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A systematic review exploring challenges, achievements, and future directions of the impacts of children's 24-hour movement behaviors and health in Nigeria

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Abstract

The 24-hour movement behavior (24h MB) framework integrates physical activity (PA), sedentary behavior (SB), and sleep as interdependent determinants of child and adolescent health. Evidence from low- and middle-income countries suggests suboptimal adherence to these behaviors, with implications for growth, cognitive development, and cardiometabolic risk. However, synthesized evidence from Nigeria remains limited. This systematic review systematically mapped evidence on prevalence patterns, health outcomes, contextual determinants, and intervention opportunities related to 24h MB among Nigerian children and adolescents. The systematic review followed PRISMA guidelines and included studies retrieved from PubMed, Scopus, ScienceDirect, Frontiers, BMC, and African Journals Online between 2010 and 2025. A total of eight empirical studies met the inclusion criteria. Methodological quality was assessed using the Joanna Briggs Institute critical appraisal tools. Findings indicate consistently suboptimal movement behavior patterns. PA adherence ranged from 37% to 87.5%, while sedentary behavior compliance ranged from 87% to 100%, and sleep deficits affected up to one-third of adolescents. Urban children consistently demonstrated lower PA levels and higher sedentary time compared with rural counterparts. Health outcomes included impaired gross motor development, elevated cardiometabolic risk indicators, and reduced sleep quality among adolescents. Key determinants included inadequate PA infrastructure, increasing screen-based entertainment, academic pressures, gender norms, insecurity, and socioeconomic disparities. Facilitators included rural active-play environments, school-based physical education initiatives, and emerging policy engagement through national surveillance frameworks. Despite these insights, the evidence base is limited by small sample size, cross-sectional design, and geographic clustering in southwestern Nigeria. The review concludes that Nigerian children's 24h MB patterns are socially patterned and suboptimal, requiring integrated, equity-focused interventions across education, health, and urban systems to support Sustainable Development Goal 3 and broader child well-being targets.

Key words: 24-hour movement behaviors, physical activity, sedentary behavior, sleep, Nigeria, child health.

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Introduction

The 24-hour movement behavior (24h MB) paradigm represents a paradigm shift in pediatric public health, recognizing that physical activity (PA), sedentary behavior (SB), and sleep interact across the full day to shape developmental trajectories.[1-5] World Health Organization guidelines for children under 5 years recommend ≥180 minutes of PA [including ≥60 minutes of moderate-to-vigorous PA (MVPA)], ≤1 hour of screen-based SB, and 10-13 hours of good-quality sleep.[6] For ages 5-17 years, Canadian 24h MB guidelines similarly prescribe 60 minutes of MVPA, ≤2 hours of recreational screen time, and 9-11 hours of sleep nightly.[1-5] Global pooled analyses reveal that only 14.3% (95% confidence interval: 9.7-20.7) of 3- to 4-year-olds meet all three recommendations, with Africa showing relatively higher adherence (23.9%) yet still far below optimal levels.[7] Non-adherence correlates with increased adiposity, poorer cognitive outcomes, and elevated cardiometabolic risk (CMR) across high-, middle-, and low-income settings.[8,9] In low- and middle-income countries (LMICs), structural and behavioral transitions amplify risks.[10] Urbanization, motorized transport, and digital device proliferation have displaced active play and extended sedentary time, while economic pressures and academic demands compress sleep.[10,11] Systematic reviews confirm that African adolescents exhibit 30% prevalence of excessive sedentary behavior, with sub-regional variation highest in Southern and East Africa.[11] These patterns foreshadow adult non-communicable disease (NCD) burdens, given that childhood movement behaviors track into adulthood.[12]

Nigeria, Africa's most populous nation, exemplifies these dynamics. With over 40% of its population under 15 years and rapid urban growth (projected 60% urbanization by 2050), Nigerian children navigate environments marked by traffic congestion, insecurity, inadequate recreational infrastructure, and competing academic priorities.[13] National report cards consistently grade overall PA as

"D" or "C", sedentary behaviors as "F" or "B-", and highlight persistent overweight/obesity despite high active-transportation grades.[14,15] Early Nigerian data indicated moderate PA levels (C grade) but high sedentary behavior (F grade) among school-aged children.[14] Subsequent updates revealed declining overall PA alongside modest gains in active play and school-based opportunities.[15] Empirical studies underscore urban-rural divides. Rural preschoolers in Lagos State accumulate significantly more light-intensity PA (LPA) (127.1 *vs*. 110.5 min) and MVPA (126 *vs*. 92.3 min) and less sedentary time (587.8 *vs*. 633.9 min) than urban counterparts, with corresponding advantages in gross motor skills.[16] Primary school learners in Lagos show 72.8-87.5% meeting PA guidelines *via* self-report or a pedometer, yet high socioeconomic status (SES) predicts lower activity.[17] Among secondary adolescents, only 5% engage in regular organized sport, and one-third sleep <6 hours nightly.[18] Sleep-specific data reveal shorter night-time duration (8.7-9.6 hours) and a higher prevalence of problems (enuresis 42%, snoring 28%) compared with international norms.[19] Urban adolescents further exhibit poorer sleep quality and higher CMR scores linked to short sleep.[20,21] These patterns intersect with broader determinants.

SES inversely associates with PA but positively with screen time.[17] Gender differences favor boys in objective PA.[16,17] Cultural norms that emphasize academic achievement over physical play, coupled with limited policy enforcement of physical education, constrain opportunities.[22,23] Climate (heat discouraging outdoor activity), insecurity, and device access further compound SB.[24] Despite challenges, nascent successes exist. Nigeria's participation in Global Matrix initiatives has driven policy dialogue, school physical exercise curricula, and community sports programmes.[13] Multi-level interventions demonstrate feasibility for increasing PA among in-school adolescents.[22] Yet integrated 24h MB surveillance remains sparse; most studies examine isolated behaviors rather than compositional data.[9] This review addresses that gap by synthesizing Nigerian evidence within global and African contexts, highlighting actionable pathways to optimize child health amid demographic and epidemiologic transitions.

Objectives of the study

This systematic review synthesizes evidence on children's 24h MB: PA, SB, sleep, and associated health outcomes in Nigeria. Specific objectives include: i) to determine prevalence and patterns of adherence to 24h MB guidelines among Nigerian children aged 0-18 years; ii) to evaluate impacts on physical, cardiometabolic, cognitive, and developmental health; iii) to identify contextual challenges and successes in promotion; iv) to propose evidence-based recommendations and future research directions tailored to Nigerian settings.

Methods

Study design

This systematic review was conducted to map existing evidence on 24h MB among Nigerian children and adolescents. The review followed PRISMA guidelines,[25] enhanced by the Joanna Briggs Institute (JBI) guidance for systematic reviews.[26] The systematic approach was selected due to the heterogeneity of existing studies and the exploratory nature of the research question, which aimed to identify gaps rather than estimate pooled effects.

Information sources and search strategy

A comprehensive and systematic search strategy was implemented across six electronic databases: PubMed, Scopus, ScienceDirect, Frontiers, BMC, and African Journals Online. The search covered January 2010 to December 2025 to capture post-guideline and contemporary evidence relevant to 24h MB frameworks.

Search terms combined controlled vocabulary (MeSH where applicable) and keywords, including: "child" OR "adolescent" OR "preschool" AND "Nigeria", "physical activity", "sedentary behaviour" OR "screen time" OR "sleep" "24-hour movement" OR "24h movement" OR "integrated movement behaviour" AND "health" OR "outcome" OR "impact" OR "obesity" OR "cardiometabolic risk" OR "motor development". Reference lists of included studies were hand-searched to ensure completeness of retrieval. English language restrictions were applied. Database-specific adaptations were applied to optimize sensitivity.

Eligibility criteria

Inclusion criteria

Inclusion criteria required empirical studies (cross-sectional, cohort, intervention) reporting at least two components of 24h MB (PA, SB, or sleep) in Nigerian children or adolescents (0-18 years), including associated health outcomes.

Exclusion criteria

Exclusion criteria included non-Nigerian populations, adult-only samples, non-empirical studies, and studies focusing on a single behavior without health outcome linkage. Table 1 presents the inclusion and exclusion criteria of the included studies.

Risk of bias assessment

Methodological quality was assessed using JBI critical appraisal tools for cross-sectional and prevalence studies.[26] Studies were not excluded based on quality; however, findings were interpreted in light of a moderate risk of bias, particularly due to the cross-sectional design, self-report measures, and regional sampling bias. Table 2 presents the risk of bias assessment of the included studies.

Study selection

Two independent reviewers conducted title/abstract screening and full-text eligibility assessment. Disagreements between reviewers were resolved through discussion and consensus, with arbitration by a third reviewer when necessary.

Data extraction and synthesis approach

Standardized extraction captured authors/year, objectives, design, sample size/setting, key findings, and conclusions.

Data synthesis approach

A narrative thematic synthesis was conducted. Findings were grouped into four domains: prevalence patterns, health outcomes, determinants, and intervention/success factors. No meta-analysis was performed due to heterogeneity in design, outcomes, and measurement tools.

Study selection and screening procedure (with PRISMA flow chart)

The process followed PRISMA 2020 guidelines. Initial search yielded 248 records. After deduplication (n=68), 180 titles/abstracts were screened, excluding 130 irrelevant studies. Full-text review of 50 articles excluded 42 [reasons: adult samples (n=12), single behavior only (n=18), no health outcome (n=8), duplicate data (n=4)]. A total of 8 studies met the criteria for inclusion. Figure 1 shows the selection and screening procedure.

Table 1. Inclusion and exclusion criteria.

Criterion	Inclusion	Exclusion
Population	Children and adolescents aged 0-18 years residing in Nigeria	Studies focused exclusively on adults (>18 years) or non-Nigerian populations
Study design	Empirical primary studies (cross-sectional, longitudinal, or intervention) with quantitative or mixed-methods data	Reviews, editorials, conference abstracts without full data, case reports, or qualitative-only studies without measurable outcomes
Behaviors/outcomes	Reporting data on at least two of the three 24-hour movement behavior components (physical activity, sedentary behavior, sleep) or one component plus a linked health outcome (*e.g.*, cardiometabolic risk, motor development, obesity)	Single-behavior studies without any health linkage or integrated 24h analysis
Setting	Conducted in any Nigerian geographic location (urban/rural, any state)	Studies conducted outside Nigeria or with no clear Nigerian sample
Language/publication	English or any language with English abstract; peer-reviewed or grey literature with primary data (January 2010 - December 2025)	No language restriction applied; non-retrievable full texts
Data availability	Sufficient detail for extraction (sample size, setting, key findings on 24-hour movement behavior or health)	Duplicate publications or secondary analyses of the same dataset without new data

Table 2. Quality appraisal/risk of bias.

Authors (year)	Quality assessment/Risk of bias
Oginni *et al*. (2025)[16]	Moderate quality; cross-sectional preschool sample with limited representativeness
Ojedoyin *et al*. (2022)[17]	Moderate quality; cross-sectional student sample with limited representativeness
Akinola *et al*. (2022)[18]	Moderate quality; cross-sectional student sample with limited representativeness
Senbanjo (2018)[19]	Moderate quality; community-based cross-sectional sample with limited representativeness
Olorunmoteni *et al.* (2024)[20]	Moderate quality; cross-sectional student sample with limited representativeness
Olorunmoteni *et al*. (2025)[21]	Moderate quality; cross-sectional adolescent sample with limited representativeness
Oyeyemi *et al.* (2016)[24]	Moderate quality; cross-sectional student sample with limited representativeness
Maduabuchi *et al*. (2015)[27]	Moderate quality; cross-sectional student sample with limited representativeness

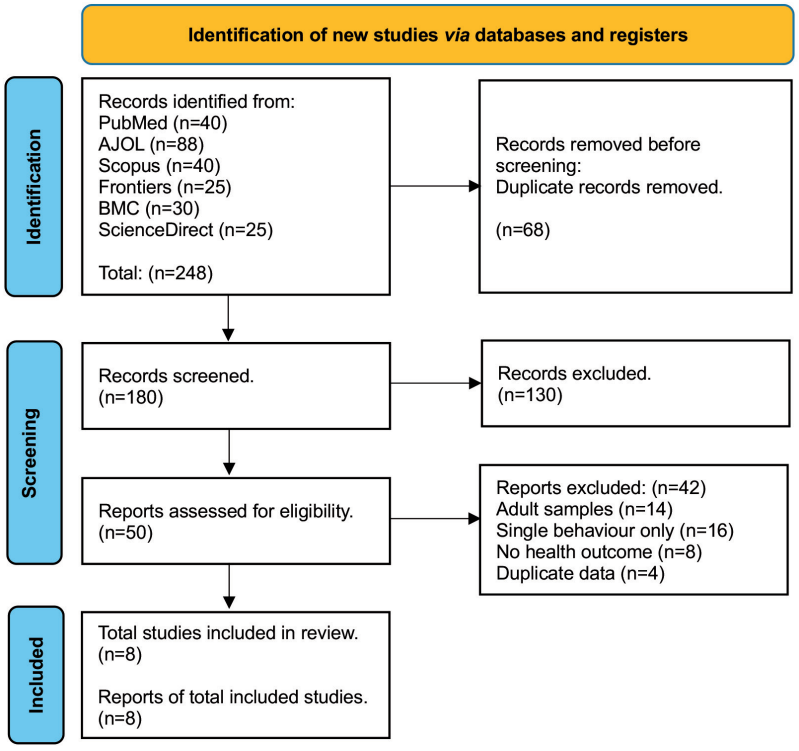

Figure 1. Diagram of the PRISMA 2020 process for systematic reviews and meta-analyses.

Results

Characteristics of included studies

Eight studies met the predefined inclusion criteria and were included in this review, all of which provided empirical data on at least two components of 24h MB or their associations with health outcomes among Nigerian children and adolescents.[16-21,24,27] All included studies were conducted between 2016 and 2025, reflecting the relatively recent emergence of integrated movement behavior research within the Nigerian context.[16-21,24,27] The study designs were predominantly analytical cross-sectional (n=6), with one school-based intervention study and one mixed-methods or observational analytic study, highlighting a strong reliance on observational methodologies across the evidence base.[16-21,24,27] This predominance of cross-sectional designs limits causal inference but provides important descriptive and associative insights into behavioral patterns and health outcomes.[8,9]

Sample sizes varied considerably across studies, ranging from fewer than 200 participants in smaller school-based assessments to over 1000 participants in larger community or multi-school studies, with a combined sample size of approximately 5722 children and adolescents.[16-21,24,27] The populations studied spanned early childhood (preschool-aged children), primary school-aged children, and adolescents, thereby capturing a broad developmental spectrum but also introducing heterogeneity in behavioral patterns and measurement approaches.[16-21,24,27] Geographically, there was marked clustering of studies in south-western Nigeria, particularly in Lagos and Oyo States (n=6), with limited representation from other regions, including one study from the north-east and one from the south-east (Enugu).[16-21,24,27] Measurement approaches varied across studies, reflecting methodological heterogeneity in the assessment of movement behaviors. Two studies employed objective measures, such as accelerometers, to quantify PA and sedentary time, while one study used pedometers to estimate step counts.[16,17] The remaining studies relied on self-report or parent-report questionnaires to assess PA, SB, and sleep patterns, introducing potential recall and reporting biases.[18-21,24,27]

Health outcomes assessed included anthropometric indicators [*e.g.*, body mass index (BMI), waist circumference], CMR markers, and motor skill development, with fewer studies examining cognitive or psychosocial outcomes.[16,21] This variability in outcome measures further contributes to heterogeneity and limits comparability across studies.[9] Overall, the included studies provide valuable but fragmented evidence on children's 24h MB in Nigeria, characterized by methodological diversity, regional clustering, and a predominance of cross-sectional designs.[16-21,24,27] These features necessitated a narrative synthesis approach rather than meta-analysis and underscore the need for more standardized and nationally representative research.[9] Table 3 presents the summary of the included studies.

Quality appraisal of included studies

The methodological quality of the included studies was assessed using the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies.[26] Overall, the quality of the evidence base was rated as moderate, with most studies meeting a substantial proportion of the appraisal criteria but exhibiting consistent methodological limitations.[16-21,24,27] Key strengths across the studies included clearly defined research objectives, appropriate sampling strategies within defined populations, and the use of validated or widely accepted instruments for measuring movement behaviors and health outcomes.[16-21,24,27]

Notably, two studies utilized accelerometry, which enhances measurement accuracy for PA and SB, while another incorporated pedometer-based assessments, providing objective estimates of movement.[16,17] Several studies also demonstrated methodological rigor through adjustment for key confounding variables, including age, sex, SES, and urban-rural residence, thereby strengthening the internal validity of reported associations.[16,17,21] However, important limitations were identified across the evidence base. The majority use cross-sectional designs, thereby precluding causal inference and limiting the ability to establish temporal relationships between movement behaviors and health outcomes.[8,9] Measurement bias represents another significant concern, as 4 studies relied primarilyon self-report or parent-report measures, which are susceptible to recall bias and social desirability bias.[18-21,24,27] Geographical clustering of studies, predominantly in south-western Nigeria, introduces potential selection bias and limits external validity.[16-21,24,27]

Additionally, heterogeneity in measurement tools, age groups, and outcome variables limits comparability across studies and precludes quantitative synthesis.[9] The absence of compositional data analysis approaches further restricts the ability to capture the interdependent nature of 24h MB.[8] Importantly, risk of bias assessments informed the interpretation of findings but did not warrant exclusion of any study, given the already limited evidence base. Findings were interpreted with caution, particularly in relation to prevalence estimates and the strength of associations. Despite these limitations, the consistency of key patterns such as urban-rural disparities, socioeconomic gradients, and age-related declines in PA across studies enhances confidence in the overall direction of findings.[16-21,24,27] In summary, while the included studies provide moderately robust evidence on children's 24h MB in Nigeria, methodological constraints, particularly cross-sectional designs, measurement variability, and limited geographic coverage necessitate cautious interpretation and highlight critical priorities for future research.[8,9] Table 2 presents the quality appraisal of the included studies.

Thematic review/key themes

Thematic synthesis of the included studies identified four interrelated domains: i) prevalence and patterns of 24h MB adherence; ii) health impacts; iii) contextual challenges; and iv) enabling factors and emerging successes.[16-21,24,27]

Prevalence and patterns of 24-hour movement behavior adherence

Across the included studies, adherence to the integrated 24h MB guidelines among Nigerian children and adolescents was consistently suboptimal, with substantial variation by age, geography, and SES.[16-21,24,27] PA guideline compliance ranged widely, from as low as 37% among adolescents in north-eastern Nigeria to between 72.8% and 87.5% among primary school children in urban south-western settings.[17,18,24] In contrast, compliance with SB guidelines, primarily defined by screen-time thresholds, was relatively higher, ranging from 87% to 100%, although this tended to decline with increasing age and SES.[17,24]

Table 3. Summary of the included studies.

Authors (year)	Objectives of the study	Study design	Sample size and study setting	Key findings	Conclusions
Oginni *et al.* (2025)[16]	Examine geographic disparities in PA, SB, sleep, and gross motor skills between rural and urban preschoolers	Cross-sectional (accelerometer + parent-report)	131 preschoolers (mean age 3.4±0.8 years); urban and rural preschools, Lagos State, Nigeria	Rural children had higher LPA (127.1 *vs*. 110.5 min), MVPA (126 *vs*. 92.3 min), lower SB (587.8 *vs*. 633.9 min); no sleep difference; better gross motor skills in rural group	Rural preschoolers demonstrate superior PA and motor profiles; targeted urban interventions required
Ojedoyin *et al.* (2022)[17]	Investigate levels, patterns, and correlates of PA and SB among primary school children	Cross-sectional (self-report CPAQ/YAP + pedometer)	733 learners (6-12 years); 40 public/private primary schools, Lagos State, Nigeria	72.8-87.5% met PA guidelines (objective/self-report); 87.3-100% met SB; boys outperformed girls objectively; high SES negatively associated with PA	High SES predicts reduced PA; objective measures reveal lower adherence than self-report
Akinola *et al*. (2022)[18]	Describe dietary habits, PA, and sleep patterns among secondary school adolescents	Cross-sectional survey	1,120 adolescents; public/private secondary schools, Lagos, Nigeria	Only 5% engaged in sport ≥5×/week; 26% >2 h screen time daily; 33% slept <6 h/night with difficulties	Inadequate PA and insufficient sleep prevalent; multi-pronged lifestyle interventions needed
Senbanjo (2018)[19]	Assess sleep patterns, problems, and socio-demographic correlates in children	Prospective hospital-based cross-sectional	432 children (1-12 years); Lagos State University Teaching Hospital	Night sleep 8.7-9.6 h (decreasing with age); high prevalence of enuresis (42%), snoring (28%), fear of sleeping alone (38%); shorter than international norms	Nigerian children exhibit shorter sleep and more problems than global peers
Olorunmoteni *et al*. (2024)[20]	Compare multidimensions of sleep health (duration, quality, daytime sleepiness, apnoea risk) between rural and urban adolescents	Cross-sectional survey	900 adolescents (mean age 15.1±1.4 years); rural/urban secondary schools, southwestern Nigeria	79% short sleep (<8.5 h); urban adolescents had higher poor sleep quality (p=.004), short sleep (p<.001), daytime sleepiness (p=.044), and apnoea risk (p=.006); school end time and private school type independently associated with poorer sleep	Rural adolescents had better overall sleep health; urban and school-related factors drive disparities
Olorunmoteni *et al*. (2025)[21]	Examine associations between sleep health and cardiometabolic risk (CMR) in adolescents	Cross-sectional survey	900 adolescents (mean age 15.1±1.4 years); rural/urban secondary schools, Oyo State, Nigeria	Shorter sleep and poorer quality linked to higher CMR score, BMI z-score, WC z-score; urban adolescents had worse sleep metrics	Poor sleep health independently associated with adverse CMR; sleep optimization may prevent future NCDs
Oyeyemi *et al*. (2016)[24]	Patterns and associated factors of PA among adolescents	Cross-sectional survey	1,006 adolescents; secondary schools, Maiduguri, north-eastern Nigeria	Only 37% met 60 min MVPA/day; lower in girls and older adolescents	Low PA prevalence; socio-demographic factors critical for targeted promotion
Maduabuchi *et al.* (2015)[27]	Describe sleep patterns, practices, and problems among schooling adolescents	Cross-sectional survey	443 adolescents; secondary schools, Enugu State	Mean weekdays sleep 7.84 h, weekend 8.65 h; 22.8% abnormal sleep onset latency; 5.9% difficulty falling asleep; shorter than recommended	Short sleep duration and problems common; early school start and lifestyle factors contribute

CMR, cardiometabolic risk; PA, physical activity; SB, sedentary behavior; LPA, light-intensity physical activity; MVPA, moderate-to-vigorous physical activity; CPAQ, children physical activity questionnaire; YAP, youth activity profile; SES, socioeconomic status; BMI, body mass index; WC, waist circumference.

Sleep patterns emerged as a critical area of concern, particularly among adolescents, with up to one-third reporting short sleep duration (<6 hours per night), alongside evidence of poor sleep quality indicators.[18,19] Urban-rural disparities were consistently observed, with rural preschool children accumulating higher levels of LPA and MVPA, alongside lower sedentary time compared with their urban counterparts.[16] These differences translated into more favorable overall movement profiles among rural populations, although sleep duration appeared relatively similar across settings.[16] Collectively, these findings indicate that while individual components of movement behaviors may meet recommended thresholds in certain subgroups, integrated adherence to all three components remains low, reflecting imbalanced time-use patterns across the 24-hour day.[8]

Impacts on health outcomes

The included studies demonstrate consistent associations between suboptimal 24h MB and adverse physical and developmental health outcomes.[16,21] Among preschool-aged children, higher levels of PA, particularly in rural settings, were associated with improved gross motor skill development, highlighting the importance of active play in early childhood development.[16] Among older children and adolescents, insufficient PA and short sleep duration were linked to increased CMR, including higher BMI z-scores, waist circumference, and composite risk scores.[21] Short sleep duration and poor sleep quality emerged as independent predictors of adverse health outcomes, reinforcing the importance of sleep as a critical component of the 24h MB framework.[18,19,21]

High levels of SB, particularly screen-based activities, were associated with poorer physical fitness and increased risk of overweight and obesity, although findings were not entirely consistent across studies due to measurement variability.[17,24] Evidence on cognitive and psychosocial outcomes was limited but suggested potential associations between balanced movement behaviors and improved academic engagement and emotional well-being.[23] Overall, while causal relationships cannot be established due to the predominance of cross-sectional designs, the consistency of associations across studies supports the role of integrated movement behaviors as key determinants of child health.[8,9]

Contextual challenges to optimal movement behaviors

Multiple structural, socio-cultural, and environmental barriers to optimal 24h MB were identified across the included studies.[16-21,24,27] Infrastructural limitations, including inadequate access to safe recreational spaces, poor urban planning, and traffic-related safety concerns, were major constraints on PA, particularly in urban areas.[24] Socioeconomic factors further compounded these challenges, with higher SES associated with increased SB due to greater access to digital devices and motorized transport.[17] Conversely, lower-SES populations often faced environmental constraints such as unsafe neighborhoods, which also limited opportunities for active play.[20]

Educational pressures and the prioritization of academic achievement over PA were consistently reported as barriers within school environments, contributing to reduced time for structured and unstructured PA.[18,22] This was particularly evident among adolescents, who also reported high levels of screen time and insufficient sleep.[18] Gender disparities were also prominent, with girls consistently engaging in lower levels of PA than boys, reflecting socio-cultural norms and restrictions on participation in outdoor activities.[16,17] Additionally, broader contextual factors such as climate (heat), insecurity, and rapid digitalization were identified as contributors to increased SB and reduced active play.[24] These findings highlight the multi-level and interdependent nature of barriers to optimal movement behaviors in the Nigerian context.[9,11]

Enabling factors and emerging successes

Despite these challenges, several enabling factors and positive developments were identified.[13,15] Rural environments continue to provide natural advantages for PA through active transportation and unstructured play opportunities, contributing to more favorable movement behavior profiles among rural children.[16] At the policy level, Nigeria's participation in Global Matrix initiatives has improved national awareness and benchmarking of PA and SB indicators among children and adolescents.[13,15]

These efforts have facilitated the development of report cards and increased visibility of movement behaviors within national health and education discourse.[13] School-based interventions, including structured PA programs and teacher-led initiatives, demonstrated potential to improve PA levels when implemented consistently.[22] Similarly, community-based programs and non-governmental organization initiatives have contributed to increased opportunities for organized sport and recreational activities in selected settings.[22]

At the household level, family practices such as encouraging active play, regulating screen time, and promoting sleep hygiene were identified as important facilitators of healthier movement behaviours.[17,19] While these successes remain limited in scale, they provide a foundation for scaling contextually appropriate interventions aimed at improving integrated 24h MB among Nigerian children.[13]

Synthesis of key themes

Taken together, the thematic findings reveal a consistent pattern of low integrated adherence to 24h MB guidelines, shaped by interacting environmental, socioeconomic, and cultural determinants.[16-21,24,27] While rural contexts offer protective advantages for PA, urbanization, digitalization, and academic pressures contribute to increasingly sedentary and imbalanced movement profiles.[17,24] The evidence underscores the need for integrated, multi-level interventions that address not only individual behaviors but also the broader structural and contextual factors influencing children's daily time use.[1,9] Although the current evidence base is limited in size and scope, the consistency of findings across studies provides a strong foundation for informing policy and practice in the Nigerian context.[8,9]

Discussion

This systematic review demonstrates consistently suboptimal 24h MB patterns among Nigerian children, with strong evidence of urban disadvantage, socioeconomic patterning, and age-related decline in PA and sleep duration.[16-21,24,27] These findings align with global and African trends but reflect distinct contextual amplifiers related to urbanization, schooling pressure, and infrastructure limitations.[7,14,15] These patterns are shaped by structural, behavioral, and environmental constraints operating at multiple levels of influence. The observed patterns can be interpreted through an ecological systems framework, in which 24h MB is shaped by interacting individual, household, institutional, and environmental factors. Urbanization reduces access to safe play spaces, while school sys-

tems prioritize academic performance over PA. These layered determinants collectively constrain healthy movement behavior patterns.

Comparison with global and regional evidence

Global evidence consistently demonstrates that adherence to integrated 24h MB guidelines among children is low, with only 14.3% of preschool-aged children meeting combined PA, SB, and sleep recommendations across 33 countries.[7] This pattern is mirrored in LMICs, where structural and environmental constraints further limit adherence to optimal movement behaviors.[9,10] Within Africa, relatively higher adherence rates have been reported compared with global averages (23.9%), yet these remain substantially below recommended thresholds, indicating a continent-wide gap in achieving integrated movement health targets.[7,11] Nigerian findings align partially with this regional trend, particularly among younger children, where moderate PA compliance has been documented, but diverge significantly in adolescence, where adherence declines sharply across all movement domains.[17,18,24]

In the present synthesis, PA adherence ranged from as low as 37% among north-eastern adolescents to 72.8-87.5% among primary school children in urban southwestern settings, while SB compliance remained relatively high (87-100%), reflecting a paradox where low screen-time thresholds are met despite overall inactivity.[17,18,24] These findings are consistent with Global Matrix evaluations, which assign Nigeria grades of "D" or "C" for overall PA and "F" to "B-" for SB, indicating persistent inadequacies despite modest improvements over time.[13-15] Compared with high-income countries, where rural disadvantage in PA is more commonly observed, Nigerian data reveal a contrasting "urban penalty", with urban preschoolers accumulating 7-8% more sedentary time and lower levels of MVPA than rural counterparts.[16] This divergence reflects contextual differences in built environments, transport systems, and safety concerns that uniquely shape behavior patterns in LMIC urban settings.[10,11]

Similar urban-rural gradients have been reported in other African contexts, including South Africa and Tunisia, where rural children demonstrate higher total PA but comparable or increasing sedentary exposures due to emerging digital penetration.[11] These cross-country consistencies suggest that while urbanization is a shared driver of behavioral change, its impact may be more pronounced in settings with weaker infrastructure for active living, such as Nigeria.[10] Notably, the absence of compositional data analyses in Nigerian studies limits direct comparison with global research that quantifies behavioral trade-offs within the 24-hour day; however, the directional consistency of findings, particularly the clustering of low PA, high SB, and insufficient sleep, supports the generalizability of global movement-behavior models to the Nigerian context.[8,9] Overall, Nigerian children's 24h MB profiles reflect broader LMIC transitions, but they exhibit amplified disparities driven by rapid urbanization, socioeconomic inequality, and policy implementation gaps, underscoring the need for context-specific adaptation of global guidelines.[10,11,15]

Mechanisms linking 24-hour movement behavior to health outcomes in the Nigerian context

The associations between 24h MB s and health outcomes observed in this review can be explained through interdependent physiological and behavioral mechanisms operating within the constraints of the 24-hour day.[8,9] In early childhood, higher levels of LPA and MVPA, particularly among rural preschoolers, are strongly associated with improved gross motor development, reflecting the role of movement in neuromuscular coordination and early functional skill acquisition.[16,28-30] This relationship is consistent with global evidence demonstrating that reallocating time from SB to active movement enhances motor competence and developmental trajectories.[8] Conversely, elevated SB, particularly screen-based exposure, is associated with reduced opportunities for active play and impaired motor skill development, a pattern observed among urban preschool populations in Nigeria.[16,17] These effects are compounded by environmental constraints that limit outdoor activity, thereby reinforcing SB at loops.[10]

Among adolescents, sleep emerges as a critical yet under-recognized determinant of cardiometabolic health. Evidence from included studies indicates that shorter sleep duration and poor sleep quality are independently associated with higher CMR scores, increased BMI z-scores, and greater waist circumference.[21] These findings align with international studies demonstrating that insufficient sleep disrupts metabolic regulation, including glucose metabolism, appetite hormones, and inflammatory pathways.[8] Sleep deficits in Nigerian children are further shaped by contextual factors, including academic demands, household crowding, and environmental conditions such as heat and noise, which collectively reduce sleep duration and quality.[19,24] These contextual stressors may amplify physiological stress responses, thereby exacerbating CMR beyond what is observed in high-income settings.[21] Importantly, the 24h MB framework emphasizes that these behaviors are not independent; rather, they compete for time within a fixed 24-hour period.[8] As such, increases in SB driven by screen use or academic demands inevitably displace both PA and sleep, leading to compounded adverse health effects.[9] This time-use substitution mechanism provides a unifying explanation for the clustering of multiple risk factors observed among Nigerian children.[31]

The Nigerian context also reflects an ongoing epidemiological transition, in which traditional patterns of high PA are being replaced by sedentary lifestyles, particularly in urban areas.[14,17] This transition contributes to the early emergence of NCD risk profiles, including obesity and metabolic dysfunction, among children and adolescents.[14,21] While the predominance of cross-sectional designs limits causal inference, the consistency of associations across multiple studies and alignment with established biological pathways strengthen the plausibility of these mechanisms.[22] The convergence of behavioral, environmental, and physiological evidence suggests that improving 24h MB profiles could yield synergistic benefits across multiple health domains, including physical, metabolic, and developmental outcomes.[8,9]

Contextual determinants, barriers, and facilitators: a systems perspective

The patterns of suboptimal 24h MB observed among Nigerian children reflect the interaction of multiple determinants operating across individual, household, institutional, and environmental levels rather than isolated behavioral choices.[1,9,11] This multi-level pattern is consistent with ecological systems theory, which explains how health behaviors are shaped by interrelated influences within social and physical environments.[1,5] At the environmental level, rapid urbanization in Nigeria has significantly reshaped children's daily movement patterns through reduced access to safe recreational spaces, increased traffic congestion, and heightened concerns about safety and insecurity.[13,24] These constraints limit opportunities for outdoor play and contribute to increased reliance on indoor, screen-based sedentary activities, particularly among urban popula-

tions.[17,24] In contrast, rural settings provide more opportunities for unstructured play and active transportation, which likely explains the consistently higher levels of PA and lower sedentary time observed among rural children.[16]

At the household level, SES demonstrates a complex relationship with movement behaviors in the Nigerian context.[17] Higher SES is associated with increased access to digital devices, private transportation, and academic resources, all of which contribute to reduced PA and increased SB.[17] This pattern reflects broader lifestyle transitions observed in LMICs, where economic advancement is often accompanied by more sedentary lifestyles.[10,11] Conversely, lower-SES households may face environmental and infrastructural constraints, including unsafe neighborhoods and limited access to recreational facilities, which also restrict opportunities for active play.[20] At the institutional level, the school environment plays a critical but underutilized role in shaping 24h MB among children and adolescents.[22,23] Educational systems in Nigeria often prioritize academic performance over PA, resulting in reduced time allocation for physical education and organized sport.[18,22] This imbalance contributes to prolonged SB during school hours and may indirectly affect sleep duration due to increased academic workload and study time.[18,19]

At the socio-cultural level, gender norms and cultural expectations further influence movement behavior patterns.[16,17] Boys consistently demonstrate higher levels of PA than girls, reflecting sociocultural norms that favor male participation in outdoor and sporting activities.[16,17] Additionally, cultural emphasis on academic achievement often leads to reduced prioritization of active play within both household and school settings.[22,23] Importantly, these determinants operate synergistically, reinforcing disparities in movement behaviors across population groups.[9,11] From a 24-hour time-use perspective, increases in SB necessarily displace the time available for PA and sleep due to the fixed nature of the day.[1,8] This behavioral substitution mechanism explains why factors such as urbanization and digital exposure have cumulative effects across all movement domains rather than isolated impacts.[8,10]

Facilitators and opportunities for intervention

Despite these barriers, several facilitators provide opportunities for improving 24h MB among Nigerian children.[13] Rural environments demonstrate protective effects from natural activity opportunities, suggesting that improving urban design and access to safe play spaces could replicate these benefits.[16] School-based interventions, including structured PA programs and teacher-led initiatives, have shown potential to increase PA levels when consistently implemented.[22] Nigeria's participation in Global Matrix initiatives has also contributed to increased awareness and monitoring of child PA and SB at the national level.[13,15] These initiatives have supported benchmarking and policy dialogue, thereby strengthening the evidence base for intervention planning.[13]

At the household level, family-based strategies such as regulating screen time, encouraging active play, and promoting healthy sleep routines represent feasible and cost-effective approaches to improving movement behaviours.[17,19] Such approaches are particularly relevant in resource-constrained settings, where large-scale infrastructural interventions may be difficult to implement.[20]

Implications for policy and practice

Translating these findings into action requires a shift from single-behavior interventions to integrated 24h MB strategies embedded within existing systems. From a policy perspective, current frameworks remain fragmented and insufficiently enforced. There is a need to institutionalize 24h MB within national child health and education policies through mandatory daily PA requirements in schools; inclusion of sleep health within school health programs; regulation of child-targeted digital media exposure; and integration of movement behavior indicators into national surveillance systems.

From a practice perspective, schools and primary healthcare systems provide critical implementation platforms. Routine screening of movement behaviors, combined with teacher and healthcare provider training, can facilitate early identification and intervention. From an urban planning perspective, intersectoral collaboration is essential. Designing child-friendly environments that promote active transport and safe play is fundamental to addressing structural barriers.

Directions for future research

The findings also highlight critical gaps requiring targeted research investment. First, there is a need for nationally representative studies that capture regional diversity, particularly in northern and underserved areas. Second, longitudinal designs are necessary to establish causal relationships between movement behaviors and health outcomes. Third, future research should adopt compositional data analysis approaches to reflect the interdependent nature of 24h MB, rather than examining behaviors in isolation. Finally, there is a need for implementation and cost-effectiveness studies to identify scalable, context-appropriate interventions within resource-constrained settings.

Synthesis

Taken together, the barriers and facilitators identified in this review reflect a complex, multi-level system in which behavioral, environmental, and structural factors interact to shape children's movement patterns. Addressing these challenges requires coordinated, theory-informed interventions that recognize the interdependence of behaviors within the 24-hour day and the broader socio-ecological context in which they occur.

Conclusions

This systematic review synthesizes the available evidence on children's 24h MB in Nigeria and demonstrates consistently low integrated adherence to PA, SB, and sleep guidelines across age groups. While some subgroups, particularly primary school children, show moderate compliance with PA or SB thresholds, these gains are offset by persistent sleep deficits and imbalanced time-use patterns, especially among adolescents. The evidence further reveals pronounced inequities, with urban residence, higher SES, and gender norms contributing to less favorable movement profiles, while rural environments offer relative protective advantages for PA and motor development. These patterns reflect broader structural and behavioral transitions associated with urbanization and digitalization in LMICs.

Although the evidence base remains limited in size and largely cross-sectional, the consistency of findings across studies provides a coherent picture of emerging public health concerns. Suboptimal 24h MB is associated with early markers of CMR, poorer motor development, and potential long-term implications for NCD burden. Addressing these challenges requires a shift from fragmented,

single-behavior approaches to integrated, context-specific strategies that recognize the interdependence of movement behaviors within the 24-hour day. Nigeria is at a critical juncture where early, coordinated action can shape healthier developmental trajectories and reduce future health and economic burdens.

Recommendations

Based on the evidence synthesized in this review, the following actionable recommendations are proposed.

i. Develop and implement national 24h MB guidelines: establish Nigeria-specific guidelines aligned with global frameworks, integrating PA, SB, and sleep into a single policy instrument to guide schools, healthcare providers, and families.
ii. Strengthen school-based implementation: mandate and enforce daily structured PA (≥60 minutes MVPA) within school curricula, supported by teacher training, monitoring systems, and infrastructure audits to ensure compliance.
iii. Integrate movement behavior screening into health systems: incorporate routine assessment of PA, SB, and sleep into pediatrics and school health services to enable early identification and targeted interventions.
iv. Invest in child-friendly urban environments: promote multisectoral collaboration to develop safe play spaces, active transport systems, and recreational infrastructure, particularly in urban areas where activity opportunities are constrained.
v. Regulate screen exposure and promote sleep hygiene: implement policies limiting child-targeted digital media exposure while promoting public health campaigns on sleep duration and quality, particularly for adolescents.
vi. Establish national surveillance systems: adopt device-based (*e.g.*, accelerometer) surveillance through national agencies to generate reliable, representative data for monitoring trends and evaluating interventions.
vii. Target equity gaps explicitly: design interventions that prioritize underserved populations, including girls, urban low-SES groups, and underrepresented regions, to avoid widening health disparities.

Implications of the study

Public health implications

The findings position 24h MB as a critical, modifiable determinant of child health in Nigeria, with direct implications for the prevention of obesity, CMR, and early functional decline. Suboptimal integration of PA, SB, and sleep reflects broader epidemiological transitions in LMICs and signals an emerging NCD burden if left unaddressed. By identifying consistent behavioral deficits across age groups, this review supports the prioritization of integrated movement behavior strategies within national public health frameworks aligned with Sustainable Development Goal 3 targets.

Clinical and practice implications

The evidence underscores the need to incorporate routine assessment of movement behaviors into pediatric and school health services. Early identification of insufficient PA, excessive sedentary time, and poor sleep patterns can facilitate low-cost, preventive interventions at the point of care. The findings further highlight the role of families and schools as primary intervention platforms, where behavior change strategies such as structured active play and sleep hygiene education can be feasibly implemented.

Research implications

This review highlights substantial gaps in the Nigerian evidence base, including the limited number of studies (n=8), reliance on cross-sectional designs, and a lack of nationally representative data. The absence of compositional and longitudinal analyses restricts understanding of causal pathways and behavioral interactions.8 Future research must prioritize device-based measurement, multiregional sampling, and longitudinal designs to strengthen inference and guide intervention development.

Policy implications

The findings provide empirical justification for integrating 24h MB into national health and education policies, particularly the National School Health Policy and child health strategies. Current policy approaches remain fragmented, focusing predominantly on PA while neglecting SB and sleep. The evidence supports a shift toward integrated, multi-sectoral policy frameworks that link education, health, and urban planning systems, with clear accountability and implementation mechanisms.

Economic implications

Improving movement behaviors in childhood has long-term economic implications through reduced healthcare costs, improved cognitive development, and enhanced workforce productivity. Early investment in preventive strategies targeting 24h MB can mitigate future economic burdens associated with NCD, particularly in resource-constrained settings.

Equity and social implications

The review highlights pronounced disparities across urban-rural, socioeconomic, and gender lines, indicating that current behavioral patterns may reinforce existing health inequities. Without targeted interventions, disadvantaged populations, particularly urban low-income groups and girls, may experience disproportionate health risks. Addressing these inequities requires context-specific, inclusive strategies that prioritize vulnerable populations and underserved regions.

Educational and system implications

The findings reinforce the role of schools as central platforms for shaping movement behaviors, but they also reveal gaps in the implementation of existing physical education mandates. Embedding integrated 24h MB education within curricula and teacher training can shift prevailing norms that prioritize academic performance over holistic child development. More broadly, the evidence supports the need for coordinated, system-level approaches that align education, health, and community structures to sustain behavioral change.

Collectively, these implications position the review as a catalyst for evidence-informed, contextually grounded action that extends beyond academic contribution to tangible improvements in Nigerian child health and development.

Strengths and limitations of the study

A major strength of this review is its comprehensive and systematic synthesis of the emerging evidence on 24h MB in Nigeria, incorporating multiple databases and grey literature sources. The use of established methodological frameworks (PRISMA guidelines) enhances transparency and reproducibility.[25] The review also pro-

vides integrated analysis across PA, SB, and sleep, moving beyond single-behavior approaches that dominate existing literature. Additionally, the application of quality appraisal tools (JBI) strengthens the interpretation of findings by explicitly considering methodological rigor.

However, several limitations should be acknowledged. First, the small number of included studies (n=8) limits the breadth and generalizability of findings, particularly in a country as diverse as Nigeria. Second, the predominance of cross-sectional designs precludes causal inference and limits understanding of temporal relationships between behaviors and health outcomes. Third, geographic clustering of studies primarily in south-western Nigeria restricts national representativeness and may bias estimates of prevalence and behavioral patterns. Fourth, heterogeneity in measurement tools (objective *vs*. self-report) introduces potential bias and limits comparability across studies. Finally, the absence of compositional data analysis in included studies constrains the ability to fully capture the interdependent nature of 24h MB.

Despite these limitations, the consistency of key findings across studies supports the validity of the overall conclusions and highlights important directions for future research and policy.

Review of existing gaps in the literature

Existing gaps include a lack of longitudinal designs, cost-effectiveness evaluations, and studies in disability or conflict-affected populations. These limitations notwithstanding, the review provides the most comprehensive synthesis to date and identifies clear priorities for advancing the field.

Future directions

The findings of this review highlight several priority areas for advancing research and practice on 24h MB in Nigeria. Future research should prioritize: nationally representative, multi-wave studies using device-based measures and compositional data analysis across all six geopolitical zones; longitudinal designs tracking 24h MB from preschool to adolescence, with particular focus on priority populations (urban low-SES girls, rural northern adolescents, and children with disabilities); scalable intervention trials evaluating school-family-community partnerships and digital tools for behavior change in resource-constrained settings; and cost-effectiveness and policy implementation studies to inform sustainable scaling. Inclusion of indigenous knowledge and conflict-affected areas would further strengthen relevance.

References

1. 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:S311-27.
2. Hossian M, Mielke GI, Nisar M, et al. Global research on 24-hour movement behaviours guidelines in children and adolescents: a systematic review. Int J Behav Nutr Phys Act 2025; 22:108.
3. Ademoyegun AB, Afolabi TO, Idowu OA, et al. Prevalence and correlates of adherence to the 24-h movement guidelines among Nigerian physiotherapy undergraduates. Bull Fac Phys Ther 2025;30:14.
4. Hossain MS, Raheem E, Okely AD. 24-hour movement guidelines and weight status among young children in a district town in northern Bangladesh. Brain Behav 2023;13:e3094.
5. Zeng N, Jiang S, Ringer A, et al. Associations between combinations of 24-hour movement behaviours and dietary outcomes in children: a systematic review. Nutrients 2024;16:3678.
6. World Health Organization. Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age. 2019. Available from: https://www.who.int/publications/i/item/9789241550536.
7. Chong KH, Sudo M, Tanaka C, et al. Pooled analysis of physical activity, sedentary behavior, and sleep among children aged 3 to 4 years from 33 countries. JAMA Pediatr 2024;178:1199-207.
8. Zhao M, Zhang Y, Herold F, et al. Associations between meeting 24-hour movement guidelines and myopia among school-aged children: a cross-sectional study. Complement Ther Clin Pract 2023;53:101792.
9. Silva AFD, Martins PC, Santiago LN, Silva DAS. Mapping evidence on integrated 24-hour movement behaviors in children and adolescents: a scoping review of reviews. Children 2025; 12:260.
10. Wachira LJ, Muthuri S, Ochola S, et al. Lifestyle transition towards sedentary behavior among children and adolescents in low- and middle-income countries. In: Physical activity and sedentary behaviour in children. Marques A, Gouveia ER (eds). London, UK: IntechOpen; 2021.
11. Abonie US, Ackah M. Prevalence and disparities in adolescents' sedentary behavior from twenty-three African countries: evidence from World Health Organization Global School-based Student Health Survey. Public Health 2024;231:124-32.
12. Manyanga T, Barnes JD, Chaput JP, et al. Indicators of physical activity among children and youth in nine African countries: results from the Global Matrix 3.0 study. J Phys Act Health 2018;15:S274-83.
13. Active Healthy Kids Global Alliance. Nigeria 2023 Report card on physical activity for children and youth. 2023. Available from: https://www.activehealthykids.org/nigeria/
14. Akinroye KK, Oyeyemi AL, Oduwole AA, et al. Results from Nigeria's 2013 report card on physical activity for children and youth. J Phys Act Health 2014;11:S88-92.
15. Adeniyi AF, Odukoya OO, Oyeyemi AL, et al. Results from Nigeria's 2016 report card on physical activity for children and youth. J Phys Act Health 2016;13:S231-6.
16. Oginni J, Aoko O, Ajiborisade E, et al. Geographic disparities in physical activity, sedentary behaviour, sleep time, and gross motor skills in Nigerian preschoolers. Front Public Health 2025;13:1506705.
17. Ojedoyin OO, Olagbegi OM, Nadasan T, Govender P. Levels and patterns of physical activity and sedentary behaviour of primary school learners in Lagos State, Nigeria. Int J Environ Res Public Health 2022;19:10745.
18. Akinola IJ, Odugbemi B, Bakare OQ, et al. Dietary habits, physical activity and sleep pattern among in-school adolescents in Lagos, Nigeria. Ann Health Res 2022;8:157-69.
19. Senbanjo IO. Sleep patterns and problems in Nigerian children: a community-based study. Acta Paediatr 2018;107:1449-54.
20. Olorunmoteni OE, Gómez-Olivé FX, Fatusi AO, Scheuermaier K. Multidimensions of sleep health among in-school adolescents in rural and urban areas in southwestern Nigeria. Sleep Health 2024;10:S170-9.
21. Olorunmoteni OE, Scheuermaier K, Fatusi AO, et al. Poor sleep health is associated with worse cardiometabolic risk among rural

and urban schooled Nigerian adolescents. Sci Rep 2025;15: 41768.
22. Oluwasanu MM, Oladepo O. Effects of a multi-level intervention on the pattern of physical activity among in-school adolescents in Oyo State, Nigeria: a cluster randomised trial. BMC Public Health 2017;17:833.
23. Oluwasanu MM, Oladepo O, Ibitoye SE. Qualitative views of Nigerian school principals and teachers on the barriers and opportunities for promoting students' physical activity behaviours within the school settings. BMC Public Health 2021; 21:2302.
24. Oyeyemi AL, Ishaku CM, Oyekola J, et al. Patterns and associated factors of physical activity among adolescents in Nigeria. PLoS One 2016;11:e0150142.
25. Page MJ, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71.
26. Hilton M. JBI critical appraisal checklist for systematic reviews and research syntheses. J Can Health Libr Assoc 2024; 45:180-3.
27. Maduabuchi JC, Obu HA, Chukwu BF, et al. Sleep pattern and practice among adolescents school children in Nigerian secondary schools. Pan Afr Med J 2014;19:313.
28. Draper CE, Tomaz SA, Cook CJ, et al. Understanding the influence of 24-hour movement behaviours on the health and development of preschool children from low-income South African settings: the SUNRISE pilot study. S Afr J Sports Med 2020; 32:v32i1a8415.
29. Ltifi MA, Turki O, Ben-Bouzaiene G, et al. Exploring urban-rural differences in 24-h movement behaviours among Tunisian preschoolers: insights from the SUNRISE study. J Sport Health Sci 2024;7:48-55.
30. Carson V, Tremblay MS, Chastin SFM. Cross-sectional associations between sleep duration, sedentary time, physical activity, and adiposity indicators among Canadian preschool-aged children using compositional analyses. BMC Public Health. 2017; 17:848.
31. Okely AD, Reilly JJ, Tremblay MS, et al. Cross-sectional examination of 24-hour movement behaviours among 3- and 4-year-old children in urban and rural settings in low-income, middle-income and high-income countries: the SUNRISE study protocol. BMJ Open 2021;11:e049267.

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