



Association between adherence to 24-h movement guidelines and sociodemographic factors among Malaysian preschoolers: Findings from SEANUTS II Malaysia

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Abstract

Background: Adhering to 24-h movement guidelines (24-hMG) have health benefits for young children; yet research on Malaysian preschoolers' movement behaviors is limited. This study investigates the association between adherence to 24-hMG and sociodemographic factors of Malaysian preschoolers.

Methods: Data from 939 preschoolers aged 3–6 years (mean age = 4.83 ± 0.04 years, 53.7% boys) from the Second South East Asian Nutrition Surveys (SEANUTS II) Malaysia study was analyzed. Socio-demography, physical activity, sedentary behaviors, and sleep were parent-reported via questionnaire. Associations between adherence of 24-hMG and sociodemographic factors were analyzed using complex samples logistic regression.

Results: Only 12.1% of preschoolers adhered to the overall 24-hMG, and 67.1%, 54.7%, and 42.7% of preschoolers adhered to physical activity, sleep, and sedentary behavior guidelines, respectively; while 6.8% did not meet any guidelines. Compared to 3–4-year olds, preschoolers aged 5–6 years had higher odds of adhering to physical activity guidelines, sedentary behavior guidelines, and overall 24-hMG, but lower odds of adhering to sleep guidelines. Chinese and Indian preschoolers were more likely to adhere to sedentary behavior guidelines than Malay preschoolers; however, Chinese preschoolers had lower odds of adhering to physical activity guidelines. Paternal tertiary education was associated with a higher likelihood of adherence to sleep guidelines.

Conclusion: Our findings suggest that adherence to 24-hMG among Malaysian preschoolers is associated with age, ethnicity, and paternal education level. This underscores the importance of targeted interventions and health awareness program to promote healthy movement behaviors, particularly among children under 5, ethnic minorities, and educationally disadvantaged families.



1 | INTRODUCTION

As early childhood is a critical period for habit formation, it is essential to promote healthy behaviors from an early age for optimal growth and development, and higher quality of life. This is in line with the Goal 3 of the United Nation's sustainable development goals (SDGs) to ensure healthy lives and promote well-being for all at all ages (United Nations, 2015). Healthy 24-h movement behaviors, such as being active, limiting sedentary screen time, and sleeping sufficiently, are associated with well-being, particularly in young children. Canada pioneered the development of movement guidelines for children aged under 5 years and for children between 5 and 17 years old (Tremblay et al., 2016, 2017), followed by other countries, such as Australia (Okely et al., 2017), New Zealand (New Zealand Ministry of Health, 2017), and South Africa (Draper et al., 2020).

In 2019, WHO launched the guidelines for physical activity, sedentary behaviors, and sleep for children under 5 years of age, known as the 24-h movement guidelines (24-hMG), which recommend children to be active during the day and have adequate sleep (WHO, 2019). The latest WHO guidelines for physical activity and sedentary behaviors for children aged 5–17 years did not include sleep component; however, they emphasized that children in this age range should not neglect the importance of sleep in their daily lives (WHO, 2020). An Asia-Pacific consensus statement on integrated 24-hMG proposed similar guidelines for Asian children below 5 years of age (Loo et al., 2022) and for children aged 5–18 years (Loo, Okely, Pulungan, et al., 2022), irrespective of sex, socioeconomic, and cultural backgrounds. Adherence to these guidelines provides various health benefits, especially in addressing childhood obesity (Kovács et al., 2015).

Demography and socioeconomic background are significant determinants of children's health, as they contribute to the multifaceted nature of children's engagement in movement behaviors (Wong et al., 2016). A recent study of preschoolers in New Zealand revealed that the adherence to movement guidelines varies according to such sociodemographic factors as ethnicity, mother's education, sex, and residential area (Hedayatrad et al., 2022). A similar study in Singapore involving preschoolers aged 5–6 years indicated that sociodemographic backgrounds, including sex, ethnicity, child age, and maternal behaviors influence the adherence to the movement guidelines (Chen et al., 2019). Another study conducted among low-income Brazilian preschoolers underscored the association between the characteristics of a child's primary caregiver and the child's movement behaviors, highlighting the likely impact of parental

employment and income on fostering healthy behaviors in children (de Lucena Martins et al., 2021).

A recent Malaysian study reported that only 6.5% of preschoolers aged 4–6 years in Kuala Lumpur adhered to the 24-hMG and the number of guidelines met by children were associated with lower odds of overweight and obesity (Lee et al., 2021). While the study reported the associations between adherence to 24-hMG and obesity among Malaysian preschoolers, the associations with sociodemographic factors were not explored. To date, no study has reported the adherence to 24-h movement behaviors in a nationally representative sample of preschoolers in Malaysia. To address this gap, this study examined the associations between the adherence to age-specific 24-hMG and sociodemographic factors among Malaysian preschoolers aged 3–6 years. We hypothesized that sex, ethnicity, household income, and maternal education level are associated with adherence to the 24-hMG.

2 | MATERIALS AND METHODS

2.1 | Study population

This study is part of the South East Asian Nutrition Surveys II (SEANUTS II), a cross-sectional, multi-country nutrition study conducted among children aged 6 months to 12 years old in four countries, namely Malaysia, Indonesia, Vietnam, and Thailand. The design and protocol of the study have been described in previous publications (Poh et al., 2023; Tan et al., 2024). The data collection in Malaysia was conducted between April 2019 and March 2020 in both urban and rural areas in the Central, East Coast, Northern, and Southern regions of Peninsular Malaysia. Children with physical disabilities and those suffering from diseases or conditions that might affect their habitual physical activity were excluded. A total of 2989 children were enrolled in the main study, of which 1023 children were preschoolers aged between 3 and 6 years. Recruitment was conducted using home-based approaches, with young children primarily being recruited through home visits. For children attending preschools, data collection was also conducted at their nurseries or kindergartens.

2.2 | Study procedures

Sociodemographic information as well as information on physical activity, sedentary behaviors, and sleep of children were collected through parent-reported questionnaires. These questionnaires were originally developed in

English by the researchers and forward-backward translated into Malay and Mandarin Chinese. These questionnaires were pretested by parents for clarity, comprehensibility, and feasibility before implementation. Parents were recruited from two kindergartens: one of which uses Malay and the other uses Chinese as the main mediums of instruction. The final questionnaires were made available in bilingual formats of Malay-English or Mandarin-English.

2.3 | Measurements

2.3.1 | Physical activity

Two items on the parent's questionnaire were used to measure a child's physical activity behavior throughout the course of the day. The preschooler's overall physical activity participation was assessed by responses to the question "Does your child spend at least 180 minutes (3 hours) throughout the day in various physical activities (e.g., crawling, walking, running, climbing, standing)?" Meanwhile, the child's involvement in moderate to vigorous physical activity (MVPA) was assessed by the amount of time spent playing very actively while doing the physical activity, through the question "From the time spent in this physical activity, about how many hours does your child spend in energetic play [any activity that increases the heart rate, gets your child out of breath some of the time and increased sweating (i.e., walking briskly, dancing, jogging, hiking, cycling, swimming)]?"

2.3.2 | Sedentary behaviors

To assess a child's sedentary behavior and screen time, parents were also required to report if the child's movements were restricted for more than an hour at a time, as well as their activities involving screens, such as watching television or playing with gadgets, throughout the entire day. The following questions were asked: "Do you usually restrain your child for more than one hour at a time (i.e., sitting in a stroller or high chair, leave him/her in a playpen)?" and "How many hours a day does your child usually watch/play with electronic devices (i.e., TV, smartphone, computer, tablet, PlayStation)?"

2.3.3 | Sleep

The overall sleep duration and daytime naps were proxy-reported by parents via a questionnaire, the Children's Sleep Habits Questionnaire-Abbreviated (CSHQ-A)

(NICHD SECCYD-Wisconsin, 2017) which is adapted from CHSQ (Owens et al., 2000). Night-time sleep was obtained by deducting the time spent on daytime naps from overall sleep duration, as reported by parents.

2.3.4 | Movement behavior guidelines

Three different guidelines were used to determine the adherence to physical activity, sedentary behavior, and sleep guidelines among the preschoolers in this study, that is, the WHO, 2019 Guidelines on Physical Activity, Sedentary Behaviour and Sleep for Children under 5 years (WHO, 2019), the WHO, 2020 Guidelines on Physical Activity and Sedentary Behaviour for Children and Adolescents (5–17 years) (WHO, 2020) and the Canadian 24-Hour Movement Guidelines for Children and Youth (Tremblay et al., 2017). Table 1 shows the summary of age-specific guidelines used in this study.

2.3.5 | Sociodemographic characteristics

The sociodemographic characteristics including the child's age, sex, ethnicity, parental education level, parental employment status, and total monthly household income were also reported by parents. The monthly household income in Malaysian Ringgit (MYR; 1 US Dollar = 4.69 MYR as of 30 September 2023) was categorized into three groups namely low income (≤ 4849 MYR); middle income (between 4850 MYR and 10 959 MYR); and high income ($\geq 10 960$ MYR), respectively (Department of Statistics Malaysia, 2020).

TABLE 1 Age-specific 24-h movement guidelines.

Guidelines	3–4 years old	5–6 years old
Physical activity	Engaged in a total physical activity of ≥ 3 h, and with at least an hour of MVPA (WHO, 2019).	Spent at least 60 min per day on MVPA (WHO, 2020).
Sedentary behavior	Movements were not restricted for more than 1 h at a time, and with less than an hour of sedentary screen time (WHO, 2019).	Less than 2 h of screen time per day (Tremblay et al., 2017).
Sleep	Slept for 10–13 h per day, including naptime (WHO, 2019).	Nine to 11 h of sleep per night (Tremblay et al., 2017).

2.3.6 | Anthropometric measurements

Body weight was measured using SECA 874 weighing scale (Seca GmbH, Germany), to the nearest 0.05 kg, while wearing light clothing. Standing height without shoes was measured using SECA 213 stadiometer (Seca GmbH, Germany), to the nearest 0.1 cm. All measurements were taken twice, and the average value was used for analysis. Height and weight measurements were used to calculate age and sex standardized body mass index-for-age z-scores (BAZ), based on WHO classifications (WHO, 2006, 2007), using WHO Anthro version 3.2.2 software (World Health Organization, Geneva, Switzerland) for children aged below 5 years (WHO, 2011) and WHO AnthroPlus version 1.0.4 software (World Health Organization, Geneva, Switzerland) for children aged 5 and above (WHO, 2009).

2.4 | Statistical analysis

Descriptive data were presented in mean and standard error (SE) for continuous data and in percentage (%) and 95% confidence interval (CI) for categorical data. Weight factor was derived based on the projected Malaysian population aged 3–6 years in 2019, as per the Malaysian census database in 2010 (Department of Statistics Malaysia, 2010) for complex samples analysis. Complex samples Chi-square test was used to assess the associations between the adherence to physical activity, sedentary behavior, and sleep guidelines with sex. Associations between adherence to movement guidelines and sociodemographic factors were examined by using complex samples logistic regression. The dependent variable is the adherence to the movement guidelines (0: did not adhere; 1: Adhered to guideline) based on the individual guidelines, that is, physical activity, sedentary behavior, and sleep, and combination of all three recommendations (overall guidelines). Independent variables include child's age, sex, ethnicity, area of residence, total monthly household income, mother's and father's education level, and working status. Odds ratio (OR) and 95% CI were calculated. All analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corporation, Armonk, New York, USA). The statistical significance level was set at $p < .05$.

2.5 | Ethics statement

The study protocol was reviewed and approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia (no: JEP-2018-569). This study was registered in

the Dutch Trial Registry (NL7975) and conducted according to the guidelines of the Declaration of Helsinki. Permission to conduct the study was obtained from all relevant parties, including the Department of Community Development (KEMAS) under the Ministry of Rural Development, the Department of National Unity and Integration under the Ministry of National Unity, kindergartens, and nurseries, as well as community leaders. Written informed consent was obtained from the parents/guardians of the subject prior to study.

3 | RESULTS

3.1 | Characteristics of study population

Of the recruited 1023 preschoolers, 84 were excluded due to missing or invalid data, bringing the final sample to 939 preschoolers (53.7% boys) which represent approximately 1.3 million of children aged 3–6 years in Peninsular Malaysia. Table 2 shows the sociodemographic and physical characteristics of the study sample. There were 55.9% of preschoolers aged 3–4 years and 44.1% of preschoolers aged 5–6 years. Most of the preschoolers were of Malay ethnicity (75.5%) and resided in urban areas (74.7%). Among the preschoolers, 61.1% came from low-income families, while 51.6% of the mothers and 42.1% of the fathers had tertiary education. The prevalence of overweight and obesity among the preschoolers was 13.6%.

3.2 | Proportions of preschoolers adhering to the movement guidelines

The Venn diagram in Figure 1 shows the proportion of preschoolers who adhered to the physical activity, sedentary behavior, and sleep guidelines. Overall, a high proportion of preschoolers adhered to the physical activity guidelines (67.1%), followed by sleep guidelines (54.7%) and sedentary behavior guidelines (42.7%). Only 12.1% of the preschoolers adhered to all three guidelines, while 6.8% of the preschoolers did not adhere to any of the guidelines. There were no significant associations found between the adherence to individual guideline or any combinations of guidelines and sex in this study (Table 3).

3.3 | Associations between adherence to movement guidelines and sociodemographic factors

The associations of sociodemographic factors with adherence to the individual and all combinations of movement

TABLE 2 Sociodemographic and physical characteristics of subjects.

Characteristics	Unweighted count (<i>n</i>)	Estimated population	Percentage (%)	95% CI	Mean	SE
All	939	1 324 004				
Age group					4.83	0.04
3–4 years old	405	740 277	55.9	52.1–59.7		
5–6 years old	534	583 728	44.1	40.3–47.9		
Sex						
Boys	480	711 065	53.7	49.7–57.6		
Girls	459	612 939	46.3	42.4–50.3		
Ethnicity						
Malay	563	1 000 051	75.5	72.1–78.6		
Chinese	283	201 136	15.2	13.3–17.3		
Indian	70	71 660	5.4	4.0–7.2		
Others ^a	23	51 158	3.9	2.0–7.3		
Area of residence						
Urban	678	989 661	74.7	71.3–77.9		
Rural	261	334 343	25.3	22.1–28.7		
Total monthly household income (MYR) ^b					4806.8	182.80
Low ($\leq$ 4849 MYR)	549	802 231	61.1	57.1–64.9		
Middle (4850–10 959 MYR)	309	429 058	32.7	29.0–36.5		
High ($\geq$ 10 960 MYR)	69	82 380	6.3	4.8–8.2		
Missing data (<i>n</i> = 12)						
Maternal education level						
No schooling/primary education	41	46 837	3.6	2.4–5.2		
Secondary education	429	590 623	44.9	41.0–48.9		
Tertiary education	461	678 398	51.6	47.6–55.5		
Missing data (<i>n</i> = 8)						
Paternal education level						
No schooling or primary education	46	50 038	4.0	2.9–5.6		
Secondary education	480	670 236	53.9	49.9–57.8		
Tertiary education	370	523 848	42.1	38.2–46.1		
Missing data (<i>n</i> = 43)						
Maternal working status						
Working	598	839 857	64.1	60.2–67.8		
Not working	330	469 950	35.9	32.2–39.8		
Missing data (<i>n</i> = 11)						
Paternal working status						
Working	880	1 221 041	98.3	96.9–99.1		
Not working	15	21 337	1.7	0.9–3.1		
Missing data (<i>n</i> = 44)						
Body weight status						
Wasting (<5 years old) / Thinness ($\geq$ 5 years old)	49	80 045	6.0	4.4–8.2		
Normal weight	749	1 064 324	80.4	77.2–83.2		

(Continues)

TABLE 2 (Continued)

Characteristics	Unweighted count (n)	Estimated population	Percentage (%)	95% CI	Mean	SE
At risk of overweight / Overweight/ Obese	141	179 635	13.6	11.3–16.2		
Anthropometry						
Weight (kg)					17.0	0.2
Height (cm)					104.9	0.3
Body mass index (BMI) (kg/m ²)					3.2	0.0
BMI-for-age Z-score (BAZ)					−0.19	0.05

^aOther ethnicities include *Bumiputera* Sabah/Sarawak, indigenous groups (*Orang Asli*), Siamese, Eurasian, Punjabi, and others.

^bIncome category: 1 US Dollar = 4.69 MYR (as of September 30, 2023).

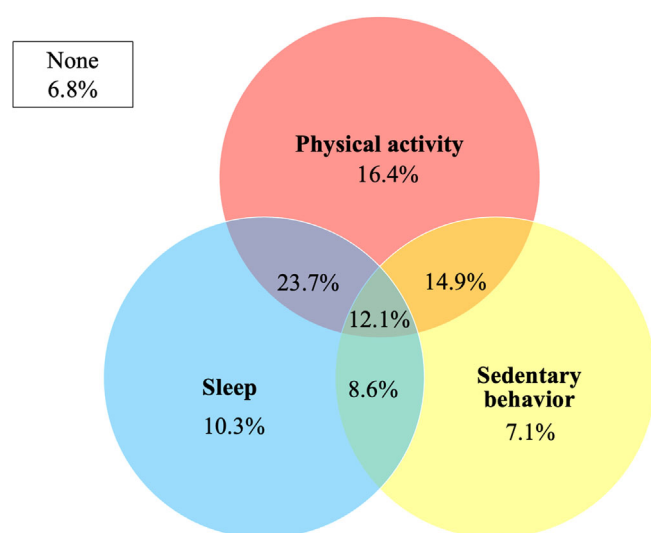


FIGURE 1 Proportion of subjects adhered to the age-specific 24-h movement guidelines.

guidelines are presented in Table 4. There were significant associations of a child's age group, ethnicity, and paternal education level with guidelines adherence. Preschoolers aged 5–6 years were more likely to adhere to recommendations for physical activity (OR 1.64, 95% CI 1.14, 2.36) and sedentary behavior (OR 5.98, 95% CI 4.15, 8.62), but were less likely to comply with sleep guidelines (OR 0.27, 95% CI 0.19, 0.38) as compared to 3- to 4-year olds. While the adherence to physical activity guidelines was lower among Chinese preschoolers (OR 0.20, 95% CI 0.13, 0.30), adherence to sedentary behavior guidelines was higher among Chinese (OR 3.13, 95% CI 2.04, 4.80) and Indian (OR 2.09, 95% CI 1.04, 4.22) preschoolers, compared to Malay preschoolers. Additionally, preschoolers whose fathers had college or university education were more likely to adhere with sleep guidelines (OR 2.71, 95% CI 1.13, 6.51), compared to preschoolers whose fathers had no school or primary school level

education. For overall movement guidelines compliance, only the child's age group was significantly associated with the adherence to guidelines, where preschoolers aged 5–6 years were 1.9 times more likely to adhere to all three guidelines, compared to preschoolers aged 3–4 years (OR 1.87, 95% CI 1.14, 3.08).

4 | DISCUSSION

This study reported that over two-thirds of preschoolers (67.1%) adhered to physical activity guidelines, with only 55% adhering to sleep guidelines, and around 40% adhering to sedentary behavior guidelines. The findings of this study differ from Lee et al.'s (2021) study of preschoolers in Kuala Lumpur, where the highest percentage in the study was recorded for adherence to sleep guidelines (55.2%) followed by adherence to physical activity guidelines (48.7%) and adherence to guidelines for screen time (25.2%). Preschoolers in the current study were more active and demonstrated higher adherence to sedentary behavior guidelines; however, their adherence to sleep guidelines were almost similar in terms of percentage, compared with the preschoolers in Lee et al.'s (2021) study. Nonetheless, these two studies differ slightly in terms of research methodology such as the number of subjects, age group of subjects, study locations, and the instruments used to measure movement behaviors. For example, the respondents in this study totaled 939 children aged 3–6 years from four zones in Peninsular Malaysia, including urban and rural areas, while Lee et al.'s (2021) subjects were 230 children aged 4–6 years from urban areas in Kuala Lumpur. Additionally, physical activity was measured differently. Lee et al. (2021) measured physical activity using an Actical accelerometer worn on the waist for seven consecutive days, while the present study used a parent-reported questionnaire.

TABLE 3 Proportion of subjects adhering to the 24-h movement guidelines based on sex.

Parameters	Unweighted count (n)	Estimated population	All (%)	Girls (%)	Boys (%)	p-Value*
<i>Adhere to individual guidelines</i>						
PA						
Yes	592	888 695	67.1	65.2	68.8	0.339
No	347	758 303	32.9	34.8	31.2	
SB						
Yes	491	565 701	42.7	45.7	40.1	0.149
No	448	758 303	57.3	54.3	59.9	
SD						
Yes	479	724 581	54.7	52.9	56.3	0.406
No	460	599 423	45.3	47.1	43.7	
<i>Adhered to combination of two guidelines</i>						
PA and SB						
Yes	295	357 571	27.0	28.8	25.4	0.308
No	644	966 434	73.0	71.2	74.6	
PA and SD						
Yes	291	473 953	35.8	34.4	37.0	0.506
No	648	850 051	64.2	65.6	63.0	
SB and SD						
Yes	222	274 522	20.7	21.5	20.1	0.643
No	717	1 049 482	79.3	78.5	79.9	
<i>Overall guidelines</i>						
Adhered to all three guidelines	123	160 524	12.1	12.6	11.7	0.549
Adhered to any two guidelines	439	624 476	47.2	46.9	47.4	
Adhered to one guideline	315	448 455	33.9	32.2	35.3	
Did not adhere to any guidelines	62	90 550	6.8	8.3	5.6	

Abbreviations: SB, sedentary behavior; SD, sleep; PA, physical activity.

*Significant at $p < .05$ as reported by Complex Sampling Chi-square test.

However, this study's findings are similar to the findings from Gao et al.'s (2022) study in China. Gao et al. (2022) reported high adherence to physical activity guidelines (62.3%), followed by sleep (53.8%) and screen time (52.8%) guidelines among preschoolers. The study involved 10 967 preschool children aged 3–6 years from 5760 settlements in 471 districts from 31 regions across China and used subjective methods via questionnaires to assess all three components of movement behavior. Although Gao et al. (2022) conducted the study during the COVID-19 pandemic (between September 2020 and November 2020), they reported that, at the time of data collection, the pandemic did not have a major impact on the daily life of the Chinese population. This observation aligns with the decrease in COVID-19 cases in China since May 2020, prompting the Chinese government to

reduce its response measures. Consequently, movement restrictions were lifted, allowing the public to return to work and school.

In comparison to children in studies from Australia, Japan, and Finland, Malaysian children had a relatively low percentage of adherence to physical activity (67.1%) and sleep guidelines (54.7%), but a higher percentage of adherence to sedentary behavior guidelines (42.7%). In Australia, physical activity guidelines were most adhered (93.1%) followed by sleep (88.7%) and screen time (17.3%) guidelines (Cliff et al., 2017). The same pattern was also reported in Japan and Finland where adherence to physical activity guidelines was highest (Japan: 91.6%, Finland: 85.0%), followed by adherence to sleep guidelines (Japan: 82.5%, Finland: 76.0%) and adherence to screen time guidelines (Japan: 33.7%, Finland: 35.0%)

TABLE 4 Associations between adherence to 24-h movement guidelines and sociodemographic factors.

		Odds ratio (95% CI)			
Variables	Reference group	PA	SB	SD	PA & SB & SD
Sex					
Girls	Boys	0.92 (0.64–1.33)	1.28 (0.90–1.83)	0.88 (0.63–1.25)	1.10 (0.67–1.80)
Age group					
5–6 years old	3–4 years old	1.64* (1.14–2.36)	5.98** (4.15–8.62)	0.27** (0.19–0.38)	1.87* (1.14–3.08)
Ethnicity					
Chinese	Malay	0.20** (0.13–0.30)	3.13** (2.04–4.80)	1.28 (0.86–1.91)	0.69 (0.36–1.33)
Indian		0.57 (0.29–1.15)	2.09* (1.04–4.22)	0.98 (0.52–1.86)	1.33 (0.54–3.30)
Others ^a		0.51 (0.16–1.63)	0.83 (0.34–2.00)	2.14 (0.61–7.45)	2.01 (0.62–6.53)
Area of residence					
Urban	Rural	0.92 (0.59–1.45)	0.70 (0.46–1.07)	0.91 (0.60–1.38)	0.80 (0.46–1.37)
Total monthly household income ^b					
Middle income	Low income	0.90 (0.54–1.49)	0.62 (0.38–1.01)	0.76 (0.47–1.23)	0.77 (0.40–1.51)
High income		0.66 (0.32–1.35)	0.53 (0.26–1.08)	0.73 (0.34–1.54)	0.37 (0.11–1.19)
Maternal education level					
High school	No school/primary school	0.92 (0.36–2.37)	0.76 (0.27–2.16)	0.62 (0.26–1.46)	0.40 (0.10–1.51)
College/University		0.89 (0.32–2.45)	0.91 (0.29–2.83)	0.74 (0.29–1.87)	0.86 (0.20–3.71)
Paternal education level					
High school	No school/primary school	0.88 (0.41–1.89)	1.60 (0.72–3.55)	2.23 (1.00–4.98)	1.63 (0.44–5.97)
College/University		1.18 (0.51–2.77)	1.86 (0.75–4.57)	2.71* (1.13–6.51)	1.86 (0.43–8.11)
Maternal working status					
Not working	Working	0.90 (0.57–1.42)	0.80 (0.53–1.21)	1.33 (0.90–1.98)	1.12 (0.66–1.89)
Paternal working status					
Not working	Working	0.42 (0.12–1.50)	1.68 (0.27–10.34)	1.44 (0.45–4.63)	0.70 (0.13–3.94)

Abbreviations: SB, sedentary behavior; SD, sleep; PA, physical activity.

^aOther ethnicities include *Bumiputera* Sabah/ Sarawak, indigenous groups (*Orang Asli*), Siamese, Eurasian, Punjabi, and others.

^bLow-income category (≤ 4849 MYR); Middle income category (4850–10 959 MYR); High-income category ($\geq 10 960$ MYR); 1 US Dollar = 4.69 MYR (as of September 30, 2023).

*Significant at $p < .05$ as reported Complex Sampling Logistic Regression. **Significant at $p < .001$ as reported by Complex Sampling Logistic Regression.

(Kim et al., 2020; Leppänen et al., 2019). In this study, sedentary behavior was operationalized, based on screen time recommendations for children aged 5 and above, and for 3- to 4-year-olds, it included both screen time and nonrestricted movement recommendations. Most previous studies reported adherence to sedentary behavior guidelines primarily through screen time recommendations. This emphasis may be due to the perceived ease for children to adhere to nonrestricted movement recommendation, as opposed to limitations on screen time. For example, Meredith-Jones et al. (2019) reported that only a small number of children in New Zealand were restricted in their movements (<10%) and sedentary behavior was mostly reported for screen time compliance.

Even though preschoolers in Japan, Finland, and Australia demonstrated higher adherence to physical activity and sleep guidelines in terms of percentage, compared to Malaysian preschoolers in this study, it is crucial to consider various factors influencing the adherence to these guidelines. These factors encompass methodological differences, including the use of different types of assessment tools for physical activity and sleep components, environmental influences such as the built environment supporting physical activity and sleep quality, and societal differences, including cultural norms and socioeconomic disparities, across countries. For instance, according to Lee et al. (2016), the availability of a playground motivates Malaysian preschoolers to engage in active play; however, only 14% of preschoolers played actively in outdoor areas, and an even lower proportion played actively at friend's or neighbor's house and in kindergarten (1.8%). The study also revealed that parent's concern about child safety was the primary barrier preventing these children from playing actively (Lee et al., 2016). This suggests that Malaysian preschoolers may face restrictions imposed by parents, hindering their ability to fully utilize outdoor facilities or spaces, thus limiting their physical activity. This observation may differ from developed countries such as Japan, Australia, and Finland, where lower crime rates, strong neighborhood social cohesion, and better outdoor equipment support children and their communities in engaging physical activities.

In regard to overall adherence to the age-specific 24-hMG, the current study revealed that a mere 12.1% of Malaysian preschoolers adhered to all three guidelines. Several studies also reported similar percentages of adherence to all movement guidelines among preschoolers, such as, 14.9% in Australia (Cliff et al., 2017), 12.7% in Canada (Chaput et al., 2017), and 10.0% in Belgium (Decraene et al., 2021). There were also studies that reported a higher percentage of adherence with all

three guidelines among preschoolers, for example, 21.5% adherence reported in Japan (Kim et al., 2020), 18.4% in Sweden (Berglind et al., 2018), and 16.4% in China (Gao et al., 2022). On the other hand, there are studies that reported much lower prevalence of adherence among preschoolers, with Singapore reporting 5.5% adherence (Chen et al., 2019), and a smaller study from Malaysia reporting a 6.5% adherence (Lee et al., 2021). However, the current study reported a slightly higher percentage of overall adherence to the movement guidelines when compared with a systematic review and meta-analysis study that reported an average of 11.3% for overall adherence among preschoolers. The percentages of adherence were calculated based on data reported from 23 countries in seven continents around the world (Tapia-Serrano et al., 2022). In addition, the current study found a slightly lower percentage of children who did not adhere to any guidelines (6.8%) as compared to Tapia-Serrano et al. (2022) study, which reported that 8.8% of preschoolers did not adhere to any of the guidelines.

The present study found that older preschoolers (5–6 years old) were more likely to adhere to physical activity and sedentary behavior guidelines, as well as the overall 24-hMG, compared to younger preschoolers (3–4 years old). These findings are supported by Nilsen et al. (2019) who reported that, in addition to engaging more in MVPA, older preschoolers are also less sedentary than younger preschoolers. Besides that, a longitudinal study among children aged 2–6 years shows that the increase in physical activity parallels the age when children are more active as they reach the age of 6 (Bergqvist-Norén et al., 2022). Moreover, the adherence to overall movement guidelines tends to improve as children grow older, as evidenced by studies in New Zealand (Meredith-Jones et al., 2019) and by De Craemer et al. (2020), who reported a significant association between increasing age and adherence to movement guidelines among preschoolers. For older preschoolers who are 5–6 years old, the presence of a more organized daily school routine, coupled with a school environment that promotes activity, may help reduce sedentary time in this age group. As this study applied age-specific movement guidelines, it is critical to note that different age recommendations could influence preschoolers' adherence to these guidelines. For instance, this study found a high proportion of preschoolers in both age groups achieved the MVPA recommendation, that is, 69.4% for preschoolers aged 3–4 years and 72.4% for those aged 5–6 years (data not shown). However, when considering the combination of total physical activity and MVPA recommendations, only 63.0% of the 3-to-4-year-old preschoolers fully adhered to the physical activity guidelines appropriate for their age group. This highlights the importance of adhering to age-



appropriate guidelines, particularly given the rapid developmental and behavioral changes occurring in children during these formative years, to ensure their healthy growth.

Preschoolers aged 5–6 years were less likely to adhere to sleep guidelines as compared to younger preschoolers aged 3–4 years in the current study. This finding may be attributed to the increased tendency for older preschoolers to sleep less (Wu et al., 2018), in line with the reduction or cessation of daytime naps and bedtimes later at night as children grow older (Price et al., 2014). A study of preschoolers in Singapore highlighted that nap time is important for preschoolers, even though the sleep recommendations for children aged 5 and older do not include daytime naps (Chen et al., 2019). Since most of the 5- to 6-year-old children in Malaysia are also in preschool, the habit of napping may not be part of the daily routine of these children. This, coupled with time spent on activities outside of school hours and homework, may impact the children's sleep routines. This should be curbed as later bedtimes and insufficient sleep among children may result in emotional problems which in turn could contribute to the development of depression and anxiety (Whalen et al., 2017), as well as having long-term effects on cognitive development, especially when preschoolers enter school years (Nieto et al., 2019; Tomaso et al., 2021). A longitudinal study of young children suggested that the likelihood of adhering to the movement guidelines at a later age significantly correlates with adherence to these guidelines at an earlier age (Meredith-Jones et al., 2019). Therefore, it is important to monitor and promote not only healthy sleep behavior patterns, but also the overall movement behaviors from a young age, as early habits can have a lasting impact on a child's health and adherence to overall movement guidelines in the future.

The present study also reports that preschoolers of Chinese ethnicity have lower odds of adherence to physical activity guidelines, but are more likely to adhere to sedentary behavior guidelines, compared to their Malay counterparts. The results of this study are closely aligned with Chen et al.'s (2019) study of multiracial children in Singapore. The study reported that preschoolers of Malay ethnicity were 1.8 times more likely ($p < .05$) to adhere to physical activity guidelines, compared to preschoolers of Chinese ethnicity (Chen et al., 2019). In addition, Malay preschoolers are also reported to have lower odds (OR 0.33, $p < .05$) of adhering to screen time guidelines when compared to Chinese preschoolers in Singapore (Chen et al., 2019). In our study, besides Chinese preschoolers, Indian preschoolers are also more likely to adhere to sedentary behavior guidelines, compared to Malay preschoolers. This shows that Malay preschoolers may be physically active but also spend more

sedentary time, compared to preschoolers of other ethnic groups in this study.

The present study found that the preschoolers whose father had higher level of education, namely, tertiary education were more likely to adhere to sleep guidelines, compared to preschoolers whose fathers had no schooling or low levels of education. The results of this study are supported by the findings by Gao et al. (2022) who reported that preschoolers whose fathers were highly educated had higher odds (OR 1.18, $p < .05$) of adhering to sleep guidelines than preschoolers whose fathers were poorly educated in China. A systematic review revealed that parents' education levels are important in determining children's sleep patterns, and highly educated parents tend to report that their children have healthy sleep practices (McDowall et al., 2017). In fact, fathers are reported to be more sensitive to children's sleep problems while they are sleeping than mothers (Coles et al., 2022), thus suggesting the importance of the fathers' role in shaping young children's sleep patterns.

To the best of our knowledge, this is the first nationwide study of Malaysian children that reports on the adherence to 24-hMG and associations with sociodemographic factors among preschoolers aged 3–6 years. The population-based data are obtained from four main regions in Peninsular Malaysia, highlighting a major strength of the present study, as it allows for broader generalization. However, several limitations should be noted. First, the cross-sectional nature of this study limits our ability to delineate the causality from the variables examined. Second, the indicators used in this study were collected through the use of questionnaires. This subjective method has the potential to introduce overestimation or underestimation when determining children's movement behavior due to the likelihood of reporting bias from parents. Additionally, since parents were the sole proxy-reporter of their child's behavior in this study, it is important to consider the possibility of reporting bias regarding activities at preschool or daycare. Since parents are likely not present with the child during those times, they may not be able to report accurately on them. Furthermore, due to the COVID-19 pandemic, data collection from children living in East Malaysia was not conducted. Thus, although participants in the present study are representative of urban and rural children in Peninsular Malaysia, the sample does not represent children living in the two states of East Malaysia.

5 | CONCLUSION

In conclusion, only 12.1% of Malaysian preschoolers aged 3–6 years adhered to the overall 24-hMG due to low adherence to sedentary behavior and sleep

guidelines. The adherence rates to all three guidelines were comparable between sexes. The adherence to 24-hMG among Malaysian preschoolers was associated with child's age, ethnicity, and paternal education level. Future studies should explore the association of adhering to 24-hMG with other factors and health indicators, while intervention programs and health awareness should be emphasized specifically for children under 5 years old, ethnic minorities, and educationally disadvantaged families to promote healthy movement behaviors in children.

AUTHOR CONTRIBUTIONS

Christine Joan: Methodology; data analysis; writing—original draft preparation; visualization. **Denise Koh:** Methodology; writing—review and editing; supervision. **Jyh Eiin Wong:** Methodology; writing—review and editing; supervision; project administration. **Ilse Khouw:** Writing—review and editing. **Bee Koon Poh:** National Coordinator; methodology; writing—review and editing; supervision; project administration; funding acquisition. All authors have read and approved the final draft to be submitted.

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CONFLICT OF INTEREST STATEMENT

Ilse Khouw is an employee of FrieslandCampina. All other authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Data generated or analyzed during this study is not publicly available due to confidentiality and compliance with European General Data Privacy Regulations. Data is however available from the authors upon reasonable request and after permission from project funder.

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