



CLINICAL REVIEW

Validity and reliability of sleep time questionnaires in children and adolescents: A systematic review and meta-analysis



Marcus V. Nascimento-Ferreira^{a, c, *}, Tatiana S. Collese^{a, b, c},
 Augusto César F. de Moraes^{a, b, c}, Tara Rendo-Urteaga^{a, b, c}, Luis A. Moreno^{b, c, d},
 Heráclito B. Carvalho^{a, c}

^a Youth/Child and Cardiovascular Risk and Environmental (YCARE) Research Group, School of Medicine, University of Sao Paulo, Sao Paulo, Brazil

^b Growth, Exercise, Nutrition and Development (GENUD) Research Group, Faculty of Health Sciences, University of Zaragoza, Zaragoza, Spain

^c Department of Preventive Medicine, School of Medicine of the University of São Paulo, São Paulo, Brazil

^d School of Health Sciences of the University of Zaragoza, Zaragoza, Spain

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SUMMARY

Sleep duration has been associated with several health outcomes in children and adolescents. As an extensive number of questionnaires are currently used to investigate sleep schedule or sleep time, we performed a systematic review of criterion validation of sleep time questionnaires for children and adolescents, considering accelerometers as the reference method. We found a strong correlation between questionnaires and accelerometers for weeknights and a moderate correlation for weekend nights. When considering only studies performing a reliability assessment of the used questionnaires, a significant increase in the correlations for both weeknights and weekend nights was observed. In conclusion, moderate to strong criterion validity of sleep time questionnaires was observed; however, the reliability assessment of the questionnaires showed strong validation performance.

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Introduction

Sleep duration is considered a crucial behavior in the context of a healthy lifestyle [1–4], and in children and adolescents, insufficient sleep time has been shown to be a risk factor for several outcomes [5–7]. However, evaluating sleep schedule and sleep time remains a challenge in epidemiological studies. Historically, studies examining sleep have been performed with tools that require a controlled environment (e.g., polysomnography and electroencephalography) [8–10]. However, this requirement hampers the analysis of sleep time in free-living environments (spontaneous activities of individuals at home or away that are not evaluated under clinical laboratory conditions).

To better understand the relationship between sleep time and health outcomes, the sleep schedule must be identified in non-controlled contexts [11]. Accelerometers have gained significant popularity in sleep medicine in the past two decades [8] because of its characteristics as an objective tool (direct measure) and a non-intrusive method and because of its suitability for a pediatric population [10]. Accelerometry is based on small wrist watch-like devices that monitor movements for extended periods. The raw activity scores (e.g., in 1-min epochs) are translated to sleep-wake scores based on computerized scoring algorithms [8].

To assess sleep time, the duration from sleep onset to wake up time [1], accelerometers, which use activity-based monitoring, have been applied as the gold standard (criterion validity) in a free-living context [1,9]. However, the logistical costs for this technology remain relatively high [12].

In recent years, the need to develop applicable instruments with reduced costs and greater comfort for epidemiological studies of

* Corresponding author. Youth/Child and Cardiovascular Risk and Environmental (YCARE) Research Group, School of Medicine, University of Sao Paulo, Sao Paulo, Brazil. Tel./fax: +55 11 3061 7074.

E-mail address: marcus1986@usp.br (M.V. Nascimento-Ferreira).

Abbreviations

ALSPAC	Avon longitudinal study of parents and children
AMI	Ambulatory Monitoring Inc
AW	Actiwatch™
CCTQ	Children's chronotype questionnaire
CRD	Centre for reviews and disseminations
CRSP	Children's report of sleep patterns
CRSP-S	Children's report of sleep patterns – sleepiness scale
CSHQ	Children's sleep habits questionnaire
CSRQ	Chronic sleep reduction questionnaire
MeSH	Medical subject heading
SHS	Sleep habits survey
SSTQ	Sleep schedule time questionnaire
UK	United Kingdom
US	United States
WHO	World Health Organization

pediatric populations has caused an increase in the generation of sleep time questionnaires (a subjective tool). However, despite this increase in the number of such tools [13], only a few have been validated and standardized (reliable measures) using appropriate psychometric criteria [14–17].

Extensive studies evaluating instruments for monitoring sleep time have been conducted; these studies have separately described the validity, reliability, methodology, indications and limitations for both subjective and objective tools [8,10,13,14]. Thus far, no systematic reviews verifying the validity and reliability of sleep time questionnaires in children and adolescents compared with objective instruments (accelerometry) have been performed. Thus, the aims of this study were (i) to assess the criterion validity of sleep time questionnaires in children and adolescents and (ii) to analyze the effect of reliability assessment on validation performance.

Methods

The present study followed the systematic review methodology proposed by Clark & Oxman [18]. This systematic review examined studies reporting the criterion validity and reliability of questionnaires used to assess sleep time in a free-living environment on weeknights and weekend nights. For sleep time measurement in a free-living environment, an accelerometer is considered the most accurate tool [9,15,16,19].

Identification of eligible studies

Electronic search and other sources

The searches were performed using the electronic databases MEDLINE (PubMed), Web of Science, EMBASE, SPORTDiscus, Bio-Med Central and SCOPUS. Moreover, the references from the articles found in these databases were reviewed, and corresponding authors were contacted to identify other relevant studies, key articles and previous reviews [1,13,14]. These databases were searched from 1967 until the most recently published articles in December 2014. The present review is registered in the PROSPERO database (CRD42014013923).

The following descriptors and medical subject reading (MeSH) terms were used as search terms in the databases. These descriptors were divided into two independent lists, one list for children and the other list for adolescents:

List A: (“early childhood” OR “child” OR “preschool” OR “children” OR “preschoolers” OR “childhood”) AND (“sleep”) AND (“instrument” OR “survey” OR “diary” OR “questionnaire” OR “self-report”) AND (“accelerometer” OR “accelerometry” OR “motion sense” OR “heart rate” OR “inclinometer” OR “activity monitor” OR “ActiGraph” OR “GENEActiv”) AND (“reliability” OR “calibration” OR “reliable” OR “test-retest” OR “reproducible”) AND (“validity of results” OR “validities” OR “valid” OR “validation” OR “validity”).

List B: (“adolescence” OR “adolescents” OR “youth” OR “teen” OR “teenager”) AND (“sleep”) AND (“instrument” OR “survey” OR “diary” OR “questionnaire” OR “self-report”) AND (“accelerometer” OR “accelerometry” OR “motion sense” OR “heart rate” OR “inclinometer” OR “activity monitor” OR “ActiGraph” OR “GENEActiv”) AND (“reliability” OR “calibration” OR “reliable” OR “test-retest” OR “reproducible”) AND (“validity of results” OR “validities” OR “valid” OR “validation” OR “validity”).

Selection criteria

The inclusion criteria were as follows: i) the study population was composed of children and/or adolescents according to the World Health Organization (WHO) classification [20], ii) the study was original research, iii) the study was performed with at least one subjective measurement (questionnaire) and an objective measurement (an accelerometer, i.e., an Ambulatory Monitoring Inc (AMI) device, Mini-Mitter device, Cambridge device, or other device) for sleep time, and iv) the study reported the validity of the subjective measurement.

Studies in which the participants had different diseases (or disturbances) that could interfere with sleep time were excluded. These criteria were set to increase inter-study comparability. In addition, review articles or books and studies with subjects outside the age range (2–19 y) were excluded.

Data extraction

Potentially relevant papers were selected by i) screening the titles, ii) screening the abstracts, and iii) retrieving and screening the full article to determine whether it met the inclusion criteria if the abstract did not provide sufficient data or was not available. The literature screenings were performed by two authors (Nascimento-Ferreira MV and Collese TS) independently using a pre-defined study extraction form, and the results were compared. If a disagreement occurred, then the article was evaluated by a third researcher (Fig. 1). Publications in English, Spanish and Portuguese were screened.

The publication data included study characteristics (i.e., authors, tool acronym, location, publication year, population, respondent), sample size, validation test length, test-retest period, objective and subjective tools, measurement units, internal consistency tests (when used), reliability coefficient (when used) and criterion validity coefficient (Tables 1 and 2).

The criterion validity and reliability coefficients (internal consistency and test-retest) were separately retrieved from original studies for week and weekend nights as well as estimated effects and tests used.

Validity, reliability and statistical analyses of sleep time measures

The criterion validation adopted for sleep time was objective measurement using accelerometers [1,9,15,16]. As the units and sleep variables of measurement differed among studies (Fig. 2), we adopted measures of the *sleep period variable* (the most common measurement in the included studies) as *proxies* of sleep time in both accelerometer (criterion) and questionnaire (predictor)

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