Study protocol

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Physical activity, sedentary behavior and sleep measured by smartwatch: a scoping review protocol

Atividade física, comportamento sedentário e sono medidos por smartwatch: protocolo de revisão de escopo

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ABSTRACT

The health impacts of physical activity (PA), sedentary behavior (SB), and sleep are well established; thereby, the identification of instruments to assess and monitor these behaviors at a populational level is relevant. In this context, smartwatches, which are wristwatch-shaped devices equipped with sensors, have been identified as alternatives for objectively measuring PA, SB, and sleep. Therefore, this protocol aimed at describing the goals and methods of a scoping review to map the literature on the use of smartwatches to objectively measure PA, SB, and/or sleep across the lifespan (e.g., children, adolescents, adults, and elderly) and in different contexts. Studies will be included if they use smartwatches to objectively measure at least one of the behaviors (PA, SB, and sleep) in children, adolescents, adults, and older adults, published after 2013. No language filter will be applied. Searches will be carried out in six databases (Pubmed/Medline, Scopus, Web of Science, LILACS, IEEE Xplore Digital Library, Scielo, Health Technology Assessment Database, and Cochrane clinical trials) and two clinical trial repositories. The screening and data extraction will be performed independently by two authors who had previous experience in reviews and technologies. The synthesis of the results will follow the Joanna Briggs Institute framework for extracting the results in scoping reviews. The results can contribute to scientific progress by identifying gaps and research trends, guiding future studies, and informing companies, healthcare professionals, and the general public who use smartwatch as a measurement tool for physical activity, sedentary behavior, and sleep.

Scoping review registration: https://osf.io/aycgp/

Keywords: Wearable electronic devices; Physical activity; Sedentary behavior; Sleep.

RESUMO

Os impactos da atividade física (AF), comportamento sedentário (CS) e sono na saúde são bem estabelecidos, tornando-se relevante identificar instrumentos que permitam avaliar e monitorar esses comportamentos em nível populacional. Nesse contexto, os smartwatches, que são dispositivos em formato de relógio de pulso, compostos por sensores, tem sido apontado como alternativa para mensurar objetivamente AF, CS e sono. Portanto, o objetivo deste protocolo foi descrever os objetivos e métodos de uma revisão de escopo para mapear a literatura científica sobre o uso de smartwatches para medir objetivamente AF, CS e/ou sono em diferentes populações e contextos. Os estudos serão incluídos se usarem smartwatches para medir objetivamente pelo menos um dos comportamentos (AF, CS e sono) em crianças, adolescentes, adultos e idosos, publicados após 2013. Nenhum filtro de idioma será aplicado. As buscas serão realizadas em sete bases de dados (Pubmed/Medline, Scopus, Web of Science, IEEE Xplore Digital Library, Scielo, LILACS, Health Technology Assessment Database e Cochrane Clinical Trials) e dois repositórios de ensaios clínicos. A triagem e extração dos dados serão realizadas de forma independente por dois autores com experiência prévia em revisões e tecnologias. A síntese dos resultados seguirá o framework do Joanna Briggs Institute para extração dos resultados nas revisões de escopo. Os resultados podem contribuir para o progresso científico, identificando lacunas e tendências de pesquisa, orientando futuros estudos, empresas que atuam neste mercado, profissionais de saúde e o público em geral que utilizam smartwatch como um instrumento de medição para atividade física, comportamento sedentário e sono.

Registro da revisão de escopo: *https://osf.io/aycgp/*

Palavras-chave: *Dispositivos eletrônicos vestíveis; Atividade física; Comportamento sedentário; Sono.*

Introduction

Each moment of the day is spent in one of the three basic activities (physical activity – PA; sedentary behavior – SB; sleep) which play a pivotal role in maintaining/improving health across lifespan[1]. Over the past decades, compelling evidence has highlighted the beneficial health effects of sufficient PA, low SB, and adequate sleep individually[2,3], and more recently the relevance of

addressing these behaviors in an integrated approach has gained momentum[4, 5]. Thus, more accurate and reliable ways to measure these behaviors in the population are relevant to evaluate and monitor the levels, patterns, and trends[6]. Establishing or producing adequate instruments to carry out it in different contexts and populations has always been a challenge for science[6].

PA, SB and sleep can be measured in subjective ways, which have social-desirability bias and recall bias, as well as objective ways that are free from these biases[6,7]. In PA and SB research, the accelerometer-measured behavior is considered the standard for the measurement[6,8], however it has a high cost, low storage, processing and transfer capacity data, besides that, as it has been designed for research purposes, it does not encourage users to use it on a daily basis or for long periods of time, which leads to data loss by removing the device.

The best measurement standard for physiological dimension of sleep is polysomnography, an invasive, expensive method requiring the person to stay at least one night in the place where the test is performed[6,7]. Accelerometers are also used to objectively measure sleep parameters such as sleep duration, movements during sleep, awakenings, and some accelerometers are validated from polysomnography[9,10].

The technological advance has provided the creation of new devices such as smartwatches that have the ability to facilitate measurements of these behaviors. Smartwatches are wristwatch-shaped devices classified as general-purpose computers that can be connected to a network and have sensors to monitor activities (e.g., PA, SB and sleep), in addition to receiving and sending messages, making calls and calls autonomously or dependent on smartphone connection[11-13]. Due to technological advances, smartwatches can have two or more sensors and have the ability to measure behavioral (e.g., PA, SB and sleep), environmental (e.g., Location and luminosity) and physiological variables (e.g., Heart rate and body temperature)[12, 14]. Studies that consider the use of smartwatches highlight the relevance of using this type of technology and point to a range of positive points such as high public acceptance, discrete detection and other characteristics that make them more acceptable and common[12,15].

According to the forecast made by the International Data Corporation (IDC), smartwatches and wristbands represented 95% of all wearables on the market, among which the growth in millions of units shipped to the smartwatch market in the world could be 22 times greater in 2022[16]. Besides that, global end-user spending on smartwatches was nearly 4 times that of wristbands and it was predicted that by the year 2021 this spending would be about 9 times bigger while wristband spending would decrease by 10%[17].

In recent reviews, the wearable technologies have been used by consumers as objective measurement instruments in research on PA, SB, and sleep area[14,18] , combining these behaviors throughout the 24 hours a day[19]. Some of these devices have connectivity of high speed and high processing power[12], which allow the extraction and transfer of large volumes of data through wireless connection to third-party systems and archiving in clouds in real time[14,15]. Another relevant aspect is the fact that each user can have a login and password and can continue transmitting their data even when switching devices, which allows monitoring and tracking for long periods.

In a systematic review, the validity and reliability of activity trackers from two popular manufacturers for measuring physical activity and sleep parameters in adults showed divergent results, as well as for physical activity measures in older adults. However, for children and adolescents, only sleep parameters were analyzed, and good levels of validity and reliability were not found[20]. In a meta-analysis, the use of activity trackers in interventions with the adult population increased participation in physical activity compared to those who did not use this technology[18]. More recently, a scoping review protocol related to wearable and mobile technologies to measure and promote healthy sleep behaviors in adolescents[21]. However, among these activity trackers, there is a range of different devices with different functions, market shares, and preferences of use by consumers, therefore, this information is extremely relevant since the evaluated technology is based on consumer use, as well as identifying this type of knowledge across different age groups.

To date, there is a lack of evidence related to the validation studies considering the available smartwatch that objectively measure physical activity[14,22], sleep parameters[23] and others physiological parameters[24] among children, adolescents, adults and elderly. Therefore, mapping the evidence on their use to carry out objective measures of these behaviors in different populations and contexts seems relevant.

Considering the aforementioned gaps and possibilities, mapping the evidence on the use of smartwatches to perform objective measures of these behav-

iors in different populations and contexts is relevant. Therefore, the aim of the scope review described in this protocol is to map the evidence on smartwatches used to objectively measure PA, SB, and sleep in children, adolescents, adults, and elderly individuals, regardless of their health. More specifically, the main reasons for using smartwatches, measured variables, and psychometric characteristics will be evaluated.

The results can contribute to scientific progress by identifying gaps and research trends, guiding future studies, and informing companies, healthcare professionals, and the general public who use this technology as a measurement tool for physical activity, sedentary behavior, and sleep.

Methods

Protocol and registration

This protocol has been registered on the Open Science Framework (https://osf.io/aycgp/). The Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) will guide the report of the scoping review[25] and this protocol was prepared and written according to the Joanna Brings Institute (JBI)[26] as presented in Supplementary file 1.

Eligibility criteria

This protocol of scoping review will address the following question: What is the available evidence on the use of smartwatches to objectively measure physical activity, sedentary behavior, and sleep in childrens, adolescents, adult and older adult? For this, studies that meet the eligibility criteria based on the Population, Content, and Contex framework (PCC framework)[26] will be considered, as follows:

Population

Studies conducted with any population (e.g., children, adolescents, adults or old adults) of or health conditions will be considered eligible.

Concept

Studies will be included that used smartwatches to perform objective measurements any variable of PA, SB and sleep.

We consider as smartwatches wristwatch-shaped devices classified as general-purpose computers that can be connected to a network and have sensors to monitor activities (e.g., PA, SB and sleep), in addition to receiving and sending messages, make and receive calls, autonomously or dependent on smartphone connection[11-13].

PA was considered as any bodily movement produced by the skeletal muscles that require energy expenditure >1.5 metabolic equivalents (METs)[27], and PA measurements were included regardless of the type (e.g., steps, PA time, intensities, walking time) or domains (leisure-time, domestic, occupational, or transportation).

SB was considered sedentary behaviour as any wake-based behaviour which incurs ≤1.5 METs during a sitting, reclining, or lying down posture[28], and SB measurements were included regardless of the frequency, interruptions, time, type (e.g., sedentary time, seated time, bouts, breaks) or domain of SB occurs (leisure-time, occupational and transportational).

Studies will be included if they considered sleep as a reversible state of reduced responsiveness to/and interaction with the environment[29], and sleep measurements were included regardless of the dimensions (e.g., duration, efficiency, timing, sleepiness and quality).

Context

Considering the review aims to map existing evidence on smartwatches, studies conducted in any context (e.g., at home, school, community, at work, daily living environments, public and private institutions) will be included.

This scoping review will include primary studies that measured PA, SB, and/or sleep though smartwatches in humans. As the year 2013 was the year that the main electronics manufacturers started the production of smartwatches[30,31] and its insertion in health research grew exponentially in 2014[32], only studies published after 2013 will be considered eligible. No limits regarding language will be applied.

Source of evidence and search strategy

An electronic search of the literature will be carried out in seven databases (PubMed, Scopus, Web of Science, IEEE Xplore Digital Library, Scielo, LILACS, Health Technology Assessment Database, Cochrane Clinial Trials). Additional search will include: i) consultation of the reference lists of all included studies; and ii) search in two clinical trial repositories, namelly the Clinical Trials and the Brazilian Repository of Clinical Trials. The same eligibility criteria will be applied to the screening of references in clinical trial repositories.

Keywords will be selected by assessment of the Medical Subject Headings (MeSH) in the National Library of Medicine and relevant text to the area. The

organization of search terms will be carried out according to PCC framework[26]. The search strategy for each database is presented on Supplementary file 2.

Selection of sources of evidence

The references found in the electronic searches in all databases will be downloaded to a single EndNote® X9 library. A single reviewer will perform the duplicates removal in two steps: i) an automated evaluation will be conducted using the "find duplicates" tool, available on EndNote® software; and ii) a manual search of all references will be performed to further ensure that all duplicates have been removed. Then, the references will be transferred to the Rayyan QCRI software[33], where the selection process with be carried out.

The selection process will be carried out in two steps: i) reading of the title/abstract; and ii) reading the full text. Before the screening begins, a random sample of 10 references will be selected to perform a pilot screening to reduce disagreements between reviewers and improve decision making. A step-by-step description of the selection process will be provided below:

In the first step, two reviewers will independently read the titles and abstracts of the retrieved references to assess if they meet the inclusion criteria. After that, a consensus meeting will be performed to solve disagreements. When consensus is not reached, a third reviewer will be consulted.

In the second step, the remaining studies considered eligible in title/abstract screening phase will have their full text assessed to confirm that they meet the inclusion criteria. In this phase, the reasons for exclusion of each individual study will be pointed out. Again, after the screening process, a consensus meeting will be performed to solve disagreements and, when necessary, a third reviewer will be consulted. The selection process will be described using the PRISMA-ScR flowchart[25].

Data charting process and data items

Similar to the screening process, a random sample of 15 references will be selected to perform a pilot extraction to improve the extraction's quality and reduce disagreements between reviewers. Two independent reviewers will perform data extraction using an Excel spreadsheet elaborated by a review team member based on the recommendations of the JBI for data extraction, which will include all variables that should be filled by them (See Supplementary file 3). For instance, extracted data will include study characteristics (author, year of publication, study design, sample size, country in which the study was conducted), population characteristics (mean age, sex, health condition), measured behavior (PA, SB and sleep), smartwatch brand and model, reason for using the smartwatch (measure dependent variable, independent variable, self-monitoring, validation, other reasons). For validation studies, the contexts of free life and laboratory environments, measure to be validated, reference instrument.

Synthesis of results

A descriptive synthesis of the studies will be adopted to describe the characteristics of the publications retrieved in this review according to population, context and concept. When presenting the data, the summarized results will be grouped by population groups (specific population, children and adolescents, adults, and older adults), taking into account their socioeconomic condition (e.g., low, middle, or high-income countries) and according to the clinical condition of the samples (e.g., apparently healthy individuals or those with a clinical condition). Will be included as measures of PA, the time spent in different PA intensities (light, moderate, vigorous, very vigorous, and/or total PA), step counts, and walking distance and time. For SB, the total time spent in SB, the number and duration of bouts of SB, and number of breaks. Finally, for sleep it will be considered sleep duration, states, sleep latency, efficiency and/or quality, and the wake after sleep onset (WASO). In the event of a protocol modification in the full publication of the results of this scoping review, the authors will clarify and justify all modifications in a specific section.

Dissemination strategies

The results of this scoping review will be submitted for publication in a peer-reviewed journal (preferably open access) and scientific meetings and conferences on PA, SB, and sleep and technological research. Once published, the results will be disseminated through digital science communication platforms, including academic social media, to amplify its reach and usefulness.

Discussion

This protocol aimed at providing the rationale, goals, and methods of the scoping review with the objective of mapping the evidence on smartwatches used to objectively measure PA, SB, and sleep in children, adolescents, adults, and elderly individuals, regardless of their

health. More specifically, the main reasons for using smartwatches, measured variables, and psychometric characteristics will be evaluated.

This scoping review will identify information about the extension and scope of evidence on the use of smartwatches to objectively measure PA, SB and/or sleep regardless of study design (e.g., cross-sectional, longitudinal, randomized clinical trials), purpose of measurement (e.g., outcome, exposure, self-monitoring of interventions, validation), context (e.g., laboratory, school, free-living condition), taking into account their socioeconomic condition (e.g., low, middle, or high-income countries) and population (e.g., children, adolescents, adults, older adults and clinical population).

Although smartwatches are the most widely available wrist technologies on the market and the ones that users buy the most in the world[17,34], it is possible that some studies will report the use of smartwatches; however, they are using other wrist devices instead[32]. Therefore, the number of included studies could be reduced as they will not meet the eligibility criteria. In addition, it is possible that studies report the measurement of PA, SB and/or sleep but not provide information on how it was measured/which sensors were used[20]. Despite these possible limitations, the results of the review can contribute to scientific progress by identifying gaps and research trends, guiding future studies, and informing companies, healthcare professionals, and the general public who use this technology as a measurement tool for physical activity, sedentary behavior and sleep.

Conflict of interest

The authors declare no conflict of interest.

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Author contribution:

Silva JF and Tassitano RM participated in the conceptualization and original draft preparation. Silva JF, Tassitano RM and Germano-Soares AH, participated in the methodology. Silva JF, Tassitano RM, Germano-Soares Barbosa Filho VC, Mota JG, Silva LCB and Oliveira TV, participated in the review and editing. All authors have read and agreed to the published version of the manuscript.

References

1. Stappers NEH, Van Kann DHH, Ettema D, De Vries NK, Kremers SPJ. The effect of infrastructural changes in the built environment on physical activity, active transportation and sedentary behavior - A systematic review. Health Place. 2018;53:135–49.
2. Owen N, Sugiyama T, Eakin EE, Gardiner PA, Tremblay MS, Sallis JF. Adults' sedentary behavior. Am J Prev Med. 2011;41(2):189–96.
3. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? Lancet. 2012;380(9838):258–71.
4. Prince SA, Butler GP, Rao DP, Thompson W. Evidence synthesis - Where are children and adults physically active and sedentary? - a rapid review of location-based studies. Health Promot Chronic Dis Prev Can. 2019;39(3):67–103.
5. Kelso A, Reimers AK, Abu-Omar K, Wunsch K, Niessner C, Wäsche H, et al. Locations of physical activity: where are children, adolescents, and adults physically active? A systematic review. Int J Environ Res Public Health. 2021;18(3):1240.
6. Tcymbal A, Demetriou Y, Kelso A, Wolbring L, Wunsch K, Wäsche H, et al. Effects of the built environment on physical activity: a systematic review of longitudinal studies taking sex/gender into account. Environ Health Prev Med. 2020;25(1):75.
7. Smith M, Hosking J, Woodward A, Witten K, MacMillan A, Field A, et al. Systematic literature review of built environment effects on physical activity and active transport - an update and new findings on health equity. Int J Behav Nutr Phys Act. 2017;14(1):158.
8. Ding D, Sallis JF, Kerr J, Lee S, Rosenberg DE. Neighborhood environment and physical activity among youth: A review. Am J Prev Med. 2011;41(4):442–55.
9. Condello G, Puggina A, Aleksovska K, Buck C, Burns C, Cardon G, et al. Behavioral determinants of physical activity across the life course: a "DEterminants of DIet and Physical ACtivity" (DEDIPAC) umbrella systematic literature review. Int J Behav Nutr Phys Act. 2017;14(1):58.
10. Parajára M do C, de Castro BM, Coelho DB, Meireles AL. Are neighborhood characteristics associated with sedentary behavior in adolescents? A systematic review. Int J Environ Health Res. 2020;30(4):388–408.
11. Timperio A, Salmon J, Ball K, te Velde SJ, Brug J, Crawford D. Neighborhood characteristics and TV viewing in youth: nothing to do but watch TV? J Sci Med Sport. 2012;15(2):122–8.
12. Van Kann DHH, de Vries SI, Schipperijn J, de Vries NK, Jansen MWJ, Kremers SPJ. Schoolyard characteristics, physical activity, and sedentary behavior: combining gps and accelerometry. J Sch Health. 2016;86(12):913–21.
13. Gorely T, Marshall SJ, Biddle SJH, Cameron N. Patterns of sedentary behaviour and physical activity among adolescents in the United Kingdom: Project STIL. J Behav Med. 2007;30(6):521–31.
14. Parker KE, Salmon J, Villanueva K, Mavoa S, Veitch J, Brown HL, et al. Ecological correlates of activity-related behavior typologies among adolescents. BMC Public Health. 2019;19(1):1041.
15. IBGE. Panorama da cidade de Feira de Santana/BA. Brasil, 2022. [citado 2022 jan 3] Disponível em: https://cidades.ibge.gov.br/brasil/ba/feira-de-santana/panorama.

16. Costa FF, Schmoelz CP, Davies VF, Di Pietro PF, Kupek E, de Assis MAA. Assessment of diet and physical activity of brazilian schoolchildren: Usability Testing of a Web-Based Questionnaire. JMIR Res Protoc. 2013;2(2):e31.

17. Jesus GM, Assis MAA, Kupek E, Dias LA. Avaliação da atividade física de escolares com um questionário via internet. Rev Bras Med Esporte. 2016;22(4):261–6.

18. Jesus GM, Assis MAA, Kupek E. Validade e reprodutibilidade de questionário baseado na Internet (Web-CAAFE) para avaliação do consumo alimentar de escolares de 7 a 15 anos. Cad Saúde Pública. 2017;33(5).

19. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, IL: Human Kinetics Books; 1988.

20. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012;7(4):284–94.

21. Ridley K, Ainsworth BE, Olds TS. Development of a Compendium of Energy Expenditures for Youth. Int J Behav Nutr Phys Act. 2008;5(1):45.

22. Kärmeniemi M, Lankila T, Ikäheimo T, Koivumaa-Honkanen H, Korpelainen R. The built environment as a determinant of physical activity: A systematic review of longitudinal studies and natural experiments. J Behav Med. 2018;52(3):239–51.

23. Stierlin AS, De Lepeleere S, Cardon G, Dargent-Molina P, Hoffmann B, Murphy MH, et al. A systematic review of determinants of sedentary behaviour in youth: a DEDIPAC-study. Int J Behav Nutr Phys Act. 2015;12:133.

24. Hino F, Reis RS, Ribeiro IC, Parra DC, Brownson RC, Fermino RC. Using observational methods to evaluate public open spaces and physical activity in Brazil. J Phys Act Health. 2010;7 Suppl 2:S146-154.

25. Jesus GM, Dias LA, Cerqueira P de A, Assis MAA, Kupek E. Diferenças de gênero na avaliação qualitativa de atividades físicas e sedentárias de escolares de 7 a 10 anos no nordeste brasileiro. Rev Bras Ciênc Esporte [Internet]. 2020;42.

26. Bejarano CM, Carlson JA, Cushing CC, Kerr J, Saelens BE, Frank LD, et al. Neighborhood built environment associations with adolescents' location-specific sedentary and screen time. Health Place. 2019;56:147–54.

27. Santos, ACB. Perfil de uso e prática de atividade física de crianças e Adolescentes em espaços públicos abertos em Florianópolis, Santa Catarina. 2020.

28. Evenson KR, Jones SA, Holliday KM, Cohen DA, McKenzie TL. Park characteristics, use, and physical activity: A review of studies using SOPARC (System for Observing Play and Recreation in Communities). Prev Med. 2016;86:153–66.

29. Knuth AG, Hallal P. School environment and physical activity in children and adolescents: systematic review. Rev. Bras. Ativ. Fís. Saúde [Internet]. 2013;17(6):463-7.

30. Carson V, Spence JC, Cutumisu N, Cargill L. Association between neighborhood socioeconomic status and screen time among pre-school children: a cross-sectional study. BMC Public Health. 2010;10(1):367.

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SUPPLEMENTARY MATERIALS

Supplementary Material 1 - PRISMA-P Checklist

PRISMA-ScR (Preferred Reporting Items for Systematic review and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) 2018 checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		TITLE	
Title	1	Identify the report as a scoping review.	01
		ABSTRACT	
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	02
		INTRODUCTION	
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	04
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	06
		METHODS	
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	07
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	07
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	09
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	09
Selection of sources of evidence†	9	State the process for selecting sources of evidence (e.g., screening and eligibility) included in the scoping review.	09
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	10
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	10
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	None
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	10
		RESULTS	
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	None
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	None
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	None
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	None
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	None

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		DISCUSSION	
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	11
Limitations	20	Discuss the limitations of the scoping review process.	12
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	12
		FUNDING	
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	None

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).
From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

Supplementary Material 2 – Search strategy

Draft search strategy for each electronic databases queried: PubMed (including MEDLINE), Scopus, Web of Science, IEEE Xplore Digital Library, Scielo, LILACS, Health Technology Assessment Database and CENTRAL (Cochrane Central Register of Controlled Trials).

For each search listed below, no start date and language were applied, and databases were searched from their inception or date of the earliest available publication.

	Database	PubMed (including MEDLINE)	Number of articles reached
	Descriptors/keywords		Data of search:
1#	("smartwatch sensors") OR ("smartwatch data") OR ("wrist wearables") OR (wristwatch*) OR ("wrist watch*") OR (smartwatch*) OR (fitbit) OR ("smart watch*") OR (huawei) OR (pulsewatch*) OR ("apple watch*") OR ("samsung gear*") OR (garmin) OR ("garmin fenix") OR ("garmin forerunner") OR ("g watch") OR (amazfit) OR ("jawbone up*")		
2#	("active lifestyle"[Title/Abstract]) OR (physical activity [MeSH Terms]) OR ("physical inactivity"[Title/Abstract]) OR (walking [Title/Abstract]) OR (cycling[Title/Abstract]) OR ("movement behav*" [Title/Abstract])		
3#	(sedentar*[Title/Abstract]) OR ("television viewing"[Title/Abstract]) OR ("tv viewing"[Title/Abstract]) OR (sitting [Title/Abstract]) OR ("seated time"[Title/Abstract]) OR ("screen time"[Title/Abstract]) OR ("video game"[Title/Abstract]) OR (driving [Title/Abstract])		
4#	(sleep) OR ("sleep duration"[Title/Abstract]) OR (actigra*[Title/Abstract]) OR (polysomnogr*[Title/Abstract])		
5#	#2 OR #3 OR #4		
6#	1# AND 5#		

	Database	**CENTRAL (Cochrane Central Register of Controlled Trials)**	Number of articles reached
	Descriptors/keywords		Data of search:
1#	("smartwatch sensors") OR ("smartwatch data") OR ("wrist wearables") OR (wristwatch*) OR ("wrist watch*") OR (smartwatch*) OR (fitbit) OR ("smart watch*") OR (huawei) OR (pulsewatch*) OR ("apple watch*") OR ("samsung gear*") OR (garmin) OR ("garmin fenix") OR ("garmin forerunner") OR ("g watch") OR (amazfit) OR ("jawbone up*")		
2#	(("physical activity") OR ("active lifestyle") OR ("physical inactivity") OR (walking) OR (cycling) OR ("movement behavior")):ti,ab,kw		
3#	((sedentar*) OR ("television viewing") OR ("tv viewing") OR (sitting) OR ("seated time") OR ("screen time") OR ("video game") OR (driving)):ti,ab,kw		
4#	(sleep):ti,ab,kw OR ("sleep duration"):ti,ab,kw OR (actigra*):ti,ab,kw OR (polysomnogr*):ti,ab,kw		
5#	#2 OR #3 OR #4		
6#	#1 AND #5		

	Database	Health Technology Assessment Database;	Number of articles reached
	Descriptors/keywords		Data of search:
1#	smartwatch* OR "smart watch*" OR "wrist wearables" OR wristwatch* OR "wrist watch*" OR (fitbit) OR huawei OR pulsewatch* OR "apple watch*" OR "samsung gear*" OR garmin* OR "g watch" OR amazfit OR "jawbone up*"		
2#	("active lifestyle") OR ("physical activity") OR ("physical inactivity") OR (walking) OR (cycling) OR ("movement behav*")		
3#	(sedentar*) OR ("television viewing") OR ("tv viewing") OR (sitting) OR ("seated time") OR ("sedentary lifestyle") OR ("screen time") OR ("video game") OR (driving)		
4#	(sleep) OR ("sleep duration") OR (actigra*) OR (polysomnogr*)		
5#	#2 OR #3 OR #4		
6#	#1 AND #5		

	Database	IEE Xplore Digital Library; Filtro JOURNALS & MAGAZINES	Number of articles reached
	Descriptors/keywords		Data of search:
1#	("Abstract":wristwatch* OR "Abstract":smartwatch* OR "Abstract":"smart watch*" OR "Abstract":fitbit OR "Abstract":"apple watch*" OR "Abstract":"samsung gear*" OR "Abstract":garmin* OR "Abstract":amazfit)		
2#	("Abstract":"physical activity" OR "Abstract":"physical inactivity")		
3#	("Abstract":sedentari* OR "Abstract":"screen time")		
4#	OR ("Abstract":sleep*)		
5#	#2 OR #3 OR #4		
6#	#1 AND #5		

	Database	Scielo	Number of articles reached
	Descriptors/keywords		Data of search:
1#	smartwatch OR wristwatch* OR fitbit OR huawei OR pulsewatch* OR "apple watch*" OR garmin*		
2#	"active lifestyle" OR "physical activity" OR "physical inactivity" OR walking OR cycling OR "movement behav*"		
3#	sedentar* OR "television viewing" OR "tv viewing" OR sitting OR "seated time" OR "sedentary lifestyle" OR "screen time" OR driving		
4#	sleep* OR actigra* OR polysomnogr*		
5#	#2 OR #3 OR #4		
6#	#1 AND #5		

	Database	LILACS	Number of articles reached
	Descriptors/keywords		Data of search:
1#	Words = (fitness Trackers OR smartwatch OR wristwatch OR fitbit OR huawei OR apple watch OR garmin OR wearable)		
2#	Words = (physical activity OR sleep OR sedentary behavior OR screen time)		
3#	1# AND 2#		

	Database	Scopus	Number of articles reached
	Descriptors/keywords		Data of search:
1#	smartwatch* OR "smart watch*" OR "wrist wearables" OR wristwatch* OR "wrist watch*" OR fitbit OR huawei OR pulsewatch* OR "apple watch*" OR "samsung gear*" OR garmin* OR "g watch" OR amazfit OR "jawbone up*" AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (SRCTYPE, "j"))		
2#	"active lifestyle" OR "physical activity" OR "physical inactivity" OR walking OR cycling OR "movement behav*" AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (SRCTYPE, "j"))		
3#	sedentar* OR "television viewing" OR "tv viewing" OR sitting OR "seated time" OR "sedentary lifestyle" OR "screen time" OR driving AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (SRCTYPE, "j"))		
4#	sleep* OR actigra* OR polysomnogr*		
5#	#2 OR #3 OR #4		
6#	#1 AND #5		

	Database	Web of Science	Number of articles reached
	Descriptors/keywords		Data of search:
1#	(TI= (smartwatch* OR "smart watch*" OR "wrist wearables" OR wristwatch* OR "wrist watch*" OR fitbit OR huawei OR pulsewatch* OR "apple watch*" OR "samsung gear*" OR garmin* OR "g watch" OR amarjit OR "jawbone up*")) OR AB=(smartwatch* OR "smart watch*" OR "wrist wearables" OR wristwatch* OR "wrist watch*" OR fitbit OR huawei OR pulsewatch* OR "apple watch*" OR "samsung gear*" OR garmin* OR "g watch" OR amarjit OR "jawbone up*")		
2#	(TI= ("active lifestyle" OR "physical activity" OR "physical inactivity" OR walking OR cycling OR "movement behav*")) OR AB= ("active lifestyle" OR "physical activity" OR "physical inactivity" OR walking OR cycling OR "movement behav*")		
3#	(TI= (sedentar* OR "television viewing" OR "tv viewing" OR sitting OR "seated time" OR "sedentary lifestyle" OR "screen time" OR driving)) OR AB= (sedentar* OR "television viewing" OR "tv viewing" OR sitting OR "seated time" OR "sedentary lifestyle" OR "screen time" OR driving)		
4#	(TI= (sleep* OR actigra* OR polysomnogr*)) OR AB= (sleep* OR actigra* OR polysomnogr*)		
5#	#2 OR #3 OR #4		
6#	#1 AND #5		

Supplementary material 3 - Template for data extraction

Supplementary material 3 - Template for data extraction

Category	Variables	Content	Category of answers
Study profile	Reference	First author and date of publication	ex: Silva Francisco et al 2019
	Study_type	Study design	1- Randomized clinical trial 2- Cohort study 3- Cross-sectional study 4- Longitudinal study 5- Piloto stady 6- Validation stady
	Country_study	Country of study	Open
	n_study	Number of participants	In numbers
	Sex	% of men	In percentage
Population	Populations groups	Populations groups	Specific poAdulton, Children, Adolescents, Adultos, Older Adutlt
	Range_age_sample	The age range of the study participants	Categories of age range, mean and median age will be accepted
	Smartwatch Brand	Smartwatch model	Open
	Physical_activity	PA measure	Open
	Sedentary_behavior	SB measure	Open
	Sleep	Sleep measure	Open
Intervention/Exposures	Behaviors_combination	Which combinations were used	1- PA + SB 2- PA + sleep 3- SB + sleep 4- PA + SB + sleep
	Intervention_combination	Which combination of behaviors was focus of the intervention	1- PA + SB 2- PA + sleep 3- SB + sleep 4- PA + SB + sleep
Statistical procedure	Statistical_analysis	Which statistical procedure was employed to analyze the validation stady	Open
Outcomes	Health_outcomes	Which outcomes were evaluated	Open
Main results	Descriptive_synthesis	Descriptive synthesis of the results for each outcome	Open

PA = physical activity; SB =– sedentary behaviour