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Weekday and weekend physical activity patterns and their correlates among young adults

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Abstract

Background: Accelerometers enable assessment of within and between day variation in physical activity. The main aim was to examine weekday and weekend physical activity patterns among young adults. Additionally, correlates of the physical activity patterns were examined.

Methods: Overall 325 adults (mean age 26.0 years, standard deviation 0.03) from the Special Turku Coronary Risk Factor Intervention Project used a wrist-worn ActiGraph accelerometer continuously for 1 week. Physical activity patterns over weekdays and weekends were identified by using the group-based trajectory modeling. Adolescent leisure time physical activity (LTPA) and sociodemographic characteristics (sex, marital and family status, education, work status, occupation, and health consciousness) were examined as possible correlates of physical activity patterns using multinomial regression analysis.

Results: Five patterns were identified: *consistently low activity* (45%), *active on weekday evenings and weekends* (32%), *consistently moderate activity* (11%), *active on weekdays* (7%), and *consistently high activity* (5%). Low adolescent LTPA was associated with *consistently low activity* pattern in young adulthood. Women were

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more likely than men to belong in the more physically active groups (all other groups except *active on weekdays*, odds ratios between 2.26 and 6.17). Those in the *active on weekdays* group had lower education, were more often in the working life and in manual occupations than those in the *consistently low activity* group.
Conclusions: Marked heterogeneity in physical activity patterns across the week was observed among young adults. Especially history of physical activity, sex, education, work status, and occupation were associated with different physical activity patterns.

KEYWORDS
accelerometry, education, employment, marital status, physical activity, trajectory

1 | INTRODUCTION

Physical activity is a key factor in promoting health and preventing many chronic diseases. Assessment of physical activity has developed from survey-based methods to device-based assessments (e.g., accelerometers), which can capture physical activity 24 h per day without recall and information bias.[1] Device-based assessments also enable examination of physical activity patterns, that is, the manner in which physical activity accumulates throughout the day and week. Individuals may accumulate the same volume of physical activity in different ways such as many shorter episodes daily (e.g., active commuting) or few longer episodes (e.g., going to the gym) couple of times per week.[2] Previous studies comparing physical activity between weekdays and weekends, and workdays and days off, have indicated that there are differences in physical activity volume and timing of physical activity during the day.[3,4]

Physical activity patterns may also have health implications beyond the physical activity volume. For instance, recent accelerometer-based studies have suggested that physical activity during leisure time compared to work-related physical activity was associated with lower systolic blood pressure[5] and better cardiorespiratory fitness.[6] A recent study implies that the timing of physical activity across waking hours may also matter, as those being physically active mainly between middays and afternoons had lower risk of cardiovascular and all-cause mortality compared to those who were physically active mostly during mornings or evenings.[7]

Examining the heterogeneity, that is, variation of physical activity patterns within a day or a week is needed to identify sub-groups with suboptimal physical activity behavior and, consequently, pinpoint the potential times during the day or week to increase physical activity. This information is important for the development of targeted physical activity interventions. In previous literature heterogeneity in physical activity patterns across the week has been identified using a cluster analysis[8] and latent class analysis,[9–11] which both enable identification groups of individuals who share a similar weekly physical activity pattern. Previous studies based on the National Health and Nutrition Examination survey from the US and the UK Biobank study among adult populations have identified the following groups: consistently inactive, consistently active, active only on weekdays/weekends, and morning/evening movers.[8,9] The main limitation in these large studies is that they have examined physical activity patterns over the entire week, which does not take into account possible heterogeneity in daily patterns between weekdays and weekends. Moreover, heterogeneity of physical activity patterns have so far been examined in working-age populations including predominantly middle-aged and older adults.[8–12] There are indications of different daily timing and contexts (work vs. home) of physical activity among young adults compared to middle-aged and older adults,[13,14] and therefore more detailed information on variation in daily physical activity patterns among younger adults are also needed to increase understanding of young adults' physical activity behaviors, and thus aid the promotion of physically active lifestyle in this age group.

Identifying correlates, that is, factors associated with different physical activity behavior is also essential for physical activity promotion. One of the identified correlates is previous history of physical activity as physical activity levels in childhood and adolescence seem to carry over to young adulthood. The least physically active children tend to behave similarly during both adolescence and young adulthood.[15] In contrast, despite the overall decreasing trend in physical activity from childhood to young adulthood, children who are more physically active tend to sustain higher levels of physical activity relatively well during adolescence and some even into young adulthood.[15,16] However, aside from average physical activity levels, it is not known how young adults' physical activity history associates with their current physical activity patterns.

Moreover, several sociodemographic characteristics are shown to associate with average levels of physical

activity[17,18] and may thus also associate with different physical activity patterns. Previous evidence based on self-reported and accelerometer-based measures of physical activity has indicated that those with higher education engage more in leisure time physical activity (LTPA) compared to individuals with lower education,[18,19] which may also be reflected in variations of physical activity on weekdays and weekends. Educational differences are suggested to be linked to attitudes and knowledge, such as interest in physical activity and awareness of its health-benefits, as well as social support and access to resources for engaging in physical activity.[20,21] However, accelerometer-based total and weekday activity levels are consistently higher among lower level occupations, indicating that worktime physical activity contributes markedly to daily total physical activity levels.[3,4,22] Previous studies applying cluster and latent class analysis have shown that the consistently least active individuals were more often unemployed and had lower education compared with the higher activity groups.[8–10] Accelerometer-based physical activity data have also indicated that married individuals are more likely to belong to the more active groups compared to the lowest activity group,[10] and that individuals with children have higher levels of total daily physical activity compared to nonparents.[23] Collectively, these observations lend support to the notion that these individual-level characteristics may be correlates of the weekday and weekend physical activity patterns also among young adults.

The main aim of this study was to identify patterns of weekday and weekend physical activity among young adults by using accelerometry data from a population-based cohort. Additionally, the aim was to examine the association of known correlates of physical activity, for example, adolescent LTPA and sociodemographic characteristics with the identified physical activity pattern groups. This study is important as there are evident gaps in knowledge regarding in detail assessed physical activity patterns and their correlates in young adults. The provided data can be applied in efforts to promote a physically active lifestyle.

2 | METHODS

2.1 | Study population

The Special Turku Coronary Risk Factor Intervention Project (STRIP) study is a prospective, randomized controlled trial aiming to prevent atherosclerosis beginning in infancy.[24] A detailed description of the study design has been reported.[24,25] In brief, families of 5-month-old infants, born between July 1989 and December 1991, were recruited at well-baby clinics in Turku, Finland by nurses. At the age of 7 months, 1062 infants (57% of the eligible age-cohort) were randomly allocated to either a dietary intervention ($n = 540$) or control ($n = 522$) group. The cohort also included two children with Down syndrome, two children with familial hypercholesterolemia, and five children who had been randomized into the intervention group but had missed the first study appointments before age 13 months and were later treated as controls. Additionally, a group of 45 children, born between March and July 1989, were recruited to the cohort and randomized (intervention $n = 22$, control $n = 23$) to pilot the study protocols, and they were included in the current study. The intervention group received individualized dietary counseling aiming at a heart-healthy diet at least biannually between the ages of 7 months and 20 years.[26] Additionally, guidance to avoid smoking was given and a physically active lifestyle was encouraged, but it was not a structured, continuous part of the intervention. The children in the control group received only the basic health education given at Finnish well-baby clinics and school health care.

The first post-intervention follow-up of the participants was conducted between April 2015 and January 2018 when they were 26 years old.[27] Out of the cohort of 1116 individuals, 1072 were invited to participate, and of these, 551 provided follow-up data (51%).[25] In the prior attrition analyses, those attending to the follow-up visit did not differ from those not attending in terms of parental socioeconomic status, health status, or health behaviors.[27]

At the follow-up visit ($n = 546$), participants were inquired of their willingness to participate in a 1-week accelerometer measurement. Overall, 467 (86%) agreed to participate and were given an accelerometer with instructions. Formation of the analytical study sample is illustrated in Supplement 1. Eventually 378 wore the accelerometer and filled in a daily log successfully. Those having insufficient amount of accelerometer data based on the commonly used criteria, that is, <4 valid measurement days of at least 10 h of waking wear time per day ($n = 14$),[28] and those having less than 2 valid weekdays and 2 valid weekend days ($n = 28$) were excluded to allow a reliable analysis for weekdays and weekend physical activity. Also, because the focus was on daytime physical activity patterns, those reporting night or evening shifts were excluded ($n = 11$), leaving 325 participants to the final analytical sample.

2.2 | Assessment of physical activity with accelerometry

At the age of 26 years, physical activity was measured 24 h per day over 8 consecutive days and 7 consecutive nights with the triaxial ActiGraph wActiSleep-BT accelerometer (ActiGraph). The accelerometer was initialized to record

at 80 Hz. During the follow-up visit, an assisting study person gave the participants both oral and written information on how to wear the accelerometer. Participants were asked to start the measurement in the morning on the follow-up visit day, but in some cases, for example, the participant had an atypical week—a later starting time was allowed. Participants were instructed to wear the accelerometer on their nondominant wrist for the following 8 days at all times, including during water-based activities such as swimming, but to remove it for sauna. In an accompanying log, the participants were asked to record date, waking time, and bedtime on each measurement day. The accelerometer did not provide any feedback to the participants on their activity. After the measurement period, the participants returned the accelerometer and the log by mail. Data were collected during all four seasons (23% spring, 19% summer, 31% autumn, and 26% winter) between April 2015 and March 2018.

Data from the accelerometers were downloaded and converted into 60-second epochs in the ActiLife software, V.6.13 (ActiGraph). As an indicator of physical activity, we used the vector magnitude counts per minute (VM CPM) which were calculated as the square root of the sum of squared activity counts (i.e., acceleration) of the three axes. Higher VM CPM refers to higher acceleration which is assumed to correspond to higher intensity physical activity, whereas low VM CPM demonstrates low acceleration, for example, stationary or sedentary activities.[28] We included wear time between the first and last times recorded in the log, and excluded non-wear time using the Choi algorithm.[29] We further excluded time spent sleeping using the ActiGraph algorithm available in the ActiLife software,[30] and hours with less than 60 min of wear time (<2% of the hours). A valid measurement day was defined as a minimum of 10 h of wear time during waking hours. In the current study, the mean number of valid measurement days was 6.9 (standard deviation [SD] 0.5). For the analyses we used two measures of physical activity: (i) the mean VM CPM of 2 consecutive hours (hours between 6:00 and 24:00) for the group-based trajectory models (GBTM) and (ii) the mean daily VM CPM as an indicator of total daily physical activity volume.

2.3 | Assessment of adolescent LTPA

Adolescent LTPA was assessed with a self-administered questionnaire during the follow-up at the ages of 13, 15, 17, and 19 years.[31] In the questionnaire, the frequency, duration, and intensity of habitual LTPA was reported in multiple-choice questions. LTPA was calculated as a multiple of the resting metabolic rate (metabolic equivalent [MET] h/week) by multiplying the frequency, mean duration, and mean intensity of weekly LTPA. Accumulated total adolescent LTPA was calculated as an area under the curve between the ages of 13 and 19 years after fitting smooth, individual-specific curves, by mixed model regression splines, on the data. Accumulated total adolescent LTPA was further calculated per year to reflect average yearly accumulation of LTPA during adolescence.

2.4 | Sociodemographic characteristics

Sex, marital status (single/married or cohabiting), family status (no children/one child or more), level of education (basic, i.e., at least upper secondary education or advanced, i.e., education obtained from university or university of applied sciences, whether ongoing or completed), work status (no, i.e., students and those outside of workforce or yes, i.e., employees or entrepreneurs), and occupational status (routine and manual occupations or higher grade and intermediate occupations) were assessed with a self-administered questionnaire. Health consciousness was assessed with a question: "How much do you usually pay attention to your health habits?" and the response options were, (a) a lot, (b) some, (c) difficult to say, (d) a little, or (e) none. Health consciousness was categorized as, no (little or no) or yes (some or a lot). Those answering difficult to say were excluded ($n = 41$, 13%).

2.5 | Health-related characteristics

At the follow-up study visit, waist circumference (cm), body mass index (kg/m^2) as well as diastolic and systolic blood pressure (mmHg) were measured by a study nurse.[27] Concentrations of serum lipids (total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides) and serum insulin were analyzed using standard methods.[27] Self-reported LTPA at the age of 26 years was inquired with the same self-administered questionnaire and the MET h/week were generated similarly as during adolescence. Quality of diet was assessed using a diet score, where a higher score indicates a healthier diet (range 0–33).[26] Smoking habits were inquired and participants reporting to smoke at least once a day were regarded as regular smokers.

2.6 | Statistical analysis

The sociodemographic characteristics of the study population are presented as mean values and SDs for the

continuous variables and as frequencies and percentages for the categorical variables. As an attrition analysis, we studied whether the sociodemographic and health-related characteristics differed between the current study population ($n = 325$) and those who (a) were not willing to participate in the accelerometry measurements or (b) did not provide adequate accelerometry data ($n = 221$). For categorical variables, the chi-square test and for continuous variables, the Student's *t*-test was used.

We examined the heterogeneity of physical activity patterns for weekdays and weekends using GBTM.[32,33] The GBTM model was applied to the mean VM CPM of 2 consecutive hours for weekdays and weekends. The GBTM is an exploratory tool for recognition and visualization of different patterns of temporal change and, as such, an adequate model for analysis of unobserved heterogeneity in developmental paths. The detailed description of the fit statistics and parameter estimates of the model are given in the Supplementary Material. The analyses were conducted using *proc traj* in the SAS software (v. 9.4 SAS Institute) and class-numeration was assisted by the fit-criteria assessment plot[34] in the RStudio software (v. 3.6.3; RStudio, PBC).

We compared daily total physical activity levels (VM CPM) on all days, weekdays, and weekends between the physical activity pattern groups using analyses of covariance (ANCOVA, *proc glm*; SAS statistical software, version 9.4 (SAS Institute, Inc.), adjusting for sex and accelerometer wear time during waking hours. Additionally, adolescent LTPA was compared between the physical activity pattern groups using ANCOVA (*proc glm*) and adjusting for sex. Associations between adolescent LTPA, sociodemographic characteristics (sex, marital status, family status, education, work status, occupation, and health consciousness) and physical activity patterns were examined using a multinomial logistic regression (*proc logistic*). For adolescent LTPA, odds ratios (ORs) were given per 10 MET h/week/year adolescent LTPA and the model was adjusted for sex. For sociodemographic characteristics, models were adjusted for sex and education. We used those groups considered having the most unfavorable physical activity patterns (i.e., consistently low physical activity and those who were active only on weekdays around midday) as a reference. Results are presented as ORs and their 95% CIs.

3 | RESULTS

3.1 | Participant characteristics

The mean age of the participants was 26.0 years (SD 0.03), and the majority of them were women (58%) and had a high education (68%) (Table 1). No difference in daily total physical activity was found between those who had received the STRIP counseling intervention (47% of study population) and the controls (53%) (intervention: 2483 VM CPM, SD 562; control: 2447 VM CPM, SD 620, $p = 0.60$). In the attrition analyses, there were no differences in terms of education and health-related characteristics between the study population and those who were not willing to participate in the accelerometer measurements or did not provide adequate accelerometer data (Supplement 2).

3.2 | Physical activity patterns

For the patterns of weekday and weekend physical activity, a 5-trajectory solution with curvilinear polynomial shape yielded the best fit (Supplement 3, Figure 1). Almost half of the participants (45%) belonged to the pattern group entitled as *consistently low activity*, showing low levels of activity across the day on both weekdays and weekends. The second largest pattern group, *active on weekday evenings and weekends* (32%), included those who had low physical activity during midday on weekdays, and high activity during weekday evenings and weekends. Participants in the *consistently moderate activity* (11%) group had moderate levels of physical activity, particularly in the evenings on both weekdays and weekends. Those in the *active on weekdays* (7%) group had high levels of physical activity in the mornings and middays on weekdays, and low activity during weekday evenings and weekends. The participants who comprised the *consistently high activity* (5%) group had the highest levels of physical activity across the day on both weekdays and weekends.

Daily total physical activity level across all days was highest in the *consistently high activity* group (3780 VM CPM, 95% CI 3600–3960) and lowest in the *consistently low activity* group (1990 VM CPM, 95% CI 1930–2050) (Figure 2). Participants in the *active on weekdays* and *active on weekday evenings and weekends* groups accumulated almost equal levels of daily total physical activity across all days (2700 VM CPM, 95% CI 2550–2850 and 2720 VM CPM, 95% CI 2650–2790, respectively). However, the *active on weekdays* group had higher levels of activity on weekdays (the mean difference 338 VM CPM, 95% CI 151–526) and lower levels of activity on weekends when compared with the *active on weekday evenings and weekends* group (the mean difference 870 VM CPM, 95% CI 663–1077). Daily total physical activity for the *consistently moderate activity* group was 2890 VM CPM (95% CI 2780–3010).

TABLE 1 Participant characteristics by physical activity pattern groups.

	All $n = 325$	Consistently low activity $n = 145$ (45%)	Active on weekdays $n = 23$ (7%)	Active on weekday evenings and weekends $n = 105$ (32%)	Consistently moderate activity $n = 37$ (11%)	Consistently high activity $n = 15$ (5%)	p value[d]
Women, N (%)	189 (58)	60 (41)	10 (43)	85 (81)	23 (62)	11 (73)	<0.0001
Marital status, N (%)							0.04
Single	152 (48)	78 (55)	8 (38)	44 (42)	19 (53)	3 (20)	
Married/cohabiting	165 (52)	63 (45)	13 (62)	60 (58)	17 (47)	12 (80)	
Family status, N (%)							0.03
No children	287 (91)	131 (94)	21 (100)	88 (85)	34 (97)	13 (87)	
Children	27 (9)	8 (6)	0 (0)	16 (15)	1 (3)	2 (13)	
Level of education, N (%)							0.0003
Basic	103 (32)	44 (31)	16 (76)	27 (26)	10 (27)	6 (40)	
Advanced	215 (68)	97 (69)	5 (24)	77 (74)	27 (73)	9 (60)	
Work status, N (%)							0.001
No	151 (47)	81 (57)	4 (19)	38 (37)	20 (54)	8 (53)	
Yes	167 (52)	60 (43)	17 (81)	66 (63)	17 (46)	7 (47)	
Occupation, N (%)							<0.0001
Manual	57 (18)	20 (14)	14 (61)	14 (13)	5 (14)	4 (27)	
Non-manual	151 (46)	58 (40)	5 (22)	64 (61)	18 (49)	6 (40)	
Missing[a]	117 (36)	67 (46)	4 (17)	27 (26)	14 (38)	5 (33)	
Health consciousness, N (%)[b]							0.01
No	83 (26)	47 (33)	8 (38)	15 (14)	10 (27)	3 (20)	
Yes	235 (74)	94 (67)	13 (62)	89 (86)	27 (73)	12 (80)	
Measurement season, N (%)							0.14
Winter	84 (26)	45 (31)	3 (13)	20 (19)	12 (32)	4 (27)	
Spring	76 (23)	29 (20)	10 (43)	30 (29)	5 (14)	2 (13)	
Summer	63 (19)	24 (17)	3 (13)	26 (25)	7 (19)	3 (20)	
Autumn	102 (31)	47 (32)	7 (30)	29 (28)	13 (35)	6 (40)	
Number of valid measurement days, mean (SD)	7.0 (0.4)	6.9 (0.5)	7.0 (0.6)	7.0 (0.2)	7.0 (0.3)	7.0 (0.4)	0.64

TABLE 1 (Continued)

	All $n = 325$	Consistently low activity $n = 145$ (45%)	Active on weekdays $n = 23$ (7%)	Active on weekday evenings and weekends $n = 105$ (32%)	Consistently moderate activity $n = 37$ (11%)	Consistently high activity $n = 15$ (5%)	p value[d]
Adolescent LTPA, MET h/week/year, mean (SD/95% CI)[c]	19.4 (12.0)	16.9 (14.9–18.8)	18.5 (13.7–23.3)	21.9 (19.5–24.2)	23.6 (19.9–27.4)	17.5 (11.5–23.4)	0.004

Abbreviations: CI, confidence interval; LTPA, leisure time physical activity, self-reported; SD, standard deviation.

[a]Included students (74%), those outside of workforce (24%) and workers who did not provide information of their occupation (3%).

[b]No indicating not paying attention health habits or just a little, yes indicating paying attention to health habits to some extent or a lot. Those answering difficult to say were excluded ($n = 41$, 13%).

[c]Estimated means and their 95% CIs from the ANCOVA model, adjusted with sex, p-value for comparisons between each physical activity pattern group.

[d]p-values for chi-square and ANCOVA models for comparisons between each physical activity pattern group.

3.3 | Correlates of physical activity patterns

Adolescent LTPA by the physical activity pattern groups is presented in Table 1. Those in the *consistently low activity* group had the lowest adolescent LTPA (16.9 MET h/week/year, 95% CI 14.9–18.8), followed by those in the *consistently high activity* (17.5 MET h/week/year, 95% CI 11.5–23.4) and *active on weekdays* (18.5 MET h/week/year, 95% CI 13.7–23.3) groups. Highest levels of adolescent LTPA were observed among those in the *active on weekday evenings and weekends* and the *consistently moderate activity* groups, (21.9 MET h/week/year, 95% CI 19.5–24.2 and 23.6 MET h/week/year, 95% CI 19.9–27.4). When using the participants in the *consistently low activity* group as the reference group, those in the *active on weekday evenings and weekends* and *consistently moderate activity* groups had more likely higher level of adolescent LTPA (ORs 1.47, 95% CI 1.15–1.88 and 1.62, 95% CI 1.19–2.19, respectively) (Table 2).

Additionally, sociodemographic characteristics were compared between the physical activity pattern groups (Tables 1 and 2). Table 2 presents the associations between sociodemographic characteristics and the physical activity pattern groups using participants in the *consistently low activity* group as the reference group. Compared to the *consistently low activity* group, there were more women in the other physical activity pattern groups (with ORs ranging between 2.26 and 6.17), except for the *active on weekdays* group. Those having *consistently high activity* were more likely married or cohabiting compared to those in the *consistently low activity* group (OR 4.83, 95% CI 1.29–18.09). Those *active on weekday evenings and weekends* had more likely children (OR 3.01, 95% CI 1.15–7.93) and those *active on weekdays* had less likely advanced education (OR 0.14, 95% CI 0.05–0.40) and nonmanual occupation (OR 0.19, 95% CI 0.05–0.69) compared to the *consistently low activity* group. Those *active on weekdays* and *active on weekday evenings and weekends* were more likely currently working (OR 8.12, 95% CI 1.77–37.13 and OR 3.03, 95% CI 1.69–5.46, respectively) than those in the *consistently low activity* group. Health consciousness differed only with respect to those *active on weekday evenings and weekends* as they were more likely health conscious (OR 2.23, 95% CI 1.10–4.51).

As a supplementary analysis, associations between the sociodemographic characteristics and physical activity pattern groups were assessed using the *active on weekdays* group as a reference, that is, the group who had high activity during midday but low activity levels during weekday evenings and weekends, that is, during the usual leisure time hours (Supplement 4). All other groups had more likely advanced than basic education (ORs between 4.38

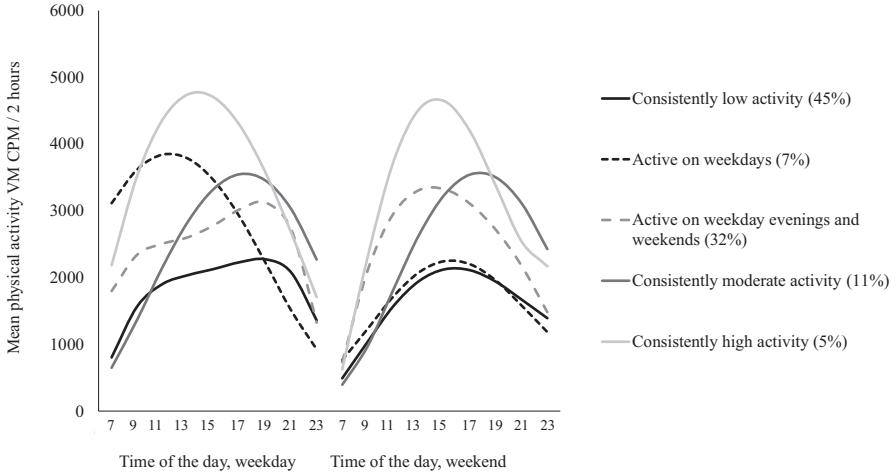

FIGURE 1 Patterns of physical activity for weekdays and weekends (multivariate group-based trajectory model).

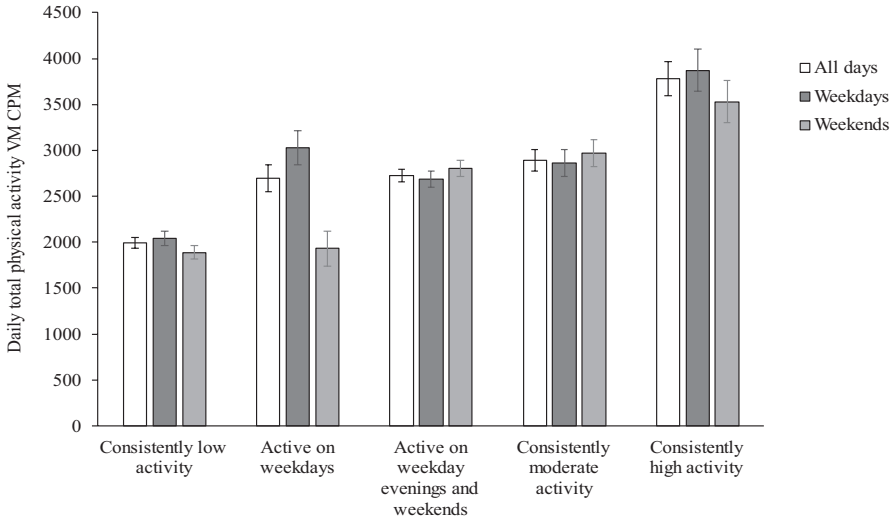

FIGURE 2 Mean daily total activity on all days, weekdays, and weekends by physical activity pattern groups. Error bars indicate 95% confidence intervals.

and 8.30) and a nonmanual occupation (ORs between 1.58 and 6.69) (except for the *consistently high activity* group) than those in the *active on weekdays* group.

4 | DISCUSSION

Our study examined the heterogeneity of weekday and weekend physical activity patterns using GBTM. Five distinct physical activity groups were identified: *consistently low activity*, *active on weekday evenings and weekends*, *consistently moderate activity*, *active on weekdays* and *consistently high activity*. Our study expands the current knowledge of weekday and weekend physical activity patterns from middle-aged and older adults to younger adults and showed that physical activity pattern groups differed by various individual characteristics.

Consistently low activity pattern, that is, low physical activity levels throughout the week, was the most common physical activity pattern among young adults, which is consistent with observations among middle-aged and older adults. Moreover, also adolescent LTPA was lowest in this group, which supports the previous findings that low leisure-time physical activity levels carry over from adolescence to young adulthood.[15,16] Given that the majority of the members of this group were either outside of the workforce, mostly students or engaged in nonmanual work, the highly sedentary nature of studying as well as the nonmanual workhours[4,35,36] may, at least partly, explain the low activity levels on weekdays.

Another common physical activity pattern was *active on weekday evenings and weekends*, which comprised about a third of the study population. Unlike those in the *consistently low activity* group, those who were *active on weekday evenings and weekends* seemed to compensate the low midday activity levels by increasing activity on weekday evenings and on weekends, the typical times for LTPA. Some of the physical activity may be accrued during childcare duties as this group overall had more likely children and the parents in this group, mainly women, had young children (<9 years old). Previous findings have indicated that parents of especially young children accumulate more light physical activity compared to nonparents.[23] High activity during typical times for LTPA may be related

TABLE 2 Associations between sociodemographic characteristics and physical activity patterns for weekdays and weekends. *Consistently low activity* group was used as the reference.

	Consistently low activity	Active on weekdays			Active on weekday evenings and weekends			Consistently moderate activity			Consistently high activity		
	OR (ref)	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Female vs. male	1	1.53	0.59	3.97	6.17	3.38	11.26	2.26	1.07	4.77	4.02	1.21	13.33
Married/cohabiting: yes vs. no	1	1.72	0.65	4.52	1.71	0.99	2.96	1.12	0.53	2.35	4.83	1.29	18.09
Children: yes vs. no	1	–	–	–	3.01	1.15	7.93	0.48	0.06	3.98	2.17	0.40	11.93
Education: advanced vs. basic	1	0.14	0.05	0.40	1.09	0.60	2.01	1.13	0.50	2.56	0.59	0.20	1.81
Work status: yes vs. no	1	8.12	1.77	37.13	3.03	1.69	5.46	1.37	0.65	2.91	1.85	0.60	5.73
Occupation: nonmanual vs. manual[a]	1	0.19	0.05	0.69	1.15	0.44	3.00	1.24	0.35	4.42	0.51	0.10	2.66
Health consciousness[b]: yes vs. no	1	1.27	0.46	3.52	2.23	1.10	4.51	1.14	0.49	2.66	1.87	0.47	7.37
Adolescent LTPA[c]	1	1.13	0.77	1.66	1.47	1.15	1.88	1.62	1.19	2.19	1.02	0.60	1.72

Note: Multinomial logistic regression models adjusted for sex and education.

Abbreviation: LTPA, leisure time physical activity.

[a]Those whose occupation information was missing (students, those outside of workforce, workers with missing information of occupation) were excluded from the analysis ($n = 117$, 36%).

[b]No indicating not paying attention health habits or just a little, yes indicating paying attention to health habits to some extent or a lot. Those answering difficult to say were excluded ($n = 41$, 13%).

[c]Odds ratios (ORs) per 10 MET h/week/year adolescent LTPA. The model adjusted for sex.

to this group's high education, as previous studies have shown that high education usually associates with an interest in health and health behaviors, positive attitudes towards physical activity, sufficient financial resources, and social support for LTPA.[20,21] This group was also observed to have high levels of LTPA across adolescence, suggesting long-term routines for LTPA.

A minority of the participants belonged to the *active on weekdays* group. Those having lower education and a manual occupation were more presented in this group compared to the other groups, which likely explains high activity levels during midday on weekdays (including typical worktime). In contrast, weekday evening and weekend physical activity levels were low (typical leisure time), which is consistent with previous studies among individuals with lower education.[37] Low LTPA may be related to the need to recover from physically strenuous work, but also to other factors such as limited financial resources and social support.[20,21] Those in the *active on weekdays* group also had relatively low levels of adolescent LTPA, that is, the time before entering the work life. This suggests that other factors than worktime physical activity such as missing routines for LTPA may also explain low physical activity levels during leisure time in this group.

The most physically active groups, that is, *consistently moderate and consistently high activity* groups were small (11% and 5%, respectively). Those in the *consistently high activity* were more likely married or cohabiting than single when compared to those in the *consistently low activity* group, which is in line with previous accelerometer-based findings in the adult population from United States.[10] However, the main difference between the most active groups and the least active group (*consistently low activity*) was that in the active groups there were more women than men. This finding corroborates prior studies showing that women have more total accelerometer-measured daily physical activity compared to men.[4,8,37] Some of this sex difference may also be explained by engagement in household chores. Although time use statistics from Finland suggest that the gap between women and men in time used for household chores has diminished during the last decades, women still use more time in household chores compared to men across all age groups[38,39] and these activities are likely well captured with wrist-worn accelerometers. Moreover, active commuting tends to be slightly more common among women compared to men across all age groups in Finland.[40] In the current study, more women compared to men reported paying attention to their own health habits (82% vs. 62%), which may also explain some of the sex differences in physical activity patterns as physical activity is part of a healthy lifestyle.

Our findings point out groups of individuals who may benefit from targeted interventions to increase physical activity. The most significant efforts may be required for individuals with low activity levels throughout the week, such as those in the *consistently low activity* group, in which men, students, and those outside of workforce were more presented than in other groups. For instance, physical activity could be promoted in weekday contexts during daytime (e.g., at learning institutions) and on weekends during leisure time. Another possible group that could benefit from efforts to increase physical activity, particularly during weekday evenings and weekends, is the group categorized as *active on weekdays*; mostly men or individuals with basic education or working in manual occupations. This is because a recent study among 40–79 year-old Dutch adults suggests that those active only on weekdays have poorer cardiometabolic health compared to those who are consistently moderately or highly active.[12] Moreover, relying solely on work-related physical activity may not provide all the health benefits of physical activity.[5,6,11] However, we did not examine health implications of the observed physical activity patterns among young adults and thus, future studies are needed to elaborate this aspect.

The most important strengths of this study include assessment of physical activity with accelerometry, which is not subject to recall and information bias like self-reports[1] and taking into account the heterogeneity in physical activity patterns between weekdays and weekends using GBTM.[33] Moreover, we were able to utilize the information on physical activity groups' history of LTPA, which was collected at several time points during adolescence. The main limitation is that we did not have information on the participants' working hours and thus, we did not have accurate information on the contexts of physical activity (work vs. leisure). Moreover, wrist-worn accelerometers have inherent limitations to capture some types of physical activity, such as cycling and weight lifting, which may lead to underestimation of physical activity. In terms of examining family status and occupation as possible correlates of physical activity patterns, the study population had very few parents (9%) and a relatively high proportion of students who had not yet completed their vocational training (31%). This, however, likely reflects the life circumstances of 26-year-olds. Finally, the study population was relatively small and comprised participants of an infancy-onset long-term dietary counseling intervention study, possibly attracting for instance those more interested in health habits.

5 | PERSPECTIVE

In recent years, there has been a growing interest in physical activity patterns, which refer to the manner in which physical activity is accumulated during a day

and week. For instance, physical activity can be accrued regularly every day at work or during commuting versus over weekends during leisure time. The information on different physical activity patterns and the timing of physical activity throughout the day and week can be used to targeting and implementing physical activity interventions to those who would benefit the most from increasing physical activity. As an example, this information would enable the identification of the least active time windows during the day and week, which may be the most opportune moments for increasing physical activity. Given that most of the previous studies have focused on adults, we examined the heterogeneity of physical activity patterns and their correlates among young adults. Our findings demonstrate a large heterogeneity in weekday and weekend physical activity patterns among young adults. Moreover, we identified correlates such as history of physical activity, sex, education, work status, and occupation that were associated with different physical activity patterns.

AUTHOR CONTRIBUTIONS

Suvi Rovio, Harri Niinikoski, Hanna Lagström, Antti Jula, Jorma Viikari, Tapani Rönnemaa, Olli Raitakari, and Katja Pahkala designed the longitudinal STRIP study including the follow-up at age 26 years. Katja Pahkala and Sari Stenholm designed the accelerometry data collections and the here described study. Kristin Suorsa conducted the analyses with the help of Tuija Leskinen and Jaana Pentti. Kristin Suorsa drafted the manuscript. All authors contributed to data interpretation, revised article critically, and approved the final version of manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicting interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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