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DO THEY KNOW WHAT IT MEANS? PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR KNOWLEDGE IN ADULTS

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Dissertação defendida em provas públicas para a obtenção do grau de Mestre em Exercício e Bem-Estar, no curso de Mestrado em Exercício e Bem-Estar, Especialização em Exercício, Nutrição e Saúde conferido pela Universidade Lusófona de Humanidades e Tecnologias, com o Despacho de Nomeação de Júri Nº 05/2022, de 7 de janeiro de 2022, com a seguinte composição:

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RESUMO

Objetivo: A presente dissertação tem como objetivo investigar o conhecimento e compreensão dos adultos sobre as definições de atividade física (AF) e comportamento sedentário (CS). Os objetivos secundários são determinar a associação entre o nível de conhecimento destes conceitos e o tempo despendido em CS e AF, bem como com a idade, escolaridade, tempo de sono, o facto de ter um amigo ou familiar que trabalhe na área da saúde ou exercício e ainda com o índice de massa corporal (IMC), assim como verificar diferenças entre sexos.

Método: A dissertação está dividida em duas partes. A primeira é uma revisão sistematizada sobre a compreensão, conhecimento e perceção de adultos sobre os conceitos de AF e CS. A pesquisa foi realizada em duas bases de dados, a PubMed e a SPORTDiscus. Foram encontrados 1347 artigos, sendo que 9 cumpriram os citérios de inclusão e foram considerados na revisão. A qualidade dos estudos foi avaliada através dos critérios EPPI, tendo 4 estudos sido avaliados com a máxima qualidade, ou seja, elevada fiabilidade e elevada utilidade.

A segunda parte é uma investigação observacional transversal sobre o conhecimento, destes mesmos conceitos e a sua associação com as variáveis supramencionadas em 300 adultos de língua portuguesa. Foi criado um questionário que mediu o conhecimento dos participantes por via de scores (score total, score da AF e score do CS) que eram pontuados a cada resposta correta (1 ponto). Os scores de conhecimento foram associados às variáveis da idade, AF, CS, nível de escolaridade, IMC, horas de sono, amigo ou familiar ligado à saúde ou exercício e comparados entre sexo. A análise estatística foi realizada em SPSS (v. 25.0). A comparação entre grupos foi realizada através da análise One-way ANOVA, as associações entre duas variáveis contínuas foram realizadas por via de correlações e regressões lineares, e associações entre variáveis contínuas e variáveis categóricas foram realizadas através de regressões logísticas e coeficiente de Spearman. Um *p-value*<0,05 foi considerado significante.

Resultados: A revisão demonstrou que muitos participantes interpretam AF como exercício ou como atividades mais intensas. O CS foi interpretado como estar sentado ou não fazer nada, sendo por vezes associado a dormir. A investigação original demonstrou que os participantes sabiam diferenciar AF de exercício físico (64.3%) e que o CS incluía, para além de estar sentado, também estar deitado (72.7%) e não incluía dormir (95.3%). Não foi encontrada diferença no conhecimento entre sexos ou níveis de escolaridade. Não foi encontrada associação entre conhecimento e nível de AF ou CS (p>0,05). Maior idade

(p=0.007) e IMC (p=0.034) estão associados a um menor conhecimento. Participantes com mais horas de sono (+5h) tinham um maior conhecimento (p<0.05), tal como os participantes que tinham alguém próximo (familiar ou amigo) na área do exercício ou saúde (p=0.018).

Conclusões: A interpretação dos conceitos de AF e CS difere. A AF ainda é várias vezes entendida apenas como exercício físico. O comportamento sedentário parece ser melhor percecionado, uma vez que tem menos conceitos com os quais poderá ser confundido. Os participantes da investigação original pareceram demonstrar mais conhecimento que os participantes da revisão. No entanto, é necessário ter em conta que esta era uma amostra de elevado nível de escolaridade. As duas questões, no artigo original, que geraram mais respostas erradas estão relacionadas com as recomendações sobre AF da Organização Mundial de Saúde e com a classificação do estar em pé como AF, indicando que estes dois temas necessitam de uma atenção especial aquando da transmissão de informação ao público.

***Palavras-chave**: atividade física; comportamento sedentário; conhecimento; perceção; compreensão*

ABSTRACT

Objective: The present dissertation aims to investigate physical activity (PA) and sedentary behavior (SB) knowledge and understanding in adults. The secondary objectives are to determine the association between the level of knowledge of these concepts and the time spent in SB and PA, as well as with age, education, sleep time, having a friend or family member in the health or exercise field, and with the body mass index (BMI), and comparisons between genders.

Method: The dissertation is divided in two parts. The first is a systematized review of adults' understanding, knowledge, and perception of the concepts of PA and SB. The research was carried out in two databases, PubMed and SPORTDiscus. We found 1347 articles, 9 of which met the inclusion criteria and were included in the review. The quality of the studies was assessed using the EPPI criteria, with 4 studies being evaluated with the highest quality, i.e., high reliability and high usefulness. The second part is a cross-sectional observational investigation into the knowledge of these same concepts and their association with the aforementioned variables in 300 Portuguese-speaking adults. A questionnaire was created to

measure the participants' knowledge through scores (total score, PA score, and SB score) that were scored for each correct answer (1 point). Knowledge scores were associated with different variables such as age, PA, SB, education level, BMI, hours of sleep, friend or family member in the health or exercise field. Statistical analyses were performed using SPSS program (v. 25.0). Comparison between groups was performed using One-way ANOVA analysis, associations between two continuous variables were performed using correlations and linear regressions, and associations between continuous and categorical variables were performed using logistic regressions and Spearman coefficient. A p-value<0.05 was considered significant.

Results: The review showed that many participants interpret PA as exercise or as more intense activities. SB was interpreted as sitting or doing nothing, being sometimes associated with sleeping. The original investigation showed that participants knew how to differentiate PA from physical exercise (64.3%) and that SB included, in addition to sitting, also lying down (72.7%) and did not include sleeping (95.3%). There was no difference in knowledge between genders or educational levels. No association was found between knowledge and level of PA or SB (p>0.05). Higher age (p=0.007) and BMI (p=0.034) were associated with lower knowledge. Participants with more hours of sleep (+5h) had greater knowledge (p<0.05) as did participants who had someone close (family or friend) in the field of exercise or health (p=0.018).

Conclusions: The interpretation of the concepts of AF and SB differs. PA is still often understood as physical exercise. SB seems to be better perceived as it has fewer concepts to be confused with. Participants in the original investigation appeared to demonstrate more knowledge than participants in the review. However, it is necessary to mention that this was a sample with a high level of education. The two questions, in the original article, that generated more wrong answers were related to the recommendations of PA from the World Health Organization and the classification of standing as PA, indicating that these two topics need special attention when transmitting information to the public.

Keywords: *physical activity; sedentary behavior; knowledge; perception; understanding*

ABBREVIATIONS

BMI	body mass index
EPPI	evidence for policy and practice information
IPAQ	international physical activity questionnaire
MET	metabolic equivalent of task
MS	multiple sclerosis
OR	odds ratio
PA	physical activity
PAQ	physical activity questionnaire
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
SB	sedentary behavior
ST	sitting time
USA	United States of America
WHO	World Health Organization

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CHAPTER I
DISSERTATION INTRODUCTION

Context

Physical activity (PA) is "any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al., 1985). Sedentary behavior (SB) is "any waking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalent of task (METs), while in a sitting, reclining, or lying posture (Tremblay et al., 2017)

Health and PA have been associated since Hippocrates (460-370 B.C.), who advised a combination of eating and exercising as essential to promote health (Berryman, 2010) and evidence for this association has been accumulating over the last few decades (Hills et al., 2015). However, physical inactivity is growing notably (World Health Organization [WHO] 2018), causing it to be characterized as a global pandemic, representing the forth greatest cause of death worldwide (Kohl et al., 2012).

The 2018 Eurobarometer showed that 15% of Europeans did not walk for 10 consecutive minutes in a week and that 12% spend more than 8.5 hours/day in a sitting position (*Eurobarometer*, 2018). If PA benefits and physical inactivity dangers are, today, well known, how can we explain the growing number of people not partaking in any kind of PA? Technology and economic evolution certainly play a big role in this growing behavior (WHO, 2018) but could there be something else explaining these trends?

Multiple studies have shown a deeper misinterpretation not only related to PA terms but also to the meaning of common words (Heather et al., 2013). In addition to that, cognitive biases are one of the main problems with self-report instruments, and can lead people to believe they are more physically active than they actually are (Ekelund et al., 2020).

In this sense, understanding the definitions of PA, SB and other related constructs is key for any person, especially when it comes to answer questions like "Do you engage in PA?". The aim of this dissertation is to investigate adult's knowledge and understanding about PA and SB constructs, among distinct groups based on the amount of PA, SB, level of education, age, and other variables.

CHAPTER II
DISSERTATION METHOD

Method and Organization

This dissertation is composed by two studies. They can be found on Chapter III.

The first one, Chapter III.1, is a systematized review about adults' knowledge regarding PA and SB constructs. We searched PubMed and SPORTDiscus databases for papers examining adults' knowledge, perceptions, and understanding about PA and SB definitions, from inception to the 13th of April 2021. In addition, we included hand-searched articles from several reference lists. Nine studies were included, and their quality was assessed by an adapted version, for adults, of evidence for policy and practice information (EPPI) criteria.

The second study, Chapter III.2, is an original investigation on Portuguese speaking adults' understanding regarding these concepts. Based on the conclusions of the systematized review, we used the main perceptions and misconceptions shown by participants in the review to ask Portuguese adults their opinion about what behaviors they regarded as PA and SB in all its forms. A questionnaire with a total of fifteen questions was developed to quantify how many people correctly perceived PA and SB concepts in its different forms.

The dissertation ends, in Chapter IV, with a general discussion and conclusion, where we examine the most significant findings of both studies. Based on the results, we also suggest further investigation on this topic.

CHAPTER III
DISSERTATION OUTCOMES

III. 1 SYSTEMATIZED REVIEW

Do they Know What it Means?
Physical Activity and Sedentary Behavior Knowledge in Adults – Systematized Review of Qualitative Studies

III.1.1 Abstract

Aim: Multiple studies have shown a deeper misinterpretation not only related to PA terms but also to the meaning of common words. In a qualitative study of responses to questions in Physical Activity Questionnaires, some participants showed difficulty in understanding what was being asked, leading the investigators to believe that they were not getting accurate information. Data clearly exposes some uncertainty regarding the information we receive from self-reported questionnaires, which raises a question: Are the answers we are getting a true reflection of the reality? Our goal in the current investigation is to investigate: Can adults really define and understand PA and SB concepts?

Method: We searched PubMed and SPORTDiscus databases for papers examining adults' knowledge, perceptions, and understanding about PA and SB definitions, from inception to the 13th of April 2021. We used a combination of the keywords 'perceptions' OR 'definition' OR 'knowledge' AND 'physical activity' AND sedentary behavi*. To be included in this review, full-text articles had to be written in English, had to include participants' definition, or understanding, or perception of PA and/or SB, and had to study adult population (+18 years old).

Results: 9 investigations were included in this review with a total of 318 participants. All studies were about specific populations regarding gender, or medical conditions, or older age. PA construct was frequently misunderstood. Many participants perceived PA as exercise or leisure activities that required a higher intensity than basic daily activities. SB was defined as

every activity done while sitting, SB had a negative connotation such as “vegetating”. Few participants thought of naps and sleep as SB.

Conclusion: PA and SB´s definitions and perceptions vary greatly and there is still need for further investigation on this topic, on general population, and to establish deeper associations on why this occurs. PA seems to be, in many cases, misconceived as exercise. SB appears to be better understood, probably because, unlike PA it does not have a similar behavior to be confused with.

III.1.2 Introduction

Regular PA has shown to result in various health benefits (Hills et al., 2015). This connection hardy composes a novelty, as it has been acknowledged since Hippocrates (460-370 B.C.), who already advised a combination of eating and exercising as essential to promote health, perpetuating the idea that exercise is also medicine (Berryman, 2010).

As world technology and economy evolve, we have been observing an ongoing decrease in PA and increase in SB (WHO, 2018) which have been negatively impacting our health (Thompson et al., 2020). In 2013, physical inactivity costed, worldwide, 53.8 billion international dollars (INT$) to the health-care systems (Ding et al., 2016). Physical inactivity is a modifiable risk factor for innumerable noncommunicable diseases (NCDs), such as cancer, type 2 diabetes, cardiovascular, and chronic respiratory diseases (WHO, 2018). Physical inactivity has also been associated with metabolic syndrome, obesity, depression, and an increased risk of all-cause mortality in adults (Thompson et al., 2020).

According to the World Health Organization (WHO), NCDs are responsible for about 71% of all deaths worldwide, killing 41 million people each year (WHO, 2018). A recent review and meta-analysis showed that SB has been linked to a gradual mortality increase starting at about 7.5 hours of SB/day, with this association being stronger above 9.5 hours per day (Ekelund et al., 2019). On the other hand, although higher levels of PA at any intensity are associated with a lower risk of premature mortality (Ekelund et al., 2019), high levels of moderate intensity PA (60-75 min/day) only seem to eliminate the increased risk of death

associated with overall sitting time (ST) but not with TV-viewing time, a specific SB (Ekelund et al., 2016).

Regardless of this fact, there is still a wide number of people who do not engage in any PA in Europe (*Eurobarometer*, 2018). The 2018 Eurobarometer showed that 15% of Europeans did not walk for 10 consecutive minutes in a week and that 12% spend more than 8.5 hours/day in a sitting position (*Eurobarometer*, 2018). In Portugal, numbers tend to match with the European trend as 29% of inquired people revealed not to walk for 10 consecutive minutes in a week and 10% declared spending more than 8.5 hours/day in a sitting posture. In addition to that, 74% of the sample reported not to practice any exercise or sport and 64% denied partaking in any other type of PA such as cycling, dancing, or gardening (*Eurobarometer*, 2018).

Santos and colleagues assessed sedentary time and its patterns of accumulation during waking hours via accelerometry, in a representative sample of 4575 Portuguese participants aged 10-102 years old (Santos et al., 2018). It was found that in female adults, sedentary time ranged from 7.6 hours/day (at ages 45-49) to 8.8 hours/day (at ages 20-24), while older women (85+) reached 10.2 hours per day of sedentary time. Concerning male adults, their sedentary time ranged from 8.3 hours (50-54 years) to 8.8 hours (35-39 years), while older men (85+) reached 9.6 hours of sedentary time. This means that during adulthood a Portuguese woman is at least, in a best-case scenario, 7.6 hours/day of waking period in sedentary time. For a Portuguese man this number is 8.3 hours/day. These findings seem to contradict the self-reported Eurobarometer answers, where only 10% of the inquired declared spending more than 8.5 hours/day in a sitting position.

One of the main problems with self-report instruments is their tendency to cognitive biases, such as recall bias, that can lead people to believe they are more physically active than they actually are (Ekelund et al., 2020). A 2020 systematic review and meta-analysis compiling 185 studies and 55.199 participants compared self-reported and device measured SB in adults, showing that self-reported SB was underestimated by ~1.74 hours/day (Prince et al., 2020). According to this investigation, under-reporting SB resulted mainly from single question measures (e.g., International PA Questionnaire – IPAQ), while multi-item questionnaires, ecological momentary assessments (EMAs), and diaries presented more concordance with the objective data. There was no significant difference, in SB, between these instruments and inclinometers (Prince et al., 2020). However, there was a great amount of individual variability with half of the sample over-reporting and another half under-reporting SB. In the same way, a 2011 review (Lee et al., 2011) found that, in most studies, the IPAQ-short form (SF) overestimated PA level by 36% to 173%, with only one study underestimating it by 28%.

Data clearly exposes some uncertainty regarding the information we receive from self-reported questionnaires, which raises a question: Are the answers we are getting a true reflection of the reality? We now know that general population erroneously evaluates or estimates their SB and PA. This can happen for several reasons. One of them is the already mentioned cognitive bias that comes with self-reported instruments. Even though this could be a major concern, there may be other issues to consider. While it is possible that questions are not being perfectly put and explained to participants, our goal in the current investigation is to investigate: Do they really know what these questions mean? Concepts like SB and PA are widely used and possibly familiar to the public. But can they really define each of these concepts? Can they tell the difference between exercise and PA? Do they know if sleeping is considered a SB? Do they know that working on the computer while sitting is a SB? What about standing? Do they know that daily basic activities are also PA?

In the first Portuguese Physical Activity Barometer (Silva et al., 2018) a nation-wide survey performed in 2016 with a representative sample of 1068 adults, 43% of the participants did not perceive daily activities, such as stair climbing or standing, as PA and only 2% were aware of the WHO PA recommendations. In spite of that, 76% believed that PA was important for good health and 100% of the sample believed that regular PA improves quality of life (Silva et al., 2018). In addition to that, in a 2020 cross-sectional investigation, encouraged by the Portuguese General Health Direction (DGS), 45% of the inquired participants acknowledged having some difficulty understanding health-related information (Direção Geral da Saúde [DGS], 2020). This question was made to understand health literacy defined as the cognitive and social abilities and personal capability to obtain, understand, and use information to promote and maintain good health (DGS, 2020).

Multiple studies have shown a deeper misinterpretation not only related to PA terms but also to the meaning of common words. In a qualitative study of responses to questions in IPAQ and PA scale for Elderly (PASE) (van Uffelen et al., 2011), some participants showed difficulty in understanding what was being asked. The misunderstanding rouse from only reporting the activities provided as examples, not comprehending the use of the word "weekday" or the meaning of "sitting activities", leading the investigators to believe that they were not getting accurate information.

Another investigation concerning the qualitative attributes and quantitative measurement properties of PA questionnaires (PAQs) (Heather et al., 2013), observed problems in the participants' ability to understand ambiguous terms such as "posture" or "activity". Heather and colleagues interviewed 22 adults, aged 23-74 years, aiming to evaluate

the Sedentary Time and Activity Reporting Questionnaire (STAR-Q). Participants misunderstood different terms, such as activity, posture, dinning, and naps. They also wondered if, instead of the last 4 weeks, they could report their usual activity habits. Interviewees expressed difficulty in categorizing walking and shopping as a light intensity activity as they were not listed in the examples. The same happened regarding "walking to a store to get groceries", where participants were confused whether to classify it as exercise or transportation which led to double-counting.

In 2015, Finger and colleagues aimed to examine how two different PAQs performed in diverse segments of population in Europe (Finger et al., 2015). Investigators learned that both questionnaires, IPAQ-SF and US National Health Interview Survey – Adult Core Physical Activity Questionnaire (NHIS-PAQ), only performed as intended with young and employed population and people that engaged in regular exercise (Finger et al., 2015). In all countries, difficulties were very much alike. Respondents had trouble comprehending words and concepts such as moderate and vigorous as they understood these intensities as mentally hard or stressful but not as physical effort; showed some difficulty defining leisure time, specially self-employed or retired people; found confusing if they should consider last seven days or a regular week, as the last 7 days were not representative of usual behavior due to illness or vacation, for example; mentioned how effortful it was recalling activities like walking, sitting or in general light and moderate as they tend occur spontaneously throughout the day and without "conscious recognition". On the contrary, planned, and scheduled activities were easier to recall, and participants tended to classify them as vigorous PA. Some respondents were also unable to distinguish between PA intensity levels - light, moderate, and vigorous – and included some activities multiple times. Participants answered questions only stating the activity given as example and forgetting others; struggled with calculating frequency and duration, specially of sitting and walking as they are "so normal" activities. Participants affirmed they were not affected by social desirability however, they still preferred the questionnaire where they could report a lot of daily activities, making them look active. Participants also felt that questions were sometimes too long and confusing (Finger et al., 2015).

Physical literacy is the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in PA for life (Whitehead, 2013). This definition seems to be the most widely accepted despite some disparities (Edwards et al., 2017). It embodies 4 elements: the affective element (motivation and confidence); the physical element (physical competence); the cognitive element (knowledge and understanding); and the behavioral element (engagement in PA for life) (Society & Life, 2021).

As a multifaceted construct, many tools have been designed to measure Physical Literacy. These tools, however, do not focus on the understanding of constructs like PA and SB.

The present review aims to investigate adults' knowledge and understanding about SB and PA definitions, which would be within the cognitive literacy domain.

III.1.3 Method

Although this it is not a systematic review, our systematized review followed, when possible, the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist, (Liberati et al., 2009).

Literature search strategy

We searched PubMed and SPORTDiscus databases for papers examining adults' knowledge, perceptions, and understanding about PA and SB definitions, from inception to the 13th of April 2021. We used a combination of the keywords 'perceptions' OR 'definition' OR 'knowledge' AND 'physical activity' AND sedentary behavi*' in the "title/abstract" field; and a free text search of the terms 'perceptions' OR 'attitudes' OR 'opinion' AND 'physical activity' AND 'sedentary behavior', respectively. In addition, we included hand-searched articles from several reference lists.

Inclusion and Exclusion Criteria

To be included in this review, full-text articles had to be written in English, had to include participants' definition, or understanding, or perception of PA and/or SB, and had to study adult population (+18 years old). Studies were excluded if they were in any other language than English, if the sample was under 18 years old, and if there was no participants' definition or perception regarding PA or SB. There were no restrictions considering the date of publication.

Screening, Selection and Quality of articles

The abstract screening and study selection was performed by one investigator and confirmed with a second one, if any doubt occurred. Quality of studies was assessed by an adapted version, for adults, of evidence for policy and practice information (EPPI) criteria (Martins et al., 2021; Rees et al., 2011).

Full criteria used to appraise studies' quality are described on table 1.

Table 1. Criteria used to appraise studies' quality

Criterion (*with guidance for reviewers*	
1. Were steps taken to increase rigor in the sampling? *Consider whether:* **the sampling strategy was appropriate to the questions posed in the study (e.g. was the strategy well reasoned and justified?)* **attempts were made to obtain a diverse sample of the population in question (think about who might have been excluded; who may have had a different perspective to offer);* **characteristics of the sample critical to the understanding of the study context and findings were presented (i.e. do we know who the participants were in terms of, for example, basic socio-demographics, characteristics relevant to the context of the study, etc).*	1- No, not at all/Not stated/Can't tell 2- Yes, a few steps were taken 3- Yes, several steps were taken 4- Yes, a fairly thorough attempt was made
2. Were steps taken to increase rigor in the data collected? *Consider whether:* **data collection tools were piloted/(and if quantitative) validated;* **(if qualitative) data collection was comprehensive, flexible and/or sensitive enough to provide a complete and/or vivid and rich description of people's perspectives and experiences (e.g. did the researchers spend sufficient time at the site/with participants? Did they keep 'following up'? Was more than one method of data collection used?);*	1- No, not at all/Not stated/Can't tell 2- Yes, a few steps were taken 3- Yes, several steps were taken 4- Yes, a fairly thorough attempt was made

** steps were taken to ensure that all participants were able and willing to contribute (e.g. processes for consent, language, barriers, power relations between adults and children/young people)*	
3. Were steps taken to increase rigor in the analysis of the data? *Consider whether:* **data analysis methods were systematic (e.g. was a described/can a method be discerned?);* **diversity in perspective was explored;* **(if qualitative) the analysis was balanced in the extent to which it was guided by preconceptions or by the data);* **the analysis sought to rule out alternative explanations for findings (in qualitative research this could be done by, for example, searching for negative cases/exceptions, feeding back preliminary results to participants, asking a colleague to review the data, or reflexivity; in quantitative research this may be done by, for example, significance testing).*	1. No, not at all/Not stated/Can't tell 2. Yes, a few steps were taken 3. Yes, several steps were taken 4. Yes, a fairly thorough attempt was made
4. Were the findings of the study grounded/supported by the data? *Consider whether:* **enough data are presented to show how the authors arrived at their findings;* **the data presented in the interpretation/support claims about patterns in data;* **the data presented illuminate/illustrate the findings;* **(for qualitative studies) quotes are numbered or otherwise identified and the reader can see they don't just come from one or two people.*	1. Limited grounding/support 2. Fair grounding/support 3. Good grounding/support
5. Please rate the findings of the study in terms of their breadth and depth. *Consider whether:* *(NB: it may be helpful to consider 'breadth' as the extent of description and 'depth' as the extent to which data has been transformed/analyzed);* **a range of issues are covered;* **the perspectives of participants are fully explored in terms of breadth (contrast of two or more perspectives) and depth (insight into a single perspective);* **richness and complexity has been portrayed (e.g. variation explained, meanings illuminated);*	1. Limited breadth or depth 2. Good/fair breadth but very little depth 3. Good/Fair depth but very little breadth 4. Good/fair breadth and depth

**there has been theoretical/conceptual development.*	
6. To what extent does the study privilege the perspectives and experiences of participants? *Consider:* **whether there was a balance between open-ended and fixed response options;* **whether participants were involved in designing the research;* **whether there was a balance between the use of an a priori coding framework and induction in the analysis;* **the position of the researches (did they consider it important to listen to the perspectives of participants?);* **whether steps were taken to assure confidentiality and put participants at ease;*	1. Not at all 2. A little 3. Somewhat 4. A lot
7. Overall, what weight would you assign to his study in terms of the reliability/trustworthiness of its findings? *Guidance:* *Think (mainly) about the answers you have given to questions 1 to 4 above.*	1. Low 2. Medium 3. High
8. What weight would you assign to this study in terms of usefulness of its findings for this review? *Guidance:* *Think (mainly) about the answers you have given to questions 5 and 6 above and consider:* **the match between the study aims and findings and the aims and purpose of the synthesis;* **its conceptual depth/exploratory power.*	1. Low 2. Medium 3. High

Data Extraction

After the screening process, we started the data extraction for each article, that included: author, year, country, study design, instrument, population, ethnicity, age, gender, BMI, level of education (when reported), and PA and/or SB definitions within the paper.

III.1.4 Results

Studies Selection

The search identified 1347 potentially relevant papers. Of these, 1042 were identified in PubMed, 302 in SPORTDiscus, and 3 were searched manually. After a title and abstract screening, we excluded 1317 articles as the papers were not aiming the subject of investigation. From the remaining 30 articles, we excluded 2 for being duplicates and 2 because they were not available/found. We then read the 26 full-text articles remaining. Nine articles fulfilled the inclusion criteria and were included for analysis.

A more detailed description of the search and screening process can be observed in Figure 1.

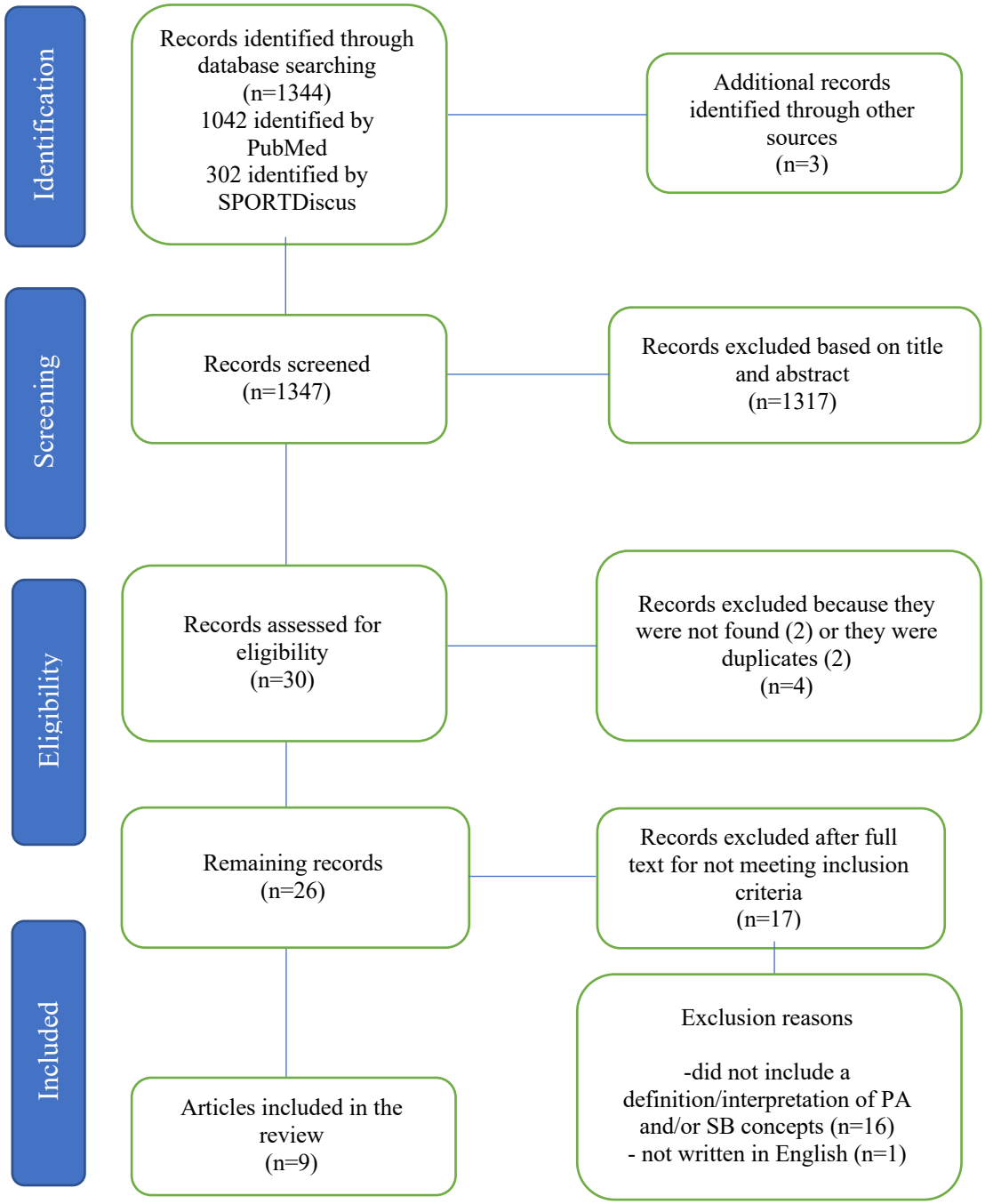

Fig. 1 – Flow diagram of study selection

Studies' Characteristics

These nine studies were held between 2003 and 2021. All of them were cross-sectional qualitative studies and aimed to understand people's perceptions, interpretations, and perspectives about PA and/or SB. One focused solely on SB perceptions (Mcewan et al., 2016). Different specific populations were analyzed, some regarding ethnicity and/or gender: Arab-

Australian adults (El Masri et al., 2021), African American and American Indian women (Tudor-Locke et al., 2003), and Sweedish women (Johnson et al., 2008). Others regarding health conditions like stroke (Bailey & Stevenson, 2021), osteoarthritis (Webber et al., 2020), multiple sclerosis (MS) (Kinnett-Hopkins et al., 2019); and others regarding age, especifically older adults (Grossman & Stewart, 2003; Harrison et al., 2020; Mcewan et al., 2016).

Five studies took place in the United States of America (USA) (Bailey & Stevenson, 2021; Grossman & Stewart, 2003; Harrison et al., 2020; Kinnett-Hopkins et al., 2019; Tudor-Locke et al., 2003), two in Canada (Mcewan et al., 2016; Webber et al., 2020), one in Australia (El Masri et al., 2021), and another one in Sweden (Johnson et al., 2008). They had a total of 318 participants with an average of 35 participants per study. Participants were mostly women (77.4%) and the average age was approximately 64 years old.

BMI was only reported in two studies, and it was not used in the analysis. Level of education was reported in 6 studies. Five of them disclosed each participant's education level (El Masri et al., 2021; Harrison et al., 2020; Johnson et al., 2008; Kinnett-Hopkins et al., 2019; Mcewan et al., 2016; Webber et al., 2020), while one only described their participants as "well-educated" (Johnson et al., 2008). The level of PA was also reported in 5 studies. One study reported PA level, in another related study (Bailey, 2020), according to the IPAQ, as low, moderate, and high (Bailey & Stevenson, 2021); another study reported PA level for the whole sample "underactive adults" which were described as participating in less than 20 minutes of endurance-type PA, at moderate intensity, three times per week for at least 3 months (Grossman & Stewart, 2003); another study only included participants who engaged in a 6 month exercise program; another study reported minutes per week of moderate-to-vigorous PA (Webber et al., 2020); another study categorised PA level as "no activity", "low activity", "somewhat low activity", "somewhat high activity", "high activity" (Harrison et al., 2020); another study reported what participants self-reported about enganging in aerobic PA and strengthening activities (Mcewan et al., 2016).

Methods used to obtain information from participants differed. Five studies used focus groups (El Masri et al., 2021; Harrison et al., 2020; Johnson et al., 2008; Mcewan et al., 2016; Webber et al., 2020), three used interviews (Bailey & Stevenson, 2021; Grossman & Stewart, 2003; Kinnett-Hopkins et al., 2019), and one investigation used both interviews and focus groups (Tudor-Locke et al., 2003). All focus groups and interviews were semi-strucutured as they followed a questioning script/guide.

Papers' quality was assessed through an adapted version of EPPI criteria. Four studies were classified with high reliability and high usefulness; three with medium reliability and

high usefulness; one with medium reliability and low usefulness; and one with low reliability and medium usefulness. A detailed assessment of each study is shown on table 3.

Table 2. General characteristics of the 9 included studies

Authors (year); country;	**Study design and instruments**	**Population; ethnicity; age; gender; BMI; education level**	**PA and/or SB definitions**	**Study Quality**
Bailey, R. R., & Stevenson, J. L. (2021). USA	Qualitative study Semi-structured interview	Community- dwelling adults with stroke (n=15) Ethnicity – White (n=10), African American (n=4), Asian (n=1) aged 43-79 (age average 62.9 years) Male – 60% Level of education - NR	11 participants described PA as activities that require moderate to vigorous intensity, like exercise and sports; 7 participants identified daily living activities as PA Most participants thought it was important to avoid too much sitting due to boredom or to avoid sitting for long (definition or description was not discussed)	Reliability: High Usefulness: High
El Masri, A., Kolt, G. S., & George, E. S. (2021). Australia	Qualitative study Focus groups	Arab Australians (n=28) Ethnicity – Arab Australians aged 35-64 years (mean age 45 years) Male – 28.6% Level of education - 5 had university or higher	Most participants associated PA with movement, energy expenditure and occupational activities, some identified PA with more structured exercise, sports, and more strenuous activities Participants could identify different SB, including sitting for transportation, work, and relaxation	Reliability: Medium Usefulness: High
Harrison, E. A., Lord, L. M., Asongwed, E., Jackson, P., Johnson-Largent, T., Jean Baptiste, A. M., Harris, B. M., & Jeffery, T. (2020). USA	Qualitative study Focus group with semi-structured guide	Urban-community-residing older adults (n=58) Ethnicity – African American (n=42); Hispanic/White (n=8); Asian/Chinese (n=8) Aged 55 + (mean age 72)	Most participants defined PA as including everyday activities and could differentiate between PA and exercise which they agreed was more structured, like a class SB was not discussed	Reliability: Medium Usefulness: Low

		Male – 15.5% Level of education – 3 had bachelor's degree		
Webber, S. C., Ripat, J. D., Pachu, N. S., & Strachan, S. M. (2020). Canada	Qualitative study Focus groups with semi-structured interview guide	Individuals with knee osteoarthritis and knee arthroplasty (n=22) Ethnicity - NR aged 56-76 (mean age – 67.4 years) Male – 36.3% Level of education – 12 had community college or higher	Participants were familiar with the term "PA" and knew it included different daily activities SB was defined as doing anything while in sitting position; lowest level on the continuum of physical activity	Reliability: High Usefulness: High
Kinnett-Hopkins, D., Learmonth, Y., Hubbard, E., Pilutti, L., Roberts, S., Fanning, J., Wójcicki, T., McAuley, E., & Motl, R. (2019). USA	Qualitative study Semi-structured interview	People with MS (n=53) Ethnicity – Caucasian (n=52); Other (n=1) aged 31 – 77 (mean age 55.3 years) Male – 23.6% Level of education: 67.2% college graduates	43% of participants understood the meaning of PA and described it as any activity with movement 57% of participants did not give clear definition of PA and associated it with exercise 83% of participants understood SB as it was associated with sitting and lying; 11% thought of it as sitting exercise; 6% included sleeping and napping	Reliability: High Usefulness: High
Mcewan, T., Tam-Seto, L., & Dogra, S. (2016). Canada	Qualitative study Focus groups with semi-	Older adults (n=26) Ethnicity – Caucasian (n=24); Other (n=2) Mean age 74	PA was not discussed SB definition was given to participants before each focus group; Participants used activities to define SB, such as computer use or knitting;	Reliability: High Usefulness: High

	structured questions	Male - 23% Level of education – 30.7% had community college or higher	SB had a negative connotation and was described as “doing nothing”, “not moving”, “vegetating” and “relaxation”	
Johnson, I., Tillgren, P., & Hagströmer, M. (2008) Sweden	Qualitative Study Focus groups with semi-structured guide “questioning route”	Swedish women (n= 27) Ethnicity - NR aged 35 - 69 (median age 52) Female – 100% Level of education - “well educated”	PA interpretation ranged from any kind of movement to structured exercise; some participants thought it was a new term used instead of exercise; one participant said she never heard the concept of PA SB was not discussed	Reliability: Medium Usefulness: High
Grossman, M. D., & Stewart, A. L. (2003) USA	Qualitative Study interview with guide	Older Adults (n=33) 75 years of age or older Ethnicity - NR Male – 45.5 % Level of education – NR	PA was a vague term to most people; Personal definitions of PA ranged from light housekeeping to daily walking PA as a personal attribute rather than a variable behavior SB was not discussed	Reliability: Low Usefulness: Medium
Tudor-Locke, C., Henderson, K. A., Wilcox, S., Cooper, R. S., Durstine, J. L., & Ainsworth, B. E. (2003). USA	Qualitative study Interview and focus groups	African American and American Indian women aged 40 + Ethnicity - African American; American Indian (n=56) Female – 100% Level of education- NR	PA definition ranged from structured exercise for the purposes of improving oneself to the demands of daily work and home life PA was associated with being “in really good shape” and in “good health” SB was not discussed	Reliability: Medium Usefulness: High

BMI – Body mass index; NR – Not reported; PA- Physical activity; SB - Sedentary behavior; USA – United States of America

Table 3. Studies’ full assessment according to each item of EEPI criteria

EPPI Criteria	(Bailey & Stevenson, 2021)	(El Masri et al., 2021)	(Harrison et al., 2020)	(Webber et al., 2020)	(Kinnett-Hopkins et al., 2019)	(Mcewan et al., 2016)	(Johnson et al., 2008)	(Grossman & Stewart, 2003)	(Tudor-Locke et al., 2003)
1.	Yes, several steps were taken	Yes, a fairly thorough attempt was made	Yes, a few steps were taken	Yes, several steps were taken	Yes, several steps were taken	Yes, several steps were taken	Yes, a few steps were taken	Yes, several steps were taken	Yes, a fairly thorough attempt was made
2.	Yes, a fairly thorough attempt was made	Yes, a fairly thorough attempt was made	Yes, several steps were taken	Yes, several steps were taken	Yes, several steps were taken	Yes, several steps were taken	Yes, a fairly thorough attempt was made	Yes, a fairly thorough attempt was made	Yes, several steps were taken
3.	Yes, a fairly thorough attempt was made	Yes, a fairly thorough attempt was made	Yes, a fairly thorough attempt was made	Yes, a fairly thorough attempt was made	Yes, a fairly thorough attempt was made	Yes, several steps were taken	Yes, several steps were taken	Yes, a few steps were taken	Yes, several steps were taken
4.	Good grounding/support	Fair grounding/support	Limited grounding/support	Good grounding/support	Fair grounding/support	Fair grounding/support	Fair grounding/support	Limited grounding/support	Fair grounding/support
5.	Good breadth and depth	Good breadth and depth	Limited breadth or depth	Good breadth and depth	Good breadth and depth	Good breadth and depth	Good breadth and depth	Fair breadth but very little depth	Good/fair breadth but very little depth
6.	A lot	Somewhat	A little	Somewhat	A lot	A lot	A lot	A lot	A lot
7.	High	Medium	Medium	High	High	High	Medium	Low	Medium
8.	High	High	Low	High	High	High	High	Medium	High

Lowest assessment score; Medium assessment score; High assessment score; Highest assessment score

Synthesis of Findings

Most participants were women. From all nine studies, two were about women's perceptions and, as such, 100% of participants, in these two cases, were women. On the other seven studies, women formed 40%, 71%, 85%, 64%, 76%, 77% and 55% of participants, respectively.

Some participants understood the general concept of PA, identifying it with daily activities, movement, and energy expenditure (El Masri et al., 2021; Harrison et al., 2020; Webber et al., 2020). Often, the participants would describe PA as exercise or sports or think of it as any activity that required a higher intensity than everyday activities (Bailey & Stevenson, 2021; Johnson et al., 2008; Kinnett-Hopkins et al., 2019; Tudor-Locke et al., 2003). Participants also associated PA to "being in really good shape" or "good health" (Tudor-Locke et al., 2003). Some older people also perceived themselves as being active enough if they felt they were "doing well for their age" and were more aware of some sedentary lifestyle dangers, than PA benefits (Grossman & Stewart, 2003).

Mental and physical well-being, weight loss, and prolonged life were some of the benefits associated with practicing PA (Harrison et al., 2020). However, although participants were aware of these health benefits, they did not know the recommended public guidelines or how much PA they must attain, each week, to get those benefits (El Masri et al., 2021; Webber et al., 2020)

SB was defined as every activity done while sitting (Webber et al., 2020) and, for some participants, SB had a negative connotation such as "vegetating" (Mcewan et al., 2016). A few participants thought of naps and sleep as SB (Kinnett-Hopkins et al., 2019). Not many people were knowledgeable of the deleterious impact associated with prolonged sitting (El Masri et al., 2021). In a study, sitting for too long was associated with joint stiffness and falling asleep (Mcewan et al., 2016). The reason for avoiding SB was mainly for boredom and not wanting to spend long periods of time sitting (Bailey & Stevenson, 2021).

III.1.5 Discussion

This systematized review aimed to analyze people's knowledge and understanding of PA and SB's definitions. It seems that there is still no clear answer for this question as we found that PA and SB's perceptions vary greatly throughout the population.

PA construct was frequently misunderstood. Many participants perceived PA only as exercise or leisure activities that required a higher intensity than basic daily activities. This was mainly noticeable in people with stroke (Bailey & Stevenson, 2021), Swedish women (Johnson et al., 2008), African American and Indian American women (Tudor-Locke et al., 2003), and in adults with MS (Kinnett-Hopkins et al., 2019). However, almost half of these last participants (with MS) provided a proper definition of PA, describing it as all kind of movement, including daily activities. These conflicting numbers can, perhaps, be related to the fact that PA guidelines for adults with MS only refer to recommended exercise (2 aerobic and 2 strength training sessions per week). This may contribute to aggravate the already existent confusion between both concepts (PA and exercise) in this population (Kinnett-Hopkins et al., 2019). On the contrary, Harrison and colleagues (Harrison et al., 2020) found that the majority of the older African American, Hispanics, and Asian adults were knowledgeable about PA

definition and could differentiate it from exercise. However, it is important to note that participants of this study were part of a volunteer group that helped homebound seniors and, as such, were required to participate in monthly educational workshops, which could explain this divergent result. Nonetheless, it is still a hopeful result, showing how fitting education can help older adults in this matter.

Very much alike, most Arab-Australian adults also understood the meaning of PA (El Masri et al., 2021) and could differentiate it from exercise but in this case, participants were not associated with any protocol that educated them about PA and were of younger age. Participants stated they had a more physically active lifestyle in their country of origin due to more intensive labor activities/work and due to walking for transportation and errands. Awareness about their change in daily habits may have conducted them to be more knowledgeable about it. In both cases, more than half of the sample had high school or a lower level of education. Despite their awareness to PA's benefits, Arab-Australians did not know the recommended guidelines about the amount of PA they should accumulate to get the health benefits. The same happened with individuals with knee osteoarthritis and knee arthroplasty (Webber et al., 2020) where more than half of the sample had higher than high school level of education. Evidence has demonstrated guideline's knowledge gap on many occasions, ranging from young adults (Vaara et al., 2019) and employed adults (Knox et al., 2015) to the general population (Silva et al., 2018). Individuals with osteoarthritis and knee arthroplasty may also have a deeper knowledge due to peculiarities of their condition, as, for example, they are presented with more information and instructions from their doctors or physical therapists and are constantly educated on how their behaviors could affect their health.

It was interesting to note that participants who were aware of the meaning of PA, when asked how they could be less sedentary, still talked about engaging in exercise rather than replacing their SB with light PA (Webber et al., 2020) which seems to show that although the difference between PA and exercise is somehow known, light PA benefits are still not sufficiently clear. Older underactive adults (Grossman & Stewart, 2003) tended to believe daily tasks/activities were enough to get PA benefits and that they were active enough even though they had different levels of activity. Aging process was also seen as barrier and reason for not being active or "pushing too hard" as they feared negative health consequences. However, they revealed interest in knowing more about PA, specially about what they could and could not do regarding their specific medical condition.

There were some negative associations with the term PA, as some participants stated they did not like PA and had negative memories regarding "physical exercise" in school

(Johnson et al., 2008). These women had mixed feelings about PA and while women who engaged more regularly in PA expressed more positive feelings towards PA, women that considered themselves inactive felt guilty for not being physically active enough (Johnson et al., 2008).

SB construct was less investigated. It was mainly described as "anything done while sitting on your butt" (Webber et al., 2020) or as "sitting" or "doing nothing" (Kinnett-Hopkins et al., 2019), but other participants associated it with sitting while exercising like cycling or "arm exercises" and a few thought of sleeping and napping as SB (Kinnett-Hopkins et al., 2019).

Once again, mixed feelings were expressed regarding this behavior. While some participants perceived it as a negative trait like lack of discipline, others thought of it as a needed rest for the body and mind, a type of relaxation (Webber et al., 2020). Older adults' perception still varied greatly (Mcewan et al., 2016). A negative, almost expected, connotation was associated with the term SB and although participants knew they had indeed sedentary activities, they did not like being associated to the term and even felt insulted by it. Unexpectedly, the same participants also perceived numerous benefits from those activities they engaged in. Social and cognitive benefits but most importantly emotional benefits like a "reason to get out of bed in the mornings" (Mcewan et al., 2016).

Lastly, it is noticeable that most participants were women. This seems to reveal a greater willingness from this gender to participate in these types of investigations. It is a trend seen before as literature refers that men are considered a "hard-to-reach" population when it comes to promote PA, prevent illness, or even just having annual health check-ups, characterizing them as less interested in this kind of topic (Bottorff et al., 2015).

Strengths and Limitations

This systematized review has some strengths and limitations that should be considered. Firstly, all were qualitative studies, which allowed us to understand more clearly participants' knowledge and perceptions about this topic. Normally, this type of studies has a smaller sample size which was the case.

A significant part of the participants were women. This fact did not enable us to understand men's knowledge as deeply as we would desire. In addition to that, these studies investigated specific groups. We could not find an investigation analyzing general population's

knowledge regarding PA and SB constructs. On the other hand, this variety of groups allowed us to compare perceptions.

Another limitation of these studies is the fact that not all participants' answers were identified, and as so, their perceptions could not be associated to their age, socioeconomic status, level of education or BMI, making it impossible to extract associations between these variables.

The focus groups method was used in six studies. This method grants an opportunity to have more conversation and shared experiences, but it can also make participants feel uneasy to share their true perceptions or compelled to agree with other opinions, leading to false findings (Johnson et al., 2008). A more individual approach, in which the participant can fully reflect his/her opinion in an anonymous manner may be of relevance in this type of investigation.

The last limitation has to do with the fact that only one investigation was held in Europe, being a gap that we intend to compensate in our original study.

III.1.6 Conclusion

PA and SB´s definitions and perceptions vary greatly and there is still need for further investigation on this topic to establish deeper associations on how and why this occurs. PA seems to be, in many cases, misconceived as exercise. SB appears to be better understood, probably because, unlike PA it does not have a similar behavior than could be confused with.

When giving recommendations, it is important for researchers, medical staff, or PA instructors to know the persons' understanding and perceptions regarding these constructs beforehand, so that one understands exactly the meaning of what is being advised. Recommendations like increasing PA levels may be mistaken for increasing vigorous exercise, which may lead to disregard, by thinking they would not be able to perform it, or on the contrary, can lead to the adoption of this practice which in special populations can entail severe health consequences.

It is also important to promote more educative programs and discussion about PA benefits and how to get them, and SB deleterious effects and how to avoid them. Future research must try to analyze general population's knowledge about PA and SB constructs without limiting their sample to a specific condition, so that generalization is warranted. Also, more investigation on this topic is needed in the European countries, as most studies originate from other parts of the world.

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III.1.7 References

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III.2 ORIGINAL INVESTIGATION

Do they Know what is means? – Physical Activity and Sedentary Behavior Knowledge in Portuguese Speaking Adults

III.2.1 Abstract

Aim: This investigation aims to understand and quantify Portuguese speaking adults' knowledge and perceptions about the definitions of PA and SB. Secondary aims are to associate their knowledge with gender, PA level, age, education level, sitting time (ST) level, BMI, sleep time, and with having a friend or family working in the health or exercise field.

Method: We developed a questionnaire with fifteen questions, based on the results from a systematized literature review and fine-tuned in a pilot study, to understand how many participants could correctly perceive several aspects of these concepts (PA and SB) and, consequently, measure their knowledge. For these analyses, 300 participants were included.

Results: 64.3% of participants were aware that PA and exercise were different concepts and 73% agreed that house chores were PA. 72.6% of participants were aware that SB does not only refer to sitting and 95.3% of participants knew that sleep is not a SB. We found no differences for any knowledge scores between genders ($p>0.05$). There was no association between any knowledge score (total, PA, and SB) with weekly PA and daily ST ($p>0.05$). Age was inversely associated with total knowledge (β -0.843; $p= 0.007$) and with PA knowledge (β-1.147; $p= 0.004$). Participants who slept less than 5 hours had a significantly lower total knowledge score when compared to other participants who slept more ($p <0.05$). Participants who had a friend or family member working in the health or exercise field had a higher PA knowledge score ($p = 0.036$) and engaged in more PA ($p = 0.024$). A logistic regression showed

a positive association between having a friend or family member in these fields and practicing PA (OR=1.002; p=0.026).

Conclusion: Most participants could differentiate PA from exercise which was the biggest misconception in previous studies. Although participants knew that daily activities like house chores or playing with children are PA, there seemed to be some incongruities when asked to consider their personal daily PA behaviors, as some participants declared not having any PA. Knowledge was not positively associated with weekly PA, which was our hypothesis. ST did not differ regarding the knowledge level. Further investigation on this topic is needed.

III.2.2 Introduction

PA construct is still frequently misunderstood. Recent investigations showed that many participants perceived PA as exercise or leisure activities that required a higher intensity, thus not including basic daily activities as PA (Bailey & Stevenson, 2021). Even though there is awareness of PA benefits, there also seems to be a knowledge gap about the recommended amount of PA that each person should engage in, in older adults (Webber et al., 2020) but also in younger adults (Vaara et al., 2019) and working aged adults (Knox et al., 2015). In the first Portuguese Physical Activity Barometer (Silva et al., 2018), a nation-wide survey performed in 2016 with a representative sample of 1068 adults, 43% of the participants did not perceive daily activities, such as stair climbing or standing, as PA and only 2% were aware of the WHO PA recommendations. In spite of that, 76% believed that PA was important for good health and 100% of the sample believed that regular PA improves quality of life (Silva et al., 2018).

SB construct has been less investigated but seems to be better understood by the general population than PA. It was mainly described as “anything done while sitting on your butt” (Webber et al., 2020) or as “sitting” or “doing nothing” (Kinnett-Hopkins et al., 2019), but there were still some misconceptions, as some participants associated it with exercising while sited (i.e. cycling) and a few thought of sleeping and napping as SB. Detrimental health implications of prolonged sitting were less known than PA health benefits (El Masri et al., 2021).

In a 2020 cross-sectional investigation, encouraged by the Portuguese General Health Direction (DGS), 45% of the inquired participants acknowledged having some difficulty understanding health-related information (DGS, 2020). This question was made to understand health literacy defined as the cognitive and social abilities and personal capability to obtain, understand, and use information to promote and maintain good health (DGS, 2020). Knowing there are still some misconceptions about PA and SB and acknowledging that a considerable part of Portuguese population had some difficulty understanding information about health, we aim to investigate if the same may be happening with PA/SB concepts.

Thus, our goal in the current investigation is to investigate if adults really know what PA and SB mean. Concepts like SB and PA are widely used and possibly familiar to the public. But can they really define each of these concepts? Can they tell the difference between exercise and PA? Do they know if sleeping is considered a SB? Do they know that working on the computer while sitting is a SB? What about standing? Do they know that daily basic activities are PA? Secondary goals of this investigation are to determine the association between the level of knowledge and the time spent in SB and PA, as well as to explore if the level of knowledge varies according to important variables such as gender, age, education level, BMI, sleep time and having a friend or family working in the health or exercise field. We hypothesize that: 1) a great percentage of inquired participants will reveal a low knowledge level for both concepts; 2) SB knowledge will be higher than PA knowledge; 3) Knowledge will be positively associated with a) PA, b) level of education, c) having a close family or friend working in the health or exercise field; and negatively associated with d) age and e) BMI; 4) SB will not differ greatly in relation to knowledge scores.

III.2.3 Method

Study Design

Considering our previous systematized review, where all investigations were qualitative studies and that through them it was possible to understand how participants perceived and understood PA and SB definitions, this investigation will be quantitative to determine how many participants, understand PA and SB in a correct manner and consequently to quantify their knowledge.

This observational cross-sectional investigation used a questionnaire to analyze Portuguese speaking adults' knowledge regarding PA and SB constructs. Ethical approval for this investigation was granted by the Physical Education and Sport Faculty's Ethical Committee of Universidade Lusófona de Humanidades e Tecnologias in Lisbon (JL2221).

As this questionnaire was shared and completed online, via Google Forms, and autonomously performed by the participants, an informed consent was given by accepting to participate before fulfilling any question. A message explaining that the investigation intended to investigate adults' opinion about PA appeared as they clicked on the link. The message stated that their participation was completely voluntary and anonymous and that if they agreed to participate, they should press "NEXT" to access and complete the questionnaire, otherwise, they could click out of this window. If at any time, during the questionnaire completion, would they change their mind, they were informed they could also click-out of the page and their answers would not be saved. However, if they changed their mind after the submission of their answers, we would not be able to remove their participation as it was anonymous.

Recruitment of Participants

To be included in this investigation, participants had to be 18 years or older, speak Portuguese and fulfil all questions within the questionnaire. Convenience sampling was used to recruit participants through online surveys distributed via social media channels (Facebook and WhatsApp). Snowball sampling was also used, as participants who fulfilled the questionnaire were asked to share it with other people they might know.

Instruments

As to the authors best knowledge, there was no validated questionnaire to measure PA and SB concepts knowledge, a questionnaire was developed, in Portuguese, by the author with the help of an external specialist and it was built and piloted according to the aims of this investigation and based on the literature research.

The questionnaire was tested and fine-tuned in a pilot phase comprising ten participants meeting the inclusion criteria. The results from this pilot study were not included in the final analysis. At this stage, participants were asked if they had any doubt regarding the questions

and what they thought was being asked. After this preliminary analysis, the questionnaire was reformulated to best fit the purpose of the investigation.

Another 10 participants belonging to the whole sample answered the final version of the questionnaire in two different separate occasions for test-retest reliability analysis.

As participants clicked on the link to access the questionnaire, they were presented with an informed consent message, informing that their participation in the investigation was voluntary and completely anonymous and that during the time of completion, if they changed their mind, they could exit, and their information would not be kept.

Participants were also informed that the aim of this investigation was to understand their opinion and that as such, there were no wrong or right answers. This approach was taken to promote their honest answers and not to conduce them to search online for the right answer. Questions were asked in an easy way to understand (colloquial) Portuguese, so it could be understood by anyone who wanted to participate, independently of their education level. Participants were reassured of their anonymity as this could be a fundamental feature to ensure honest answers.

The questionnaire was divided into two sections. The first gathered demographic and anthropometric information: age, gender, weight, height (BMI was calculated using the standard formula *weight (kg) / [height (m)]*^{2}), occupation, nationality (Portuguese or other), education level. To make some more associations that could give us a better insight on how personal habits and variables may affect people's perception regarding these concepts, we also asked if when in school, they enjoyed Physical Education classes, if they lived alone, and if they had anyone close (family member or friend) in the health or exercise area.

Participants were also questioned about their daily routines such as: how many hours they spent, per day i) sitting, ii) lying down, and iii) sleeping; if they engaged in PA, physical exercise, or sports, what kind of PA, how frequently, and the average duration of each PA/exercise/sport session. Accumulated PA per week was calculated multiplying the weekly frequency with the duration of each session. Sitting time (ST) was used as a proxy of SB and assessed by the conversion of hours in minutes/day.

The second section was about PA and SB knowledge. Fifteen statements were presented, and participants had the options to agree or disagree with each one (dichotomous answer). Table 4 describes each statement and the rationale behind it, depicting what each question aimed to assess in terms of PA and SB knowledge.

Table 4. Questionnaire statements and rationale about PA and SB knowledge

KNOWLEDGE STATEMENTS	RATIONALE
1. Physical Activity and Physical Exercise are synonymous.	To assess if participants could differentiate between PA and Exercise;
2. Standing still (ex: waiting for the bus), is a sedentary behavior.	To assess if participants could differentiate SB from the standing posture;
3. I can only be physically active if I play any kind of sport or perform physical exercise.	To assess if participants knew that daily chores and daily living tasks are also a type of PA and could be enough to be physically active;
4. To practice physical activity and to be physically active is the same thing.	To assess if participants know that, although they may practice some PA, they can still be physically inactive, if they do not reach the recommended amounts;
5. I will only have health benefits if I practice/engage in physical activity every day.	To assess if participants know that any amount of PA even if sporadically still provides health benefits when comparing to no PA;
6. Spending too much time sitting is harmful for my health.	To assess if participants are aware of the deleterious health effects of SB;
7. To obtain health benefits, physical activity must be of vigorous intensity (high effort intensity that makes you breath harder than usual).	To assess if participants know that any kind of PA, even light PA, provides health benefits;
8. House chores/housework like hanging clothes or sweeping are physical activity.	To assess if participants know that PA includes all movement /tasks even the movements that are not intended as PA;
9. To be in sedentary behavior means to be sitting.	To assess if participants know that SB includes a variety of other postures rather than sitting (i.e., lying);
10. To play hide and seek, with your children, is physical activity.	To assess if participants know that PA includes any movement and not only exercise;
11. To work standing is physical activity,	To assess if participants know that standing is also PA;
12. Sleeping at night is sedentary behavior.	To assess if participants know that sleeping is not SB;

13. Napping, during the day, is sedentary behavior.	To assess if participants know that napping is not SB;
14. Studying or working while lying down is sedentary behavior.	To assess if participants know that lying down, while awake, is SB.
15. The World Health Organization recommends at least 400 minutes of weekly moderate physical activity to adults.	To assess if participants know the recommended amounts of PA to attain (i.e., 150-300 minutes/week);

Data collection

Questionnaires were made available online between the 13th of August 2021 and 15th of October 2021, and participation was anonymous and confidential as we did not gather any identification or contact (e.g., name, email, telephone number, address, etc.).

Knowledge Scores

The Total knowledge score was assessed by summing the PA Knowledge and SB Knowledge, scoring a total between 0 and 15, with higher scores indicating higher knowledge. Each correct answer contributed with 1 point. PA knowledge was assessed through 10 questions (0-10), and SB knowledge was assessed through 5 questions (0-5).

Statistical analysis

After the data collection was completed, it was transferred to an Excel document, where all qualitative answers were coded and all the mistypes were corrected manually, as for example, height from meters to centimeters (1.60 to 160).

Statistical analyses were performed using the SPSS software (v. 25.0) and a *p-value* <0.05 was considered statistically significant. Descriptive statistics including mean and standard deviation (SD) were performed for all continuous variables. Frequency analyses were performed for all categorical variables. Comparisons between groups were performed using the One-way ANOVA, with Post Hoc test when more than two groups existed. Correlations

and linear regressions were performed to examine the association between each two continuous variables, while logistic regressions were used for determining the association between continuous and categorical (dichotomic) variables. Correlations between a continuous and categorical variables (with more than two levels) were assessed using the Spearman's correlation coefficient. Reliability for the 15 questions was analyzed with a test-retest matrix analysis.

III.2.4 Results

Descriptive results

Overall, 304 adults participated in this survey. Four participants did not complete the full questionnaire and thus were excluded. The remaining 300 participants were included in the analyses. Most participants were female (67%; n=201). Regarding nationality, although all were Portuguese speaking adults, 5.7% were from other nationalities than Portuguese. The average age was 33.0 (SD ± 11.5) years-old and ranged from 18 to 75 years-old. Average BMI was 23. 6 kg/m^2 (SD ± 3.5), ranging from 17 to 40 kg/m^2. Regarding the level of education, 72% of respondents had a bachelor's degree or higher. Most participants (63%) acknowledged having someone close, a friend or family member, working in the health or exercise field. Accumulated PA/week was, on average 184 minutes (SD± 198.6) and ranged from 0 to 1050 minutes/week. ST/day was, on average, 401 minutes (SD± 143) which corresponds to around 6 hours and 40 minutes and ranged from 60 to 570 minutes/day. All characteristics of the sample are reported in table 5.

Table 5. Participants' characteristics

	Frequency	% or mean (SD)
Age (years)		33.0 (± 11.5)
18-24	71	23.7%
25-34	133	44.3%
35-44	53	17.7%
45-54	17	5.6%
55-64	21	7%
65- 75	5	1.7%
Gender		
Female	201	67.0%
Male	99	33.0%
Education		
Lower than university	83	27.7%
Bachelor's degree	139	46.3%
Masters or PhD	78	26.0%
BMI		23.6 (± 3.5)
< 18.5 Kg/m^2	8	2.7%
18.5 - 24.9 Kg/m^2	202	67.3%
25.0 - 29.9 Kg/m^2	74	24.7%
30.0 - 34.9 Kg/m^2	13	4.3%
35.0 - 39.9 Kg/m^2	2	0.7%
>40 Kg/m^2	1	0.3%
Do you live alone?		
Yes	53	17.7%
No	247	82.3%
In school did you enjoy physical education classes?		
Yes	239	79.6%
No	59	19.7%
I did not have PE classes	2	0.7%
Do you have anyone close working in the health or exercise field?		
Yes	190	63.3%
No	110	36.7%

Do you practice any PA/exercise/sport?		
Yes	224	74.7%
No	76	25.3%
PA per week (calculation from frequency x duration)		184 minutes (±199)
Achieves 150 min/week	124	41.3%
Does not achieve 150 min/week	176	58.7%
Sitting Time/day		401 minutes (±143)
Up to 3 hours	29	9.7%
From 3 to 5 hours	47	15.7%
From 5 to 7 hours	71	23.7%
From 7 to 9 hours	85	28.3%
More than 9	68	22.6%
Hours of Sleep		
Less than 5 hours	7	2.3%
From 5 to 6 hours	28	9.3%
From 6 to 7 hours	103	34.4%
From 7 to 8 hours	122	40.7%
From 8 to 9 hours	36	12%
More than 9	4	1.3%

Reliability results

Test-retest reliability is a measure of reliability obtained by having the same participants answer the same questionnaire twice, in a short period of time. Ten participants answered this questionnaire in two different occasions with some weeks apart. Their answers are made available in table 6.

Participant 1 and participant 4 changed 1 answer each. Participant 5 changed 2 answers. Participant 8 changed 3 answers. Participants 6 and 10 changed 4 answers each. Overall, in a universe of 150 answers given in both moments there were only 16 non-matching answers (10.7%). It is important to mention that all alterations from participants' 1, 4, and 10 were from incorrect to correct answers, which could possibly mean that after the first time they answered the questionnaire, they might have searched for the correct answers.

Finally, in 10 participants, 4 had a perfect test-retest reliability. The questions with lower reliability were Q5 related to how frequently it was necessary to practice PA to achieve health benefits; and Q11 related to work, while standing, being PA.

Table 6. Knowledge questions' reliability test-retest analysis

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Q1	D/D	D/D	D/D	A/A	D/D	D/D	D/D	D/D	D/D	D/D
Q2	D/D	A/A	A/A	A/A	A/A	A/D	D/D	D/D	D/D	D/D
Q3	D/D	D/D	D/D	D/D	D/D	D/A	D/D	D/D	A/A	D/D
Q4	D/D	D/D	D/D	A/A	D/D	D/D	D/D	D/D	D/D	A/D
Q5	A/A	D/D	D/D	A/A	A/A	A/D	D/D	D/A	D/D	A/D
Q6	A/A	A/A	A/A	A/A	A/A	A/A	A/A	A/A	A/A	A/A
Q7	D/D	D/D	D/D	D/D	D/D	D/D	D/D	D/A	A/A	D/D
Q8	A/A	A/A	A/A	A/A	A/D	A/D	A/A	A/A	D/D	A/A
Q9	D/D	D/D	D/D	A/A	D/D	D/D	D/D	D/D	A/A	D/D
Q10	A/A	A/A	A/A	A/A	A/A	A/D	A/A	A/A	A/A	A/A
Q11	A/A	D/D	D/D	D/A	D/A	D/D	A/A	A/A	A/A	D/A
Q12	D/D	D/D	D/D	A/A	D/D	D/D	D/D	D/D	D/D	D/D
Q13	D/D	D/D	D/D	A/A	D/D	D/D	D/D	D/D	D/D	D/D
Q14	D/A	A/A	A/A	A/A	A/A	A/A	A/A	A/A	A/A	D/A
Q15	A/A	A/A	A/A	D/D	A/A	A/A	D/D	A/D	D/D	A/A

In red are the answers that were altered; P- Participant, Q- Question; A- Agree; D- Disagree with the statement.

Main Findings

Knowledge Results

The total knowledge score was, on average, 10.7 (± 2.1), which corresponds to 71.3% of correct answers and ranged from 5 to 15; PA score was, on average, 6.8 (± 1.65), which corresponds to 68% of correct answers and ranged from 1 to 10; SB score was, on average, 3.8 (± 0.89) which corresponds to 76% of correct answers and ranged from 0 to 5. 64.3% of participants were aware that PA and exercise were different and 73% agreed that house chores

were PA. 72.6% of participants were aware that SB does not only refer to sitting, but also lying down (68.7%). 95.3% of participants knew that sleep is not a SB.

Physical Activity, Sedentary Behavior, and Knowledge

As shown in tables 7 and 8, there was no association between any knowledge score (total, PA, and SB) with weekly PA and daily ST ($p>0.05$).

Table 7. Correlation and linear regression results between minutes of PA/week and all knowledge scores

	PA/ week & Total Knowledge	PA/ week & PA Knowledge	PA/week & SB Knowledge
r	0.045	0.093	-0.067
β; p-value	4.193; 0.439	11.193; 0.106	-14.761; 0.249

r -Pearson correlation coefficient.

Table 8. Correlation and linear regression results between minutes of ST/day and all knowledge scores

	ST/day & Total Knowledge	ST/day & PA Knowledge	ST/day & SB Knowledge
r	0.088	0.098	0.027
β; p-value	5.904; 0.130	8.424; 0.091	4.269; 0.644

r -Pearson correlation coefficient.

Age and Knowledge

Through a correlation and a linear regression analysis we found that age was inversely associated with total knowledge and with PA knowledge, but not with SB knowledge (table 9).

Table 9. Correlation and linear regression results between age and all knowledge scores

	Age & Total Knowledge	Age & PA Knowledge	Age & SB Knowledge
r	**-0.155**	**-0.165**	-0.062
β; p-value	**-0.843; 0.007**	**-1.147; 0.004**	-0.799; 0.282

r -Pearson correlation coefficient; Values in bold are significant ($p<0.05$)

Education Level and Knowledge

Through an ANOVA analysis we found no differences for any knowledge score between the 3 levels of education ($p>0.05$). Additionally, no correlation was found between any knowledge score and any education level (Spearman's correlation coefficient).

Table 10. Correlation and ANOVA results between the education level and all knowledge scores

	Education & Total Knowledge	Education & PA Knowledge	Education & SB Knowledge
Spearman's coefficient; p-value	0.066; 0.256	0.051; 0.375	0.045; 0.442
ANOVA p-value	>0.05	>0.05	>0.05

The p-values for the ANOVA post-hoc results were multiple, thus we did not present all values, as they were all non-significant.

Friends or Family and Knowledge

ANOVA analysis showed no differences between having or not having a friend or family member working in the health or exercise field, for total knowledge and SB knowledge. However, the ANOVA showed a significant difference between these two groups for PA knowledge, with the group having a friend or family member working in the health or exercise field being associated with higher PA knowledge score. The logistic regression analysis showed no association between the factor of having or not having a friend or family member working in the health or exercise field and total and SB knowledge (both $p>0.05$). However, having more PA knowledge increased the odds of having a friend or family member working in the health or exercise field by 19%, as shown in table 11.

Table 11. ANOVA and logistic regression results between having friends or family working in the health or exercise field and all knowledge scores

	Friends & Total knowledge	Friends & PA knowledge	Friends & SB knowledge
ANOVA p-value	0.123	**0.036**	0.768
OR; p-value	1.101; 0.088	**1.190; 0.018**	0.948; 0.693

OR – odds ratio; Values in bold are significant

BMI and Knowledge

As shown in table 12, the association between BMI with Knowledge Scores were tested using a correlation and a linear regression analysis and we found that BMI was negatively associated with total knowledge and with SB knowledge, but not with PA knowledge.

Table 12. Correlation and linear regression results between BMI and all knowledge scores

	BMI & Total Knowledge	BMI & PA Knowledge	BMI & SB Knowledge
r	**-0.122**	-0.095	**-0.114**
β; p-value	**-0.073; 0.034**	-0.044; 0.101	**-0.029; 0.048**

r -Pearson correlation coefficient; Values in bold are significant

Other Findings

Gender and Knowledge

Through an ANOVA analysis we found no differences for any knowledge scores between genders ($p>0.05$).

Sleep and Knowledge

The ANOVA analysis showed that participants who slept the least (less than 5 hours) had a significantly lower total knowledge score when compared to other participants who slept more (up to 9 hours) ($p < 0.05$). Participants who slept less than 5h also had a significantly lower score on PA knowledge when compared to participants who slept from 6 to 9 hours ($p < 0.05$). There was no significant difference in SB knowledge between different hours of sleep ($p > 0.05$). There was also no correlation between any knowledge score and the sleep time category.

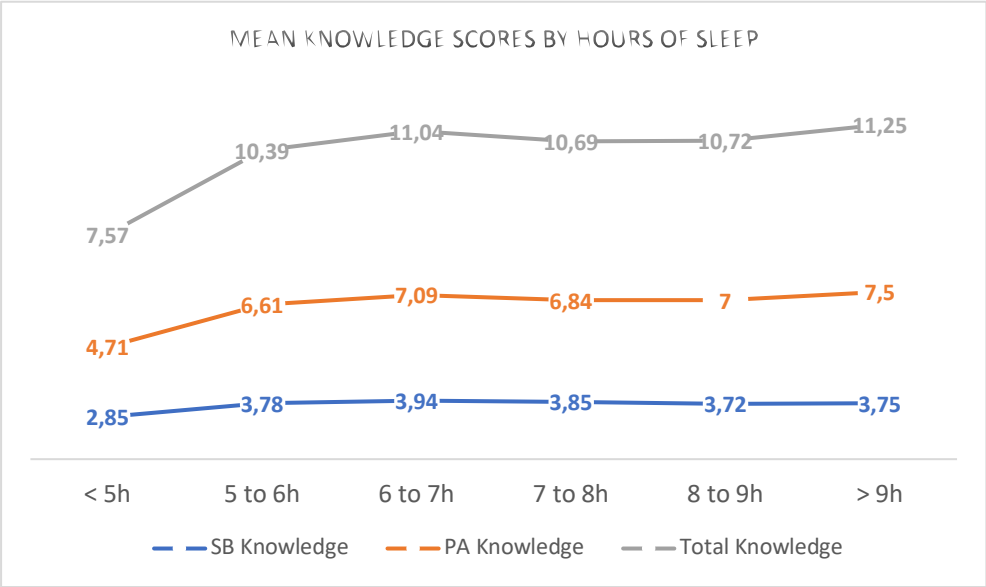

Figure 2. Mean of knowledge scores by hours of sleep

PA and Level of Education

While participants with lower than university education accumulated, on average 232 minutes of PA/week, participants with a bachelor's degree accumulated 174 minutes, and participants with a master's or PhD accumulated 154 minutes of PA/ week, being the difference between the highest and the lowest levels of education of significance ($p=0.039$), assessed through an ANOVA (Post Hoc) analysis.

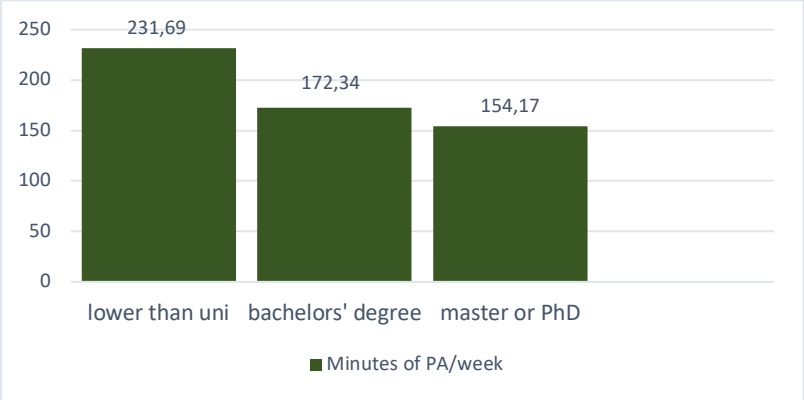

Figure 3. Mean of minutes of PA per week by levels of education

Friends or family in the health or exercise field and PA

Participants with friends or family in the health or exercise field had on average 204 minutes of PA/week. Participants who did not have friends or family in these fields had on average, 150 minutes of PA/week. Through an ANOVA analysis, we found a significant difference ($p = 0.024$) in the amount of PA that people with and without friends accumulate. A logistic regression showed a positive association between having a friend or family member in these fields and practicing PA (OR=1.002; p=0.026).

III.2.5 Discussion

From all fifteen knowledge statements, there were only 2 of them that most participants did not know the correct answer: 11 – "To work standing is physical activity" and 15 – "The World Health Organization recommends at least 400 minutes of weekly moderate physical activity to adults". This last question was the one that got the most incorrect answers, while question 6 "Spending too much time sitting is harmful for my health" was the one that got the most correct answers, which probably indicates that it could have been eliminated from the questionnaire.

Our first hypothesis was that a great percentage of participants would reveal a low knowledge level on both PA and SB concepts. This was not the case, as the total knowledge score was, on average, 71.3% of correct answers. Nonetheless, it is necessary to mention that when preparing the questionnaire and before starting the data collection, we did not expect to have so many participants with higher education, as 72.3 % of participants had at least a bachelor's degree and from the 27.7 % who had lower than university education, almost half (12%) were, at that moment, college students.

Our second hypothesis was that SB knowledge would be higher than PA knowledge which was confirmed by the results. SB knowledge average score was 76% and PA knowledge 68%. Previous studies support this finding as SB was widely understood by many participants (Mcewan et al., 2016; Webber et al., 2020). Question 6 (Spending too much time sitting is harmful for my health) was the question that got the most correct answers, as only 2.3% of participants disagreed with this statement. This was very surprising as in previous literature, most participants were unaware of deleterious effects of prolonged sitting (El Masri et al., 2021; Webber et al., 2020). Again, the higher education of our participants may explain these contradicting findings.

Contrary to what we expected, there was no association between knowledge and PA. This could be explained by the possibility that, perhaps, (some) participants did not include light daily PA when asked if they engaged in any PA (some participants declared not having any kind of PA). Another possible explanation could be the type of occupation that many people nowadays have, which is mainly sedentary. A review about health knowledge in older adults shows that in studies, where adults used activity monitors, there was no significant difference of steps between older adults with adequate and inadequate knowledge (Lim et al., 2021). This is rather true when it comes to highly educated people, who usually have jobs that demand a sitting position. The amount of PA/week illustrates this trend as participants with lower than university education accumulated, on average, 232 minutes of PA/week, participants with a bachelor's degree accumulated 174 minutes and participants with a master's or PhD accumulated only 154 minutes of PA/week.

We expected a negative association between age and knowledge, and that is what we found, as older participants had a lower total knowledge score and PA knowledge score. Although significant, this association was weak, with a low correlation between these variables.

Regarding the level of education, there was no association to any kind of knowledge. However, this can possibly be related to the small percentage of participants who had a lower education which led to an insufficient group comparison.

Having a family member or friend working in the health or exercise field was associated with a higher PA knowledge. This finding constitutes a positive sign for future programs as it depicts how more impactful it is to have this information coming from someone close. PA/week supports this finding as there was a significant difference in this activity between people who had friends in these fields (204 min/week) and people who did not (150 min/week).

BMI was negatively associated with total knowledge and SB knowledge which could correspond to the idea that people with higher knowledge would also be more knowledgeable about maintaining a healthy weight.

ST did not differ in relation to different knowledge levels which was expected. Transportation, social interactions, and office jobs require great amounts of ST, making it harder to decrease this behavior even when people understand their detrimental effects. In fact, our results show that the higher the education, the lower the amount of PA and although in our investigation we found no association between education and knowledge probably due to insufficient group comparison, that is still a possibility. People with a higher education tend to have a more sedentary job. It is also necessary to mention that many people, especially older adults, do enjoy their ST due to the different activities it enables, like knitting, socializing, board games and computer use and that people identify social and cognitive benefits in these activities (Mcewan et al., 2016). In fact, these activities are associated with a better perceived health and wellness in middle-aged and older adults (O'Neill & Dogra, 2016).

More than 5 hours of sleep were associated with higher knowledge levels. This finding emphasizes the Canadian Society for Exercise Physiology's (CSEP) 24- H Movement Guidelines that recommends between 7 to 9 hours of good-quality sleep for adults (Canadian Society for Exercise Physiology, [CSEP], 2020) and 7 to 8 hours for older adults (CSEP, 2020), as one of the means to improve cognition and physical function. On the other hand, less hours of sleep were associated with a higher BMI, an association that was, as well, suggested before (Garfield, 2019).

The WHO recommends, for adults, at least 150 minutes of moderate PA/week. Our results show that only 41.3% of our participants achieved this time recommendation of PA in any intensity. There was an observable gap difference between who followed this recommendation (150 minutes/week) and who did not, as the first group accumulated, on average, 363 minutes of PA/ week and the second accumulated 58 minutes. This becomes more

interesting as there was almost no difference in ST/day between these two groups, as the first group sat for 402 minutes/day, and the second sat for 400 minutes/day. So, if people sat for the same amount of time per day, how could they have so different amounts of PA per week? A possible explanation is that (some) participants did not account for the light PA that is done while pursuing daily activities and only accounted for PA they were aware of performing. This tendency was reported before, where people who answer PAQs say it was harder for them to remember PA that was common or "spontaneous" as it was performed without "conscious recognition" (Finger et al., 2015). So, it could be that they just forgot about this light PA. It could also be that although they know, in theory, that daily activities are considered PA (as shown by our results), when it comes to scan their practical life for these moments, they do not acknowledge them as PA. Future research should take this in consideration when asking for participants' PA. Maybe, it would be beneficial to briefly help them to identify these activities in their lives and warning them to include it in their PA answers, before they respond.

Also related to this gap, is a, seemingly, general misconception about what is PA. Our results show that most participants agreed that daily house chores (73%) and playing with kids (85.6%) is PA, and that waiting for the bus standing was not considered SB (62.7%). However, working while standing was also not considered PA (54.3%). Thus, in a way it seems participants know that PA is not only related to exercise (64.3%), but to any kind of activity performed during the day. On the other hand, standing was not considered PA. Previous qualitative studies show that people tend to associate PA with movement (El Masri et al., 2021; Kinnett-Hopkins et al., 2019) and "moving around" (Tudor-Locke et al., 2003). In Portugal, a previous study demonstrated that 43% of participants did not recognize standing as PA (Silva et al., 2018). The most widely accepted definition of PA is "any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al., 1985), showing that people's perception is quite right. Energy expenditure of standing has a variety of METs estimations' depending on the type of standing: 1.3 for standing quietly in a line; 1.5 for copying documents; 1.8 for standing talking in person or on the phone, writing, painting, or standing fidgeting; 2.0 for laundry; 2.0 for holding a child; 2.5 light effort arts and crafts; 3.0 for playing rock and roll in a guitar; and others (Ainsworth et al., 2011). According to this definition and estimation, standing while working should be considered PA. On the contrary, a 2016 study (Gibbs et al., 2016) found that typing and writing while standing, sitting or sitting and standing (30 minutes each) at a desk, all expended less than 1.5 METs (Kowalsky et al., 2021). However, this study was done on a small sample (n=18) and participants were abstaining for any food for 8h and any moderate-to-vigorous PA for 24h. Additionally to that, participants

were fitted with a metabolic mask and heart rate monitor which could, unconsciously, decreased their range of movements. The desk work they were performing included typing articles from a magazine to a computer, copying definitions, reading and mathematical problems. This study supports participants perception that this behavior (working while standing) could, in fact, be an in-between PA and SB as it did not expend more than 1.5METs but also was not in a reclined, sitting or lying position.

Actually, the Sedentary Behavior Research Network (SBRN) 2017 consensus differentiated two categories of standing: active standing (for example ironing clothes, which is >2 METs) that is characterized as a stationary physical activity; and passive standing (for example waiting for the bus, which is ≤ 2 METs) that is characterized as a stationary non-sedentary behavior (Tremblay et al., 2017). So, if participants assumed that "standing while working" was done at a desk, they could be right – it may actually not be PA. If participants, however, thought of an assembly line, they were wrong – it probably is PA. Further investigation on people's perception about different types of standing can be of interest.

About the recommendation of the WHO for PA, the great majority of participants did not know the recommended amount they should be engaging (77.3%), which is alarming and must be transmitted to the public authorities responsible for the dissemination of these guidelines, so that they can reach a larger audience.

Strengths and Limitations

There are some strengths and limitations to this investigation that should be noted. Firstly, as, to our knowledge, there was no other previous established method for measuring the understanding of these concepts. Our questionnaire was designed specifically for this investigation, which means it was never used before, so rectifying and improving could be needed if intended to use on broader populations or aims. However, it was the first questionnaire that aimed to analyze participants' understanding about PA and SB concepts. Additionally, it was based on a previous systematized review, which allowed us to first understand people's feelings and perceptions to then determine how many people feel and think the same way (Tenny et al., 2021). In comparison to previous studies, the sample size was much bigger which represents a strength to this investigation.

Another limitation is due to the fact that, as in other studies (Bailey & Stevenson, 2021; Harrison et al., 2020), when asking about PA of participants, we had to use the same concepts

we were trying to understand if they perceived correctly. Although unavoidable, we tried to mitigate this issue by using ST questions instead of SB questions, by using the words PA, exercise and sports when asking for their daily PA and giving the option to choose "other kind of PA" and even write what kind of PA they engaged in. Having the possibility to use accelerometers or any other objective manner of measuring PA and SB would have provided us a more definite conclusion.

This investigation allowed to gather a more generalized population, as there were no other excluding factors to participants other than not speaking Portuguese and being younger than 18 years of age. Yet, most participants were women, which is a common limitation as we can conclude from previous studies (El Masri et al., 2021; Harrison et al., 2020; Kinnett-Hopkins et al., 2019; Mcewan et al., 2016; Webber et al., 2020). Participants were also highly educated, which could have influenced the results. Additionally, the fact that this questionnaire was distributed online could signify a loss of personal connection and opportunity to observe and delve in more deep interactions and as consequently have a clearer viewpoint of participants true perceptions. On the other hand, having an anonymous and more private opportunity to answer the questionnaire, entails an opportunity to have a bigger sample and possibly a more honest opinion as participants may not feel any constraint, peer pressure or even shyness.

III.2.6 Conclusion

Most participants could differentiate PA from exercise which was the biggest misconception in previous studies. Although participants knew that daily activities like house chores or playing with children are PA, there seemed to be some incongruities when asked to consider their personal daily PA behaviors, as some participants declared not having any PA, while still having very few hours of ST. Standing seems to not be perceived as PA and, in some instances, this perception may be right.

Knowledge was not associated with PA level, which did not confirm our hypothesis. This could be due to participants not acknowledging their own light PA as such. ST did not differ regarding knowledge, as expected. Participants with friends or family working in the health or exercise field had a higher knowledge about PA definition and did engage in more

PA/week, which could indicate an impactful new way to get to the population that has a low interest or knowledge about this topic.

Recommendations of PA are still not known to the great majority of participants, and almost all participants knew that prolonged sitting is detrimental for health, and the majority was able to differentiate SB from sleep.

Thus, many questions remain unanswered and further investigation is needed. For future investigation, we suggest a method that joins both quantitative and qualitative aspects, as to first establish people's main perceptions regarding these concepts, and then to attempt to understand the rationale behind these perceptions.

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CHAPTER IV
DISSERTATION GENERAL DISCUSSION

IV.1 Main Findings

PA and SB have a broad perception. There are still some misconceptions, especially regarding PA and exercise, but many participants, even not knowing the exact definition, seem to understand what it essentially is: “moving around” and “sitting on your butt”. However, they still do not acknowledge all their daily movements as PA.

PA, along all studies, including our investigation, seems to be associated with movement. This was visible in the qualitative studies where participants clearly expressed this perception but also in our investigation, as participants did not perceive standing as PA. In fact, there could be an in-between, as there seems to be some standing that does not expend energy above 1.5 METs (Ainsworth et al., 2011; Gibbs et al., 2016; Kowalsky et al., 2021). Standing seems to generate many misunderstandings and doubts as it is still not clear how it should be characterized. The SBRN 2017 consensus suggests calling it stationary non-SB, which, in our opinion could deepen the confusion in the population. Perhaps a “movement” based distinction could be a better way to distinguish PA from SB.

SB is better known than PA, maybe because, as we previously stated, there is no other similar behavior that participants could confuse it with, unlike PA and exercise.

Lastly, it is noticeable that most participants were women. This seems to reveal a greater willingness from this gender to participate in these types of investigations. It is a trend seen before as literature refers that men are considered a “hard-to-reach” population when it comes to promote PA, prevent illness, or even just having annual health check-ups, characterizing them as less interested in this kind of information (Bottorff et al., 2015). This justifies that future investigation should try to include more men, so that a further understanding on this gender regarding these literacy issues can be attained.

Strengths and Limitations

The main strength of this dissertation was the relationship between the systematized review and the original investigation. All basis for the latter were retrieved from the first, allowing almost a continuity of findings. Likewise, the development of a questionnaire that analyses new parameters and the large sample size in the original investigation. It is possible,

that in future use, it may need improvements or alterations, but it is still a forward step in the investigation of this topic. The main limitation, was, once again, that both investigations included more women than men, probably because as we have seen before, men are not very interested in this kind of topic (Bottorff et al., 2015).

IV.2 Conclusion

It is clear that there is room for improvement in what concerns people's perception and knowledge about these concepts. As the first investigation to associate this knowledge with other variables, there is still need for further investigation to help us understand why and how people's perceptions are affected and what could we do to do make the learning process simpler and more effective.

However, there are some considerations that we can already make, that can be of aid for future interventions. Firstly, when studying this associations, PA and SB measurements should be done by an objective mean. This will allow for more conclusive results. Another main consideration, is the need to focus on the male population, attracting their interest for this matter, as seen before in other successful interventions (Wyke et al., 2019). The same applies to older people. We have seen that age was inversely associated with knowledge, so a special attention to older people may be very helpful to help combat their wrong perceptions. Being a population that may be harder to reach, not due to their uninterest (it may even be the opposite as found in the review) but to the lack of ways to interact with or attract them, an indirect intervention can be considered, as, for example, through their family. The possibility of joining older adults and their grandchildren in Physical Education (PE) classes for example, may be of interest. This way, older people will have more willingness to participate, will learn in a more joyful way and can even create their own community of grandparents, maintaining their PA levels autonomously. We also found that BMI was negatively associated with total knowledge, and as such, people with overweight or obesity may also thrive with a specific intervention. In this case, different ages will probably need different interventions, but, in our opinion, one main step in combating this problem from the beginning, is daily PE classes. Comparing our school curriculum classes and how many hours students spend sitting in the classroom, there

needs to be a balance of both mental and physical stimulus. If from young age they are taught that PA is not as important as other occupations, it will be harder to make it a priority when becoming adults.

Finally, it is important to clear up what behaviors are considered SB and PA. It can be hard for general population to, besides distinguishing PA and exercise, also distinguish between stationary PA and stationary non SB. If, indeed, passive standing has a 1.5 METs (or lower) energy expenditure, maybe, a "movement" based distinction could be a better way to characterize PA. Every waking and voluntary behavior that includes body movement would be considered PA and any waking and voluntary behavior that lacks body movement would be considered SB. The main point is that definitions need to be easy to share and understand by the general population, for them to finally, knowing what it means, be able to respond, without a doubt, to "do you engage in PA"?

IV.3 References

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CHAPTER V

APPENDICES

Knowledge Questions

Figure 1. Answers to question 1 - Physical Activity and Physical Exercise are synonymous.

64.3% of participants were correct. 35.7% of participants were incorrect.

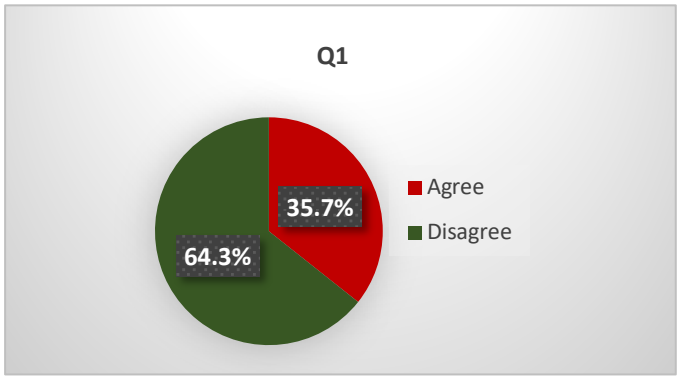

Figure 2. Answers to question 2 - Standing still (ex: waiting for the bus) is a sedentary behavior.

62.7% of participants were correct. 37.3% of participants were incorrect.

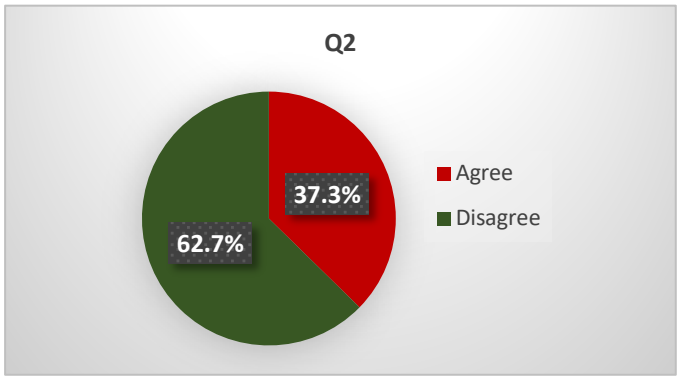

Figure 3. Answers to question 3 - I can only be physically active if I play any kind of sport or perform physical exercise.

67.7% of participants were correct. 32.3% of participants were incorrect.

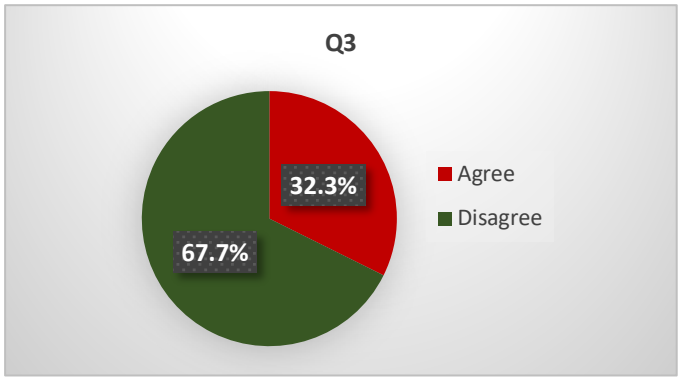

Figure 4. Answers to question 4 - To practice physical activity and to be physically active is the same thing.

71.7 % of participants were correct. 28.3% of participants were incorrect.

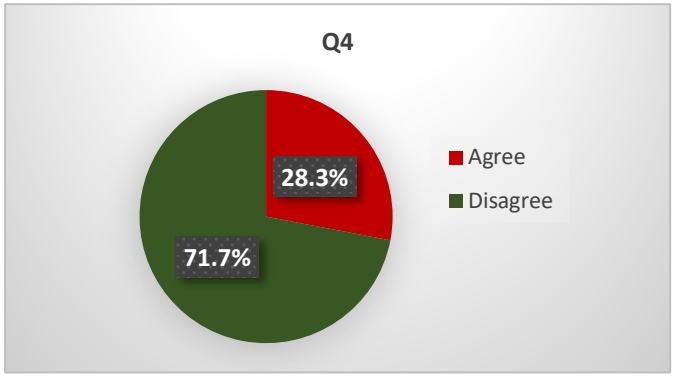

Figure 5. Answers to question 5 - I will only have health benefits if I practice/engage in physical activity every day.

77.7 % of participants were correct. 22.3 % of participants were incorrect.

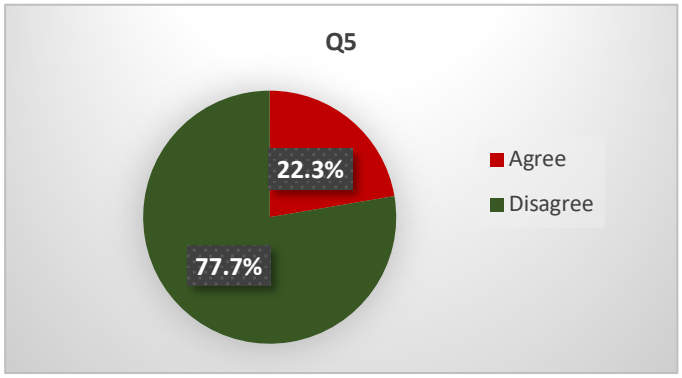

Figure 6. Answers to question 6 - Spending too much time sitting is harmful for my health.

97.7 % of participants were correct. 2.3% of participants were incorrect.

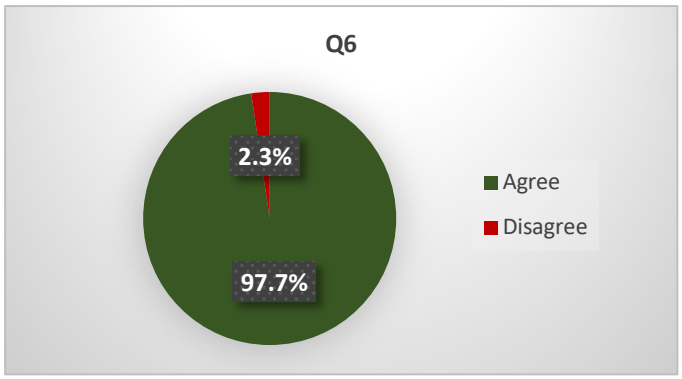

Figure 7. Answers to question 7 - To obtain health benefits, physical activity must be of vigorous intensity (high effort intensity that makes you breath harder than usual).

87.7 % of participants were correct. 12.3 % were incorrect.

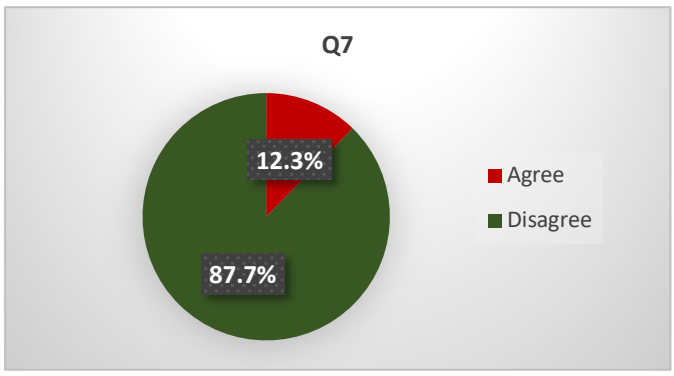

Figure 8. Answers to question 8 - House chores/housework like hanging clothes or sweeping are physical activity.

73% of participants were correct. 27% of participants were incorrect.

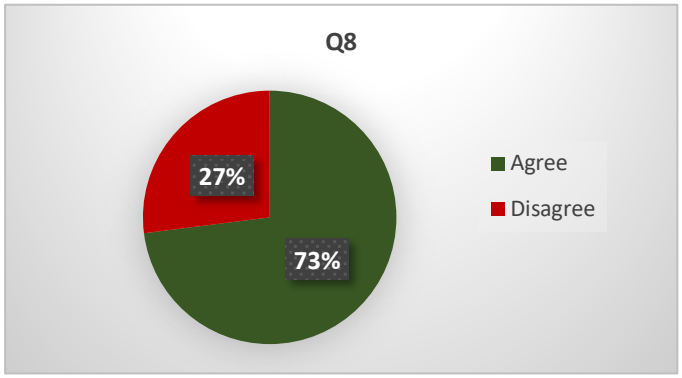

Figure 9. Answers to question 9 - To be in sedentary behavior means to be sitting.

72.7% of participants were correct. 27.3% of participants were incorrect.

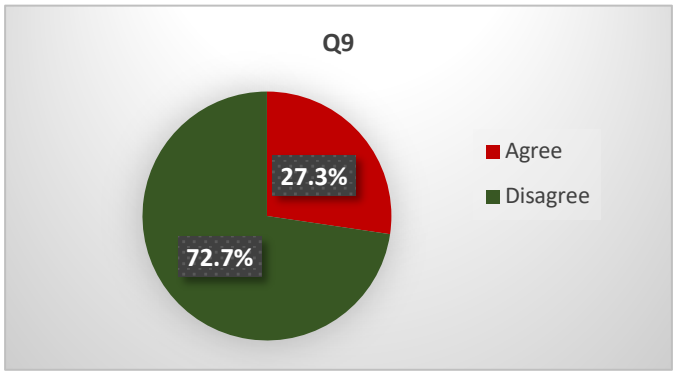

Figure 10. Answers to question 10 - To play hide and seek, with your children, is physical activity.

85.7% of participants were correct. 14.3% were incorrect.

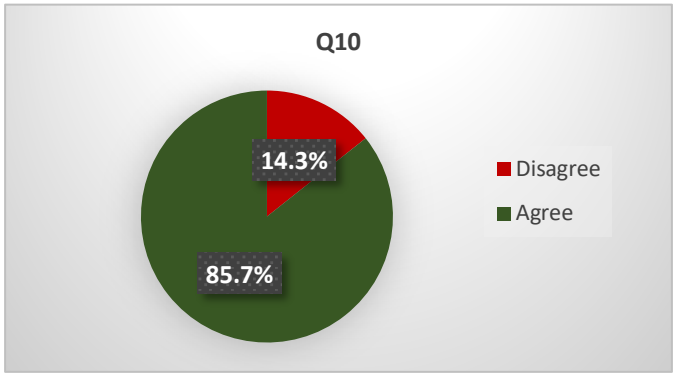

Figure 11. Answers to question 11 - To work standing is physical activity. 45.7% of participants were correct. 54.3% of participants were incorrect.

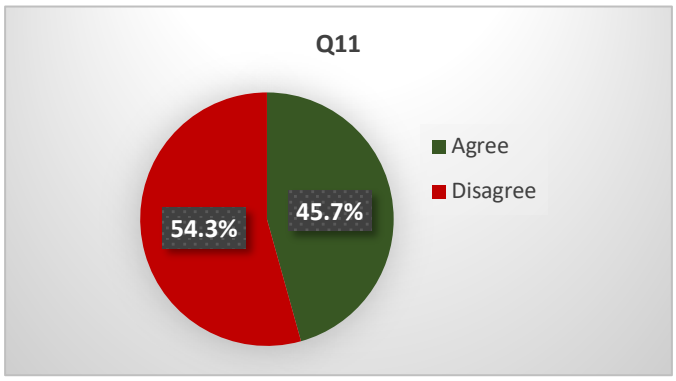

Figure 12. Answers to question 12 - Sleeping at night is sedentary behavior. 95.3% of participants were correct. 4.7% of participants were incorrect.

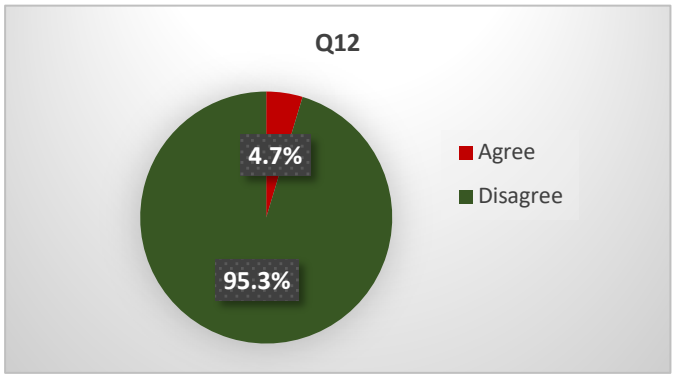

Figure 13. Answers to question 13 - Napping, during the day, is sedentary behavior. 79% of participants were correct. 21% of participants were incorrect.

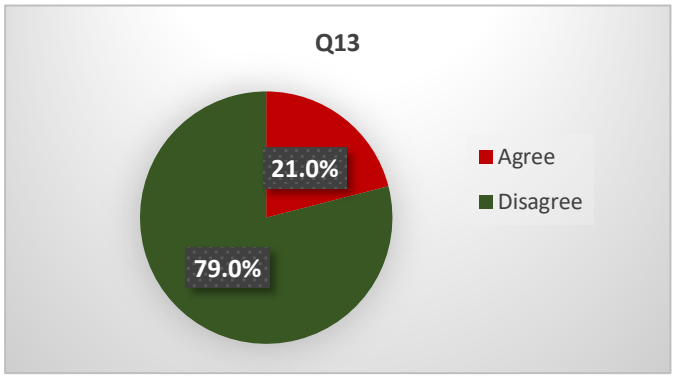

Figure 14. Answers to question 14 - Studying or working while lying down is sedentary behavior.

68.7% of participants were correct. 31.3% of participants were incorrect.

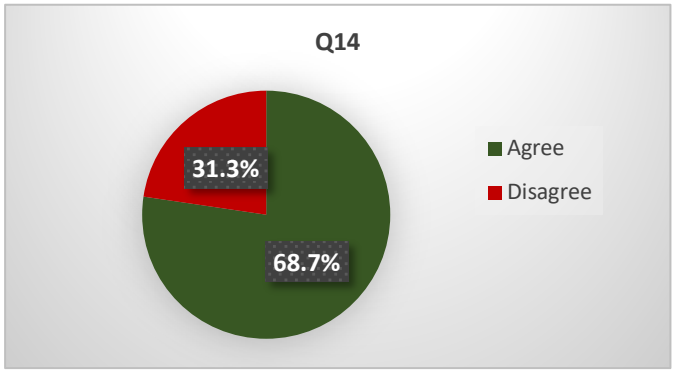

Figure 15. Answers to question 15 - The World Health Organization recommends at least 400 minutes of weekly moderate physical activity to adults.

22.7% were correct. 77.3% were incorrect.