Revista CEFAC

eISSN 1982-0216

DOI: 10.1590/1982-0216/202325110522 | Rev. CEFAC. 2023;25(1):e10522

Review articles

Evaluating the use of wearables in the masseter and temporal muscles: a scoping review protocol

Alana Moura Xavier Dantas[1]
Leonardo Wanderley Lopes[2]
Naiara de Oliveira Farias[3]
Hilton Justino da Silva[1]

[1] Universidade Federal de Pernambuco - UFPE, Recife, Pernambuco, Brasil.
[2] Universidade Federal da Paraíba - UFPB, João Pessoa, Paraíba, Brasil.
[3] Universidade Federal de Campina Grande - UFCG, Patos, Paraíba, Brasil.

ABSTRACT

Purpose: to develop a scoping review protocol that seeks to identify which procedures and for what purpose wearables available in the literature are being used on the masseter and temporal muscles.

Methods: the approach recommended by The Joanna Briggs Institute and the PRISMA-P guidelines, will follow. Databases to be searched include PubMed, Cochrane Library, LILACS, Scopus, Web of Science, Embase and grey literature. In the first step, two reviewers will independently evaluate the articles by titles and abstracts, then, a full review of the selected articles will be performed according to the inclusion and exclusion criteria. Any uncertainties or differences of opinion will be discussed for consensus. Articles published without date or language restrictions will be included. All components will be presented in tables and flow charts. In addition, a narrative summary of each component will be included for further details.

Final Considerations: this protocol will present the general state of the literature on the use of wearables in masseter and temporal masticatory muscles.

Keywords: Wearable Electronic Devices; Masseter Muscle; Temporal Muscle; Masticatory Muscles; Review

Study conducted at Universidade Federal de Pernambuco, Recife, Pernambuco, Brasil.

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

Conflict of interests: Nonexistent.

Corresponding author:
Hilton Justino da Silva
Departamento de Fonoaudiologia
CEP: 50740-520 - Recife, Pernambuco, Brasil
E-mail: hiltonfono@hotmail.com

Received on: July 13, 2022
Accepted on: January 17, 2023

INTRODUCTION

In the 1960s, the concept of wearable technology was first proposed by Edward O Thorp[1], a professor of mathematics at the Massachusetts Institute of Technology in the United States. Since then, wearables have received considerable attention from researchers around the world. In recent years, with the development of the Internet, smart hardware, and big data, wearables have developed rapidly in various fields[2]. In healthcare, in the form of portable medical devices or health electronics that can be worn directly on the body and can perceive, record, analyze, regulate and intervene to maintain health or even be used to treat diseases with the support of various technologies for identification, detection, connection, cloud services and storage[3].

By intelligently integrating mechanical functions with microelectronics and computing power, wearables can be used to achieve immediate detection of patient signals and laboratory indicators and provide exercise guidance, medication administration reminders, and so on. Real-time detection of patient parameters and accurate, intelligent online analysis of physiological and pathological information are also possible. In this way, the devices can be used to perform self-diagnosis and self-monitoring[4].

Biometric monitoring devices (BMDs) are sensors embedded in smartphones, wearables (e.g., wristbands, skin patches), or everyday objects (e.g., bottles with smart caps) that offer the opportunity to collect patient biological, physiological, or behavioral data continuously, remotely, and unobtrusively[1]. In addition, BMDs enable the measurement of health, disease progression, and treatment effects in real-life situations, from patient homes, and from widely dispersed participants living in distant locations and/or for whom mobility is limited[2].

The possible benefits that wearables can bring to the health area are diverse and their use to measure results in clinical research is growing. However, they still have negative points such as high cost, incorrect use by patients, professionals not trained to use these technologies, and difficulty in patient acceptance, among other points that underuse wearables. When used locally, as in the region of the masticatory muscles, they also have their limitations, such as short battery life, need to self-report when eating, need to turn the equipment on and off, more than one sensor to analyze mastication, among other limitations[5], which have been tried to be solved in the development of new equipment. For these reasons, the authors chose to develop a scoping review to systematically map the research done in this area, as well as to identify possible knowledge gaps. As each wearable technology differs in components, function, and purpose, researchers must be familiar with all these parameters to ensure that studies are selected appropriately.

Therefore, this manuscript aims at developing a scoping review protocol that seeks to identify which procedures and for what purpose the wearables available in the literature are being used in the masseter and temporalis muscles. To do this, it will be necessary to: (1) identify the wearables that are being used in masseter and temporalis muscles; (2) evaluate the characteristics regarding location, type and parameters of the sensor; (3) identify the outcomes investigated in the research with the devices; (4) detail the characteristics of the research (sample, target population, methodology, stages of sensor development, clinical application, protocol of use, measurements extracted, duration and condition of monitoring, indication); and (5) note the difficulties related to the topic for future solutions.

METHODS

Before developing the present review protocol, the following sources were examined to identify the existence of any previously or currently ongoing published systematic reviews or scoping reviews on a similar or identical topic: MEDLINE (PubMed), Embase, and Cochrane Database of Systematic Reviews. No relevant documents were located.

Thus, this proposed scoping review protocol will follow the approach recommended by The Joanna Briggs Institute[6] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-P)[7]. Protocol registration was previously performed at OSF Registration, under-identification osf.io/62z5t/. The methodology for scoping reviews was chosen for its suitability to address the proposed topic, that is, the identification and evaluation of wearables used in masseter and temporal muscles in adults that have been described in the literature.

To this end, a research question will guide the conduct of the review through the acronym PCC (P -population, C -concept and C -context)[6], which is the most appropriate strategy for this type of review. The following PCC, described in Chart 1, was considered for this study.

Chart 1. Population Concept Context

Mnemonic PCC	Description
Population (P)	Sensor-monitored adults
Concept (C)	Wearables
Context (C)	Masseter and Temporal

Caption: Mnemonic PCC (Population, Concept and Context)

The review question, based on the PCC strategy will be: What procedures and for what purpose are wearables on the masseter and temporalis muscles being used?

Eligibility Criteria

Inclusion criteria will be studies with wearables worn by adults aged 18-59 years, using these devices on the masseter and temporalis muscles, published in any language, covering all sources of national and international literature, without time restriction, evaluating the activity of these muscles. This review will consider primary studies including randomized clinical trials, non-randomized clinical trials, prospective and retrospective cohort studies, and case-control studies. Conference abstracts, editorials, opinion articles, animal studies, in vitro studies, and protocols will be excluded due to the inability to extract study parameters and outcome data.

Search Strategy

The search strategy for this scoping review protocol will aim to be as comprehensive as possible to identify published and unpublished studies. A three-stage search strategy will be used.

The first stage will be an initial search of relevant articles. To compose the search strategy in MEDLINE, the words of the text contained in the title and abstract, and the keywords used to describe the article are retrieved.

This initial search is followed by a second search, which will be adapted for each database. Then the reference list of all included reports and articles will be searched for further studies. For inclusion in this review, no filters or language restrictions will be applied to the search.

The databases to be searched include MEDLINE, Cochrane Library, Scopus, Web of Science, and Embase. Sources of unpublished studies and gray literature will be Google Scholar, ProQuest, and MedNar. The initial search strategy that will be used when searching the MEDLINE (PubMed) database is shown in Chart 2.

Chart 2. Search strategy - Medline via PubMed (search conducted on October 27, 2022)

Search	Keyword	Records found
#1	("monitoring, physiologic"[MeSH Terms] OR "monitoring physiologic"[All Fields] OR "physiological monitoring"[All Fields] OR "Patient Monitoring"[All Fields] OR "monitor"[All Fields] OR "monitoring system"[All Fields] OR "wearable health monitoring"[All Fields] OR "activities of daily life"[All Fields])	374.096 results
#2	("accelerometry"[MeSH Terms] OR "accelerometry"[All Fields] OR "inventions"[MeSH Terms] OR "inventions"[All Fields] OR "machine learning"[MeSH Terms] OR "machine learning"[All Fields] OR "telemedicine"[MeSH Terms] OR "telemedicine"[All Fields] OR "wearable electronic devices"[MeSH Terms] OR "wearable electronic device"[All Fields] OR "signal processing, computer assisted"[MeSH Terms] OR "smartphone"[MeSH Terms] OR "smartphone"[All Fields] OR "mobile applications"[MeSH Terms] OR "mobile applications"[All Fields] OR "computer neural network"[All Fields] OR "accelerometer"[All Fields] OR "mobile health"[All Fields] OR "wearable technology"[All Fields] OR "wearable devices"[All Fields] OR "wearable technologies"[All Fields] OR "wearable device"[All Fields] OR "digital signal processing"[All Fields] OR "wearable electronic device"[All Fields] OR "wearable electronic devices"[All Fields] OR "sensor"[All Fields])	412.645 results
#3	("masticatory muscles"[MeSH Terms] OR "masticatory muscles"[All Fields] OR "masseter muscle"[MeSH Terms] OR "masseter muscle"[All Fields] OR "temporal muscle"[MeSH Terms] OR "temporal muscle"[All Fields] OR "mastication"[MeSH Terms] OR "mastication"[All Fields] OR "masticatory muscle"[All Fields] OR "muscle activity"[All Fields] OR "masseter muscles"[All Fields] OR "temporal muscles"[All Fields] OR "chewing"[All Fields])	53.294 results
#4	#1 AND #2 AND #3	172 results

Study selection

After the search, all identified records will be collected and uploaded into EndNote reference management *software* (Clarivate Analytics, PA, USA) and duplicates removed. Studies will then be imported into Rayyan (Qatar Computing Research Institute, Doha, Qatar), where two reviewers will complete title and abstract screening blindly and independently, as allowed by the application, and selected studies will be evaluated according to the predefined inclusion criteria. Potentially relevant studies will be retrieved and read in full. The full text will then be assessed in detail against the inclusion criteria by the two independent reviewers. Reasons for the exclusion of full-text articles will be recorded and reported in the scoping review. Any disagreements that arise between the reviewers at each stage of the selection process will be resolved by a third reviewer or through discussion. The results of the search will be reported in full in the scoping review according to the PRISMA extension for scoping reviews (PRISMA-ScR) and presented in a PRISMA flow chart[8].

Data extraction

Data extraction will be performed by the two reviewers independently using a data extraction tool developed by the reviewers. Key information to be extracted will include technology type, sensor type, integrated sensors, comparison with another sensor, time of use, experiment location, purpose, clinical application, methodology, sample, battery time, and parameters used (frequency, filter, etc.), among others. This scoping review will help guide healthcare professionals in choosing the most appropriate instrument for various purposes. In addition, various components of each study will be extracted and summarized. The tool developed to extract the data will be modified according to the data extraction process and the evidence sources selected. The form of extraction is shown in Chart 3.

Chart 3. Data extraction tool

Title of the article:	
Author(s):	
Year of publication:	
Journal:	
Institution(s) where the study was conducted:	
POPULATION	
Sample Size:	
Sex:	
Age group:	
Medical Condition:	
CONCEPT	
Wearable technology used:	
Sensor type:	
Integrated sensors:	
Comparison to other sensors:	
Wearing time:	
Location of the experiment:	
Purpose:	
Clinical application:	
Methodology:	
Sensor Development Stage:	
Battery Time:	
Parameters used in the sensor:	
Critical aspects of the device:	
CONTEXT	
Location of sensor attachment:	
Monitoring condition:	

Data analysis and presentation

The data will be evaluated according to the research objectives, characterizing the methodologies used in the studies, both quantitatively and qualitatively. The findings of this review will be useful for practitioners to select an appropriate type of wearable technology for each type of indication in their day-to-day clinical practice, as well as to guide research on the need for further research in specific areas.

All components will be presented in tables and flow charts. In addition, a narrative summary of each component will be included to provide more detail, linking the findings to the research question and objectives.

DISCUSSION

Wearable Technologies are accessories used with the function of transmitting data, via the internet, for monitoring vital functions of the human body, among other functions. Wearable health devices provide their users with instant data on their activities and allow them to track advanced performance metrics including step count, heart rate, body fat percentage, sleep quality, stress levels, menstrual cycle, and fertility windows[9].

One of the goals of these devices and apps is to provide real-time feedback to patients so that they see data that illustrate how their destructive behaviors affect them physically, providing additional motivation to manage their health more proactively. Healthcare professionals need to be able to access and interpret personalized health data, as well as distill it into usable teaching points. In the past, physicians often took an authoritarian approach to health and fitness education that did little to encourage active patient participation. By employing a patient-centered approach using data collected from wearable devices, healthcare professionals have the opportunity to work closely with patients to impart measurable skills and behaviors in a real and tangible way, with the ability to track that progress over time, reducing healthcare costs[10].

In addition, developments in deep learning, a branch of machine learning, have shown increasing promise for the clinical use of wearables in healthcare. The integration of wearable technology and deep learning algorithms into the clinical pathway can aid in the processing and analysis of immense volumes of data to potentially aid in new disease phenotyping, disease surveillance, and complex decision-making[11].

Currently, in the wearables arena, most of the data collected are not used to build predictive models that are successively integrated into the clinical setting. And the current quest for knowledge around wearables is still mainly focused on technical aspects such as design, reliability and validity in controlled environments[12]. While this type of evidence remains important, the next phase towards clinical adoption will be the ability to accurately and reliably transform physiological data collected by wearables into a meaningful clinical decision, as current clinical diagnostics generally provide decisions by comparing physiological data with various heuristically defined thresholds. However, this scheme is only good for a human expert, but not for a fictitious machine. A trained physician can consolidate all the necessary data and replace relevant numbers with intuitive information to finalize his diagnosis, but a machine cannot perform such replacements. Computerized diagnosis aims to replace human intuition with various comprehensive algorithms and complicated criteria. However, the replacement has not yet been achieved. Thus, the ideal computerized assistance must evaluate the statistical significance of the findings and expand the scope of human experts to perform time-consuming and large-quantity investigations, as well as not mimic human processes. Technological advances have improved backward and forward inference to provide new evidence for quality judgment by human experts[13].

Far beyond diagnosis, the role of wearable devices in the *p-health* paradigm, i.e., participation, prevention, prediction, preemption, pervasive and personalized, has been highlighted[14]. With various technologies essential for patient monitoring, wireless devices and microchips contribute to the success of future applications[15]. To monitor chronic diseases and perform preventive care, pervasive computing is necessary to seek patient acceptance[16].

However, there are many difficulties to be faced, including high costs to miniaturize the technologies and make them lightweight, battery, sensors to implement connectivity, ethical, legal, data security, reliability and related service delivery issues among healthcare services[9].

Currently, no literature compiles masseter and temporal wearables that describe the activities of these muscles. A scoping review will fill existing gaps in the literature, providing a knowledge base on how research has been conducted in the area, and understanding the impact of these technologies scientifically or clinically. An initial search was conducted in the Cochrane Database of Systematic Reviews, JBI Evidence Synthesis, and PubMed on May 23, 2022 and did not reveal any existing scoping reviews or systematic reviews on this topic.

Thus, this scoping review aims to answer the research question by mapping the profile of publications and to plan future intervention strategies using new studies, filling in the gaps that still need to be further investigated.

The relevance of this scoping review protocol is in compiling and disseminating the wearables that are being studied, being of great importance both for clinical practice, regarding the devices that are already in clinical use, and for the scientific area, in the advancement of research on devices that are still being tested to progress to their clinical use and not be wasted. Since this is a scoping review, the methodological quality and risk of bias of the studies will not be evaluated. Adjustments in the search strategy may be necessary during the process, considering the investigative nature of scoping reviews.

FINAL CONSIDERATIONS

Understanding the research being developed with wearables in the masseter and temporalis muscles, by mapping and presenting the results proposed here, will allow professionals to know the current literature and its clinical application, revealing an analysis of the theme, to identify possible gaps that can be addressed in future studies and evidence-based clinical practice.

REFERENCES

1. Amft O, Tröster G. On-body sensing solutions for automatic dietary monitoring. IEEE Pervasive Comput. 2009;8(2):62-70. https://doi.org/10.1109/MPRV.2009.32.

2. Khan Y, Ostfeld AE, Lochner CM, Pierre A, Arias AC. Monitoring of vital signs with flexible and wearable medical devices. Adv Mater. 2016;28(22):4373-95. https://doi.org/10.1002/adma.201504366. PMID: 26867696.

3. Haghi M, Thurow K, Stoll R. Wearable devices in medical internet of things: scientific research and commercially available devices. Healthc Inform Res. 2017;23(1):4-15. https://doi.org/10.4258/hir.2017.23.1.4. PMID: 28261526.
4. Guk K, Han G, Lim J, Jeong K, Kang T, Lim EK et al. Evolution of wearable devices with real-time disease monitoring for personalized healthcare. Nanomaterials. 2019;9(6):1-23. https://doi.org/10.3390/nano9060813. PMID: 31146479.
5. Liu J, Johns E, Atallah L, Pettitt C, Lo B, Frost G et al. An intelligent food-intake monitoring system using wearable sensors. Proc 9th Int Conf Wearable Implantable Body Sens Netw. 2012;154-60.
6. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker DSC. Guidance for conducting systematic scoping reviews. Int J Evid Based Heal. 2015;13(3):141-6. https://doi.org/10.1097/XEB.0000000000000050. PMID: 26134548.
7. Moher D, Liberati A, Tetzlaff J, Altman DG, Prisma T. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Int J Surg. 2010;8(5):336-41. https://doi.org/10.1371/journal.pmed.1000097. PMID: 19621072.
8. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467-73. https://doi.org/10.7326/M18-0850. PMID: 30178033.
9. Chan M, Estève D, Fourniols JY, Escriba C, Campo E. Smart wearable systems: current status and future challenges. Artif Intell Med. 2012; 56(3):137-56. https://doi.org/10.1016/j.artmed.2012.09.003. PMID: 23122689.
10. Alvarez C, Greene J, Hibbard J, Overton V. The role of primary care providers in patient activation and engagement in self-management: a cross-sectional analysis. BMC Health Serv Res. 2016;16(1):1-8. https://doi.org/10.1186/s12913-016-1328-3. PMID: 26969293.
11. Waring J, Lindvall C, Umeton R. Automated machine learning: review of the state-of-the-art and opportunities for healthcare. Artif Intell Med. 2020;104(October 2019):101822. https://doi.org/10.1016/j.artmed.2020.101822. PMID: 32499001.
12. Khundaqji H, Hing W, Furness JCM. Smart shirts for monitoring physiological parameters: scoping review. JMIR Mhealth Uhealth. 2020;8(5):e18092. https://doi.org/10.2196/18092. PMID: 32348279.
13. Tang WH, Ho WH, Chen YJ. Data assimilation and multisource decision-making in systems biology based on unobtrusive internet-of-things devices. Biomed Eng Online. 2018;17(s2):1-13. https://doi.org/10.1186/s12938-018-0574-5. PMID: 30396337.
14. Teng XF, Zhang YT, Poon CCY, Bonato P. Wearable medical systems for p-Health. IEEE Rev Biomed Eng. 2008;1:62-74. https://doi.org/10.1109/RBME.2008.2008248. PMID: 22274900.
15. Jara AJ, Zamora-Izquierdo MA, Skarmeta AF. Interconnection framework for mHealth and remote monitoring based on the internet of things. IEEE J Sel Areas Commun. 2013;31(9):47-65. https://doi.org/10.1109/JSAC.2013.SUP.0513005.
16. Tentori M, Hayes GR, Reddy M. Pervasive computing for hospital, chronic, and preventive care. Found Trends Human-Computer Interact. 2011;5(1):1-95. https://doi.org/10.1561/1100000024.

Author contributions:

AMXD and NOF participated in the elaboration of the method and writing of the first version of the article;

LWL and HJS participated in the design, guidance on methodological conduction, and critical review of the final version of the article.