghana and findings may not be representative of all hospitality venues in Ghana. Other weaknesses worth noting are the timing of the data collection that was done from 16:00 to midnight and the months during which the study was conducted (July–September). It may be possible that smoking behavior may differ at different times of the day, the week or month. Lastly, the study is a cross-sectional design hence a causal relationship between smoke-free laws and SHS exposure cannot be implied. However, $PM_{2.5}$ is a well-established marker for SHS and highly correlates with air nicotine.

CONCLUSIONS

To the best of our knowledge, this is the first study measuring $PM_{2.5}$ concentrations and compliance to the smoke-free law in randomly selected hospitality locations within Ghana's three largest cities. Smoking was observed in about 37% and less than one per cent (<1%) of venues were fully compliant with all the measured indicators of compliance. However, there is marked improvement in air quality in these venues compared to earlier studies. Possible reasons for this improvement might be the introduction of the Tobacco Control Act (2012) and the L.I.2247 during this period, which could have led to greater enforcement of smoke-free policies compared to earlier studies and also decreasing smoking prevalence over the years. Fifteen years after the adoption of the WHO FCTC and more than five years after a National Tobacco Control Act, the study identified challenges for complete protection from SHS through legislation. There is still a considerable way to go to increase compliance with the SHS law in Ghana. Efforts are needed to develop an action plan to build on progress towards changing societal norms around smoking in hospitality venues and to ensure greater enforcement of existing smoke-free policy in Ghana.

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CONFLICTS OF INTEREST
The authors have each completed and submitted an ICMJE form for disclosure of potential conflicts of interest. The authors declare that they have no competing interests, financial or otherwise, related to the current work. A. McNeill reports grants from Research Councils UK, as part of the Global Challenges Research Fund, during the conduct of the study.

FUNDING
This work was supported by UK Research and Innovation (UKRI) with funding from the Global Challenges Research Fund (MR/P027946/2). The Tobacco Control Capacity Programme is a programme of capacity development and research coordinated by the University of Edinburgh, Scotland and involves 15 partner institutions from Africa, South Asia and the United Kingdom.

AUTHORS' CONTRIBUTIONS
AS directed the fieldwork, analyzed the data, and drafted the initial version of the manuscript. EOD, SS, and GO supervised all aspects of the fieldwork, data analysis, and interpretation related to compliance and air quality measurement. STA assisted with data analysis. KFL and DDL assisted with the fieldwork. EOD, SS, GO, FD, and TIK, were responsible for the interpretation and discussion of the study findings. All authors contributed to the revision of the manuscript for important intellectual content and final approval.

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer reviewed.

PUBLICATION 3

Adherence to smokefree policies in Ghana: Findings from a cross-sectional survey of hospitality venue owners and staff

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Tobacco Prevention & Cessation 2021;7(January):4
https://doi.org/10.18332/tpc/131058

Adherence to smoke-free policies in Ghana: Findings from a cross-sectional survey of hospitality venue owners and staff

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ABSTRACT

INTRODUCTION Implementation of and compliance with smoke-free policies (SFPs) can be problematic in many low- and middle-income countries (LMICs) due to limited resources. This study evaluated knowledge, opinions and compliance related to Ghana's SFPs among owners and staff of hospitality venues by city, staff designation, and venue type.

METHODS A cross-sectional study design was used in venue types including hotels, bars, pubs and restaurants in the three cities of Kumasi, Accra, and Tamale, in Ghana.

Data were collected between July and September 2019. Interviewer administered face-to-face surveys were conducted with owners and staff (n=142) recruited from randomly selected hospitality venues (n=154) in these three large cities of Ghana. The relationship between knowledge, opinions, and compliance items on SFPs, and city, venue type and staff designation was first studied using χ^2 or a Fisher's exact test, and then with univariate logistic regression model analysis.

RESULTS Of the 142 respondents, some had heard of Ghana's 2012 Tobacco Control Act (27.5%), smoking restriction in public places (29%), smoke-free places (22%), and display of 'no smoking' signage (6.3%). Knowledge levels were higher in Accra compared to Tamale (OR=3.08; 95% CI: 1.10–8.60). Staff designation and type of venue did not have any relationship with knowledge levels. Support for SFPs was over 80%, but opinions in support of SFPs were lower in Accra than Tamale (OR=0.25; 95% CI: 0.08–0.71). Compliance with SFPs was similar in the three cities. Hotels were three times more compliant compared to bars and pubs (OR=3.16; 95% CI: 1.48–6.71).

CONCLUSIONS The study highlights the strong support for restriction of smoking in public places including hospitality venues despite poor knowledge and low compliance levels with the current SFPs. A review of the current SFP in Ghana together with education of hospitality staff on the benefits and requirements of SFPs is recommended.

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KEYWORDS
compliance, knowledge, hospitality staff, Ghana, smoke-free policy

Received: 7 October 2020
Revised: 25 November 2020
Accepted: 30 November 2020

INTRODUCTION

There is no safe level of exposure to secondhand smoke (SHS) attributed to cigarette smoking. SHS causes heart disease, cancer and many other diseases[1]. The World Health Organization (WHO) indicates that more than 80% of the 1.3 billion tobacco users globally live in low- and middle-income countries (LMICs), where the burden of tobacco-related illness and death is heaviest. Approximately 1.2 million non-smokers die each year as a result of exposure to SHS[2]. According to the WHO Framework Convention on Tobacco Control (WHO FCTC) Article 8 (2007), the creation of 100% smoke-

free environments is the only effective science-based measure to protect populations from the harmful effects of exposure to SHS[3]. The benefits of implementation of smoke-free policies (SFPs) are numerous and include: a decline in SHS exposure leading to a substantial decline in heart disease morbidity and respiratory symptoms in workers; reduced cigarette consumption among continuing smokers; increased successful cessation among workers; and reduced tobacco use among youth[4,5].

The implementation of SFPs in many high-income countries in the past decade has shown substantial public health benefits[6,7], with no evidence of a decline in business activity in hospitality venues, such as restaurants or bars where policies are enforced[1]. However, more than 80% of the world's population (particularly in the LMICs) remains unprotected by these policies and much less effort has been expended on reducing exposure to SHS in several LMICs, including many in Sub-Saharan Africa (SSA)[6,8-10]. Despite low smoking rates in many African countries compared to other parts of the world[11], projections indicate that Africa will have the most rapid growth in tobacco smoking[11,12] by 2025. In terms of the effective SFPs, only a small number of African countries have a comprehensive or 100% SFPs covering all public and private places including hospitality venues[11-13]. Further, Africa has the weakest and lowest prevalence of effective SFPs[10]. Thus, endorsement and implementation of evidence-based policy initiatives such as SFPs are crucial.

Currently, Ghana, an LMIC in SSA, has a partial smoking ban, which prohibits smoking in enclosed public areas including hospitality venues such as restaurants, bars and nightclubs but allows for designated smoking areas (DSAs)[14,15]. While the overall prevalence of smoking in Ghana has been approximately 5% in adults[16-18] and 10% in adolescents[19,20], a third of adolescents are exposed to SHS[21]. Ghana's current SFP is faced with challenges relating to compliance and enforcement[22]. Earlier studies in Ghana have highlighted the lack of compliance and high levels of SHS in hospitality venues[9]. Interestingly, smoking was observed in about 30% of hospitality venues where smoking was prohibited, as indicated by our earlier air quality measurement study[23]. Notably, of all public places, the hospitality venues such as restaurants, bars, pubs and nightclubs have the highest SHS concentrations, and workers in these venues have the highest risk of SHS-related problems[7,24,25].

To identify drivers of attitude towards enforcement of the SFP in Ghana and to provide information that can be useful for Ghana and other countries facing challenges with implementation of SFPs, we interviewed owners and staff of hospitality venues as a follow-up to our earlier observational air-quality evaluation of hospitality venues. Specifically, we aimed to assess knowledge, opinions and compliance to the provisions of the Tobacco Control Act (TCA) (2012) and the SFP, among hospitality venue owners and staff from Ghana's three largest cities. Additionally, we sought to determine whether knowledge, opinions and compliance related to SFP differ by city, staff designation or hospitality venue type. This will help to inform context-specific recommendations towards the successful implementation of SFP in Ghana.

METHODS

Study design

A cross-sectional survey was carried out among owners and staff of hospitality venues in three cities in Ghana.

Site selection

The study was conducted in the three largest cities of Ghana (Accra, Kumasi, and Tamale) due to their large population density, diversity and high smoking prevalence. These cities also represent the major cities of the southern, middle and northern belts of the country, respectively. A list of 1532 hospitality venues including bars, pubs, restaurants, hotels and nightclubs in the three cities was obtained from the Ghana tourist authority. These venues were then stratified by the three cities: Accra (n=949), Kumasi (n=457), and Tamale (n=126). Using a margin of error of 5%, confidence limit of 95% and a response rate of 87.7% from earlier studies[22-24], a sample size of 154 venues was obtained for the study. A proportionate allocation was then made for the three cities: Accra [(949/1532) × 154 = 95], Kumasi [(457/1532) × 154 = 46], and Tamale [(126/1532) × 154 = 13]. A random number generator (Minitab version 17) was then used to randomly select the planned number of venues within each of the three

cities (simple random sampling). For consistency, the visits took place between 4 p.m. and midnight in all of the selected venues. In the case where the venue was permanently closed, the venue next on the list was selected. The study protocol was approved by the Ethics Committee of the University of Stirling (Reference number: GUEP494) and the Kwame Nkrumah University of Science and Technology (Reference number: CHRPE/AP/441/18). Informed consent was sought from each of the respondents that were interviewed for the study. Fieldworkers carried an official letter during fieldwork describing the study plus evidence of ethical approval and contact details of principal investigators.

Data collection and classification of variables

Data were collected over a 10-week period from July to September 2019, including a three-day pilot data collection in Kumasi. Owners and staff of the hospitality venues were interviewed via a pretested face-to-face interviewer-administered questionnaire adapted from similar studies[24,26]. Once the trained interviewers (n=4) arrived at the selected hospitality venues, they were required to seek an informed consent from the managers (or any person with similar authority) before commencement of the survey. If the manager or the owner was not available for an interview, we then interviewed another staff member based on the managers' recommendations. Only one eligible and consenting worker was interviewed at each venue due to the busy nature of such settings. Data were collected in a private secure place within the premises to ensure confidentiality. Descriptive variables that were collected included: type of venue (bar, hotel, nightclub, restaurant, pub), staff designation (owner, manager, waiter, other), tobacco products sold (yes or no), nature of venue (only indoor, only outdoor or both indoor and outdoor), types of tobacco products sold at the venue (manufactured cigarettes, hand-rolled cigarettes, pipes, cigars, shisha, electronic cigarettes and smokeless tobacco products), smoking allowed at venue (yes or no), sale of alcohol at venue (yes or no), presence of designated smoking area (yes or no), restriction to minors (yes or no), and smoking status of staff (smoker, non-smoker).

Respondents were then assessed on their knowledge, opinions and compliance to the SFP using KAP (knowledge, attitude and practice) scores. First, knowledge on Ghana's Tobacco Control Act (TCA) and SFP was assessed using a 9-item scale such as: ban on advertising and promotion (1), components related to SFP (3), government and tobacco industry interaction (1), advertising and promotion (1), sale and display of tobacco products (1), sale of tobacco products to minors (1), and warning on tobacco products (1). Each item response was coded as either '1=yes' or '0=no'. The mean score for each item (across all participants) was calculated and then a mean of those item-specific means was calculated to get the overall mean score. The overall mean score was then used as a cut-off for 'more knowledge' (≥ 0.09) and 'less knowledge' (<0.09) on TCA. Second, their opinions on Ghana's SFP were assessed by 10 questions on a 5-point Likert scale with options ranging from 'strongly agree' to 'strongly disagree'. The questions included the respondent's opinions on whether they had adequate information on SFPs and their views on the following statements: smoking ban has a negative effect on business, smoking ban causes financial losses, smoking ban is an unfair restriction on smokers, smoking ban results in unemployment, smoke-free bars make visits more comfortable, smoke-free bars protect the health of workers, smoking ban will encourage smokers to quit, smoking ban is necessary in public bars, and prohibition of indoor smoking in public places. For data analysis purposes, we created dichotomous outcome variables with a score of 1 given for 'agree' (strongly agree/agree) and 0 for 'disagree' (undecided/strongly disagree/disagree). Opinion scores for individual items were also computed in a similar way to knowledge scores. The overall mean score was used as a cut-off to categorize the opinions as 'agree/support' (≥ 0.54) and 'disagree/against' (<0.54).

Lastly, compliance with the SFP included five items with multiple choice options related to the venue's smoking policy. These items included: the respondent's best description of the venue's smoking policy; actions taken if someone smoked at the venue; awareness of violation penalties; law prohibiting sale and advertisements of tobacco products; and importance of no-smoking signage. Each response was coded as compliance (score = 1) or non-compliance (score = 0). The mean score for each item (across all respondents) was calculated

and then a mean of those item-specific means was calculated to get the overall mean score. The scale classified a score of ≥0.7 as 'more compliant' and a score of <0.7 as 'less compliant'.

Data analysis

Data collected were checked in the field for errors, corrected by the researchers and checked for inconsistencies before exporting into STATA 12. The names of the respondents and of the hospitality venues were not used to ensure anonymity and confidentiality. Descriptive variables such as city, type of venue, presence of designated smoking areas, types of tobacco products sold at the venue, smoking in the premises, and smoking status of interviewee, were reported as frequencies and percentages.

The relationship between knowledge, opinions and compliance items on SFP, and city, venue type and staff designation were first studied using χ^2 or Fisher's exact test (when the number in the table was <6) and then with a univariate logistic regression model. The results are presented as odds ratios (OR) with 95% confidence interval, with significance set at an alpha level of 5% ($p \leq 0.05$).

RESULTS

Characteristics of hospitality venues

A total of 154 venues were visited during the period between July to September 2019, but 142 were only analyzed as 12 (7.8%) had incomplete data. The majority of the venues were in Accra, the capital city of Ghana (47.2%), followed by Kumasi (38.0%), and Tamale (14.9%) (Table1). Hotels formed the largest part of the venues visited (69%), and most of the respondents were waiters or receptionists (76.8%). Smoking was allowed in 31% of the venues, and designated smoking areas were present in only 14%. Of the venues, 1.4% had outdoor facilities only and 98.6% had indoor facilities or both (Table 1). Approximately one in ten venues (n=18; 12.7%) had tobacco products visible for sale. The tobacco products commonly sold were manufactured cigarettes (15 venues), smokeless tobacco (18 venues) and shisha (10 venues).

Knowledge of hospitality staff on Ghana's Tobacco Control Act and smoke-free policy

Of the 142 respondents, 27.5% had heard of the TCA (2012). Table 2 provides the findings of knowledge related to the TCA stratified by city type (Accra, Kumasi, and Tamale), staff designation (owners, other) and venue type (hotel, bars, and pubs). About a third (29%) of the respondents were aware of the restriction of smoking in public places, 22% were aware of smoke-free places and only 6.3% were aware of the display of 'no smoking' signage, as components of the TCA. In addition, only 8.5% of all respondents were aware of the component on ban on tobacco advertising and promotion, and 5% were aware of the components on sale of tobacco and tobacco products. All these components were significantly different across the three cities ($p<0.05$), with more respondents in Tamale aware of them except for the component on restriction of smoking in public places (Kumasi 29.6%, Accra 35.8%, and Tamale 4.8%). All respondents were unaware of two of the components: warning labels on tobacco products, and limiting Government interaction with tobacco industry.

Overall, respondents had limited knowledge of almost all the components of the TCA with an overall mean score of 0.09. Respondents in Kumasi had the lowest knowledge scores (0.05), followed by Accra (0.10), and then Tamale (0.13). However,

Table 1. Characteristics of hospitality venues surveyed in the three cities (N=142)

Characteristics	*n (%)*
City	
Accra	67 (47.2)
Kumasi	54 (38.0)
Tamale	21 (14.8)
Type of venue	
Hotels	98 (69.0)
Other (bars/pubs/restaurants/night clubs)	44 (31.0)
Staff designation	
Owners	31 (23.2)
Other (waiters/receptionists)	111 (76.8)
Sale of alcohol	92 (64.8)
Restriction to minors	59 (41.6)
Sale of tobacco products	18 (12.7)
Smoking allowed at venue	44 (31.0)
Designated smoking area	20 (14.1)
Smoking status of hospitality staff	
Smoker	14 (9.9)
Non-smoker	128 (90.1)

Table 2. Knowledge items of hospitality venue staff on Ghana's Tobacco Control Act and smoke-free policy

Knowledge items	City				Venue type			Staff designation			
	Kumasi (n=54) n (%)	Accra (n=67) n (%)	Tamale (n=21) n (%)	p	Hotels (n=98) n (%)	Other* (n=44) n (%)	p	Owners (n=31) n (%)	Other** (n=111) n (%)	p	Mean KAP [a] score
Ban on tobacco advertising and promotion											0.08
Yes	0 (0)	7 (10.5)	5 (23.8)	**0.001**	9 (9.2)	3 (6.8)	0.754	3 (9.7)	9 (8.1)	0.725	
No	54 (100)	60 (89.6)	16 (76.2)		89 (90.8)	41 (93.2)		28 (90.3)	102 (91.9)		
Smoke-free places (public, work and transport)											0.22
Yes	5 (9.3)	19 (28.4)	7 (33.3)	**0.011**	23 (23.5)	8 (18.2)	0.481	4 (12.9)	27 (24.3)	0.223	
No	49 (90.7)	48 (71.6)	14 (66.7)		75 (76.5)	36 (81.8)		27 (87.1)	84 (75.7)		
Display of no-smoking signs											0.06
Yes	1 (1.9)	2 (3.0)	6 (28.6)	**0.001**	8 (8.2)	1 (2.3)	0.274	1 (3.2)	8 (7.2)	0.684	
No	53 (98.2)	65 (97.0)	15 (71.4)		90 (91.8)	43 (97.7)		30 (96.8)	103 (92.8)		
Warnings on tobacco products											0
Yes	0	0	0		0	0		0	0		
No	54 (100)	67 (100)	21 (100)		98 (100)	44 (100)		31 (100)	111 (100)		
Sale and display of tobacco and tobacco products											0.05
Yes	0 (0)	5 (7.5)	2 (9.5)	**0.047**	5 (5.1)	2 (9.1)	1.000	3 (9.7)	4 (3.6)	0.176	
No	54 (100)	62 (92.5)	19 (90.5)		93 (94.9)	42 (95.5)		28 (90.3)	107 (96.4)		
Prohibition of supply of tobacco to minors											0.05
Yes	1 (1.8)	3 (4.5)	3 (14.3)	0.086	6 (6.1)	1 (2.3)	0.436	0 (0)	7 (6.3)	0.347	
No	53 (98.2)	64 (95.5)	18 (85.7)		92 (93.9)	43 (97.7)		31 (100)	104 (93.7)		
Regulation of tobacco products											0.04
Yes	2 (3.7)	3 (4.5)	0 (0)	1.000	4 (4.1)	1 (2.3)	1.000	3 (9.7)	2 (1.8)	0.069	
No	50 (96.3)	62 (95.5)	25 (100)		94 (95.9)	43 (97.7)		28 (90.3)	109 (98.2)		
Limiting gov't interaction with tobacco industry											0
Yes	0	0	0		0	0		0	0		
No	54 (100)	67 (100)	21 (100)		98 (100)	44 (100)		31 (100)	111 (100)		
Awareness of restrictions of smoking in public places											0.29
Yes	16 (29.6)	24 (35.8)	1 (4.8)	**0.014**	26 (26.5)	15 (34.1)	0.358	8 (25.8)	33 (29.7)	0.670	
No	38 (70.4)	43 (64.2)	20 (95.2)		72 (73.5)	29 (65.9)		23 (74.2)	78 (70.3)		
Overall mean KAP scores											
	0.05	0.10	0.13		0.09	0.08		0.08	0.09		0.09

a KAP: knowledge, attitude and practice. Knowledge scores were assessed by giving 1 to a yes answer and 0 to a no answer for each respondent. Overall mean scores ≥0.09 were taken as more knowledge and <0.09 as less knowledge on Tobacco Control Act. Value of p was based on chi-squared or Fisher's exact test as appropriate, significance set at p≤0.05. *Other: bars, pubs, nightclubs, and restaurants. **Other: waiters and receptionists.

knowledge scores did not differ greatly by venue or staff designations. The mean knowledge scores for two of the smoke-free components (smoke-free places and awareness of restriction of smoking in public places) were higher (0.22 and 0.29, respectively) compared to other components. The lowest mean scores were observed for regulation of tobacco products (0.04). Respondent's mean scores were also low for the component on the need to display 'no smoking' signage (0.06) (Table 2).

Opinion of the hospitality staff on the SFP

Table 3 shows response to the opinions related to SFP stratified by city, venue and staff designation. Overall, nine in ten respondents supported a smoking ban in all public places: 95% in Accra, 87% in Kumasi, and 76% in Tamale (p=0.028). Similarly, 89% of all respondents supported a smoking ban in hospitality venues. A high percentage of hotel staff (92%) supported the ban compared to the staff of other venues such as bars/pubs (81%) (p=0.048), but no differences were observed across the three cities. With regard to a smoking ban protecting the health of workers, all respondents from Kumasi, and >80% from Accra and Tamale, agreed with that statement (p=0.016). Overall, over half of the respondents disagreed with the statement that smoking ban will have a negative effect on business: Kumasi 61.1%, Accra 86.8%, and Tamale 52.4% (p<0.001). However, about half of the respondents in Kumasi (53.7%) and Tamale (57.1%), and about a fourth from Accra (23.9%), agreed with the statement that a smoking ban will result in unemployment (p=0.001). In addition, about a third of the respondents (30.3%) agreed with the statement that the smoking ban is an unfair restriction on smokers, and this was

Table 3. Opinions of hospitality venue staff on Ghana's smoke-free law

Opinions	City				Venue type			Staff designation			
	Kumasi (n=54) n (%)	Accra (n=67) n (%)	Tamale (n=21) n (%)	p	Hotels (n=98) n (%)	Other* (n=44) n (%)	p	Owners (n=31) n (%)	Other** (n=111) n (%)	p	Mean KAP [a] score
Adequately informed about Ghana's SFP											0.17
Agree	8 (14.8)	13 (19.4)	3 (14.3)	0.787	18 (18.4)	6 (13.6)	0.487	5 (16.1)	19 (17.1)	1.000	
Disagree	46 (85.2)	54 (80.6)	18 (85.7)		80 (81.6)	38 (86.4)		26 (83.9)	92 (82.9)		
Public smoking ban will have a negative effect on business											0.28
Agree	21 (38.9)	9 (13.4)	10 (47.6)	**<0.001**	27 (27.6)	13 (29.5)	0.807	8 (25.8)	23 (20.7)	0.741	
Disagree	33 (61.1)	58 (86.6)	11 (52.4)		71 (72.4)	31 (70.5)		23 (74.2)	79 (79.3)		
Public smoking ban will cause financial losses											0.13
Agree	8 (14.8)	6 (9.0)	5 (23.8)	0.199	10 (10.2)	9 (20.5)	0.097	2 (6.5)	17 (15.3)	0.247	
Disagree	46 (85.2)	61 (91.0)	16 (76.2)		88 (89.8)	35 (79.5)		29 (93.5)	94 (84.7)		
Public smoking ban is an unfair restriction on smokers											0.30
Agree	14 (25.9)	17 (25.4)	12 (57.1)	**0.015**	30 (30.6)	13 (29.5)	0.898	9 (29.0)	34 (30.6)	0.864	
Disagree	40 (74.1)	50 (74.6)	9 (42.9)		68 (69.4)	31 (70.5)		22 (71.0)	77 (69.4)		
Smoking ban will result in unemployment											0.40
Agree	29 (53.7)	16 (23.9)	12 (57.1)	**0.001**	36 (36.7)	21 (47.7)	0.217	14 (45.2)	43 (38.7)	0.519	
Disagree	25 (46.3)	51 (76.1)	9 (42.9)		62 (63.3)	23 (52.3)		17 (54.8)	68 (61.3)		

Continued

Table 3. Continued

Opinions	City				Venue type			Staff designation			
	Kumasi (n=54) n (%)	Accra (n=67) n (%)	Tamale (n=21) n (%)	p	Hotels (n=98) n (%)	Other* (n=44) n (%)	p	Owners (n=31) n (%)	Other** (n=111) n (%)	p	Mean KAP [a] score
Smoke-free bars make visits more comfortable											0.82
Agree	41 (75.9)	56 (83.6)	19 (90.5)	0.451	83 (84.7)	33 (75.0)	0.128	27 (87.1)	89 (80.2)	0.596	
Disagree	12 (24.1)	11 (16.4)	2 (9.5)		14 (15.3)	11 (25.0)		4 (12.9)	21 (19.8)		
Smoking ban will encourage smokers to quit											0.56
Agree	32 (59.3)	37 (55.2)	11 (52.4)	0.837	61 (62.2)	19 (43.2)	**0.034**	19 (61.3)	61 (55.0)	0.529	
Disagree	22 (40.7)	30 (44.8)	10 (47.6)		37 (37.8)	25 (56.8)		12 (38.7)	50 (45.0)		
Smoking ban protects the health of workers											0.96
Agree	54 (100)	64 (95.5)	18 (85.7)	**0.016**	94 (95.9)	42 (95.5)	1.000	30 (96.8)	106 (95.5)	1.000	
Disagree	0 (0)	3 (4.5)	3 (14.3)		4 (4.1)	2 (4.5)		1 (3.2)	5 (4.5)		
Smoking ban is necessary in public bars											0.89
Agree	48 (88.9)	61 (91.0)	18 (85.7)	0.708	91 (92.9)	36 (81.8)	**0.048**	29 (93.5)	98 (88.3)	0.523	
Disagree	6 (11.1)	6 (9.0)	3 (14.3)		7 (7.1)	8 (18.2)		2 (6.5)	13 (11.7)		
Prohibition of indoor smoking in all public places											0.89
Support	47 (87.0)	64 (95.5)	16 (76.2)	**0.028**	89 (90.8)	38 (86.4)	0.425	27 (87.1)	100 (90.1)	0.741	
Do not support	7 (13.0)	3 (4.5)	5 (23.8)		9 (9.2)	6 (13.6)		4 (12.9)	11 (9.9)		
Overall mean KAP scores											
	0.59	0.66	0.71		0.72	0.45		0.71	0.62		**0.54**

a KAP: knowledge, attitude and practice. Opinion was assessed as a score of 1 for agree/support and 0 for disagree/do not support. The scale classified opinion as agree/support with scores ≥0.54 and disagree/against <0.54. Value of p was based on chi-squared or Fisher's exact test as appropriate, significance set at p≤0.05.

significantly different across the three cities with over half from Tamale and a fourth from Accra and Kumasi (p=0.015). Staff designation did not have any significant association with any of the responses to the opinions related to SFP.

In general, respondents had a positive attitude towards supporting SFP with an overall mean score of 0.54. Scores were highest for opinions related to prohibition of indoor smoking in public places (0.89), smoking ban is necessary in public bars (0.89), smoking ban protects the health of workers (0.96), and smoke-free bars make visits more comfortable (0.82). The lowest scores were observed for opinions related to whether respondents were adequately informed on SFP (0.17), with only 17% of the staff feeling that they were adequately informed of the SFP (Table 3). Poor assistance from enforcement authorities (n=97; 68.3%) and revenue loss from smokers (n=44; 31%) were identified as the main challenges in ensuring a smoke-free establishment in hospitality venues (Table 3).

Compliance to the smoke-free laws at the hospitality venues

Table 4 shows the response to items related to compliance to SFP at the premises visited based on

Table 4. Compliance towards Ghana's smoke-free policy

Compliance	City				Venue type			Staff designation			
	Kumasi (n=54) n (%)	Accra (n=67) n (%)	Tamale (n=21) n (%)	p	Hotels (n=98) n (%)	Other* (n=44) n (%)	p	Owners (n=31) n (%)	Other** (n=111) n (%)	p	Mean KAP [a] score
Best description of indoor SFP at your establishment											0.9
Smoking is allowed anywhere	2 (3.7)	4 (6.0)	1 (4.8)		1 (1.0)	6 (13.6)		1 (3.2)	6 (5.4)		
Smoking is allowed only in some indoor areas	3 (5.6)	9 (13.4)	3 (14.3)	0.603	6 (6.1)	9 (20.1)	**<0.001**	1 (3.2)	14 (12.6)	0.254	
Smoking is not allowed in any indoor areas	42 (77.8)	50 (74.6)	15 (71.4)		83 (84.7)	24 (54.5)		28 (90.3)	79 (71.2)		
There is no policy/don't know	7 (12.9)	4 (6.0)	2 (9.5)		8 (8.2)	5 (23.8)		1 (3.2)	12 (10.8)		
Action taken in case someone smokes in premises											0.9
Nothing, smoking is allowed	2 (3.7)	6 (8.9)	3 (14.3)	0.134	3 (3.1)	8 (18.2)	**0.007**	2 (6.5)	9 (8.1)	0.967	
Ask the person to go to a designated smoking area	11 (20.4)	9 (13.4)	0 (0)		11 (11.2)	9 (20.5)		4 (12.9)	16 (14.4)		
Ask the person to stop smoking	20 (37.0)	20 (29.7)	5 (23.8)		32 (32.7)	13 (29.5)		10 (32.3)	35 (31.5)		
Ask the person to leave the premises	19 (35.2)	31 (46.3)	12 (57.1)		48 (49.0)	13 (29.5)		15 (48.4)	47 (42.3)		
Don't know	2 (3.7)	1 (1.5)	1 (4.6)		4 (4.1)	0 (0)		0 (0)	4 (3.7)		
Aware of violation penalties on smoking in public places											0.2
Yes	16 (29.6)	4 (6.0)	4 (19.0)	**0.002**	18 (18.4)	6 (13.6)	0.487	3 (9.7)	21 (90.1)	0.286	
No	38 (70.4)	63 (94.0)	17 (81.0)		80 (81.6)	38 (86.4)		28 (90.3)	90 (9.9)		
Law prohibiting all advertisements for tobacco products											0.9
Approve	48 (88.9)	60 (89.6)	20 (95.2)	0.798	92 (93.9)	36 (81.8)	0.076	29 (93.5)	99 (89.2)	0.756	
Disapprove	4 (7.4)	5 (7.5)	0 (0)		4 (4.1)	5 (1.4)		2 (6.5)	7 (6.3)		
Refused	2 (3.7)	2 (2.9)	1 (4.8)		2 (2.0)	3 (6.8)		0 (0)	5 (4.5)		
Importance of no-smoking signs at premises											0.6
The smoking signs already present	30 (55.6)	46 (68.7)	16 (76.2)		73 (79.6)	19 (43.2)		21 (67.7)	71 (64.0)		
Yes, but we don't have signs	20 (37.0)	14 (20.9)	2 (9.5)	1.000	19 (19.5)	17 (38.6)	**0.001**	8 (11.9)	28 (25.2)	0.904	
No, they are not necessary	4 (7.4)	7 (10.4)	3 (14.3)		6 (6.1)	8 (18.2)		2 (6.5)	12 (10.8)		
Overall mean KAP scores	0.70	0.68	0.71		0.74	0.59		0.72	0.67		0.7

a KAP: knowledge, attitude and practice. Compliance was assessed by giving a score of 1 to compliance and 0 to non-compliance. The scale classified less compliant as an overall mean score <0.7 and more compliant ≥0.7. Value of p was based on chi-squared or Fisher's exact test as appropriate, significance set at p≤0.05. *Other: bars, pubs, nightclubs, and restaurants. **Other: waiters and receptionists.

Table 5. Univariate logistic regression analysis of respondent knowledge, opinion and compliance by city, the type of venue and role of the interviewee

Variable	More knowledge		Agree/support		More compliance	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Cities						
Tamale	1		1		1	
Kumasi	0.76 (0.27–2.11)	0.596	0.46 (0.15–1.32)	0.148	0.65 (0.21–2.00)	0.452
Accra	3.08 (1.10–8.60)	**0.031**	0.25 (0.08–0.71)	**0.010**	0.94 (0.30–2.87)	0.915
Venue type						
Other*	1		1		1	
Hotels	1.18 (0.54–2.55)	0.672	2.01 (0.91–4.37)	0.080	3.16 (1.48–6.71)	**0.003**
Staff designation						
Other**	1		1		1	
Owners	0.70 (0.30–1.64)	0.417	0.94 (0.40–2.18)	0.887	1.40 (0.56–3.44)	0.464

*Other: bars, pubs, nightclubs, and restaurants. **Other: waiters and receptionists. Statistical significance set at p≤0.05. OR: odds ratio. CI: confidence interval.

city, type of venue, and role of staff. About eight in ten hotels (84.7%) have an indoor SFP policy that does not allow smoking in any indoor area compared to only about half of the bars and pubs (54.5%) (p<0.001). In addition, only 6% of respondents in Accra were aware of violation penalties on smoking in public places, compared to 29.6% in Kumasi and 19% in Tamale (p=0.002). However, awareness of violation penalties was not significantly associated with the venue or staff designation. In addition, just under half (49%) of hotel staff were likely to ask individuals to leave the premise if they detected smoking activity, compared to 29% of other venue staff (p=0.007). Further, hotels were more likely to have 'no smoking' signs (76.6%), in comparison with other venues (43.2%) (p=0.007).

The overall mean score of compliance to SFP was 0.7. Compliance scores were lowest in Accra (0.68) in comparison with Kumasi (0.70) and Tamale (0.71), and hotels were observed to be more complaint (mean score 0.74) than other venues (mean score 0.59). Similar to the knowledge and opinion items, staff designation did not have any significant association on compliance levels (Table 4).

Table 5 reports the results for the summary dichotomous variable for each of the three outcomes (knowledge, opinion and compliance), which were classified based on the overall mean score for each outcome. Results suggest that compared with respondents in Tamale, respondents in Accra had higher knowledge levels of the TCA and SFP (OR=3.08; 95% CI: 1.10–8.60) than in Tamale. The odds of opinions in support for SFP were lower in Accra (OR=0.25; 95% CI: 0.08–0.71) in comparison with Tamale. Hotels were three times more compliant than other venues (OR=3.16; 95% CI: 1.48–6.71) (Table 5).

DISCUSSION

This study sought to determine the knowledge, opinions and compliance of hospitality venue staff towards the current SFP in three cities in Ghana. Knowledge levels related to the SFP among hospitality venue workers in the three cities were found to be very low. Among the three cities, the odds of having high knowledge scores were three times higher in Accra compared to Tamale, and Kumasi had lower knowledge scores compared to Tamale. High opinion scores in support were observed for prohibition of indoor smoking, smoking ban is necessary in public bars, smoking ban protects health of workers, and smoke-free bars make visits more comfortable. Compliance to smoke-free laws was higher in Tamale compared to Accra and Kumasi. Also, hotels were found to be more compliant than bars and pubs. Staff designation did not have any effect on knowledge, compliance levels or opinions in support for SFPs.

Studies in African countries such as Nigeria[27] and Uganda[28], and in the Middle East such as Lebanon[29] using similar tools, indicate higher

levels of awareness of their respective national laws (>50%). This difference could partly be attributed to the educational background of the respondents in these studies; most of the respondents in the Uganda and Lebanon studies were managers, whereas in our study, >70% of the respondents were waiters or receptionists. The level of education was found, for instance in Kenya[30] and Turkey[31], to also influence the presence and enforcement of a work SFP. Although, knowledge levels on the TCA and SFP were generally poor across the three study cities, respondents in Accra were three times more likely to have more knowledge than those in Tamale. Further, hotels were also twice as likely to support SFPs compared to bars and pubs, but the difference was not statistically significant. The differences observed between the three cities could partly be explained by the country's literacy level distribution, which is highest for Accra (86%), the capital city for Ghana, with Tamale at 43% and Kumasi at 50%[32]. In addition, literacy levels could also explain the differences observed in hotels and other venues such as bars and pubs; hotel staff may be more educated compared to the staff of bars and pubs. Thus, it is important for the public health community and tobacco control advocates to embark on educational campaigns to sensitize and educate hospitality workers on the Tobacco Control Act and its SFP components, particularly in Tamale and Kumasi, given that the SSA region, of which Ghana is part, is projected to experience a rapid increase in tobacco smoking by 2025[33] and hospitality industry workers have been known to have higher levels exposures to SHS.

Comparable to earlier studies in Ghana among adults[34] and the youth[35], our study also shows high support for opinions for SFPs among hospitality staff. Similarly, strong support (>80%) for a ban on smoking in hospitality venues in other countries in Africa[36] and Europe[31] has also been observed. Findings from the Global Adult Tobacco Survey data in SSA[37] (Nigeria, Cameroon, Kenya, and Uganda) also indicate strong support for the prohibition of smoking in public places (>90%). Aside the positive attitude towards the support for the SFP by the hospitality staff, they were not in agreement with any substantial negative economic impact of implementing effective SFP. Smoke-free policies do not reduce sales, revenues, or personnel requirements of bars and restaurants, which has been the main argument of protagonists of comprehensive SFPs[37]. However, the odds of a positive attitude towards SFPs were less in Accra compared to Tamale. This may be attributed to the perceptions of higher economic benefits related to smoking and the growing level of international connectedness[38] in Accra compared to Kumasi and Tamale. Respondents in the study also alluded that SFPs make hospitality venues more comfortable and also protect their health from SHS effects. These findings call for tobacco control proponents to advocate a review of the current partial SFP to a comprehensive SFP (100% smoke-free). Implementing 100% smoke-free venues has been shown to reduce levels of harmful biomarkers such as nicotine by 90% and cotinine by 50–89% in biological samples[39]. Nevertheless, to achieve the desired benefits of reducing SHS exposure and tobacco use, these laws must be coupled with a strong enforcement programme with well-defined regulations[39].

Findings from our earlier study[23], on air-quality measurements and observations, showed that although 60% of the hospitality locations were at least partially compliant with the smoke-free legislation, DSAs were present in only 1% of the hospitality locations, and only 50% of the venues had 'no smoking' signage. Also, compliance and air quality were poorer in Accra compared to Kumasi and Tamale. In the present survey, self-reported compliance was not significantly different across the three cities. Our study also shows that venues such as bars and pubs had lower compliance to SFPs compared to hotels, similar to previous studies[31]. One reason for this could be that the hospitality staff in bars and pubs are less likely to enforce SFPs due to fears of losing customers and consequently lowering revenues. Compliance with SFPs requires a coordinated enforcement system[37,40]. Indeed, 7 in 10 respondents in our study indicated poor assistance from enforcement authorities as the main challenge in ensuring a smoke-free establishment in hospitality venues. Although the staff designation did not have any influence on the level of compliance at the venues, studies have shown that venue managers have conflicts about enforcing a policy among their

customers on whom their livelihood depends on. Some possible solutions include actions by civil society organizations to show public support for smoke-free venues, stakeholder engagement and evidence-based advocacy as in Uganda[28]. Future studies on perceptions of civil society organizations and policy makers in Ghana on smoke-free law implementation and challenges, and opportunities related to achieving compliance with a particular focus on hospitality venues, are needed.

Strengths and limitations

The study has a number of limitations. First, findings were based on self-reports and it is possible that respondents could display social desirability bias in their response and articulate socially acceptable views on tobacco control. All respondents were, however, assured that their responses were anonymous in order to reduce this bias. Second, our study is limited to only three major cities and the findings may therefore not be representative of all hospitality venues in the country. The exclusion of the 12 venues with missing data might also slightly reduce the generalizability of the findings. Third, the sample size was relatively small, which reduced the power of the study to observe statistically significant differences between the groups. Fourth, most of our respondents were waiters and receptionists rather than managers and owners (who were unavailable for the interviews due to their limited availability), which has to be kept in mind when interpreting the results. Despite these limitations, our study provides strong evidence on the knowledge, opinion and compliance of hospitality staff towards the SFP in Ghana using a validated questionnaire[26]. Further, the use of a random sampling strategy for venue selection, collection of both observational and objective data[23] and the selection of the three largest cities in Ghana are potential strengths of this study.

CONCLUSIONS

Our findings highlight strong support for prohibition of smoking in public places including hospitality venues despite poor knowledge and low compliance levels with the current SFPs in Ghana. Ghana urgently needs to step up efforts that will help accomplish the obligations of the FCTC Article 8. In order to achieve this, there is the need to prioritize the enforcement and implementation of existing legislation. A further action is for policy makers and civil society organizations advocates dedicating resources to implement targeted media and educational campaigns to inform the public/hospitality workers about the health hazards of SHS to the non-smokers. Finally, a review of the current policy is required to facilitate the adoption and implementation of comprehensive SFPs as required by the FCTC.

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ACKNOWLEDGMENTS
We are thankful to the School of Public Health, KNUST, for providing all the technical assistance for this study. We also thank Sean Semple and his team (University of Stirling, UK) for their support on this research project. We also extend our gratitude to Patricia Amoah, Isaac Yevu and Japheth Senyo (School of Public Health, KNUST) for their support throughout the development, data collection and administration of this research.

CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

FUNDING
This work was supported by the Medical Research Council [grant number MR/P027946/2] with funding from the Global Challenges Research Fund and with additional funding from the University of Edinburgh's Scottish Funding Council Global Challenges Research Fund (GCRF) allocation.

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer reviewed.

PUBLICATION 4

Extent of illicit cigarette market from single stick sales in Ghana: findings from a cross sectional survey

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BMJ Open
In press