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24-hour movement behaviours in the early years, potential behavioural determinants and prospective associations with growth, motor and social–emotional development: the My Little Moves study protocol

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ABSTRACT

Introduction The early years are a critical period for establishing healthy 24-hour movement behaviours (physical activity, sedentary behaviour and sleep), yet studies examining prospective associations between all 24-hour movement behaviours and young children's growth and development are lacking. The My Little Moves study aims to (1) examine the prospective association between 24-hour movement behaviours of young children (ie, 0–4 years) and their growth, motor and social–emotional development; and (2) explore potential determinants of young children's 24-hour movement behaviours from an ecological perspective, to inform public health strategies aimed at promoting healthy behaviours and development.

Methods and analysis My Little Moves is a longitudinal observational cohort study, with data collection at baseline, and after 9 and 18 months follow-up. Data are collected in three subcohorts. In all subcohorts, 24-hour movement behaviours are assessed by parent-report. Additionally in subcohort 1, data on potential determinants are collected by parental questionnaires, including child, parental and environmental factors. In subcohort 2, social–emotional development is assessed using the Dutch version of the Bayley Scales of Infant and Toddler Development-third edition (Bayley-III-NL) Social Emotional Scale. In subcohort 3, data on height and weight, gross motor development, using the Bayley-III-NL Gross Motor Scale, and 7 consecutive days of 24-hour accelerometer data are collected. Hybrid model analyses are used to assess the prospective associations of 24-hour movement behaviours with young children's growth and development. Potential determinants of young children's 24-hour movement behaviours are explored using regression analysis.

Ethics and dissemination The Medical Ethics Committee of the VU University Medical Center approved the protocol for the My Little Moves study (2022.0020). The results of this study will be disseminated through the network of all authors, to inform public health strategies for promoting healthy 24-hour movement behaviours and contribute to the evidence-base of recommendations for ideal 24-hour movement behaviours in young children.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Collecting a large variety of complimentary data including both parent-reported and accelerometer data on young children's 24-hour movement behaviours, their gross motor development, social–emotional development and potential determinants of their 24-hour movement behaviour is a an important strength of the My Little Moves study.
⇒ A limitation is the design of the My Little Moves study with data collection in three subcohorts, each addressing a specific aspect of the research aim, which prevents analyses of all longitudinal associations between 24-hour movement behaviours, health and developmental outcomes and determinants in the same sample.
⇒ Another limitation is that the My Little Moves app could not be validated before the start of the data collection, due to a delay in the development of the app.
⇒ The sophisticated data analysis is another strength of this study, accounting for the alternation and accumulation of accelerometer-based 24-hour movement behaviours, and using both hip-based and wrist-based accelerometers data therewith capturing the child's movement of the arms and the body centre of gravity.

INTRODUCTION

The benefits of physical activity for physical, social and cognitive health in children and adolescents is well known.[1 2] As low levels of sedentary and screen time, and optimal sleep duration additionally have been associated with health benefits among children

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and adolescents,[1 3–5] it is now recognised that all so-called 24-hour movement behaviours are important for optimal health and development.[4 6] To address this, a number of countries have developed and released 24-hour movement guidelines for older children and youth (5–17 years).[7 8] Using these guidelines, a recent meta-analysis demonstrated that about one in five young people (aged 3–18 years) from 23 countries do not meet any of the three 24-hour movement guidelines.[9]

The early years (ie, <5 years) are a critical period for establishing healthy 24-hour movement behaviours later in life,[10 11] yet only a few studies have examined the relationship between all 24-hour movement behaviours and young children's growth and development, of which none included children <3 years.[12] The limited number of studies in the early years and therewith lack of evidence on optimal 24-hour movement behaviours is likely due to challenges in the assessment and analysis of 24-hour movement behaviours at this age. Accurate assessment of 24-hour movement behaviours in young children is challenged by the rapid and high variability in motor development.[13 14] As a result, assessment needs to be adapted to the child's developmental stage.[15 16] For example, proxy-report questionnaires need to be tailored to fit the specific behaviours of babies, infants, toddlers and preschoolers (eg, tummy time, crawling, walking), and enable reporting of the intermittent and unstructured pattern of their movement behaviours. For accelerometer-based assessments, accelerometer placement needs to be adjusted to fit the child's developmental stage (eg, tummy time, crawling, walking). In addition, specific algorithms are required to identify specific movements that do not reflect physical activity, such as 'being carried' by an adult. Similar to other age groups, the analysis of all 24-hour movement behaviours combined is challenged by the codependency of the 24-hour movement behaviours, causing collinearity problems,[17] and the alternation and accumulation of these behaviours in a 24-hour and 7 days period, which may have a different influence on children's growth and development than the total volume of these behaviours.[18]

To stimulate young children's healthy growth and development, knowledge on determinants of healthy 24-hour movement behaviours is required. However, recent reviews summarising the evidence on potential determinants of physical activity, screen behaviours and sleep generally concluded that there is either insufficient or inconsistent evidence for most included determinants.[19–22] Main reasons for this include a lack of valid and reliable measurement instruments, both for assessing 24-hour movement behaviours and potential determinants; and the focus on simple linear relationships instead of taking a more comprehensive or multifactorial approach, considering both individual and environmental factors as well as their interactions.[23] Further, there is a lack of studies in the youngest age group (ie, <2 years).

The My Little Moves study addresses the abovementioned challenges and gaps in knowledge by (1) developing measurement instruments (parent-reported data) and protocols (accelerometer-based data) to assess young children's 24-hour movement behaviours tailored to the child's developmental stage; (2) examining the prospective association between 24-hour movement behaviours and young children's growth, motor and social–emotional development; and (3) examining potential determinants of young children's 24-hour movement behaviours from an ecological perspective and taking a multifactorial analysis approach. This paper describes the protocol for data collection within the My Little Moves study. The development and content validity of the parent-report measurement instrument is described elsewhere.[24]

METHODS

Study design and participants

The My Little Moves study is a longitudinal observational cohort study that is conducted in the Netherlands, with data collection at three time points: at baseline (between April 2022 and August 2023), and after 9 and 18 months. To limit the burden for the participating children and their parents, children were included in one of three subcohorts, each addressing a specific aspect of the research aim: subcohort 1 examines potential determinants of young children's 24-hour movement behaviours; subcohort 2 examines the prospective association between young children's 24-hour movement behaviours and their social–emotional development; and subcohort 3 examines the prospective association of young children's 24-hour movement behaviours and their growth and gross motor development. We aimed to include 600 children (50% girls), stratified by cohort and age group to cover the entire 0–4 age range at baseline: (1) 0–6 months; (2) 6–12 months; (3) 12–18 months; (4) 18–24 months; (5) 24–36 months and (6) 36–48 months. Taking into account a potential drop-out of 33%, we aimed to include 800 children at baseline (ie, 270 children per cohort with 45 children per age group). Children's participation in follow-up measurements continues until a maximum age of 48 months. As a result, the number of follow-up assessments varies per child.

Children were eligible if they were apparently healthy, which was defined as typically developing children born term or moderate to late preterm (>32 weeks) and without parent-reported known developmental disorders or medical diagnoses that might influence their 24-hour movement behaviours or development. Additionally, parents needed to have basic Dutch language reading skills and own a smartphone or tablet device for data collection on 24-hour movement behaviours. Informed consent was obtained from parents before inclusion of their child. The Medical Ethics Committee of the VU University Medical Center approved the protocol for the My Little Moves study (nr. 2022.0020).

Recruitment

Originally, we planned to recruit children—via their parents—through the dynamic Sarphati cohort (https://

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www.sarphaticohort.nl/en/) and early childhood education and care (ECEC) services, within the city of Amsterdam, the Netherlands. However, to speed up recruitment, from January 2023 onwards children were additionally recruited through other community organisations and public places in Amsterdam, for example, organisations delivering sports and physical activity for young children, public libraries and playgrounds. Additionally, from January 2023, children were recruited through ECEC services, youth healthcare services and community organisations outside Amsterdam. Parents received an information letter containing a link to the My Little Moves project website (www.amsterdamumc.org/en/research/institutes/amsterdam-public-health/highlights/my-little-moves.htm). This website contained all information on the project, an informative video and a link for obtaining online informed consent using 'Survalyzer' software. Alternatively, parents could print and return a paper format of the informed consent form. Parents could also scan the QR code on a flyer that linked them to the online information letter and informed consent. All information (eg, information letter, video, informed consent form) was adapted to the specific subcohort. At the start, waves of email invitations (Sarphati cohort) and organisations (ECEC and youth healthcare services, community organisations) were randomly allocated to subcohorts 1 and 2. At a later stage, allocation was targeted to balance the sample size across subcohorts. For subcohort 3, the data collection is more intensive (requiring in-person contact with the child) and time consuming (ie, physical measurements and wearing accelerometers). Therefore, we recruited children for subcohort 3 through organisations that could support recruitment through face-to-face contact and offer a space for conducting the measurements, that is, ECEC and youth healthcare services.

Sarphati cohort

Within the Sarphati cohort, research is conducted on the growth and development of Amsterdam children. This concerns children receiving services from Youth Healthcare at the Public Health Service of Amsterdam (GGD Amsterdam) and the Parent and Child Teams of the Amsterdam Health Center Foundation. The Sarphati cohort includes a multiethnic, apparently healthy sample of young children aged 0–48 months, living in Amsterdam. The Sarphati cohort contains sociodemographic data (eg, age, sex and ethnicity of children and parents, parental education level), health and developmental data (eg, height and weight of both children and their parents), behavioural data (eg, parent-reported sleep, dietary intake, screen use of their child) and environmental data (residence and living environment) available for research. Detailed information on the Sarphati cohort is published at http://www.sarphaticohort.nl/en. All children in the Sarphati cohort aged between 4.5 and 48 months received an invitation and information letter to participate in the My Little Moves study by email. Parents and children in the Sarphati cohort were recruited for participation in subcohort 1 or 2.

ECEC and youth healthcare services

ECEC and youth healthcare services were recruited using existing networks of the My Little Moves consortium and a list of ECEC services (eg, early childhood day care centres and preschools), created by the researchers. Managers of ECEC and youth healthcare services were approached for study participation by phone or email and—in case of agreement—were asked to send the information letter to parents through email, newsletters and/or flyers by professionals working at these services. If possible, researchers visited the locations of ECEC and youth healthcare services to recruit parents and children. Parents and children approached via ECEC and youth healthcare services were recruited for participation in subcohort 1, 2 or 3.

Other community organisations and public spaces in Amsterdam

Community organisations (eg, public libraries, organisations delivering sports and physical activities for young children) were approached with the request to allow the researchers to recruit parents who visit the organisation with their children in-person, by handing information letters. Researchers also approached parents visiting public spaces (eg, playgrounds) with their children handing out information letters. Parents and children approached via other community organisations and public spaces were recruited for participation in subcohort 1 or 2.

Data collection

Procedures

Baseline measurements were collected from June 2022 until August 2023. Parents agreeing to participate provided the birth date and gender of their child through the informed consent forms. In subcohort 1, informed consent was obtained for 219 children of which 214 children (20.5±12.4 months, 53% girls) were eligible. In subcohort 2, informed consent was obtained for 202 children of which 197 children (12.3±13.0 months, 46.7% girls) were eligible. In subcohort 3, informed consent was obtained for 87 children of which 84 children (19.1±11.8 months, 43% girls) were eligible for inclusion.

Data on 24-hour movement behaviours are collected by parents in all subcohorts using the My Little Moves app, and additionally by accelerometers in children included in subcohort 3. Data on potential determinants of 24-hour movement behaviours are collected in subcohort 1, data on social–emotional development in subcohort 2 and data on growth and motor development in subcohort 3. After receiving informed consent, parents receive detailed information and links (through e-mail or the data management platform Castor EDC) to complete data collection for the subcohort their child is enrolled in. If preferred, parents receive a paper format of the questionnaire. For cohort 3, in consultation with ECEC

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Table 1 Overview of collected data, with reference to the corresponding subcohorts

Study construct	Measurement instrument	Subcohort
24-hour movement behaviours—proxy-report ► Physical activity, sedentary behaviour and sleep ► Activity categories of the My Little Moves app*	My Little Moves app, completed by parents/ caregivers	All subcohorts
24-hour movement behaviours—device-based ► Summary measures, including average acceleration, 25th percentile of acceleration	Axivity AX3 devices, placed on children's right hip and left wrist	Subcohort 3
Potential determinants: ► Child factors, including age and gender ► Parental factors, including attitudes and practices, sociodemographic characteristics, parents' own physical activity and sedentary behaviour ► Environmental factors, including home environment, neighbourhood environment, childhood day-care centre and preschool environment†	Customised questionnaire based on items of previously developed validated questionnaires, including PPAPP,[27 28] Parenting SOS questionnaire,[29] SUNRISE questionnaire,[11] BISQ-R short form,[31] IPAQ-SF,[32 33] EPAO instrument[23 34]	Subcohort 1
Social–emotional development	Bayley-III-NL Social-Emotional Scale[37 38]	Subcohort 2
Gross motor development	Bayley-III-NL Gross Motor Scale[37 38]	Subcohort 3
Growth ► BMI-Z scores	Height: portable stadiometer or length board‡ Weight: calibrated electronic (baby) scale	Subcohort 3

*Activity categories within My Little Moves app include personal care, active transport, passive transport, playing, screen use, sitting/lying calmly and sleep.[24]
†Environment of childhood day-care centres and preschools (early childhood education and care services) only assessed in case of recruitment via these organisations.
‡Depending on the child's ability to stand.
Bayley-III-NL, Dutch version of the Bayley Scales of Infant and Toddler Development-third edition; BISQ-R, Brief Infant Sleep Questionnaire Revisited; BMI, body mass index; EPAO, Environment and Policy Assessment and Observations; IPAQ-SF, International Physical Activity Questionnaire Short Form; PPAPP, Preschooler Physical Activity Parenting Practices.

professionals and/or parents, researchers schedule a time/day to assess children's growth and motor development either at the ECEC centre or at their home. After assessing children's growth and motor development, children were equipped with two accelerometers. All data is collected by trained researchers and according to standardised protocols. Table 1 provides an overview of all study variables and measurement instruments, with reference to the corresponding cohorts.

In case parents do not complete the requested My Little Moves app or questionnaires for data collection, they receive reminders 1 week and 3 weeks after receiving the original email with the request. For subcohort 3, when parents do not report any of their child's activities in the My Little Moves app after 3 days, they receive a reminder to assure alignment between app and accelerometer data.

24-Hour movement behaviours: parent-report (subcohorts 1, 2 and 3)

Parents receive an email including a request to download the My Little Moves app and detailed information on how to complete the app. Parents are asked to report the activities of their child for 7 consecutive days in the My Little Moves app, which was developed with the input of parents and professionals working with young children (see online supplemental file 1 for screenshots of the My Little Moves app). The app has a time-use diary format through which parents report all activities of their child, using the following activity categories: personal care, eating/drinking, active transport, passive transport, playing, screen use, sitting/lying calmly and sleep. Additionally, depending on the chosen category and age of the child, parents respond to follow-up questions regarding intensity (eg, for playing: active, calm), posture (eg, lying on tummy, being carried, standing with support), location (eg, indoor, outdoor), who were present (eg, one or more children, one or more adults) and type of device (for screen use). Reporting activities in the app takes about 10–30 min per day. Before filling in the timeline, on each measurement point, parents provide information on the age of their child (answering categories: 0–6 months, 6–12 months, 1–2 years, 2–3 years and 3–4 years) and the motor 'milestones' their child has reached and at which age these were achieved. These 'milestones' include roll over from back to belly, roll over from belly to back, sit without support for 5 s, crawl for 1.5 m, stand without support for 3 s, walk three steps without support. The content of the app (ie, activity categories and follow-up questions) is tailored to the age and developmental stage of the child, based on the selected age group and meeting the above-described 'milestones'.

In a content validity study, parents (n=14) and researchers (n=6) considered the My Little Moves app comprehensive, user-friendly, comprehensible and feasible to use.[24] Data from the My Little Moves app are downloaded by the software developer, and subsequently transferred to the research team using a safe and secure web-based system (ZendTo). Children's total time spent in each of the activity categories and total time spent

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Figure 1 Placement of Axivity AX3 monitors in diaper pants and wristband.

in physical activity, sedentary behaviour and sleep are calculated.

24-Hour movement behaviours: accelerometers (subcohort 3)

Data on body movement of children are collected using Axivity AX3 devices (Axivity Ltd, UK). Axivity AX3 devices are small (23×32.5×7.6 mm) and lightweight (11 g) devices that capture data on body movement (raw acceleration data, expressed in gravitational units (g)), or lack thereof, over extended periods of time. One Axivity AX3 device is placed on the child's right hip (incorporated in diaper pants that can easily be worn over the regular diaper for younger children and in a short tight pants for older children to be worn over their underwear) and one device is placed on the child's left wrist (using wristbands[25]). Device is worn for 8 consecutive days, except during showering, bathing or other water activities. Parents receive detailed instructions on the procedures regarding placement of the devices. Figure 1 presents the placements of the Axivity AX3 devices in diaper pants and wristbands.

Axivity AX3 data are processed using R package GGIR V.2.9-0,[26] including detection of sustained abnormally high values, detection of non-wear time and calculation of acceleration in gravitational units averaged over (to be specified) epoch lengths.

Potential determinants of 24-hour movement behaviours (subcohort 1)

Potential determinants of 24-hour movement behaviours include child, parental and environmental factors assessed by parent-report. Child factors include age and gender, and are collected through the informed consent form. Questions on parental and environmental factors are adapted from items from existing validated questionnaires, including the Preschooler Physical Activity Parenting Practices[27 28] (PPAPP; Dutch translation), Parenting SOS questionnaire,[29] SUNRISE questionnaire,[30] Brief Infant Sleep Questionnaire Revisited (BISQ-R) short form,[31] International Physical Activity Questionnaire (IPAQ) short form[32 33] and Environment and Policy Assessment and Observation (EPAO) instrument.[34] Parental factors include 63 items on attitudes and parenting practices regarding their child's physical activity (38 items), screen behaviour (13 items), sedentary behaviour (4 items) and sleep (8 items), including both factors on encouraging and discouraging these behaviours. Additionally, the questionnaire includes 15 items on parental sociodemographic characteristics (eg, age, sex, country of birth, educational level), 4 items on parents' own physical activity (3 items; time spent in light, moderate and vigorous activities) and sedentary behaviour (1 item; time spent in sedentary behaviours). Environmental factors include 3 items on the home environment (eg, presence of outdoor space), and 12 items on the neighbourhood (9 items on physical environmental factors, eg, presence of a park, green space or playground; 3 items on neighbourhood safety). The questionnaire takes about 30 min to complete. Online supplemental file 2 presents all questionnaire items included in the My Little Moves determinants questionnaire, including references to original sources and information on validity and reliability. Questionnaire data are transferred from Castor EDC to SPSS to be analysed on constructs related to parenting practices, parental behaviours, children's sleep and the living environment.

For all children included in subcohort 3 recruited via ECEC services, we approached the managers for approval to assess the ECEC physical and policy environment. After approval, one research assistant assessed the ECEC environment an policy during a day long visit, using a Dutch translation of the Environment and Policy Assessment and Observation (EPAO) instrument. This instrument assesses the provision, practices and policies around physical activity.[23 35 36] The instrument consists of five subscales: activities during the morning (37 items), nap time/sleep (7 items), activities in the afternoon (38 items), physical activities (14 items) and equipment and environment (14 items). Observation data ares entered in an Excel form and subsequently converted to SPSS and analysed on constructs related to opportunities, equipment and natural environment, social environment and policies related to physical activity.

Social–emotional (subcohort 2) and gross motor (subcohort 3) development

Social–emotional and gross motor development are assessed using the Dutch version of the Bayley Scales of Infant and Toddler Development-third edition (Bayley-III-NL) Motor Scale and Social Emotional Scale.[37 38] The Bayley-III-NL Social-Emotional Scale is a parent-report questionnaire to assess functional emotional milestones

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of young children. The scale contains 11 items for the youngest age group (0–3 months old) and items are added as the child gets older with a maximum of 35 items. All items are scored on a 5-point scale (0=can't tell; 1=none of the time; 2=some of the time; 3=half of the time; 4=most of the time; and 5=all of the time). It takes approximately 10–15 min to complete all required items. Examples of items included are 'Child pays attention to things around them in a calm and pleasant way, including colourful and brightly coloured objects', 'Child imitates many of your sounds, words or actions while you play with them'. Previous studies showed sufficient interitem reliability (λ–2=0.92), inter-rater reliability (r=0.59 between father and mother) and discriminant validity (p<0.001 when compared with a clinical sample).[38] Data are transferred from Castor EDC to SPSS, and subsequently a sum score is calculated for social–emotional development, which is then transformed into norm-referenced scores (eg, index score) using Pearson's Q-Global (Pearson Benelux B.V., Amsterdam, the Netherlands).

The Bayley-III-NL Motor Scale is an individually administered test that consists of two subtests: fine motor skills (66 items), and gross motor skills (72 items). In our study, only gross motor skills are assessed to limit the burden of the participants. Examples of items included in the test are sitting unsupported for at least 5 s, crawling on hands and knees for at least 1.5 m and jumping forwards for at least 60 cm. The age of the child determines the entry point of the test. If a child scores a 0 on any of the first five test items, the test is continued at the entry point associated with the previous age level. The test is discontinued if the child is not able to perform five consecutive test items correctly. To calculate the total score, the number of items for which a child tests positive (score 1) are added to the number of items that were not administered, prior to the lowest administered item. Administration of this subtest takes about 30 min per child, if preferred, in the presence of (one of) the parents. Previous studies showed sufficient interitem reliability (λ–2=0.88), test–retest reliability (r=0.75 and 0.60 between same and different test leaders, respectively), convergent validity (r=0.44 when compared with the BSID-II-NL Motor Scale) and discriminant validity (p<0.001 when compared with a clinical sample).[38] The gross motor skill sum score is calculated, entered in Castor EDC and transferred to SPSS, and then transformed into norm-referenced scores using Pearson's Q-Global (Pearson Benelux B.V., Amsterdam, the Netherlands).

Growth (subcohort 3)

Height and weight (used to calculate BMI Z-score) were measured at the location of participating ECEC and youth healthcare services or in their own home, with shoes and outer clothing removed and using standardised age-adjusted WHO protocols.[39] In short, height (cm) is measured to the nearest 0.1 cm using a portable stadiometer (Marsden HM-250P) or a length board (Seca 417) depending on the child's ability to stand. Weight (kg) is measured to the nearest 0.1 kg using a calibrated electronic (baby) scale (Seca 354). Measurements for height and weight are conducted twice. In case the second measurement differs more than 0.5 cm or 0.2 kg, respectively, from the first, a third measurement is conducted. Measurements take about 5 min. The average of two—or three—measurements is included in the analysis.

Statistical analyses

Data are presented as means±SD for continuous variables, or median (IQR) in case data are not normally distributed, and as percentages for categorical variables. All statistics are conducted in SPSS (V.28) and R (V.44.2.1). The level of significance is set at p<0.05.

By using the Spearman-Brown prophecy formula, inputting single-day intraclass correlation coefficients, the minimum number of days and hours of registration time required to achieve a reliability of 0.70 is determined, both for parent-reported and accelerometer data on 24-hour movement behaviours.[40 41] The construct validity of the My Little Moves app and accelerometers is examined by fitting general linear mixed-effects models to test for differences in accelerometer-derived acceleration across app-derived activity categories as well as physical activity, sedentary behaviour and sleep.

Hybrid mixed-model analyses are used to assess the prospective associations of 24-hour movement behaviours (based on summary measures of the My Little Moves app data and/or accelerometer data) with young children's growth, motor and social–emotional development, respectively. Using a hybrid model, we include both the individual mean score and the deviation score around the individual mean as independent variables, which enables us to disentangle the between-subjects and the within-subjects part of the prospective associations.[42] The codependency of the 24-hour movement behaviours is addressed using compositional data analysis.[17] All analyses are adjusted for children's age and gender.

Additionally, latent profile analysis is applied to the My Little Moves app data to identify 24-hour movement behaviour profiles and sequence mapping is applied to accelerometer data to explore the alternation and accumulation of 24-hour movement behaviours.[18]

Potential determinants of young children's 24-hour movement behaviours (based on summary measures of the My Little Moves app data) are explored using regression analysis, including the child, parental and environmental factors as well as two-way interactions between these factors. First, 5–10 potential determinants and two-way interactions between these potential determinants are selected, based on relevant literature and theories. Next, associations of the selected potential determinants and two-way interactions with young children's 24-hour movement behaviours are explored using regression analysis.

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DISCUSSION

The My Little Moves study contributes to the evidence-building of recommendations for ideal 24-hour movement behaviours in young children, by examining the longitudinal associations of young children's 24-hour movement behaviours (based on parent-report and/or accelerometer data) and their growth and motor and social–emotional development. Through sophisticated analyses of accelerometer-based 24-hour movement data, My Little Moves study delivers detailed information on young children's 24-hour movement patterns, in which the accumulation and alternation of physical activity, sedentary behaviour and sleep is considered. As currently accurate proxy-report tools for assessing young children's 24-hour movement behaviours are lacking,[15] a parent-report tool is developed with the involvement of parents and key stakeholders.[24] Through the My Little Moves app, this study addresses the challenge of collecting proxy-report data on 24-hour movement behaviours in young children.

By exploring potential determinants of young children's 24-hour movement behaviours, the My Little Moves study additionally contributes to guiding public health strategies for promoting healthy 24-hour movement behaviours in the early years. The My Little Moves study addresses the current gap in knowledge regarding determinants of 24-hour movement behaviours,[19–21] by exploring potential determinants from an ecological perspective taking into account interactions between potential determinants.

Strengths of My Little Moves include the collection of a large variety of complimentary data: both parent-reported and accelerometer data on young children's 24-hour movement behaviours, their gross motor development, social–emotional development and potential determinants of their 24-hour movement behaviours. Additional strengths are the sophisticated analyses of the alternation and accumulation of accelerometer-based 24-hour movement behaviours, and using both hip-based and wrist-based accelerometers data therewith capturing the child's movement of the arms and the body centre of gravity.

Limitations of the My Little Moves study include the design of the study with data collection in three subcohorts, each addressing a specific aspect of the research aim, to limit the burden of participating children and parents. This prevents us from examining all longitudinal associations between 24-hour movement behaviours, health and developmental outcomes and determinants in the same sample. An additional limitation is that, due to a delay in the development of the My Little Moves app, the app could not be validated before the start of the data collection. Finally, at the time of recruitment the Sarphati cohort (used for the recruitment of children for subcohorts 1 and 2) mainly included children from parents with a higher educational level, which limits the generalisability of the results with respect to determinants of 24-hour movement behaviours and longitudinal associations with social—emotional development.

In conclusion, the My Little Moves study addresses important challenges and gaps in knowledge around healthy 24-hour movement behaviours in early childhood. This is important to stimulate children's healthy growth and development and reduce lifestyle-related disease risk later in life.

Patient and public involvement

The My Little Moves study is initiated by a consortium consisting of (academic) researchers and professionals working in the field of public health, knowledge dissemination, physical activity promotion and childcare. The My Little Moves Advisory board—consisting of academic researchers, professionals experienced in young children's movement (eg, physiotherapist), youth healthcare professionals, ECEC professionals and parents—is consulted multiple times to provide advice on app development, study design, participant recruitment and selection of potential determinants. The My Little Moves app is developed in collaboration with parents of and professionals working with young children.

ETHICS AND DISSEMINATION

The Medical Ethics Committee of the VU University Medical Center approved this study in the Netherlands (nr. 2022.0020). The results of this study will be disseminated through the diverse networks of all authors and participants.

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Correction notice This article has been corrected since it was published. The open access license has been updated to CC BY as of 8th December 2024.

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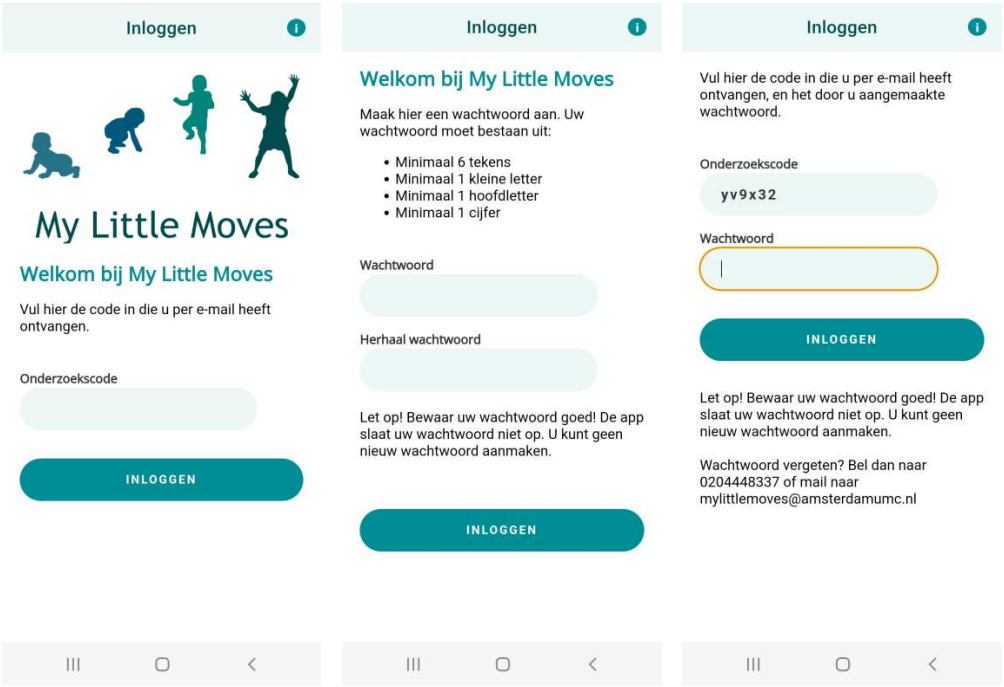
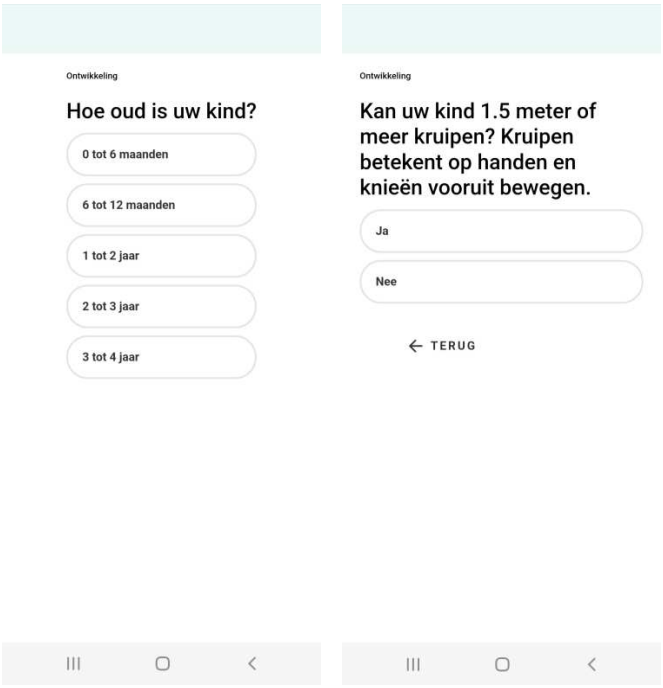
My Little Moves app version 1.1.0

Login screens.
From left to right: screen to enter research code; screen to create a password; screen to login with created password.

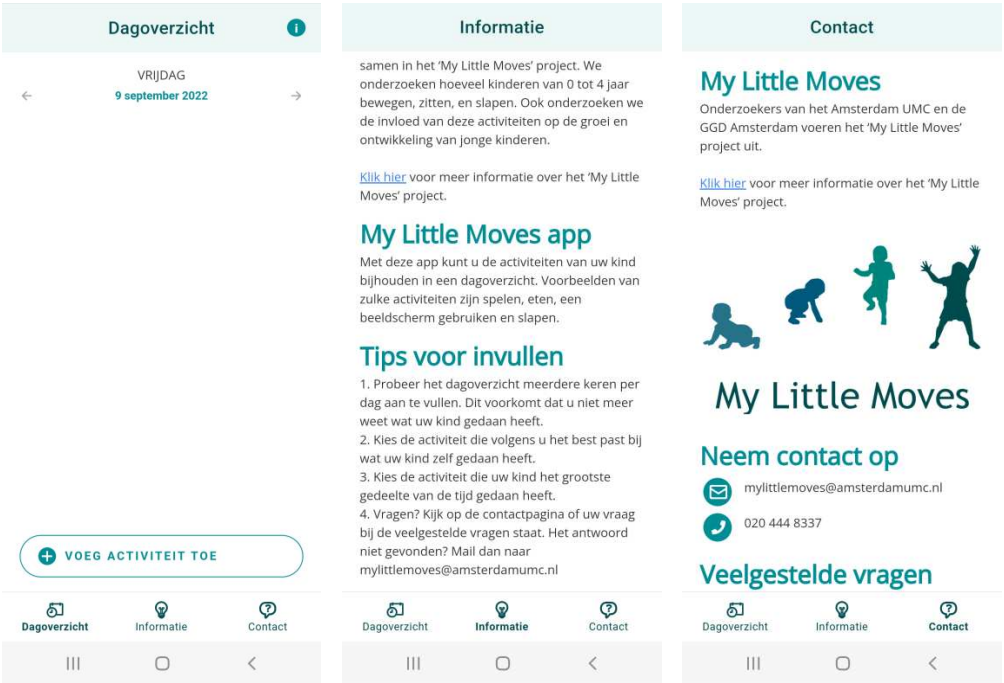


Screen start measurement period.
Information about the My Little Moves project and app. With pressing the green button, the 7 day-measurement period will be started.

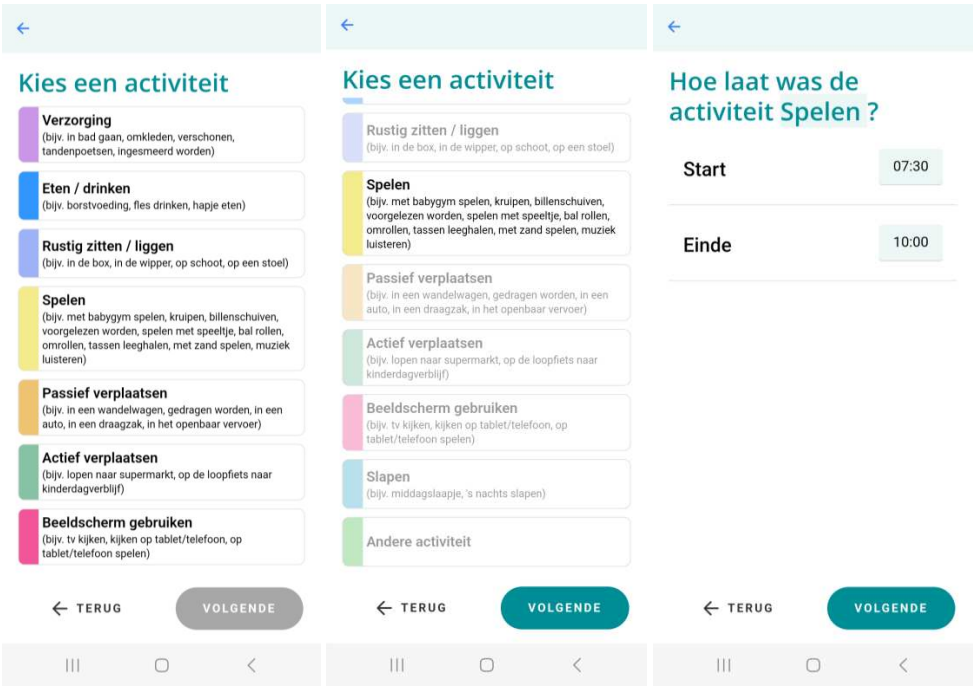
Screens intake questionnaire.
From left to right: intake question to assess the child's age group (i.e., 0-6 months, 6-12 months; 1-2 years, 2-3 years or 3-4 years); intake question to assess the child's motor development (i.e., whether child is able to crawl at least 1.5 meter).

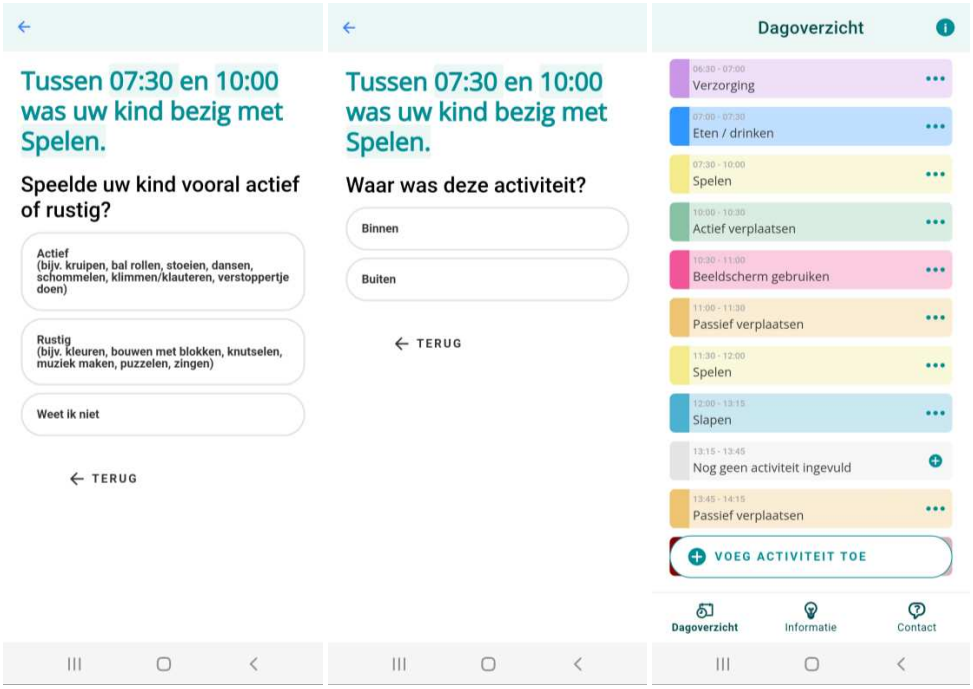


Screens main tabs.
From left to right: daily time-use overview; information about the research project; contact information and frequently asked questions.



Screens of adding an activity to the time-use overview.
From left to right and top to bottum: choosing an activity category, with age-appropriate activity examples for clarification of each category; selecting an activity category; selecting the time of the activity; follow-up question for the activity category 'playing': '*Did your child play mostly actively or calmly?';* follow-up question for the activity category 'playing': '*Where was this activity*?'; entered activities in the daily time-use overview





Appendix 1. The My Little Moves questionnaire on determinants of 24-hour movement behaviours: questionnaire items, source and psychometric properties.

Questionnaire item	Response options	Item derived from	Reliability/Validity
Socio-demographic characteristics			
1.1: Who is answering the questionnaire?	Biological mother/Biological father/Non-biological parent or caregiver/Other	Sarphati Cohort questionnaire[1]	No validity/reliability assessments
1.2: In which country was the child's biological mother born?	Netherlands/Surinam/Netherlands Antilles/Turkey/Morocco/Other	Sarphati Cohort questionnaire	
1.3. In which country was the child's biological father born?	Netherlands/Surinam/Netherlands Antilles/Turkey/Morocco/Other	Sarphati Cohort questionnaire	
1.4: What is your date of birth?	Day/Month/Year	Sarphati Cohort questionnaire	
1.5: What is your gender?	Male/Female/Other/I don't want to say	Sarphati Cohort questionnaire	
1.6: What is your highest completed education?	No education/Primary education/ Lower secondary education/Upper secondary education/Post-secondary non-tertiary education/Other[2]	Sarphati Cohort questionnaire	
1.7: What is the highest completed education of your partner?	No education/Primary education/ Lower secondary education/Upper secondary education/Post-secondary non-tertiary education/ Other	Sarphati Cohort questionnaire	
1.8: What is the postal code of your home address?	Four digits		
1.9: Does your child go to: a daycare, a child minder, informal care such as grandparents/ family/ acquaintances?	Hours per week/Days per week	Sarphati Cohort questionnaire	
1.10: What is the number of people living in your household?	Number of adults; number of children	Sarphati Cohort questionnaire	
1.11: What are the ages of the children in your household?	Years/months	Sarphati Cohort questionnaire	
1.12: What is the height of the biological mother?	Cm	Sarphati Cohort questionnaire	
1.13: What is the height of the biological father?	Cm	Sarphati Cohort questionnaire	
1.14: What is the weight of the biological mother?	Kg	Sarphati Cohort questionnaire	
1.15: What is the weight of the biological father?	Kg	Sarphati Cohort questionnaire	

Parenting practices – Child physical activity			
How often do you…			
2.1: Set an example for your child by exercising in front of him/her?	5-point scale; never-always	Translated to Dutch from PPAPP	Dutch translation of PPAPP by Gubbels et al, 2016 (1) Test-retest reliability and internal consistency scores from subscales in original PPAPP questionnaire by O'Connor et al, 2014 (2): Parental engagement original subscale (based on items 2.1, 2.3, 2.6, 2.7, 2.9, 2.12-2.14, 2.16, 2.18, 2.19, 2.23-2.25, 2.27): ICC (95% CI)=0.85 (0.75, 0.91) IIC=0.38 Cronbach's α=0.90 Promote inactivity original subscale (based on item 2.15, 2.22, 2.34): ICC (95% CI)=0.59 (0.38, 0.85) IIC=0.26 Cronbach's α=0.50 Promote screen time original subscale (based on items
2.2: Tell your child that he/she is not (yet) able to do a sport or active game or is not (yet) good enough?	5-point scale; never-always + not applicable	Translated to Dutch and adapted from PPAPP	
2.3: Play active games with your child (e.g. ball game or running)?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.4: Allow your child to watch TV for long periods of time?	5-point scale; never-always	Dutch translation of PPAPP	
2.5: Allow your child to play a lot of videogames?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.6: Go on a walk with your child?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.7: Say positive things to motivate your child to be more active?	5-point scale; never-always	Dutch translation of PPAPP	
2.8: Tell your child he/she will get hurt if he/she plays actively?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.9: Play a sport or active game together as a family?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.10: Not let your child play actively for fear of him/her getting dirty?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.11: Discipline your child for being too active?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.12: Give your child choices about what kind of activity or movement he/she wants to do?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.13: Allow your child to pick an active game to do together?	5-point scale; never-always + not applicable	Translated from PPAPP	
2.14: Dance with your child?	5-point scale; never-always + not applicable	Translated from PPAPP	

2.15: Carry your child because he/she does not want to walk or crawl?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	2.4, 2.5, 2.17): ICC (95% CI)=0.62 (0.41, 0.77) IIC=0.34 Cronbach's α=0.61 Psychological control original subscale (based om items 2.2, 2.8, 2.10, 2.11, 2.21): ICC (95% CI)=0.85 (0.75, 0.91) IIC=0.26 Cronbach's α=0.59 Restriction for safety concerns original subscale (based on items 2.33, 2.35, 2.36): ICC (95% CI)= 0.56 (0.33, 0.73) IIC=0.53 Cronbach's α = 0.82 The test-retest reliability scores for remaining original individual items: Item 2.18: ICC (95% CI)=0.62 (0.41, 0.76) Item 2.29: ICC (95% CI)=0.57 (0.34, 0.74)
2.16: Play an exercise game or sport with your child (e.g. hide and seek, tag or football)?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.17 Keep your child occupied by letting him/her watch TV?	5-point scale; never-always	Dutch translation of PPAPP	
1.18: Teach your child that being active is good for his/her health?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.19: Take your child to the park, playground, petting zoo or forest?	5-point scale; never-always	Adapted from Dutch translation of PPAPP	
2.20: Keep your child inside your home all day, regardless of the weather	5-point scale; never-always	Adapted from Dutch translation of PPAPP	
2.21: Reward your child for being still?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.22: put your child in a buggy/stroller if your child could have walked or crawled?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.23: Teach your child new and different ways to be active?	5-point scale; never-always	Dutch translation of PPAPP	
2.24: Does your child participate in an organized exercise activity (e.g. baby swimming, gymnastics, soccer or toddler dance)?	5-point scale; never-always	Adapted from Dutch translation of PPAPP	
2.25: Find age appropriate games that get your child moving?	5-point scale; never-always	Adapted from Dutch translation of PPAPP	
2.26: Not let your child play outside because there is not enough space to play?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.27: Set time aside for active play?	5-point scale; never-always	Dutch translation of PPAPP	
2.28: Not let your child participate in an organized exercise activity (e.g. baby swimming, gymnastics, football or toddler ballet) because it is too expensive?	5-point scale; never-always	Adapted from Dutch translation of PPAPP	
2.29: Have outdoor toys available for your child (e.g. sandpit, ball or (balance) bike) ?	5-point scale; never-always	Adapted from Dutch translation of PPAPP	

2.30: Allow your child to help you with chores outside (e.g. gardening or sweeping, tidying up toys?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.31: Suggest that your child play outside?	point scale; never-always + not applicable	Dutch translation of PPAPP	
2.32: Not have time to play outdoors with your child?	point scale; never-always + not applicable	Dutch translation of PPAPP	
2.33: Let your child go outside to play?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.34: Drive your child, when it was easy to walk?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.35: Not let your child play outside because you are worried about traffic?	5-point scale; never-always + not applicable	Dutch translation of PPAPP	
2.36: Not let your child play outside because you are worried about safety?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.37: Not let your child play outside because of the weather?	5-point scale; never-always + not applicable	Adapted from Dutch translation of PPAPP	
2.38: Keep your child occupied with quiet activities (such as quit games, puzzles or reading)?	5-point scale; never-always	Adapted from Dutch translation of PPAPP	
Parenting practices – Child screen behaviour			
3.1: How often do you use a screen device to educate your child?	5-point scale; never-multiple times per day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	Parent/Caregiver questionnaire SUNRISE by Okely et al, 2021 (3) No validity/reliability assessments
3.2: How often do you use a screen device to calm down your child when he/she is upset?	5-point scale; never-multiple times per day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments
3.3: How often do you use a screen device to keep your child busy while you do something else?	5-point scale; never-multiple times per day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments

3.4: How often do you offer screens to your child as a reward for good behaviour?	5-point scale; never-multiple times per day	Translated and adapted from Parenting SOS study: Screen time parenting, subscale 'use of screen time to reward/control child behavior'	Internal consistency scores from original subscales of the parenting questionnaire of the Parenting SOS study by Vaughn et al, 2013 (4): Use of screen time to reward/control child behavior original subscale (4 items): Cronbach's α = 0.79 Factor loadings = 0.57–0.94 Limiting/monitoring of screen time original subscale (10 items): Cronbach's α = 0.79 Factor loadings = 0.53–0.82
3.5: How often do you take away screens to your child as a punishment for bad behaviour?	5-point scale; never-multiple times per day	Translated and adapted from Parenting SOS study: Screen time parenting, subscale 'use of screen time to reward/control child behavior'	
3.6: How often do you use screens with your child present?	5-point scale; never-multiple times per day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments
3.7: How often does your child use screens in the two hours before bedtime?	5-point scale; never-multiple times per day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments
3.8: Do you have rules regarding how much time your child is allowed to use screens?	Yes/no	Translated and adapted from Parenting SOS study: Screen time parenting, subscale 'Limiting/monitoring of screen time'	For validity/reliability of original subscale, see questionnaire items 3.4 and 3.5
3.9: Do you have rules regarding when your child is allowed to use screens?	Yes/no	Added	No validity/reliability assessments

3.10: Do you monitor the screen use of your child?	Yes/no	Translated and adapted from Parenting SOS study: Screen time parenting, subscale 'Limiting/monitoring of screen time'	For validity/reliability of original subscale, see questionnaire items 3.4 and 3.5
3.11: Are there screens in the living room?	Yes/no	Added	No validity/reliability assessments
3.12: Are there screens in the room where your child sleeps?	Yes/no	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments
3.13: Does your child have a screen?	Yes/no	Added	No validity/reliability assessments
Parenting practices – child sedentary behaviour			
4.1: How often in the past week was your child restrained for more than one hour at a time (e.g. in a stroller, dining chair, car seat, on the back of a bike)	5-point scale; never-multiple times per day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments
4.2: How often in de past week was your child restrained (e.g. bouncer or dinging chair) so you can get things done (e.g. to cook, do the household, to shower/personal care)?	5-point scale; never-multiple times per day	Translated and adapted from Parenting SOS study: Screen time parenting, subscale 'Explicit modelling and enjoyment of screen time'	No validity/reliability assessments
4.3: How often in the past week was your child restrained (e.g. bouncer, dinging chair or bicycle seat) because you think it is safer?	5-point scale; never-multiple times per day	Added	No validity/reliability assessments
4.4: How often in the past week was your child restrained (e.g. bouncer or dinging chair) because your child is satisfied?	5-point scale; never-multiple times per day	Added	No validity/reliability assessments
Child sleep questions			

5.1: Does your child have a consistent bedtime?	Yes, bedtime does not vary by more than 30 minutes each day/No, bedtime can vary more than 30 minutes each day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	No validity/reliability assessments
5.2: Does your child have a consistent wake-up time?	Yes, this time does not vary by more than 30 minutes each day/No, this time can vary more than 30 minutes each day	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	
5.3: In the past three days, has your child not got enough sleep?	Yes/No	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	
5.3.1 (if 5.3=Yes): What were the reasons for this insufficient sleep (multiple options possible)?	Outside noise/indoor noise/too hot/too cold/too much Too much light coming in to the room/Other	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	
5.4: How many people are sleeping in the same room as your child?	Only the participating child/The participating child and other children/The participating child and adults	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	
5.4.1 (if 5.4=The participating child and other children): How many other children?	Number	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	
5.4.2 (if 5.4=The participating child and other adults): How many other adults?	Number	Translated and adapted from Parent/Caregiver questionnaire SUNRISE	
5.5: Typically, how difficult is bedtime?	5-point scale; Very easy-Very difficult	Translated from BISQ-R short form	BISQ-R by Mindell et al, 2019 (7) Test-retest reliability scores based on a Spanish version of the BISQ-R by Cassanello et al, 2018 (8): r = 0.848, with a kappa value of 0.939 (95% CI= 0.858–1.00)
5.6: How well does your child usually sleep at night?	5-point scale; Very well-Very poorly	Translated from BISQ-R short form	
5.7: Do you consider your child's sleep a problem?	5-point scale; Not a problem at all-A serious problem	Translated from BISQ-R short form	
5.8: Does your child get night feeding?	Yes/No	Added	

5.8.1 (if 5.8=yes): How many times a night does your child get night feeding?	Number	Added	No validity/reliability assessments
Parental physical activity and sedentary behaviour			
6.1: During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?	Days per week	Adopted from Dutch version of IPAQ-SF	Reliability and validity scores based on an systematic review on the measurement properties of the original IPAQ-SF by Craig et al, 2003 (9): Reliability: r = 0.66–0.91 Validity (compared to an accelerometer): r = 0.02–0.52.
6.1.1 (if 6.1=not ''no vigorous physical activities'': How much time did you usually spend doing vigorous physical activities on one of those days?	Hours/Minutes per day	Adopted from Dutch version of IPAQ-SF	
6.2: During the last 7 days, on how many days do you spend on moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.	Days per week	Adopted from Dutch version of IPAQ-SF	
6.2.1 (if 6.2=not ''No moderate physical activities ''): How much time do you usually spend doing moderate physical activities on one of those days?	Hours/Minutes per day	Adopted from Dutch version of IPAQ-SF	
6.3: Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.	Days per week	Adopted from Dutch version of IPAQ-SF	
6.3.1 (if 6.3=not ''No walking''): How much time do you usually spend walking on one of those days?	Hours/Minutes per day	Adopted from Dutch version of IPAQ-SF	
6.4: During the last 7 days, how much time did you spend sitting on a week day?	Hours/Minutes per day	Adopted from Dutch version of IPAQ-SF	
Living environment			
7.1.1: Does your home have an outdoor space?	Yes, garden/Yes, balcony/Yes, roof terrace/Yes, other/No	Added	No validity/reliability assessments
7.1.2 (if 7.1=not ''No"): Our outdoor space is suitable for:	3 point scale; Only calm play-All activities, including active play	Translated and adapted from EPAO	

7.2: The place where my child plays most indoors (e.g. the living room) is suitable for:	3 point scale; Only calm play-All activities, including active play	Translated and adapted from EPAO	Adaptation and Dutch translation by Gubbels et al, 2011 (5) Test-retest reliability and validity (gold standard observer) scores of the original subscales by Ward et al, 2015 (6): Physical activity environment Portable equipment subscale: ICC = 0.93-0.96 (observer) ICC = 0.59-0.74 (staff) r = 0.23-0.26 Fixed equipment subscale: ICC = 0.98-0.99 (observer) ICC = 0.73-0.85 (staff) r = 0.49-0.55 Inside space for gross motor activity subscale: ICC = 0.98-0.99 (observer) ICC = 0.53-0.69 (staff) r = 0.02-0.06 Inter-rater reliability and validity (compared to accelerometer) scores of the original subscales by Vaughn et al, 2017 (10):
7.3: Which of the following play equipment do you have available for your child at home inside? And Which of the following play equipment do you have available for your child at home outside?	1) Ball or other toy to throw or roll; 2) Football goal, basketball hoop, etc.; 3) Loose toys for jumping, e.g. Skippy ball; 4) Play mat or other floor covering for playing on the floor; 5) Walking car, balance bike, tricycle or other toys to ride on; 6) Rocking horse or other materials to bounce on; 7) Sandpit and/or water toys (e.g. shovels, buckets); 8) Climbing equipment (e.g. climbing frame or slide); 9) Swing; 10) Possibility to play music or musical instruments; 11) Other play equipment	Translated and adapted from the Dutch version of EPAO	

			Indoor play equipment subscale: ICC = 0.81 r = 0.11 Outdoor play environment subscale: ICC = 0.84 r = 0.04
7.4: Is there a park in your neighborhood?	Yes/No/I don't know	Added, based on a questionnaire used in the Dutch 'healthy neighborhoods project'	No validity/reliability assessments
7.4.1: How satisfied are you with this park?	Report mark between 1 and 10		
7.4.2: Have you visited this park with your child in the past month?	Yes/No		
7.5: Is there a public garden in your neighborhood?	Yes/No/I don't know		
7.5.1: How satisfied are you with this public garden?	Report mark between 1 and 10		
7.5.2: Have you visited this public garden with your child in the past month?	Yes/No		
7.6: Is there a lawn in your neighborhood?	Yes/No/I don't know		
7.6.1: How satisfied are you with this lawn?	Report mark between 1 and 10		
7.6.2: Have you visited this lawn with your child in the past month?	Yes/No		
7.7: Is there a forest in your neighborhood?	Yes/No/I don't know		
7.7.1: How satisfied are you with this forest?	Report mark between 1 and 10		
7.7.2: Have you visited this forest with your child in the past month?	Yes/No		
7.8: Is there a playground in your neighborhood?	Yes/No/I don't know		
7.8.1: How satisfied are you with this playground?	Report mark between 1 and 10		
7.8.2: Have you visited this playground with your child in the past month?	Yes/No		
7.9: Is there a sports/football field in your neighborhood?	Yes/No/I don't know		

7.9.1: How satisfied are you with this sports/football field?	Report mark between 1 and 10		
7.9.2: Have you visited this sports/football field with your child in the past month?	Yes/No		
7.10: Is there another green facility in your neighborhood?'	Yes/No/I don't know		
7.10.1: How satisfied are you with this sports/football field?	Report mark between 1 and 10		
7.10.2: Have you visited the sports/football field with your child in the past month?	Yes/No		
8.1: Most streets in my neighborhood have sidewalks	10-point scale; Disagree-Agree	Adapted from the Dutch translation of the European environmental questionnaire ALPHA	Test-retest reliability scores based on Dutch, French, English and German versions of ALPHA by Spittaels et al, 2010 (11): - item 3c Agreement: 62%; ICC: 0.69 - item 3a: Agreement: 73%; ICC: 0.74 - item 5c Agreement: 68%; ICC: 0.58 - item 5d Agreement: 62%; ICC: 0.61 - item 5e Agreement: 74%; ICC: 0.57
8.2: Most streets in my neighborhood have bike lanes	10-point scale; Disagree-Agree	Adapted from the Dutch translation of the European environmental questionnaire ALPHA	
8.3: When I walk with my child in my neighborhood I feel unsafe due to traffic (for example due to heavy traffic or unsafe traffic situations)	10-point scale; Disagree-Agree	Adapted from the Dutch translation of the European environmental questionnaire ALPHA	
8.4: When I cycle with my child in my neighborhood I feel unsafe due to traffic (for example due to heavy traffic or unsafe traffic situations)	10-point scale; Disagree-Agree	Adapted from the Dutch translation of the European environmental questionnaire ALPHA	
8.5: I do not go to the playground with my child because I am afraid of crime or being harassed	10-point scale; Disagree-Agree	Adapted from the Dutch translation of the European environmental questionnaire ALPHA	

Abbreviations: BISQ-R, Brief Infant Sleep Questionnaire Revisited; CI, Confidence Interval; EPAO, Environment and Policy Assessment and Observation; ICC, Intraclass Correlation Coefficient; IIC, Inter Item Correlation; IPAQ-SF, International Physical Activity Questionnaire Short form; PPAP, Preschooler Physical Activity Parenting Practices.

[1]Sarphati Cohort questionnaire, as part of the data collection within Sarphati Cohort, where research is conducted into the growth and development of Amsterdam children; for more information, see https://www.sarphaticohort.nl/en/over-sarphati-cohort/.

[2]Based on International Standard Classification for Education (ISCED).

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