Original article

Six-year trends and intersectional correlates of meeting 24-Hour Movement Guidelines among South Korean adolescents: Korea Youth Risk Behavior Surveys, 2013−2018

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Abstract

Background: Grounded in intersectionality theory, this study examined the 6-year prevalence trend and correlates in meeting Canada's 24-Hour Movement Guidelines (Guidelines hereafter) in a nationally representative adolescent samples of South Korea (officially the Republic of Korea).
Methods: Self-reported, annually repeated cross-sectional data collected between 2013 and 2018 were used (n = 372,433, 12−17 years old, 47.9% females). Adolescents were categorized as meeting or not meeting different sets of physical activity, screen time (ST), and sleep recommendations within the Guidelines, separately for weekdays and weekend days. Intersectional correlates included sex and social class (i.e., family economic status, parental education level, and academic performance). Multiple logistic regression analyses were performed.
Results: Overall, the proportion of adolescents meeting physical activity, ST, and sleep recommendations were 5.3%, 60.3%, and 10.2% on weekdays and 5.3%, 28.2%, and 46.4% on weekend days, respectively. Between 2013 and 2018, no substantial changes were observed for meeting the physical activity or sleep recommendation, while meeting the ST recommendation was markedly lower in 2018. The proportion of meeting all 3 recommendations were 0.5% for weekdays and 0.8% for weekend days. Overall, compared to female adolescents, male adolescents were consistently associated with more favorable patterns of meeting different sets of recommendations, regardless of social class. Among females only, social class appeared to be not important or even detrimental in meeting different sets of recommendations. Being male, compounded with social class, was associated with meeting the ST recommendation.
Conclusion: Less than 1% of Korean adolescents met the overall Guidelines. Intersectionality-based analysis and intervention may be important in promoting healthy active lifestyles among South Korean adolescents.

Keywords: Intersectionality theory; Physical activity; Sedentary behavior; Sleep; Social determinants of health

1. Introduction

The importance of considering movement behaviors that occur in a 24-h period for adolescent health is gaining momentum in health promotion research and practice.[1−3] This is because physical activity (PA), sedentary behavior, and sleep are co-dependent and, together, jointly influence health.[4−6] In support of the 24-h movement behavior approach, Canada has released the 24-h Movement Guidelines for Children and Youth (24-h movement guidelines hereafter).[2] The 24-h movement guidelines consist of recommendations for PA (at least 60 min of moderate-to-vigorous PA (MVPA)), recreational screen time (ST; no more than 2 h), and sleep duration (9−11 h for those aged 5−13 years; 8−10 h for those aged 14−17 years) over a typical 24-h day.[2]

Since the launch of the 24-h movement guidelines, studies examining the prevalence of adolescents meeting the 24-h movement guidelines and its associations with health outcomes have shown consistent findings in different

countries.[7−10] Specifically, as more of the recommendations were met, better health outcomes were observed, whereas failure to meet any of the recommendations was associated with poor health outcomes.[7−10] Also, unfavorable patterns of movement behaviors have been observed in different countries, regardless of economic development.[11] The Global Action Plan on Physical Activity 2018−2030 by the World Health Organization suggests that in order to meet the United Nations's Sustainable Development Goal 3 (good health and well-being),[12] scaling national action on the promotion of healthy active behaviors must be prioritized.[11,13] To effectively respond to the global health promotion agenda and to help promote healthy movement behaviors, each country should closely monitor and report behavioral patterns in order to strengthen the evidence base. Furthermore, identifying and addressing factors that contribute to unfavorable movement behaviors is also important to inform the development of national-level, "upstream", population-based policies for health promotion.[13]

In the context of South Korea (Korea hereafter), insufficient PA and sleep and high ST have been reported consistently. For instance, the proportion of meeting all 3 recommendations within the 24-h movement guidelines was only 1.6% based on national data.[7] Similar to the global trend,[11,14] gender has consistently been noted as a major correlate of PA and ST, indicating that girls show lower PA and higher ST than boys.[15−20] In addition to gender, other social class variables have also been associated with 24-h movement behaviors.[17,21,22] Specifically, in the Korean context, key social class variables, such as household income or parental education, have been associated with healthy behaviors.[16,17] Also, among school-aged child and adolescent populations, academic performance, which is directly related to university entrance and job opportunities, is an important factor that determines an individual's current and future class.[23] It is also well-established that the aforementioned socioeconomic factors, such as income and parental education, have a profound impact on academic performance at school.[24] With a strong societal emphasis on education, academic performance is closely linked with one's sociodemographic background. Together, these factors influence healthful behaviors in Korea.[21]

Intersectionality, first coined by Kimberlé Crenshaw,[25] a leading scholar of critical race theory, provides a theoretical framework for articulating social power dynamics and structural forces that are in play in shaping one's health and health behavior.[26,27] Recognizing that multiple social factors are inextricably related to one another, it is critical that an individual's multiple social memberships be considered simultaneously when examining the correlates of health behaviors, such as meeting the 24-h movement guidelines. However, a majority of previous literature based on large-scale, population-based surveys has investigated social factors as a single, distinct phenomenon rather than considering the intricacies of multiple social factors that are entangled and co-influence one's experiences. For example, to tease out the impact of gender on PA participation, previous research has predominantly investigated gender inequalities in relation to meeting the

MVPA recommendations, after controlling for income and education.[17,28] However, this approach largely ignores the reality that an individual's identity and experiences cannot be explained with single-axis thinking (e.g., analyzing gender alone) because every individual's social position involves a combination of multiple, intertwined factors (e.g., a female with wealthy, educated parents).

To our knowledge, the only study to have examined how racial identity, gender, class, and sexuality intersect to predict leisure time PA involved a survey of 149,574 Canadian adults.[29] The researchers found that participation in leisure time PA varied across individuals at different intersections of social categories. For example, income strongly predicted leisure time PA among men of color, but not among women of color, while women with a non-heterosexual orientation were more likely to participate in leisure time PA than their women counterparts with a heterosexual orientation.[29] Using the evidence from the Canadian study,[29] and given the unfavorable behavioral patterns observed among Korean adolescents over the years,[18,20] it is important to investigate correlates of health behaviors among younger Koreans to inform the development of future intervention strategies. Therefore, the purpose of our study, which is grounded in intersectionality theory,[25] was to examine the 6-year trend (from 2013 to 2018) and intersectional correlates of meeting the 24-h movement guidelines in a nationally representative sample of Korean adolescents. Specifically, we examined whether intersections between sex and other social class characteristics are associated with meeting different combinations of the 24-h movement guidelines. Also, separate analyses were done for weekdays and weekend days because of well-known discrepancies in health behaviors across the days of the week in this population group.[7]

2. Methods

2.1. Study participants

The Korea Youth Risk Behavior Web-Based Survey (KYRBS) is an ongoing cross-sectional survey conducted jointly by the Korea Centers for Disease Control and Prevention, the Ministry of Health and Welfare, and the Ministry of Education since 2005.[30,31] The KYRBS was designed to monitor health and health behaviors among adolescents (aged 12−18 years) in 15 different subcategories (e.g., smoking, drinking, PA, dietary habits, weight control). In our study, only data from 2013 to 2018 were used, based on the availability of continuous key behavioral variables. In each year from 2013 to 2018, approximately 70,000 adolescents from 800 middle schools and high schools were recruited for the KYRBS. In order to be consistent with the age groups included in the 24-h movement guidelines, of the 400,382 students who participated in the KYRBS survey (overall response rate 96.4%), only those aged 12−17 years were included in our analysis (n = 372,433).[2]

Individual schools and teachers provided informed written consent, and participating students and their parents were asked to provide passive consent whereby if they did not wish

to participate, they had to verbally notify a teacher who conducted the survey.[31] All participating students were assured anonymity and were randomly assigned to computers to complete the questionnaire at their school. The KYRBS survey protocol was approved by the Korea Centers for Disease Control and Prevention Institutional Review Board annually up to 2014. Institutional review board approval from 2015 was not required based on the Population Health Promotion Act 19 (approval number 117058). A more detailed description of the KYRBS survey methodology can be found elsewhere.[30,31]

2.2. Measures

2.2.1. PA

PA was self-reported by participating adolescents using 1 item. Adolescents reported the number of days they engaged in MVPA for $\geq$60 min/day during the previous 7 days, including 2 weekend days. Based on the 24-h movement guidelines,[2] adolescents were categorized into meeting or not meeting the $\geq$60 min/day MVPA recommendation.

2.2.2. Recreational sedentary-based ST

ST was self-reported by participating adolescents using 2 items. Adolescents reported the average hours and minutes spent in recreational ST for typical weekdays and weekend days separately. Based on the 24-h movement guidelines,[2] adolescents were categorized into meeting or not meeting the $\leq$2 h/day recommendation.

2.2.3. Sleep duration

Sleep duration was self-reported by participating adolescents using 8 items. Participants reported the typical bed time and wake-up time, separately for weekdays and weekend days. Based on the 24-h movement guidelines,[2] adolescents were categorized into meeting and not meeting the sleep recommendation of 9−11 h for 5- to 13-year-olds and 8−10 h for 14- to 17-year-olds.

2.2.4. Intersectional correlates

Sex (male/female), family economic status, maternal and paternal educational levels, and perceived academic performance were used as potential intersectional correlates. These variables have previously been reported individually as key correlates of movement behaviors among Korean adolescents.[17,18,20,21] Family economic status, maternal and paternal educational levels, and perceived academic performance were used to indicate social class. Family economic status and perceived academic performance were collected using a 5-point Likert scale (i.e., from low, low-middle, middle, middle-high, to high), which were then categorized for statistical purposes into 3 groups: low (low and low-middle), middle, and high (middle-high and high). Paternal and maternal education levels ($\leq$middle school graduate, high school graduate, or $\geq$post-secondary graduate) were collected. The responses were categorized into 2 groups: post-secondary graduate or higher (college and university graduate) and less than a post-secondary graduate (middle and/or high school graduate).

Although race/ethnicity is a common variable used, our study did not include these variables because Korea in general is racially and ethnically homogenous (100% Asian and 99% of Korean descent).[32] Our data also showed that more than 99% of adolescents had parents with Korean descent.

2.2.5. Common covariates

Age and body mass index (BMI) were included as common covariates. These were collected by asking participants to report their chronological age (in years), height (cm), and weight (kg). Self-reported height and weight were used to calculate body mass index (weight/height (kg/m^2)) scores for each participant.

2.3. Statistical analysis

Sample characteristics were described in the total sample (2013−2018) and stratified by sex either in means and $\pm$SD or percentages. Meeting individual recommendations and specific combinations (MVPA + ST, MVPA + sleep, and ST + sleep) and general combinations (none, 1, 2, and all 3) of the 24-h movement guidelines were described for weekdays and weekend days. Notably, MVPA was the only variable that was collected without the weekday−weekend distinction; therefore, the weekly average data were used for weekday−weekend stratified analyses. This methodological decision was made based on the availability of weekday−weekend data for ST and sleep and given the well-known differences in these behaviors by the days of the week in this population group.[7,33] Examining potential correlates of 24-h movement behaviors stratified by days of the week could better inform future intervention strategies by providing more detailed data on factors that potentially influence daily behavioral compositions on weekdays and weekend days, separately.

By taking intersectional approaches,[25,29] associations between sex, compounded with another social class variable (i.e., family economic status, maternal or paternal education level, academic performance),[21,28] and meeting the individual and specific combinations of the 24-h movement guidelines were tested using multiple logistic regression models. All analyses were controlled for age, BMI, year (to control for any period effect), and behaviors other than a respective dependent variable and were adjusted for year-specific sampling weight. Results were presented using odds ratios and 95% confidence intervals. The significant alpha level was set at a *p* value of less than 0.001 *a priori*. All statistical analyses were performed using Stata Version 14.0 software (Stata Corp., College Station, TX, USA).

3. Results

Among 372,433 participants, adolescents with incomplete data on key variables were excluded, leaving a total of 311,891 participants for the weekday data and 322,965 participants for the weekend day data. Sample characteristics are described in Table 1. On average, Korean adolescents engaged in 3.0 $\pm$ 2.1 days of MVPA for $\geq$60 min/week, 185.0 $\pm$ 133.4 min of recreational ST, and 7.0 $\pm$ 1.3 h of sleep daily.

Table 1
Sample characteristics of adolescents (aged 12−17 years)—Korea Youth Risk Behavior web-based Surveys, 2013−2018 ($n = 372,433$).

Characteristics	Overall	Girls	Boys
Sex	–	47.9	52.1
Age (year)	14.83 ±1.59	14.82 ± 1.60	14.83 ± 1.59
Height (cm)	165.07 ± 8.50	159.95 ± 5.39	169.79 ± 8.10
Weight (kg)	57.30 ± 11.80	52.62 ± 8.30	61.62 ± 12.85
Body mass index (kg/m^2)	20.91 ± 3.25	20.53 ± 2.81	21.26 ± 3.58
Age			
12 years	8.3	8.4	8.2
13 years	16.8	16.7	16.8
14 years	17.5	17.5	17.7
15 years	18.4	18.5	18.4
16 years	19.2	19.2	19.2
17 years	19.8	19.7	19.7
Family economic status			
Low	16.1	16.4	15.7
Middle	46.8	49.5	44.4
High	37.1	34.1	39.9
Father's education level			
<Post-secondary graduate	37.0	37.8	36.4
≥Post-secondary graduate	63.0	62.2	63.6
Mother's education level			
<Post-secondary graduate	45.1	47.0	43.3
≥Post-secondary graduate	54.9	53.0	56.7
Academic performance			
Low	34.0	33.9	34.2
Middle	28.2	29.2	27.3
High	37.8	36.9	38.5

Note: Data are presented as mean ± SD or percentage.

Table 2
Prevalence of meeting the Canadian 24-Hour Movement Guidelines for Children and Youth for weekdays and weekend days—Korea Youth Risk Behavior web-based Surveys, 2013−2018.

	Weekdays ($n = 311,891$)	Weekends ($n = 322,965$)
Individual recommendation		
Meeting PA recommendation	5.3	5.3
Meeting ST recommendation	60.3	28.2
Meeting sleep recommendation	10.2	46.4
Specific combinations		
Meeting PA + ST recommendations	3.4	1.9
Meeting PA + sleep recommendations	0.8	2.4
Meeting ST + sleep recommendations	5.9	12.4
General combinations		
Meeting no recommendations	33.9	35.8
Meeting any 1 recommendation	57.1	49.2
Meeting any 2 recommendations	8.5	14.2
Meeting all 3 recommendations	0.5	0.8

Note: Data are presented as percentage.
Abbreviations: PA = physical activity; ST = screen time.

The aggregated prevalence of meeting the different combinations of the 24-h movement guidelines are described in Table 2. Briefly, 5.3% met the MVPA recommendation across the week. The prevalence of meeting the ST recommendation during weekdays was more than twice as high (60.3%) as on weekend days (28.2%). Conversely, meeting the sleep recommendation during weekdays was about 5 times lower (10.2%) than for weekend days (46.4%). Regardless of the days of the week, meeting all 3 recommendations was consistently low (0.5% for weekdays and 0.8% for weekends), while meeting no recommendations was consistently high (33.9%−35.8%).

Fig. 1 depicts the 6-year prevalence trend of meeting PA, ST, or sleep recommendations within the 24-h movement guidelines by weekdays and weekend days. Overall, the proportion of meeting the ST recommendation on weekdays was consistently higher (up to 63.4%) than that of the other recommendations; however, declining patterns were observed in 2017 (60.5%) and 2018 (49.7%) compared to the previous years. Specifically, fewer than 30% of adolescents met the ST recommendation on weekend days, with a 5% decrease between 2017 and 2018. Meeting the sleep recommendation was relatively consistent in 2017−2018, with a marked difference between weekdays (9.9%−10.3%) and weekends (44.6%−45.0%). Prevalence of meeting the MVPA recommendation was consistently low (∼5%) for the 6-year period irrespective of the days of the week.

The prevalence of meeting the specific combinations of the 24-h movement guidelines between 2013 and 2018 are described in Fig. 2. In general, meeting a specific combination of 2 recommendations was low. The highest prevalence was observed with meeting the ST and sleep recommendations (9.9%−13.1% for weekend days and 4.9%−6.9% for weekdays). Across the week, meeting the PA and ST recommendations ranged between 1.5% and 3.8%, and meeting the PA and sleep recommendations ranged between 0.7% and 2.6%.

When meeting general combinations of the 24-h movement guidelines were considered, more adolescents met at least 1 recommendation during weekdays compared to weekend days (Fig. 3). Specifically, prevalence of meeting the general combinations of the guidelines lowered as the number of recommendations considered increased. In particular, the prevalence of meeting all 3 recommendations was less than 1% over the 6-year period, regardless of the days of the week. Also, meeting none of the recommendations showed a stable trend between 2013 and 2017 but increased markedly in the most recent year (2018) of data, and the increase was most noticeable for weekend days (33.9% in 2017 to 42.8% in 2018).

Intersectional correlates of meeting the individual recommendations are described in Table 3. For both weekdays and weekend days, being male was consistently associated with meeting the MVPA recommendation, regardless of social class variables (Models 1A−4A and 1D−4D). In addition, being female, compounded with having a mother with a post-secondary education (Model 3A), was associated with meeting the MVPA recommendation on weekdays compared to their female counterparts who had a less-educated mother. In contrast, females with middle or high academic performance were less likely to meet the MVPA recommendation compared to their female counterparts with low economic status or low academic performance. Unlike PA, being in a higher social class was consistently associated with meeting the ST recommendation universally in both sexes. Specifically, both female and male adolescents with higher social class were more likely to meet the ST recommendation compared to females with the

Fig. 1. The 6-year prevalence trend (%) of meeting individual recommendations of the Canadian 24-Hour Movement Guidelines for Children and Youth for week-days and weekend days—Korea Youth Risk Behavior web-based Surveys, 2013−2018. PA= physical activity; SLP = sleep; ST = screen time.

lowest social class (Models 1B−4B and 1E−4E). Compared to females in the lowest social class categories, males, irrespective of social class, were associated with meeting the sleep recommendation (Models 1C−4C and 1F−4F). However, among females, higher social class was inversely associated with meeting the sleep recommendation, and this association was more apparent during weekdays (Models 1C−4C) than during weekend days (Models 1F−4F).
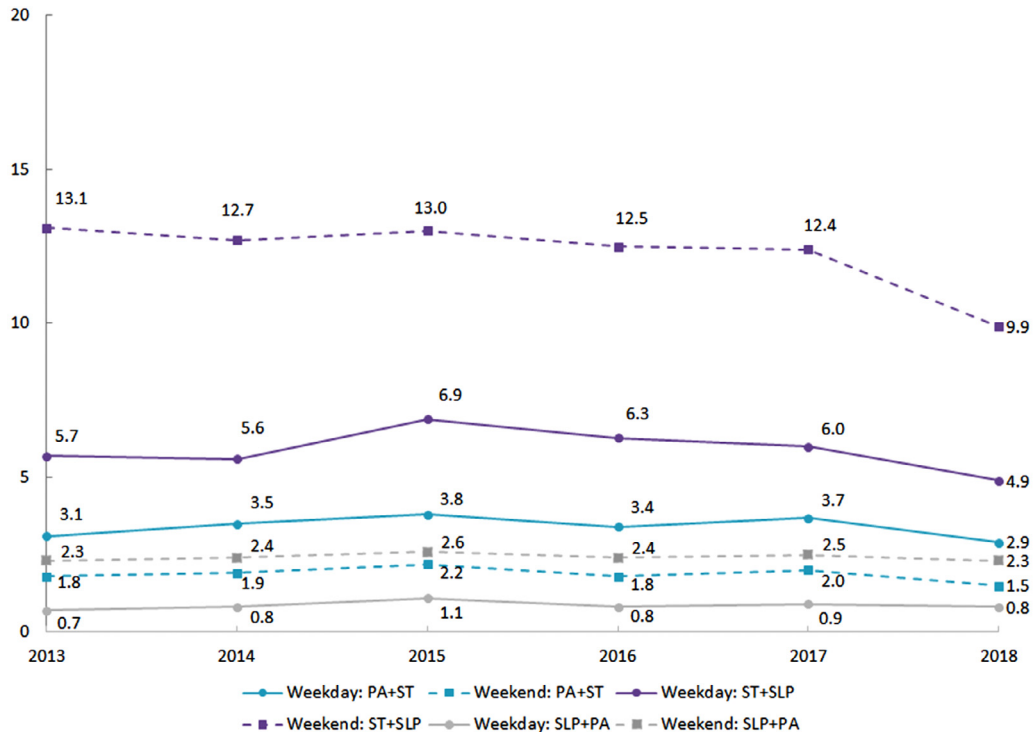

Fig. 2. The 6-year prevalence trend (%) of meeting specific combinations of the recommendations within the Canadian 24-Hour Movement Guidelines for Children and Youth for weekdays and weekend days—Korea Youth Risk Behavior Web-Based Surveys, 2013−2018. PA = physical activity; SLP = sleep; ST = screen time.
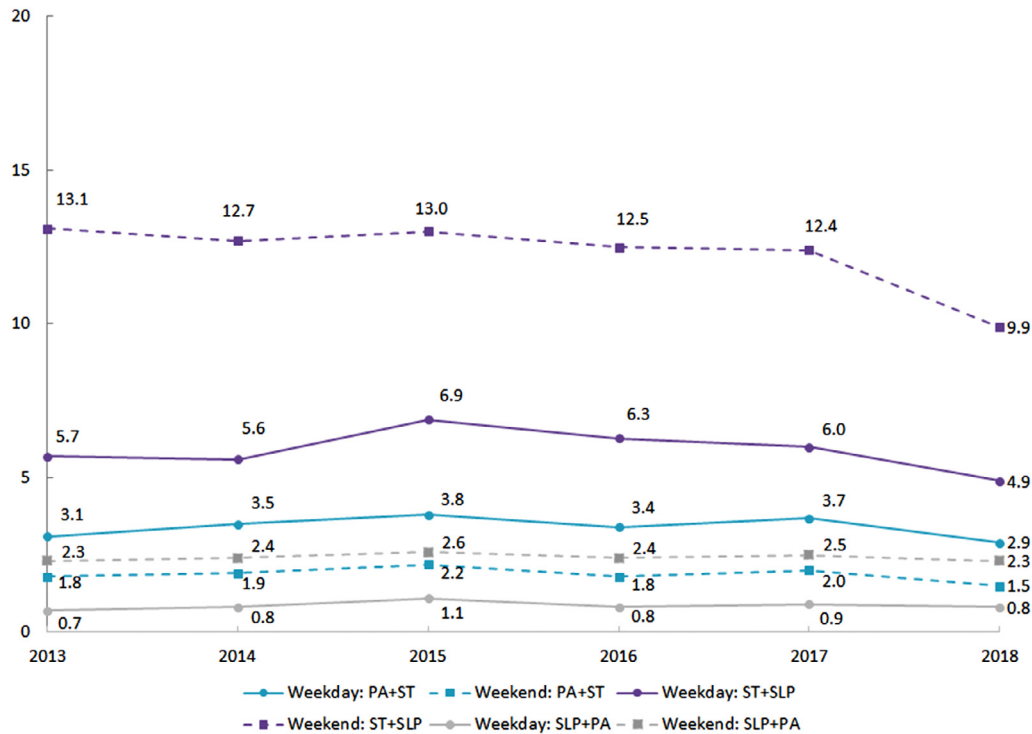
Fig. 3. The 6-year prevalence trend (%) of meeting general combinations of the recommendations within the Canadian 24-Hour Movement Guidelines for Children and Youth for weekdays and weekend days—Korea Youth Risk Behavior web-based Surveys, 2013−2018. PA = physical activity; SLP = sleep; ST = screen time.

Table 3
A total of 24 independent regression models on the associations between intersectional correlates and meeting individual recommendations of the Canadian 24-Hour Movement Guidelines for Children and Youth by weekdays and weekend days—Korea Youth Risk Behavior web-based Surveys, 2013−2018.

Intersectional correlates	Weekdays ($n = 311,891$)			Weekends ($n = 322,965$)		
	PA Model A	ST Model B	Sleep Model C	PA Model D	ST Model E	Sleep Model F
Model 1: Family economic status						
Female + low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + middle	0.81 (0.73−0.89)*	1.17 (1.14−1.21)*	0.90 (0.84−0.96)*	0.81 (0.73−0.89)*	1.05 (1.02−1.09)*	1.08 (1.04−1.11)*
Female + high	0.93 (0.84−1.03)	1.48 (1.43−1.53)*	0.77 (0.72−0.82)*	0.91 (0.82−1.01)	1.32 (1.27−1.37)*	0.96 (0.93−1.00)
Male + low	3.02 (2.73−3.33)*	1.11 (1.06−1.15)*	2.10 (1.96−2.26)*	3.06 (2.78−3.38)*	1.00 (0.95−1.04)	1.13 (1.09−1.17)*
Male + middle	2.74 (2.51−3.00)*	1.41 (1.36−1.45)*	2.21 (2.08−2.35)*	2.85 (2.60−3.11)*	1.14 (1.10−1.19)*	1.18 (1.15−1.22)*
Male + high	3.49 (3.19−3.81)*	1.71 (1.65−1.76)*	2.07 (1.94−2.20)*	3.53 (3.23−3.86)*	1.52 (1.46−1.57)*	1.08 (1.05−1.12)*
Model 2: Father's education						
Female + < post-secondary	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + ≥ post-secondary	0.98 (0.90−1.06)	1.24 (1.21−1.27)*	0.65 (0.61−0.68)*	0.96 (0.88−1.04)	1.25 (1.21−1.28)*	0.87 (0.84−0.89)*
Male + < post-secondary	3.60 (3.33−3.88)*	1.17 (1.14−1.21)*	2.29 (2.18−2.41)*	3.68 (3.42−3.96)*	1.08 (1.05−1.12)*	1.13 (1.09−1.16)*
Male + ≥ post-secondary	3.53 (3.28−3.79)*	1.48 (1.44−1.52)*	1.82 (1.74−1.91)*	3.51 (3.27−3.77)*	1.46 (1.42−1.50)*	0.97 (0.95−1.00)
Model 3: Mother's education						
Female + < post-secondary	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + ≥ post-secondary	1.11 (1.02−1.20)*	1.25 (1.22−1.28)*	0.69 (0.66−0.73)*	1.09 (1.00−1.17)	1.29 (1.25−1.32)*	0.88 (0.86−0.90)*
Male + < post-secondary	3.73 (3.48−3.99)*	1.20 (1.17−1.23)*	2.31 (2.21−2.42)*	3.81 (3.56−4.07)*	1.11 (1.08−1.14)*	1.12 (1.09−1.15)*
Male + ≥ post-secondary	3.90 (3.65−4.17)*	1.47 (1.44−1.51)*	1.95 (1.87−2.04)*	3.91 (3.66−4.17)*	1.50 (1.46−1.54)*	0.99 (0.97−1.02)
Model 4: Academic performance						
Female + low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + middle	0.70 (0.64−0.76)*	1.36 (1.32−1.40)*	0.79 (0.75−0.84)*	0.70 (0.64−0.76)*	1.06 (1.03−1.10)*	1.01 (0.98−1.04)
Female + high	0.67 (0.62−0.73)*	1.74 (1.70−1.79)*	0.65 (0.61−0.68)*	0.69 (0.63−0.74)*	1.17 (1.14−1.20)*	0.95 (0.92−0.97)*
Male + low	3.10 (2.90−3.31)*	1.17 (1.14−1.20)*	2.24 (2.14−2.34)*	3.21 (3.01−3.42)*	1.03 (1.00−1.06)	1.07 (1.04−1.10)*
Male + middle	2.55 (2.39−2.73)*	1.59 (1.54−1.64)*	2.10 (2.00−2.20)*	2.64 (2.47−2.83)*	1.15 (1.11−1.19)*	1.12 (1.09−1.15)*
Male + high	2.60 (2.44−2.78)*	2.05 (2.00−2.11)*	1.69 (1.62−1.77)*	2.70 (2.54−2.88)*	1.41 (1.37−1.45)*	1.07 (1.05−1.10)*

Notes: All analyses were controlled for age, body mass index, survey year, and behaviors other than the main dependent variable in each model (e.g., covariates were age, body mass index, survey year, ST, and sleep when the model was for PA). Data are presented as odds ratio (95% confidence interval).
* $p < 0.001$.
Abbreviations: PA = physical activity; ST = screen time.

Intersectional correlates of meeting the specific combinations of the recommendations within the 24-h movement guidelines are described in Table 4. Overall, compared to females in each of the lowest social class memberships, male sex, regardless of social class, was associated with meeting all 3 recommendations of the 24-h movement guidelines (Models 1D−8D). Similar patterns were observed for meeting specific and general combinations of 24-h movement behavior

Table 4
Associations between intersectional correlates and meeting the specific combinations or all of recommendations within the Canadian 24-Hour Movement Guidelines for Children and Youth by weekdays and weekend days—Korea Youth Risk Behavior web-based Surveys, 2013−2018 (n = 372,433).

Intersectional correlates	PA + ST Model A	PA + Sleep Model B	ST + Sleep Model C	All Model D
Weekdays (n = 311,891)				
Model 1: Family economic status				
Female + low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female − middle	0.87 (0.76−0.98)	0.99 (0.71−1.40)	0.92 (0.85−1.01)	1.21 (0.78−1.88)
Female + high	1.10 (0.97−1.25)	1.13 (0.80−1.60)	0.84 (0.77−0.93)*	1.60 (1.02−2.50)*
Male + low	3.21 (2.82−3.64)*	6.63 (4.57−8.76)*	2.03 (1.85−2.23)*	7.41 (4.85−11.33)*
Male + middle	3.08 (2.74−3.46)*	6.22 (4.58−8.45)*	2.38 (2.19−2.58)*	6.97 (4.66−10.44)*
Male + high	4.11 (3.66−4.61)*	7.67 (5.65−10.42)*	2.35 (2.16−2.55)*	8.98 (6.01−13.43)*
Model 2: Father's education				
Female + < postsecondary	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + ≥ postsecondary	1.13 (1.01−1.25)*	0.72 (0.55−0.95)*	0.70 (0.65−0.75)*	0.85 (0.61−1.17)
Male + < postsecondary	3.77 (3.42−4.16)*	6.04 (4.85−7.52)*	2.43 (2.28−2.60)*	5.83 (4.44−7.66)*
Male + ≥ postsecondary	4.08 (3.72−4.47)*	5.40 (4.36−6.69)*	2.04 (1.92−2.17)*	5.50 (4.22−7.16)*
Model 3: Mother's education				
Female + < postsecondary	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + ≥ postsecondary	1.29 (1.17−1.43)*	0.87 (0.67−1.14)	0.75 (0.70−0.80)*	1.09 (0.80−1.50)
Male + < postsecondary	4.07 (3.73−4.45)*	6.36 (5.19−7.79)*	2.43 (2.29−2.58)*	6.38 (4.95−8.22)*
Male + ≥ postsecondary	4.46 (4.10−4.86)*	6.22 (5.10−7.59)*	2.18 (2.06−2.31)*	6.66 (5.20−8.54)*
Model 4: Academic performance				
Female + low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + middle	0.81 (0.72−0.91)*	0.68 (0.51−0.90)*	0.84 (0.78−0.91)*	0.75 (0.53−1.06)
Female + high	0.84 (0.76−0.93)*	0.59 (0.45−0.77)*	0.78 (0.72−0.83)*	0.73 (0.53−1.01)
Male + low	3.30 (3.03−3.60)*	5.90 (4.86−7.18)*	2.28 (2.14−2.42)*	5.52 (4.30−7.07)*
Male + middle	2.99 (2.74−3.27)*	4.86 (3.97−5.94)*	2.40 (2.25−2.55)*	5.06 (3.93−6.52)*
Male + high	3.27 (3.01−3.55)*	4.07 (3.34−4.97)*	2.05 (1.93−2.18)*	4.30 (3.36−5.51)*
Weekend days (n = 322,965)				
Model 5: Family economic status				
Female + low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + middle	0.85 (0.71−1.01)	0.88 (0.75−1.02)	1.11 (1.05−1.16)*	0.93 (0.71−1.21)
Female + high	1.09 (0.92−1.30)	0.96 (0.82−1.13)	1.16 (1.10−1.23)*	1.14 (0.87−1.50)
Male + low	3.11 (2.62−3.69)*	3.39 (2.91−3.95)*	1.10 (1.04−1.17)	3.27 (2.48−4.29)*
Male + middle	2.91 (2.49−3.40)*	3.44 (3.00−3.96)*	1.27 (1.21−1.34)*	3.44 (2.69−4.41)*
Male + high	4.33 (3.72−5.05)*	3.94 (3.42−4.52)*	1.46 (1.39−1.54)*	5.00 (3.91−6.39)*
Model 6: Father's education				
Female + < postsecondary	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + ≥ postsecondary	1.08 (0.94−1.25)	0.96 (0.85−1.09)	1.05 (1.01−1.09)*	1.14 (0.92−1.41)
Male + < postsecondary	3.59 (3.15−4.09)*	4.19 (3.75−4.68)*	1.15 (1.10−1.20)*	4.19 (3.44−5.11)*
Male + ≥ postsecondary	4.10 (3.62−4.63)*	3.74 (3.37−4.17)*	1.32 (1.27−1.37)*	4.52 (3.75−5.44)*
Model 7: Mother's education				
Female + < postsecondary	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + ≥ postsecondary	1.32 (1.15−1.50)*	1.01 (0.90−1.14)	1.08 (1.04−1.12)*	1.07 (0.88−1.31)
Male + < postsecondary	4.05 (3.59−4.56)*	4.03 (3.65−4.46)*	1.17 (1.13−1.22)*	4.15 (3.49−4.93)*
Male + ≥ postsecondary	4.79 (4.27−5.37)*	4.03 (3.66−4.44)*	1.35 (1.30−1.40)*	4.46 (3.78−5.26)*
Model 8: Academic performance				
Female + low	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female + middle	0.76 (0.66−0.89)*	0.70 (0.61−0.80)*	1.04 (0.99−1.08)	0.77 (0.62−0.97)*
Female + high	0.70 (0.61−0.81)*	0.74 (0.65−0.83)*	1.01 (0.97−1.05)	0.67 (0.54−0.83)*
Male + low	3.12 (2.79−3.48)*	3.48 (3.16−3.83)*	1.09 (1.04−1.13)*	3.28 (2.78−3.88)*
Male + middle	2.68 (2.39−3.01)*	3.06 (2.76−3.38)*	1.21 (1.16−1.27)*	3.01 (2.53−3.57)*
Male + high	3.11 (2.79−3.46)*	3.02 (2.74−3.32)*	1.30 (1.25−1.35)*	3.31 (2.82−3.90)*

Notes: All analyses were controlled for age, body mass index, survey year, and behaviors other than the main dependent variable in each model (e.g., covariates were age, body mass index, survey year, ST and sleep when the model was for PA). Data are presented as odds ratio (95% confidence interval).
* $p < 0.001$.
Abbreviations: PA = physical activity; ST = screen time.

recommendations (Models 1A−8A, Models 1B−8B, and Models 1C−8C). Similar to the intersectional analyses of the correlates of meeting individual recommendations, the direction and strength of the associations were less consistent among female adolescents. Specifically, females with high family economic status were more likely to meet all 3 recommendations compared to those with low economic status (Model 1D). In addition, during weekdays, female adolescents with educated parents were more likely to meet PA and ST recommendations compared to their female counterparts with parents without post-secondary education (Models 2A−3A). During weekend days, being female, compounded with higher economic status (Model 5C) and educated parents (Models 6C−7C), was associated with meeting ST and sleep recommendations. Also, being female, compounded with having a mother with a post-secondary education, was associated with meeting PA and ST recommendations compared to their same sex counterparts who had a mother without a post-secondary education (Model 7A).

4. Discussion

This study describes the 6-year prevalence trend and intersectional correlates of meeting the 24-h movement guidelines[34] among 372,433 Korean adolescents aged 13−17 years. Between 2013 and 2018, the prevalence of meeting all 3 recommendations remained consistently low, while meeting none of the recommendations increased markedly from 2016 (31%) to 2018 (43%). Overall, fewer than 1% of adolescents met all 3 recommendations consistently over the 6-year period. In general, being male was more associated with meeting overall or any combination of recommendations within 24-h movement guidelines than being female, regardless of social class (i.e., economic status, parental education, and academic performance). Some dose−response patterns were observed, especially among male adolescents when compounded with social class and meeting the ST recommendation. Among female adolescents, higher social class appears to play an important role in meeting the ST recommendation; however, social class was shown to be less important or, in some instances, detrimental to meeting the PA or sleep recommendations.

Overall, only 5.3% of adolescents met the MVPA recommendation consistently over the 6-year period, which is largely consistent with previous studies in Korea (older studies ranged from 4.9% to 5.9%).[7,16,18,20] This indicates that insufficient PA among Korean adolescents not only exists but persists. The prevalence of meeting the sleep recommendation during weekend days (45%−48%) was higher than weekdays (10%−11%) over the 6-year period, which also supports previous results pertaining to Korean adolescents.[33,35] Owing to academic workloads, sleep deprivation and weekend catch-up sleep have been commonly reported among Korean adolescents.[33,36,37] Historically deeply rooted in Confucianism, Korean society puts a strong emphasis on education, and the college entrance examination determines one's social class and success. Therefore, tremendous academic pressure is put on as early as the elementary school years.[37]

Moreover, most Korean adolescents attend private "cram" schools after school hours, which in turn contributes to a lack of discretionary time when they can engage in varying leisure activities.[38] In addition to academic pressure, an increasing prevalence of Internet addiction, a rising concern in the modern Korean society, is also reported to be a contributor to irregular or inadequate sleep hours.[36]

The 6-year overall prevalence of meeting the ST recommendation was twice as high during weekdays (60%) as it was during weekend days (28%), with a steep decrease in meeting the ST recommendation in 2018 (60% in 2017 vs. 50% in 2018 during weekdays). The reversal in the trend of meeting sleep and ST recommendations during weekdays and weekends may suggest that Korean adolescents replace ST with sleep during weekends, while sleep gets replaced with ST during weekdays. Utilizing compositional analysis, time use epidemiologists have recently found that ST should be replaced with PA for health benefits among young people.[39,40] Therefore, discouraging ST while encouraging PA throughout the week, particularly during weekend days, could potentially reverse the replacement patterns between ST and sleep shown among Korean adolescents.

Replacement patterns between ST and sleep are also apparent with meeting the specific and general combinations of 24-h movement guidelines. The 6-year aggregated prevalence of meeting any pair of recommendations was, in general, low, with meeting PA and sleep recommendation during weekdays being the lowest (0.8%). Furthermore, the prevalence of meeting all 3 recommendations was less than 1%, while more than 33% of adolescents met none of the recommendations, regardless of the days of the week. This indicates that 24-h behavioral patterns among Korean adolescents are concerning. Overall, the prevalence of meeting specific combinations of 24-h movement guidelines was lower in 2018 than in 2013 (as shown in Fig. 2). For instance, the most marked decrease between 2013 and 2018 was observed in meeting ST and sleep recommendations, particularly during weekend days. When meeting general combinations was considered, the 6-year trend from 2013 to 2018 (as shown in Fig. 3) suggests that as meeting none of the recommendations increases, meeting 1 recommendation decreases on weekdays. Given this observation, encouraging adolescents who meet none of the recommendations to meet at least 1 of the recommendations may be a good strategy to alleviate this adverse trend. For adolescents who do not meet any of the recommendations, aiming to meet at least 1 recommendation may be deemed to be more achievable than meeting all 3 recommendations at once. In addition, from the perspective of time use epidemiology,[40] spending more time in 1 behavior (e.g., ST) likely takes a similar amount of time away from another behavior (e.g., sleep) within a 24-h day period. Given the replacement patterns between ST and sleep during weekdays and weekend days observed in our study, as well as the well-known weekend catch-up sleep patterns among Korean adolescents,[41] future strategies may target discouraging ST during weekdays because such effort may naturally lead to increasing sleep duration.

An intersectional analysis of the correlates related to meeting individual recommendations, and to meeting different combinations of them (or meeting all of them), suggests that male adolescents, regardless of social class, are more likely to engage in sufficient levels of 24-h movement behaviors, which supports previous findings regarding Korean adolescents.[16−18,20] When meeting individual recommendations was considered, social class, family economic status, and father's education all played a positive role in meeting the ST recommendation in both female and male adolescents. However, the role of social class in meeting the PA and sleep recommendations appears to work differently across the sexes. Specifically, social class was not as important among male adolescents (strengths of associations were similar across the social class strata). In contrast, except for mother's education, a detrimental role of social class was observed among females in meeting the overall 24-h movement guidelines, in meeting the sleep recommendation, and in meeting a combination of recommendations that included sleep. Having a mother with a post-secondary education appears to encourage female adolescents to meet PA and ST recommendations, individually and together; however, having an educated mother also appears to simultaneously deter female adolescents from meeting the sleep recommendation or meeting the ST and sleep recommendations. This result is consistent with previous findings that have reported that mothers have more pronounced influence on their daughters' PA and ST.[42,43] Evidence on sleep is lacking; however, some studies indicate that correlates of sleep/wake patterns may be largely age specific.[44] For instance, parental control is more important for younger children,[45] while for adolescents, school-related sleep restriction becomes more influential in establishing sleep patterns.[46] Perhaps the positive role that having an educated mother wields on female adolescents' healthy sleep behavior may be overshadowed by academic pressure; however, more research is needed to confirm this explanation. To encourage female adolescents to get more PA, less ST, and adequate sleep, the mother's role appears to be important in developing healthy 24-h movement behaviors among daughters.

With 2 notable exceptions, the role of social class in meeting the 24-h movement guidelines among female adolescents was less influential when meeting specific combinations of recommendations. First, family economic status was not important in, or was even detrimental to, meeting individual recommendations or specific combinations of them; but when meeting all 3 recommendations was considered, females with high family economic status exhibited better compliance during weekdays only. Such mixed roles of family economic status on meeting the 24-h movement guidelines among female adolescents should be further investigated in future studies. Second, academic performance appears to generally work against meeting all recommendations or specific combinations of them among female adolescents, except for meeting the ST recommendation. One possible explanation for this finding relates to how gender expectations are shaped in Korean society. Specifically, "coming from a good family" (a middle-upper class family with educated parents) is considered ideal

in Korea. However, unique characteristics associated with being a female from an "ideal" family, which include having good school grades and "behaving like a woman".[15] This explanation was also reflected in a previous study reporting on the preferred leisure activities among adolescents in Korea, Japan, and China.[38] The study indicated that, compared to males, female adolescents preferred passive forms of leisure (e.g., listening to music, watching television) rather than active forms of leisure (e.g., sport, PA), and that this gender difference was most apparent among Korean adolescents.[38] Societal gender expectations attached to female adolescents, combined with academic pressure, may continue to worsen sex disparities in meeting the 24-h movement guidelines among Korean adolescents, as has been reported in previous studies.[15,17,21]

Our study has several strengths. First, we used 6 consecutive years of data from a large sample of Korean adolescents while incorporating sex- and gender-based analysis.[47] Also, our study was grounded in intersectionality theory,[25] which recent health literature has highlighted its importance and applicability in quantitative research.[26,48,49] Our findings support the importance of treating social identity memberships as additive and intertwined rather than as a distinct feature when examining correlates of movement behaviors. Our findings that replacing patterns of ST and sleep between weekdays and weekends with PA staying stable adds to existing evidence pertaining to meeting the 24-h movement behavior guidelines from the perspective of time use epidemiology.[40]

Some limitations should also be mentioned. It is important to note that the KYRBS is self-reported and that the behavior data reported may have been affected by information bias (e.g., recall bias, social desirability). Nevertheless, the validity and reliability of the behavior items on the KYRBS questionnaire has been established,[50] and the levels of 24-h movement behaviors found in our study were similar to the ones from previous studies.[7,16−18,20,37] Thus, misclassification of participants for exposure and outcome variables due to information bias is likely to be non-differential, and any observed associations would have been biased toward the null. Also, the cross-sectional nature of the data used in our study does not allow us to establish causal relationships. Unlike ST and sleep measures, PA data were not available by the days of the week; thus, the prevalence of meeting the MVPA recommendation or any combinations that included PA does not account for the weekday−weekend variation. Therefore, our findings pertaining to meeting the MVPA recommendation should be interpreted with caution. We were able to capitalize on the availability of weekday−weekend data for ST and sleep because of the well-established differences in these behaviors during weekdays versus weekend days in this population group.[7,33] However, MVPA also may fluctuate between weekdays and weekend days, but no evidence pertaining to this fluctuation among the Korean adolescent population is currently available in the literature. Therefore, because these data were unavailable, we used a weekly average for MVPA. Future studies should build on our findings by collecting PA data on this population group during weekdays and weekend days separately in order to

gain a better understanding of potential weekday−weekend variations.

5. Conclusion

Patterns occurring over a 6-year period for Korean adolescents in meeting the 24-h movement guidelines and their intersectional correlates were identified in this study. Based on the 6 years of cumulative data, the prevalence of meeting the individual and different combinations of 24-h movement guidelines was generally low among Korean adolescents, particularly meeting the MVPA recommendation (5%). Also, only 0.5%−0.8% of adolescents met all 3 recommendations within the 24-h movement guidelines. Our study also found that the correlates of meeting the 24-h movement guidelines varied greatly by sex, indicating that 24-h movement behaviors, PA and sleep in particular, and their influencing factors are largely gendered in the Korean context. Male adolescents were consistently more likely to meet individual and any combinations of the 24-h movement guidelines than their female counterparts, regardless of social status. However, among females only, family economic status, paternal education, and academic performance were not important, or were even detrimental, to meeting 24-h movement guidelines, except for meeting the ST recommendation. Also, maternal education appears to play an important role in encouraging healthy lifestyles among female adolescents. Therefore, future interventions should be tailored by gender; and for female adolescents, it may be worthwhile to involve mothers. Using intersectional approaches in behavioral modification strategies may be important in promoting healthy, active living among Korean adolescents. Finally, the unfavorable 24-h movement behavior patterns among Korean adolescents observed in this study, combined with accumulating evidence on these trends,[18,20] indicate the need for continuously monitoring levels and identifying factors associated with the 24-h movement guidelines for health promotion in this population group.

Authors' contributions

EYL conceived and designed the study, obtained the datasets, interpreted statistical results, drafted the manuscript, and created the Graphic Abstract; AK conceived and designed the study, conducted data analyses, and critically edited the manuscript; RU conceived and designed the study, conducted data analyses, and critically edited the manuscript; EL helped with reviewing the literature, interpreting statistical results, creating figures and tables, and drafting the manuscript; LG helped with reviewing the literature, drafting the manuscript, and preparing the VideoSlides. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

References

1. Chaput JP, Olds T, Tremblay MS. Public health guidelines on sedentary behaviour are important and needed: A provisional benchmark is better than no benchmark at all. *Br J Sports Med* 2018;**54**:308–9.
2. Tremblay MS, Carson V, Chaput JP, et al. Canadian 24-hour movement guidelines for children and youth: An integration of physical activity, sedentary behaviour, and sleep. *Appl Physiol Nutr Metab* 2016;**41**(Suppl. 3):S311–27.
3. Tremblay MS. Introducing 24-hour movement guidelines for the early years: A new paradigm gaining momentum. *J Phys Act Health* 2020;**17**:92–5.
4. Chaput JP, Carson V, Gray CE, Tremblay MS. Importance of all movement behaviors in a 24 hour period for overall health. *Int J Environ Res Public Health* 2014;**11**:12575–81.
5. Esliger DW, Tremblay MS. Physical activity and inactivity profiling: The next generation. *Can J Public Health* 2007;**98**(Suppl. 2):S195–207.
6. Saunders TJ, Gray CE, Poitras VJ, et al. Combinations of physical activity, sedentary behaviour and sleep: Relationships with health indicators in school-aged children and youth. *Appl Physiol Nutr Metab* 2016;**41**(Suppl. 3):S283–93.
7. Lee EY, Spence JC, Tremblay MS, Carson V. Meeting 24-Hour Movement Guidelines for Children and Youth and associations with psychological well-being among South Korean adolescents. *Ment Health Phys Act* 2018;**14**:66–73.
8. Carson V, Chaput JP, Janssen I, Tremblay MS. Health associations with meeting new 24-hour movement guidelines for Canadian children and youth. *Prev Med* 2017;**95**:7–13.
9. Roman-Viñas B, Chaput JP, Katzmarzyk PT, et al. Proportion of children meeting recommendations for 24-hour movement guidelines and associations with adiposity in a 12-country study. *Int J Behav Nutr Phys Act* 2016;**13**:123. doi:10.1186/s12966-016-0449-8.
10. Shi Y, Huang WY, Yu JJ, Wong SHS. Compliance with the 24-Hour Movement Guidelines in Hong Kong adolescents: Associations with body mass index. *J Phys Act Health* 2019;**17**:287–92.
11. Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1·6 million participants. *Lancet Child Adolesc Health* 2020;**4**:23–35.
12. United Nations. *The Sustainable Development Goals Report 2018*. Available at: https://unstats.un.org/sdgs/files/report/2018/TheSustainableDevelopmentGoalsReport2018-EN.pdf. [accessed 02.22.2019].
13. World Health Organization. *Global Action Plan on Physical Activity 2018-2030: More active people for a healthier world*. Available at: http://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf. [accessed 04.01.2019].
14. Aubert S, Barnes JD, Abdeta C, et al. Global Matrix 3.0 Physical Activity Report Card Grades for children and youth: Results and analysis from 49 countries. *J Phys Act Health* 2018;**15**(Suppl. 2):S251–73.
15. Lee EY, Spence JC, Song Y, Jeon J. A systematic review of correlates of Korean girls' physical activity: An ecological perspective. *Heal Soc Sci* 2015;**40**:5–28.
16. Lee EY, Carson V, Jeon JY, Spence JC. Prevalence of physical activity and sitting time among South Korean adolescents. *Asia Pacific J Public Health* 2016;**28**:498–506.
17. Lee EY, Carson V, Jeon JY, Spence JC, Tremblay MS. Levels and correlates of 24-hour movement behaviors among South Koreans: Results from the Korea National Health and Nutrition Examination Surveys, 2014 and 2015. *J Sport Health Sci* 2019;**8**:376–85.

18. Song Y, Yang HI, Lee EY, et al. Results from South Korea's 2016 Report Card on physical activity for children and youth. *J Phys Act Health* 2016;**13**(Suppl. 2):S274–8.

19. Yoon HJ, Lee SA, Ju YJ, Nam JY, Park EC. The relationship between physical activity level of parents and that of their adolescent children. *J Phys Act Health* 2018;**15**:613–9.

20. Oh JW, Lee EY, Lim JJ, et al. Results from South Korea's 2018 Report Card on physical activity for children and youth. *J Exerc Sci Fit* 2019;**17**:26–33.

21. Lee EY, Yi KJ. Physical activity, sedentary behavior and sleep among children and adolescents: Towards an integrative approach to health promotion. *Health Soc Sci* 2016;**42**:59–84.

22. Rhie S, Rho YI, Chae KY. The effects of delaying school time on sleep duration, school performance, emotion and sleepiness in adolescent based on Korea Youth Risk Behavior Web-Based Survey. *Sleep Med* 2017;**40**: e278. doi:10.1016/j.sleep.2017.11.815.

23. Kim HY, Frongillo EA, Han SS, et al. Academic performance of the Korean children is associated with dietary behaviours and physical status. *Asia Pac J Clin Nutr* 2003;**12**:186–92.

24. Sameroff AJ, Seifer R, Baldwin A, Baldwin C. Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child Dev* 1993;**64**:80–97.

25. Crenshaw K. Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and anti-racist politics. *Univ Chic Leg Forum* 1989;**1989**:139–68.

26. Bauer GR. Incorporating intersectionality theory into population health research methodology: Challenges and the potential to advance health equity. *Soc Sci Med* 2014;**110**:10–7.

27. Krieger N. Genders, sexes, and health: What are the connections−and why does it matter? *Int J Epidemiol* 2003;**32**:652–7.

28. Lee EY, Carson V, Jeon JY, Spence JC. Prevalence of physical activity and sitting time among South Korean adolescents: Results from the Korean National Health and Nutrition Examination Survey, 2013. *Asia Pac J Public Health* 2016;**28**:498–506.

29. Abichahine H, Veenstra G. Inter-categorical intersectionality and leisure-based physical activity in Canada. *Health Promot Int* 2017;**32**:691–701.

30. Kim Y, Choi S, Chun C, Park S, Khang YH, Oh K. Data resource profile: The Korea Youth Risk Behavior Web-Based Survey (KYRBS). *Int J Epidemiol* 2016;**45**:1076–1076e. doi:10.1093/ije/dyw070.

31. Ministry of Education, Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. *The 14th Korea Youth Risk Behavior Survey, 2018*. Available at: https://www.cdc.go.kr/yhs/ [accessed 04.01.2019].

32. World Population Review. *South Korea Population 2020 (Demographics, Maps, Graphs)*. Available at: https://worldpopulationreview.com/countries/south-korea-population. [accessed 30.01.2020].

33. Kim SJ, Lee YJ, Cho SJ, Cho IH, Lim W, Lim W. Relationship between weekend catch-up sleep and poor performance on attention tasks in Korean adolescents. *Arch Pediatr Adolesc Med* 2011;**165**:806–12.

34. Tremblay MS, Carson V, Chaput J-P. Introduction to the Canadian 24-Hour Movement Guidelines for children and youth: An integration of physical activity, sedentary behaviour, and sleep. *Appl Physiol Nutr Metab* 2016;**41**(Suppl. 3):3–5.

35. Seo JH, Kim JH, Yang KI, Hong SB. Late use of electronic media and its association with sleep, depression, and suicidality among Korean adolescents. *Sleep Med* 2017;**29**:76–80.

36. Koo DL, Yang KI, Kim JH, et al. Association between morningness-eveningness, sleep duration, weekend catch-up sleep and depression among Korean high-school students. *J Sleep Res* 2020;**11**:e13063. doi:10.1111/jsr.13063.

37. Yang CK, Kim JK, Patel SR, Lee JH. Age-related changes in sleep/wake patterns among Korean teenagers. *Pediatrics* 2005;**115**:250–6.

38. Lee EY, Yi KJ, Walker GJ, Spence JC. Preferred leisure type, value orientations, and psychological well-being among East Asian youth. *Leis Sci* 2017;**39**:355–75.

39. Carson V, Tremblay MS, Chaput J-P, Chastin SFM. Associations between sleep duration, sedentary time, physical activity, and health indicators among Canadian children and youth using compositional analyses. *Appl Physiol Nutr Metab* 2016;**41**(Suppl. 3):S294–302.

40. Pedišić Ž, Dumuid D, Olds T. Integrating sleep, sedentary behaviour, and physical activity research in the emerging field of time-use epidemiology: Definitions, concepts, statistical methods, theoretical framework, and future directions. *Kinesiology* 2017;**49**:252–69.

41. Kim CW, Choi MK, Im HJ, et al. Weekend catch-up sleep is associated with decreased risk of being overweight among fifth-grade students with short sleep duration. *J Sleep Res* 2012;**21**:546–51.

42. Gustafson SL, Rhodes RE. Parental correlates of physical activity in children and early adolescents. *Sports Med* 2006;**36**:79–97.

43. Rhodes RE, Guerrero MD, Vanderloo LM, et al. Development of a consensus statement on the role of the family in the physical activity, sedentary, and sleep behaviours of children and youth. *Int J Behav Nutr Phys Act* 2020;**17**:74. doi:10.1186/s12966-020-00973-0.

44. Bei B, Wiley JF, Trinder J, Manber R. Beyond the mean: A systematic review on the correlates of daily intraindividual variability of sleep/wake patterns. *Sleep Med Rev* 2016;**28**:108–24.

45. Gau SSF, Soong WT, Merikangas KR. Correlates of sleep-wake patterns among children and young adolescents in Taiwan, China. *Sleep* 2004;**27**:512–9.

46. Bei B, Allen NB, Nicholas CL, Dudgeon P, Murray G, Trinder J. Actigraphy-assessed sleep during school and vacation periods: A naturalistic study of restricted and extended sleep opportunities in adolescents. *J Sleep Res* 2014;**23**:107–17.

47. Johnson JL, Greaves L, Repta R. Better science with sex and gender: Facilitating the use of a sex and gender-based analysis in health research. *Int J Equity Health* 2009;**8**:14. doi:10.1186/1475-9276-8-14.

48. Hankivsky O, Doyal L, Einstein G, et al. The odd couple: Using biomedical and intersectional approaches to address health inequities. *Glob Health Action* 2017;**10**:1326686. doi:10.1080/16549716.2017.1326686.

49. Buffarini R, Abdalla S, Weber AM, et al. The intersectionality of gender and wealth in adolescent health and behavioral outcomes in Brazil: The 1993 Pelotas Birth Cohort. *J Adolesc Health* 2020;**66**(Suppl. 1):S51–7.

50. Park S, Jung H, Kim J, Bae J, Kwon, K. *Reliability and Validity of the Korea Youth Risk Behavior Web-based Survey Questionnaire*. Available at: http://www.ndsl.kr/ndsl/search/detail/report/reportSearchResultDetail.do?cn=TRKO201300000170. [accessed 04.01.2019].