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AVALIAÇÃO DA LITERACIA FÍSICA EM ADULTOS

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Resumo Geral

O conceito de literacia física surge como uma resposta à tendência global da inatividade física e está sendo definido e interpretado de várias formas. Uma das mais adotadas é “a motivação, confiança, competência física, conhecimento e compreensão para manter a atividade física ao longo da vida”. A literacia física pode ser considerada uma componente fundamental da existência humana em todas as faixas etárias, pelo seu potencial de proporcionar experiências incorporadas enriquecedoras. O construto engloba um conjunto de domínios conceptualmente ligados entre si, que torna desafiante a recolha de dados empíricos e desenvolvimento dos instrumentos de avaliação. Até ao momento, nenhum instrumento de avaliação da literacia física para adultos, em contexto comunitário, foi validado em língua portuguesa. O objetivo desta dissertação de mestrado foi rever e comparar sistematicamente os instrumentos e métodos de avaliação da literacia física em adultos, e, de forma informada pela revisão, selecionar, traduzir e adaptar para português um instrumento apropriado.

Foram realizados dois estudos. A revisão sistemática procurou analisar os métodos de avaliação da literacia física em adultos face ao seu alinhamento com o conceito e às propriedades psicométricas, e foi realizada de acordo com a metodologia *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA). A revisão incluiu a literatura publicada e não publicada, e foi a primeira do género de considerar artigos publicados em língua não inglesa. No segundo estudo a escala *Perceived Physical Literacy Instrument Portuguese Version* (PPLI-PT) foi validada numa amostra de 434 adultos portugueses. A tradução e adaptação para português foram realizados com o recurso a painel de especialistas. Após a avaliação da estrutura fatorial da escala, foi efetuada a análise fatorial confirmatória, análises de invariância entre sexos, de validade concorrente, e de confiabilidade e concordância teste-reteste.

A revisão sistemática incluiu 31 artigos, publicados entre 2016 e 2022. Sete instrumentos de avaliação explícitos foram encontrados, dos quais três foram originais. Foi detetada uma inconsistência relativamente aos domínios e atributos da literacia física medidos. A falta de instrumentos validados levou a uma utilização frequente de escalas combinadas autoconstruídas. As características psicométricas das avaliações foram, em geral, insuficientemente relatadas, o que impossibilitou a comparação dos instrumentos ao nível da sua qualidade e viabilidade.

O segundo estudo forneceu evidências para a utilização adequada de PPLI-PT na população portuguesa. A escala contém 9 itens e avalia três dimensões da literacia física: sentido de si e autoconfiança (engloba habilidades de autogestão e autopercepção da aptidão física), autoexpressão e comunicação com os outros (autopercepção das habilidades sociais e da capacidade de resolução de problemas) e conhecimento e compreensão (atitude em relação à atividade física e consciencialização dos seus benefícios para a saúde). O modelo apresentou um bom ajuste aos dados e a validade de construto adequada. Surgiram algumas limitações, nomeadamente não foi verificada a invariância entre sexos, e não foi demonstrada uma consistência suficiente da escala ao longo do tempo. Mais estudos de validação são necessários para confirmar os resultados.

A presente dissertação demonstrou que embora o método mais adequado de avaliação da literacia física em adultos ainda esteja por descobrir, e as soluções existentes necessitem de mais evidências, existe crescente interesse na implementação prática do conceito, sendo amplamente aceite o seu potencial contributo no desenvolvimento do ser humano. A investigação que relaciona a literacia física com outras métricas poderá ajudar a identificar os determinantes do comportamento complexo da atividade física e apoiar eficazmente os adultos na sua jornada de literacia física.

Literacia física, atividade física, avaliação, adultos

Abstract

The concept of physical literacy emerges as a response to the global trend of physical inactivity and has been defined and interpreted in various ways, one of the most common being “the motivation, confidence, physical competence, knowledge and understanding to maintain physical activity throughout the life course”. Physical literacy can be considered a fundamental component of human existence in all age groups, due to its potential to provide enriching embodied experiences. The construct encompasses a cluster of domains, conceptually linked together. This complex structure makes collecting empirical physical literacy data challenging and constrains assessment development. So far, no physical literacy assessment instrument designed for adults and applicable in a community context has been validated in Portuguese language. This master’s thesis aimed to systematically review and compare existing physical literacy assessment attempts in adults and—informed by the review —select, translate, and adapt an appropriate instrument to Portuguese.

Two studies were carried out. The systematic review sought to analyze physical literacy assessments in adults regarding their alignment with the concept and psychometric properties and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. The review included published and unpublished literature and was the first of its kind to consider non-English papers. The second study validated the Perceived Physical Literacy Instrument Portuguese Version (PPLI-PT) in a sample of 434 Portuguese adults. Translation and adaptation were performed using the committee approach method. After assessing the factor structure of the scale, a confirmatory factor analysis, analysis of invariance between sex, concurrent validity, test-retest reliability and agreement analyses were conducted.

The systematic review included 31 articles, published between 2016 and 2022. Seven explicit assessment instruments were found, of which three were original. An inconsistency was detected regarding the physical literacy domains and attributes measured. The lack of available instruments led to a repeated utilization of self-constructed combined assessments. In general, measurement properties were reported to a limited extent, which made it impossible to compare the instruments in terms of their quality and feasibility.

The second study provided evidence for the PPLI-PT use in the Portuguese population. The scale contains nine items and assesses three domains of physical literacy: sense of self and self-confidence (encompasses self-management skills and self-perception of physical fitness), self-expression and communication with others (self-perception of social

and problem-solving skills), and knowledge and understanding (attitude towards physical activity and awareness about its benefits for health). The model presented a good fit to the data and adequate construct validity. Some limitations emerged: invariance between sex was not verified, and sufficient over-time consistency was not achieved. More validation studies are needed to confirm the results.

The present thesis demonstrated that although the most appropriate method of assessing physical literacy in adults is yet to be discovered, and the existing solutions require more evidence, there is a growing interest in the practical implementation of the concept, which confirms the wide acceptance of its potential contribution to human development. Future investigation of the relationship between physical literacy and other metrics could help identify the determinants of complex physical activity behavior and effectively support adults in their physical literacy journey.

Physical literacy, physical activity, assessment, adults

Índice

Introdução geral	pág.10
Capítulo 1. Physical literacy assessment in adults: a systematic review	
1.1 Abstract	pág.16
1.2 Introduction	pág.16
1.3 Methods	pág.18
1.3.1 Eligibility criteria	pág.18
1.3.2 Information sources	pág.19
1.3.3 Search strategy	pág.19
1.3.4 Selection process	pág.19
1.3.5 Data extraction process, data items and synthesis methods	pág.22
1.3.6 Study risk of bias assessment	pág.22
1.3 Results	pág.23
1.5 Discussion	pág.30
1.5.1 Definition alignment and domains rationale	pág.31
1.5.2 Assessment types	pág.32
1.5.3 Usability and trustworthiness	pág.33
1.5.4 Public health agenda	pág.34
1.5.5 Strengths and limitations	pág.34
Capítulo 2. Validation of the Portuguese Version of the Perceived Physical Literacy Instrument	
2.1 Abstract	pág.37
2.2 Introduction	pág.37
2.3 Methods	pág.39
2.3.1 Participants and data collection	pág.39
2.3.2 PPLI translation procedures	pág.39
2.3.3 Measures	pág.40
2.3.4 Statistical analysis	pág.41
2.4 Results	pág.43
2.5 Discussion	pág.51
2.7 Acknowledgements	pág.54
Conclusão geral	pág.55
Bibliografia	pág.58
Apêndices	pág.i

Índice de Tabelas

Tabela 1 – Full search example	pág.19
Tabela 2 – Studies summary	pág.23
Tabela 3 – Physical literacy definitions	pág.24
Tabela 4 – Explicit physical literacy instruments	pág.25
Tabela 5 – Physical literacy instruments validity and feasibility	pág.26
Tabela 6 – Instruments utilized in combined physical literacy assessments	pág.28
Tabela 7 – Perceived Physical Literacy Instrument	pág.40
Tabela 8 – Descriptive statistics of the sample	pág.43
Tabela 9 – Descriptive statistics of PPLI-PT items	pág.44
Tabela 10 – PPLI-PT goodness-of-fit statistics	pág.45
Tabela 11 – Convergent and discriminant validity analyses	pág.46
Tabela 12 – Multigroup invariance analyses between sex	pág.47
Tabela 13 – Concurrent validity analyses	pág.48
Tabela 14 – Test-retest reliability and agreement analysis	pág.49

Índice de Figuras

Figura 1 – PRISMA flow diagram for the identification of the included studies_____pág.21

Figura 2 – PPLI-PT factor structure_____pág.45

Introdução Geral

A inatividade física tem sido um dos temas principais da saúde pública nas últimas décadas (Pate et al., 1995; World Health Organization, 2018). Apesar dos avanços significativos na área e das evidências qualitativamente e quantitativamente aprimoradas (Guthold et al., 2018), a literatura existente parece fornecer uma base teórica limitada para explicar o comportamento complexo e dinâmico da atividade física (Rhodes et al., 2019). Os índices de atividade física permanecem globalmente insuficientes (World Health Organization, 2022). Em Portugal, apenas 4% da população adulta, inquirida pelo Eurobarómetro, pratica exercício ou desporto regularmente, e a mesma percentagem relata praticar regularmente a atividade física não estruturada (European Commission, 2022).

Na tentativa de dar resposta a esta tendência global de inatividade física e para trazer à luz fatores não detetados anteriormente, surgiu o conceito holístico de literacia física (Cairney et al., 2019). É um construto multidimensional que enfatiza a interconexão entre o corpo e a mente (Durden-Myers et al., 2020; Pot et al., 2018), definido e interpretado de várias formas, sendo a mais adotada “a motivação, confiança, competência física, conhecimento e compreensão para manter a atividade física ao longo da vida” (Edwards et al., 2017; Whitehead, 2010). O desenvolvimento da literacia física parece afetar positivamente diversas variáveis comportamentais, psicológicas, sociais e físicas (Edwards et al., 2017) e alguns autores consideram-na determinante na saúde pelo papel que assume na formação de trajetórias de estilos de vida fisicamente ativos (Cairney et al., 2019; Dudley et al., 2017).

Margaret Whitehead, a reconhecida pioneira do conceito, descreve seis atributos de um indivíduo fisicamente letrado: 1) A motivação para capitalizar o potencial inato de movimento que contribui significativamente para a qualidade de vida; 2) Equilíbrio, eficácia e confiança numa ampla variedade de situações fisicamente desafiantes; 3) Perspicácia na «leitura» do ambiente físico, capacidade de reconhecer, antecipar, e responder adequadamente às necessidades e possibilidades de movimento; 4) Uma consciência estabelecida de corporeidade, uma interação articulada com o meio ambiente; 5) Autoexpressão fluente por meio da comunicação não-verbal e a interação empática com os outros; 6) Capacidade de identificar e articular as qualidades essenciais que influenciam a eficácia do seu próprio desempenho de movimento e compreensão dos princípios da saúde corporal (Whitehead, 2010).

Nos últimos anos, o conceito da literacia física ganhou um interesse significativo junto dos investigadores, dos profissionais da educação, desporto e saúde, e foi integrado em várias políticas e planos estratégicos nacionais e globais de atividade física (Keegan et al.,

2013; Tremblay et al., 2018; UNESCO, 2015; Ydo, 2021). Em 2013, o governo australiano investiu \$A200 milhões num programa de promoção de atividade física por meio da literacia física (Keegan et al., 2013), estimando as futuras poupanças com os serviços de saúde em \$A13,8 bilhões. No Canadá, a literacia física é considerada um pilar fundamental para uma nação saudável. A Sport for Life, uma organização canadiana sem fins lucrativos, apoia inúmeras iniciativas baseadas em literacia física através de financiamento privado e governamental desde 2014. Nos anos de 2020-2021 a organização afirma ter impactado mais de 3,8 milhões de pessoas (Sport for life, 2021). O «Plano de Ação Global para a Atividade Física 2018-2030» da Organização Mundial da Saúde, reconheceu a literacia física como um conceito crucial e promissor (World Health Organization, 2018), enquanto a UNESCO estimula a sua promoção em contextos educacionais (UNESCO, 2015). Em Portugal, o termo literacia física já foi introduzido em alguns documentos governamentais, mas a investigação tem sido concentrada em grupos limitados (Carl et al., 2023).

O desenvolvimento de estratégias, políticas e diretrizes de saúde pública, bem como de programas de intervenção, requer uma compreensão clara de quais os componentes que constituem a literacia física e de como ela pode ser observada e avaliada. No entanto, apesar do seu valor ser reconhecido, a incerteza em torno do conceito prevalece (Young et al., 2020). A falta de clareza, marcada por uma variedade de definições e interpretações adotadas globalmente (Martins et al., 2021), prejudica a sua operacionalização (Shearer et al., 2018). A natureza complexa da literacia física torna desafiante a recolha de dados empíricos (De Dieu & Zhou, 2021) e restringe o desenvolvimento de instrumentos de avaliação.

O construto da literacia física englobe um conjunto de domínios que variam entre as definições diferentes. Comumente os domínios incluem afetivo, físico, cognitivo, comportamental e social (Cornish et al., 2020; Edwards et al., 2018; Keegan et al., 2019), potencialmente fornecendo um fundamento teórico abrangente. A maioria dos instrumentos existentes avalia os atributos da literacia física em apenas um ou dois destes domínios (De Dieu & Zhou, 2021), diminuindo a intenção holística e desvalorizando os fundamentos filosóficos do conceito (Young et al., 2020). Uma controvérsia ainda mais acentuada é se a literacia física pode sequer ser qualificada, interpretada e avaliada de acordo com as referências pré-estabelecidas. Por exemplo, Margaret Whitehead reforça que as comparações devem ser feitas apenas com o próprio indivíduo e nunca em relação a outros (Whitehead, 2013b).

Desde a sua criação original, o conceito da literacia física tem sido associado à educação física, e a maioria dos instrumentos de avaliação foi desenvolvida para crianças (De

Dieu & Zhou, 2021; Edwards et al., 2018; Y. Liu & Chen, 2020; Shearer et al., 2021). Não sabemos quais são as avaliações mais adequadas para diferentes faixas etárias e até se a avaliação deve ou não ser direcionada a uma faixa etária específica. Jean de Dieu (2021) na sua revisão sistemática aponta que praticamente todos os instrumentos existentes foram desenvolvidos contra as bases filosóficas do conceito, segundo o qual a literacia física considera todos os indivíduos sem classificação pela faixa etária ou local de residência.

É evidente que a literacia física, especialmente quando considerada não como um conjunto de habilidades a serem adquiridas em determinada idade, mas como a disposição para uma aprendizagem contínua e a capacidade de auto-adaptação às alterações físicas e ambientais, oferece benefícios para trajetos individuais dos adultos e para a saúde pública. Whitehead (2019a) chama a atenção para o facto de que, embora todos os seres humanos exibam potencial para desenvolver a literacia física, “a sua expressão específica dependerá das capacidades individuais dos indivíduos, e será particular da cultura em que vivem”. Isto é particularmente importante no contexto da literacia física na população adulta, pois a idade, o ambiente e as condições de saúde têm um tremendo impacto na forma como a literacia física é expressa. À medida que os adultos envelhecem, eles são forçados a aprender novas habilidades determinadas pela idade ou pela condição de saúde (Petrusevski et al., 2021). Face a condições crónicas, os indivíduos precisam de aprender a monitorizar o seu estado funcional e a ajustar a sua atividade conforme necessário. Precisam também de aprender estratégias de reabilitação que promovam a funcionalidade. De acordo com Whitehead (2018), os indivíduos fisicamente letrados apreciam a atividade física, e promovem-na dentro do seu círculo social. Assim, um indivíduo fisicamente letrado irá promover o estilo de vida ativo na sua família e na comunidade, gerando um crescente círculo de engajamento. É importante mencionar que para além das questões de saúde relacionadas com a atividade física, a literacia física, com sustentação filosófica no existencialismo e na fenomenologia, proporciona experiências incorporadas enriquecedoras que potenciam uma vida plena, tornando-a um componente fundamental da existência humana em todas as faixas etárias (Whitehead, 2010) .

Durante a última década foram realizados vários estudos para entender como avaliar, manter e melhorar a literacia física em adultos. Edwards (2018) fez o primeiro — e o mais abrangente até ao momento — esforço para sistematizar as avaliações da literacia física em diferentes faixas etárias. Desde então, mais quatro estudos reviram as avaliações da literacia física em adultos. O primeiro limitou-se à avaliação do domínio físico em idosos (Huang et al., 2020). O segundo focou-se nas definições adotadas e também incluiu adultos idosos (Petrusevski et al., 2021). O terceiro incluiu instrumentos de avaliação explícitos, identificando

dois instrumentos desenvolvidos para a população adulta (De Dieu & Zhou, 2021). Os autores do quarto estudo não encontraram nenhum instrumento validado e optaram por incluir na sua revisão as medidas “úteis para medir os diferentes elementos da literacia física” (Ryom et al., 2022). Todos as revisões mencionadas incluíram apenas os estudos que foram revistos por pares (exceto a da Petrusevski) e publicados em inglês.

Objetivos e Métodos da Dissertação

Até ao momento, nenhum instrumento de avaliação da literacia física para adultos, em contexto comunitário, foi validado em língua portuguesa. Considerando o crescente interesse dos investigadores nacionais, a potencial aplicação em estudos de larga escala (comunitários) em Portugal, e a participação do país em inquéritos nacionais e internacionais a este nível, os objetivos da presente dissertação centraram-se em:

- 1) Rever e comparar sistematicamente os instrumentos e métodos reportados na literatura referentes à avaliação da literacia física em adultos;
- 2) De forma informada pela revisão sistemática conduzida, selecionar, traduzir e adaptar para português, um instrumento de avaliação da literacia física em adultos e analisar as suas propriedades psicométricas.

De forma compatível com os objetivos, a dissertação está organizada em dois estudos:

- I) o primeiro, constituindo o primeiro capítulo, contém a revisão sistemática das metodologias para avaliação da literacia física em adultos, realizada de acordo com a metodologia *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) e com carácter inclusivo;
- II) o segundo, que constitui o segundo capítulo, contém o artigo de validação da escala *Perceived Physical Literacy Instrument Portuguese Version*. A tradução e adaptação para português foram realizados com o recurso a painel de especialistas. Após a avaliação da estrutura fatorial da escala, foi realizada a análise fatorial confirmatória para verificar a validade do construto. Além disso, foram realizadas análises de invariância entre sexos, análises de validade concorrente, e testes confiabilidade e concordância teste-reteste.

Os dois estudos, elaborados em inglês, foram submetidos a revistas científicas internacionais indexadas e com revisão por pares, e estão incluídos na sua forma original. A reflexão integrada acerca dos resultados está presente na conclusão geral. As referências

bibliográficas, apêndices e anexos de ambos os estudos encontram-se no final da dissertação; as tabelas e as figuras foram organizadas seguindo uma numeração única; toda a dissertação foi formatada seguindo as normas *American Psychological Association* (APA, versão 7).

CAPÍTULO 1

Physical literacy assessment in adults: a systematic review*

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Abstract

Physical literacy is a multidimensional construct that has been defined and interpreted in various ways, one of the most common being “the motivation, confidence, physical competence, knowledge and understanding to maintain physical activity throughout the life course”. Although its improvement can positively affect many behavioral, psychological, social, and physical variables, debate remains over an appropriate method of collecting empirical physical literacy data. This systematic review sought to identify and critically evaluate all primary studies (published and unpublished, regardless of design or language) that assessed physical literacy in adults or have proposed measurement criteria. Relevant studies were identified by searching four databases (Pubmed, SportDiscus, APA PsycINFO, Web of Science), scanning reference lists of included articles, and manual cross-referencing of bibliographies cited in prior reviews. The final search was concluded on July 15, 2022. Thirty-one studies, published from 2016 to 2022, were analyzed. We found seven instruments measuring physical literacy in adults, of which six were questionnaires. The Perceived Physical Literacy Instrument was the first developed for adults and the most adopted. The included studies approached physical literacy definition in two ways: by pre-defining domains and assessing them discretely (through pre-validated or self-constructed instruments) and by defining domains as sub-scales after factorial analyses. We found a fair use of objective and subjective measures to assess different domains. The wide use of instruments developed for other purposes in combined assessments suggests the need for further instrument development and the potential oversimplification of the holistic concept, which may not result in a better understanding of physical literacy. Quality and usability characteristics of measurements were generally insufficiently reported. This lack of data makes it impossible to compare and make robust conclusions. We could not identify if any of the existing physical literacy assessments for adults is appropriate for large-scale/epidemiological studies.

Introduction

Physical literacy is a multidimensional construct that has been defined and interpreted in various ways, one of the most common being “the motivation, confidence, physical competence, knowledge and understanding to maintain physical activity throughout the life course” (Edwards et al., 2017; Whitehead, 2010). Its improvement can positively affect many behavioral, psychological, social, and physical variables (Edwards et al., 2017), but does it have the power to reduce the burden of non-communicable diseases and boost well-being for life? By definition physical literacy is a gateway to lifelong participation in physical activity, with its benefits being well established (Bull et al., 2020). Some authors consider physical literacy

a logical and fundamental determinant of health—through its formative role in shaping lifelong trajectories—and call for studies to validate this relationship (Cairney et al., 2019; Dudley et al., 2017).

Despite its widely recognized value, uncertainty around the concept prevails (Young et al., 2020). The lack of clarity, marked by a variety of definitions and interpretations adopted globally (Martins et al., 2021), undermines its operationalization (Shearer et al., 2018). Developing public health strategies, policies and guidelines, as well as intervention programs, requires a clear understanding of what components constitute physical literacy, and how it can be observed and assessed. Debate remains over an appropriate method of collecting empirical physical literacy data and even the (im)possibility of such measurement (De Dieu & Zhou, 2021).

Physical literacy encompasses a cluster of domains conceptually linked together. Domains are defined differently within each distinct physical literacy interpretation, commonly including affective, physical, cognitive, behavioral, and social domains (Cornish et al., 2020; Edwards et al., 2018; Keegan et al., 2019). Most existing instruments assess attributes of physical literacy under either one or two domains while marginalizing the rest (De Dieu & Zhou, 2021), and this approach may diminish the holistic intent and philosophical underpinnings of the concept (Young et al., 2020). Another issue is whether physical literacy should be qualified, interpreted, and judged against pre-established benchmarks and standards. For instance, Margaret Whitehead argued for comparisons to be made with one's previous assessment and never in relation to others (Whitehead, 2013b).

Physical literacy is philosophically founded on respecting the nature of the human being and considers every individual without concern of age group or living place, but practically all existing assessment instruments were developed against this contention (De Dieu & Zhou, 2021), being focused on children (Edwards et al., 2018). Given its potential public health contribution, we need to understand how to access, maintain and enhance physical literacy in adults.

In 2018, Edwards made the first and the most embracing effort so far to systematize physical literacy and related constructs assessments in different age groups (Edwards et al., 2018). It seems that Edwards' work made a significant impact, as during the foundational phase of the current research we have found a recent increase in studies concerning physical literacy in adults. Since then, four more studies reviewed physical literacy assessments in adults. The first was limited to the physical domain assessments in older adults (Huang et al., 2020). The second was focused on definitions and constructs and was limited to aging adults

(Petrusevski et al., 2021). The third only included explicit assessment instruments and evaluation tools, being able to identify two for adults (De Dieu & Zhou, 2021). The authors of the fourth didn't find any validated measurement to assess physical literacy in adults and have chosen to include measurements "useful for measuring the different elements of the three overall domains of physical literacy" in their self-reported measurements review (Ryom et al., 2022). All mentioned reviews were limited to peer-reviewed literature (except for Petrusevski's) published in English.

To systematize recent progress, we sought to identify all studies that measured physical literacy in adults or have proposed measurement criteria. To our knowledge, this is the first systematic review to consider published and non-published literature, without language restriction, concerning physical literacy assessment instruments and attempts in adults. Therefore, the purpose of the current paper is: 1) To systematically review and compare existing physical literacy assessment attempts in adults in relation to its: (a) alignment to the physical literacy concept; (b) measurement properties; and 2) To propose an appropriate instrument to evaluate physical literacy in adults that can contribute to public health promotion.

Methods

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021). We developed a search strategy in advance to identify related literature. The protocol information was submitted for registration in the International Prospective Register of Systematic Reviews (PROSPERO) (registration number CRD42022340204).

Eligibility Criteria

Considering the scarcity of existing evidence, this systematic review sought to identify all studies (observational or experimental) that measured physical literacy in adults (age of 18 or older), using a physical literacy assessment method (qualitative or quantitative), or that have proposed measurement criteria. All primary studies, regardless of design, were considered eligible for inclusion to identify potentially relevant studies. Published (peer-reviewed) and unpublished literature, in the form of journal articles, dissertations/theses, pre-prints or conference papers, were examined. No language restrictions were applied to maintain the inclusive character of this systematic review and avoid language bias (Pieper & Puljak, 2021). Studies were excluded if they included samples of children or teenagers. Books or book chapters, review articles, commentaries, meta-analyses, editorials, protocol papers,

conference abstracts, and systematic reviews, were excluded. Dissertations and theses which resulted in published journal articles were excluded to avoid duplication.

Information Sources

Relevant studies were identified by searching four databases (Pubmed, SportDiscus, APA PsycINFO, Web of Science), scanning reference lists of included articles, and manual cross-referencing of bibliographies cited in prior reviews (De Dieu & Zhou, 2021; Edwards et al., 2018; Huang et al., 2020; Petrusevski et al., 2021). Google Scholar was used as a supplement search tool to identify grey literature not included in library databases (e.g., theses and dissertations). Each of the databases was searched independently.

Search Strategy

Searches included combinations of three sets of terms following PICOS: (a) terms concerning the population of interest (e.g., adults), (b) terms concerning type of “intervention”/exposure of interest, which in this case was related to measurement issues (e.g., assessment, questionnaire, instrument), and (c) terms concerning the outcomes of interest (physical literacy). All types of study design (i.e., observational, and experimental) were included, thus there were no restrictions on study design or comparator. A full search example can be seen in Table 1. Publication date restrictions were not applied in any search. The initial search was concluded on May 12, 2022, and the final on July 15, 2022, before data extraction.

Table 1

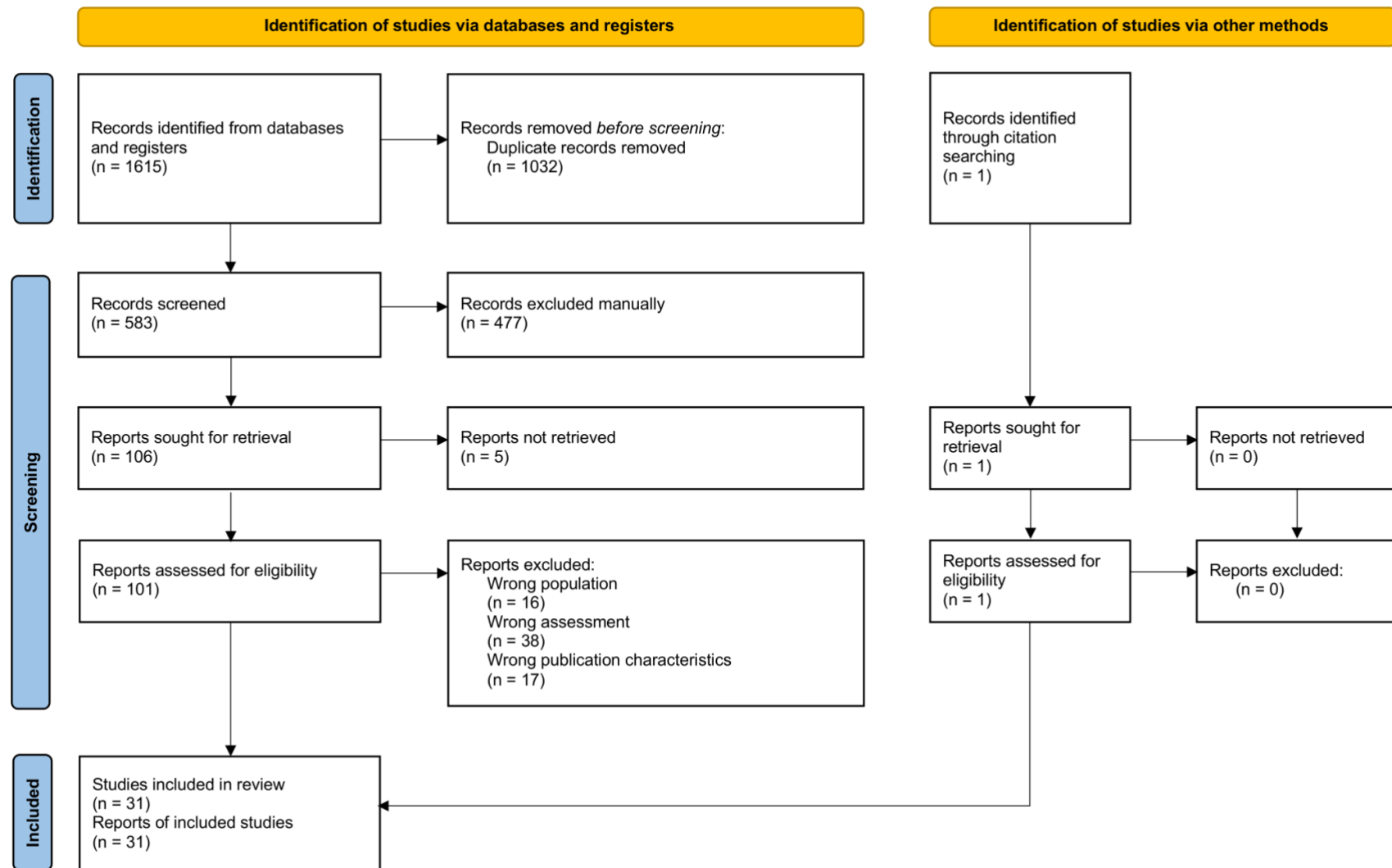
Full search example

#1	Adults OR Students
#2	Assessment OR Measurement OR Test OR Tool OR Instrument OR Battery OR Method OR Observation OR Indicator OR Evaluation OR Questionnaire
#3	“Physical literacy”
#	1 AND 3
#	1 AND 2 AND 3

Selection Process

The study selection process is detailed in the PRISMA flow chart (Figure 1). Following the initial search, all records were exported to Cadima software (Kohl et al., 2018) for screening. Duplicates were manually eliminated. Titles, abstracts, and full texts of relevant studies were screened by two authors to identify studies that fulfilled the eligibility criteria. When the full text was not accessible, we contacted the studies’ corresponding authors via ResearchGate or email. Results were cross-checked. Decisions to include or exclude studies

in the review were made by consensus. Reference lists of identified articles and prior reviews were screened to ensure that no relevant studies were overlooked.

Figure 1*PRISMA flow diagram for the identification of the included studies*

Data Extraction Process, Data Items and Synthesis Methods

A data extraction form was developed, informed by the PRISMA statement (Page et al., 2021). Data extraction was performed by two authors independently and included information about participants' characteristics, adopted physical literacy definition, assessment content, assessment characteristics, and measurement properties. A complete list of extracted items is provided in A1 File. Missing information was coded as not reported. Discrepancies during the extraction process were discussed with a third author and solved by consensus.

Following the example of Rockliffe, Google translate was initially used to assess the eligibility of non-English language abstracts and full texts (Rockliffe, 2022). Studies deemed eligible were sent for data extraction to volunteer translators identified through personal contacts.

Selected studies were evaluated and analyzed. The retrieved data were organized into a table to facilitate the synthesis process. A qualitative synthesis was carried out using descriptive analysis and constant comparison method to uncover themes connected to physical literacy assessment in adults (Barnett-Page & Thomas, 2009; Walker & Myrick, 2006). The analysis method included three stages: 1) Summarizing the included studies' characteristics; 2) Summarizing extracted data by identifying patterns, parallels, or correlations and grouping data into themes; 3) Organizing results in illustrative extracts and analytic narrative. More specifically, the data was first coded with descriptive tags (e.g. "original assessment", "physical domain", "young adults", "five domains"), then tags were compared to identify categories, similarities, and differences. Tags were refined in each iteration to establish categories (e.g. "young adults", "adults", "older adults"), and identify patterns (e.g. "practical task" was only used to access physical attributes). Studies were summarized based on identified categories and an analytic narrative was developed based on identified patterns.

To assess the quality of the available physical literacy assessment instruments, we retrieved psychometric properties and feasibility data from the studies. These data included measures of reliability, validity, and other relevant psychometric properties, such as factor structure, and item response characteristics. Feasibility data were also collected, including information on staff and equipment required, assessment time, and other available details.

Study Risk of Bias Assessment

Two authors independently assessed the quality of each study using the Effective Public Health Practice Project Quality Assessment Tool (EPHPP) (Armijo-Olivo et al., 2012).

First, each study was marked as “strong,” “moderate,” or “weak” in eight categories following EPHPP assessment sheet: selection bias (representativeness), study design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity, and analysis. The overall global rating was then determined: “strong” for studies with no weak ratings, “moderate” for studies with one weak ranking, and “weak” for studies with two or more weak ratings. Discrepancies were discussed with a third author, and the final grade decision was made by consensus. Quality appraisal summary is available in A2 File.

Results

The search strategy resulted in 1616 studies, and 102 were eligible for full-text screening. Characteristics of 31 studies included in the current review are summarized in Table 2. Most studies that attempted to measure physical literacy in adults were published after 2020. Studies were conducted in nine different countries—half of them in China—with only three published in non-English languages. Half of the studies assessed physical literacy in young adults in university settings, while older adults were underrepresented.

Table 2
Studies summary

Characteristic	Outcome (number of studies)
Year	2016 (1) (Sum et al., 2016), 2017 (1) (Arnett, 2018), 2018 (1) (Sum, Wallhead, et al., 2018), 2019 (2) (Holler, Jaunig, Amort, et al., 2021; Kwan et al., 2019), 2020 (11) (Buckler et al., 2020; Campelo, 2020; C.-C. Chen et al., 2020; Choi et al., 2020; Ha et al., 2020; Ma, Sum, Hu, et al., 2020; Ma, Sum, Li, et al., 2020; Munusturlar & Yildizer, 2020; Sum et al., 2020; Vašíčková et al., 2020; Wang et al., 2020), 2021 (7) (Cheng & Koh, 2021; Choi et al., 2021; Elsborg et al., 2021; Holler, Jaunig, Moser, et al., 2021; Ma et al., 2021; Stroffolino, 2021; Yildizer & Munusturlar, 2021), 2022 (8) (Huang et al., 2022; C. Y. Liu et al., 2022; Luo et al., 2022; Ma et al., 2022; Ng et al., 2022; Simonton et al., 2022; Souza et al., 2022; Zhang et al., 2022)
Language	English (28), Czech (1), Portuguese (1), Turkish (1)
Country	China (17), Canada (4), USA (3), Austria (2), Turkey (2), Czech Republic (1), Denmark (1), Malaysia (1), Portugal (1)
Publication type	Journal article (27), thesis (3), conference paper (1)
Age group	Young adults (17), adults (11), older adults (3)

Setting	University/college (17), school (4), community (4), professional development program (2), independent living/day care center (2), childhood education center (1), general public (1)
Physical literacy assessment approach	Pre-validated assessment (12), combined (7), combined with composite score (4), adaptation of pre-validated assessments (4), original assessment (4)
Type of measurements employed	Questionnaire (29), practical task (5), objective measure (5), interview (1)

We classified assessment approaches into five categories: 1) pre-validated physical literacy assessments; 2) combined assessments of pre-validated or self-constructed scales without a composite score; 3) combined assessments of pre-validated or self-constructed scales with a composite score; 4) adaptations of pre-validated physical literacy assessments; 5) original assessments. Original assessments included two survey-based instruments (Perceived Physical Literacy Instrument, College Student Physical Literacy Questionnaire), a speech database for assessing physical competence under the concept of physical literacy, and a focus group to evaluate confidence, physical competence, sense of self, and knowledge in relation to physical literacy. Almost all studies utilized at least one questionnaire.

Physical literacy was defined consistently within included studies, mostly using slightly different versions of Margaret Whitehead's definitions. All adopted definitions and references—as provided by authors—are listed in Table 3.

Table 3
Physical literacy definitions

Definition	Number of studies
Motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life (Whitehead, 2001, 2007, 2010, 2013a, 2016, 2019b; Whitehead & Almond, 2014)	24
The motivation, confidence, physical competence, understanding and knowledge to maintain physical activity at an individually appropriate level throughout life (Whitehead, 2001)	2
The development of motivation, confidence, physical competence, knowledge, and understanding to value and engage in a wide variety of physical activities and environments that benefit the person as a whole (Whitehead & Almond, 2014)	1

An individual's prerequisites to participate in and adhere to physical activities throughout the life-course (Whitehead, 2010)	1
A concept that values physical activity for the individual's health and active living style throughout the life course (Durden-Myers et al., 2018)	1
The ability to move with competence and confidence in a wide variety of physical activities in multiple environments that benefit the health development of the whole person (Mandigo et al., 2012)	1
Daily behavior, knowledge, self-efficacy, and motivation to be physically active throughout the lifetime (Whitehead, 2010)	1

Explicit physical literacy instruments—six questionnaires and one objective measure—are summarized in Table 4. Available psychometric properties of the instruments, as well as feasibility characteristics, are reported in Table 5.

Table 4
Explicit physical literacy instruments

Instrument (number of studies)	Type	Physical literacy domains assessed	Target population
PPLI (9)	Questionnaire, 9 items	Self and self-confidence, self-expression and communication with others, knowledge and understanding	Young adults, adults, older adults
PPLI-SC (4)	Questionnaire, 8 items	Motivation, confidence and physical competence, interaction with the environment	Young adults
PPLI (turkish) (2)	Questionnaire, 9 items	Knowledge and understanding, sense of self and self-confidence, communication	Adults
SPPLI (1)	Questionnaire, 11 items	Attitude toward physical activity, physical activity ability, sociality around physical activity	Older adults
DSPG (1)	Questionnaire, 22 items	Confidence, self-efficacy, relative ranking of literacies, physical competence	Young adults
CSPLQ (1)	Questionnaire, 38 items	Physical and behavioral, cognitive, emotional	Young adults
Speech database (1)	Objective measure	Physical competence	Young adults

Note. PPLI – Perceived Physical Literacy Instrument. PPLI-SC – Perceived Physical Literacy Instrument Simple Chinese. SPPLI – Senior Perceived Physical Literacy Instrument. DSPG –

Dotazníku sebehodnocení pohybové gramotnosti. CSPLQ - College Student Physical Literacy Questionnaire

Table 5

Physical literacy instruments validity and feasibility

Instrument and model	Validity and reliability reported	Feasibility
PPLI 9 items, 3 factors	Internal consistency Full scale Cronbach's α 0.82 (Sum et al., 2016) Domains Cronbach's α 0.73-0.76 (Sum et al., 2016), 0.66-0.93 (Choi et al., 2021), ≥ 0.85 (Ha et al., 2020) Model fit Chi-square ($p > 0.05$), CFI = 0.95, RMSEA = 0.038 (Sum et al., 2016)	Online/on-site application, 8-10 minutes required for assessment
PPLI-SC 8 items, 3 factors	Internal consistency Full scale Cronbach's α 0.91 (Ma et al., 2021) Domains Cronbach's α 0.79-0.83 (Ma, Sum, Hu, et al., 2020) Model fit RMSEA 0.03, AGFI 0.96, Normed Chi-square 1.32, NFI 0.97, CFI 0.99, TLI 0.99, PNFI 0.59 (Ma, Sum, Hu, et al., 2020)	Online/on-site application, trained assistants and 10 minutes required for assessment
PPLI (turkish) 9 items, 3 factors	Internal consistency Full scale Cronbach's α 0.8 (Munusturlar & Yildizer, 2020), 0.88 (Yildizer & Munusturlar, 2021) Domains Cronbach's α 0.71-0.87 (Yildizer & Munusturlar, 2021) Model fit Normed Chi-square 1.94, RMSEA 0.046, SRMR 0.084, RMR 0.27, NFI 0.92, NNFI 0.93, CFI 0.94, GFI 0.96, AGFI 0.97 (Munusturlar & Yildizer, 2020)	Online/on-site application
SPPLI 11 items, 3 factors	Internal consistency Full scale Cronbach's α 0.90 (C. Y. Liu et al., 2022) Domains Cronbach's α 0.80 to 0.90 (C. Y. Liu et al., 2022)	Trained assistants required
DSPG 22 items, 4 factors	Internal consistency Full scale Cronbach's α 0.72 (Vašíčková et al., 2020) Temporal stability (1 month) Intraclass correlation coefficient 0.85 (Vašíčková et al., 2020)	Not reported

CSPLQ 38 items, 3 factors	Internal consistency Full scale Cronbach's α 0.961 (Luo et al., 2022) Domains Cronbach's α 0.900-0.936 (Luo et al., 2022) Concurrent validity (athletic ability, physical condition, physical attractiveness, physical fitness, frequency of physical activity, and length of physical activity) $p < 0.05$ (Luo et al., 2022)	Online application, 10-15 minutes required for assessment
Speech database	Not applicable (Ma et al., 2022)	On-site application, recording equipment and trained assistants are required.

Note. PPLI – Perceived Physical Literacy Instrument; PPLI-SC – Perceived Physical Literacy Instrument Simple Chinese; SPPLI – Senior Perceived Physical Literacy Instrument; DSPG – *Dotazníku sebehodnocení pohybové gramotnosti*; CSPLQ - College Student Physical Literacy Questionnaire

The Perceived Physical Literacy Instrument (PPLI) (Sum et al., 2016) was the first physical literacy assessment validated for adults in 2016, adapted for Simple Chinese (PPLI-SC) in 2020 and Turkish in 2021, and recently in 2022 for the senior population (SPPLI). Both Simple Chinese and Turkish versions of PPLI, as well as SPPLI, employed factor analysis on the original pool of PPLI items for validation, resulting in adapted versions (C. Y. Liu et al., 2022; Ma, Sum, Hu, et al., 2020; Munusturlar & Yildizer, 2020). PPLI, and its adaptations, have been the most widely used instrument in included studies to assess physical literacy. All versions of PPLI reported satisfactory internal consistency and model fit. However, there was no evidence related to measurement invariance, concurrent validity, or temporal stability.

The College Student Physical Literacy Questionnaire (CSPLQ) was created specifically for young adults in 2022 (Luo et al., 2022). Apart from internal consistency analysis, the authors performed concurrent validity testing with athletic ability, physical condition, physical attractiveness, physical fitness, frequency of physical activity, and length of physical activity variables.

Dotazníku sebehodnocení pohybové gramotnosti (DSPG) is a Czech instrument, created in 2019 and validated in young adults (Vašíčková et al., 2020). It was based on the Canadian physical literacy assessment PLAYself, originally developed for school-aged children (Canadian Sport For Life, 2014). DSPG was the only instrument to provide temporal stability evidence.

Ma and colleagues introduced a novel method to measure physical competence (Ma et al., 2022). The study provided a database of speech designed to produce short-time automatic predictions of physical competence scores in CAPL2 physical literacy assessment. The method is based on the idea that there is a specific pattern of changes in an individual's speech characteristics under different physical stresses (Ma et al., 2022). In the future, speech analysis during exercise could become a valid method to predict physical competence as a part of physical literacy assessment. According to the authors, automated measurement tools can speed up assessments, thus saving time and improving accuracy.

A combined assessment approach was common in included studies. Four of them used a composite score, seven did not use it. Instruments and respective attributes are summarized in Table 6. Overall, diversity in assessments was observed. Practical tasks (ex. The Canadian Assessment of Physical Literacy, PLAYfun, The Test of Gross Motor Development 2, Timed Up and Go Test, Progressive Aerobic Cardiovascular Endurance Run), objective measures (ex. Body Mass Index, Waist circumference), and questionnaires (ex. The Physical Self-Perception Profile) were used to assess the physical domain. The behavioral domain was assessed by questionnaires (ex. International Physical Activity Questionnaire Short-Form, Physical Activity Stage of Change Assessment) and objective measures (ex. step counts, total physical activity tracking). The attitude domain was assessed by questionnaires (ex. The Behavioral Regulations in Exercise Questionnaire 3). The cognitive domain was assessed primarily by a self-constructed survey. This type of assessment method (self-constructed survey) was the most frequently employed (23% of studies), across all physical literacy domains.

Table 6

Instruments utilized in combined physical literacy assessments

Instrument	Number of studies	Physical literacy attribute assessed
Questionnaire		
BREQ-3 (Markland et al., 2004), BREQ3-PT (Cid et al., 2018)	5	Motivation
MPAM-R (Ryan et al., 1997)	1	Motivation
SMS28 (Pelletier et al., 1995)	2	Motivation
SIMS (Guay et al., 2000)	2	Motivation
BREQ-2 (Markland et al., 2004)	2	Motivation

Self-Efficacy for Exercise Questionnaire (Resnick et al., 2004)	1	Confidence
ECS (Sallis et al., 1988)	1	Confidence
ESES (Kroll et al., 2007)	1	Self-confidence
FKB-20 (Albani et al., 2006)	1	Self-confidence/self-efficacy
RACK (Renner & Schwarzer, 2010)	2	Self-efficacy
Assessment of physical activity knowledge among US citizens (Morrow et al., 2004)	1	Knowledge and understanding
Outcome Expectations for Exercise Scale (Resnick et al., 2004)	1	Understanding
PNSE (Wilson et al., 2006)	1	Motor competence
PNTS (Bartholomew et al., 2011)	1	Motor competence
PSPP (Fox, 1990)	2	Perceived physical competence
Physical activity attitudes scale (Nelson et al., 2010)	1	Positive and negative physical activity attitudes
Stanford Five City Study Questionnaire (IOX Assesment Association, 1983)	2	Attitude towards a physically active lifestyle
IPAQ-SF (Bauman et al., 2005)	4	Physical activity behaviors
GPAQ (Chu et al., 2015)	1	Physical activity behaviors
PSDQ-S (Marsh et al., 2010)	1	Physical self-concept
BAS-2 (Tylka & Wood-Barcalow, 2015)	1	Body image
PASCQ (Marcus & Lewis, 2003)	1	Physical activity state of change
Eurobarometer questionnaire (European Commission, 2018)	1	Opportunities
Practical task		
Motor skill protocol (Stodden et al., 2009)	1	Motor skill proficiency
TGMD-2 (Ulrich, 2000)	1	Physical competence
TUG (Shumway-Cook et al., 2000)	1	Physical competence
PLAYfun tool (Canadian Sport for Life, 2013)	1	Movement competence
PACER	1	Physical fitness

Grip strength	1	Physical fitness
Sit-and-reach test	1	Physical fitness
CAPL obstacle course	1	Motor performance
Objective measure		
Total physical activity tracking	2	Physical activity behaviors
Step tracking	2	Physical activity behaviors
BMI	1	Physical fitness
Waist circumference	1	Physical fitness

Note. IPAQ-SF - International Physical Activity Questionnaire Short-Form. PSPP - The Physical Self-Perception Profile. BREQ-3 - The Behavioural Regulations in Exercise Questionnaire 3. TGMD-2 - The Test of Gross Motor Development 2. BMI – Body Mass Index TUG - Timed Up and Go Test. ECS - Exercise confidence survey. MPAM-R - Motives for physical activity measure-revised. PACER - Progressive Aerobic Cardiovascular Endurance Run. CAPL - The Canadian Assessment of Physical Literacy. ESES - Exercise Self-Efficacy Scale. SMS28 - Sport Motivation Scale. SIMS - Situational Motivation Scale. FKB-20 - Body Image Questionnaire. RACK - Risk Appraisal Consequences in Korea. GPAQ - Global Physical Activity Questionnaire. PSDQ-S - Physical Self-Concept Description Questionnaire Short-Form. BAS-2 - Body Appreciation Scale-2. PNSE - Psychological need satisfaction in exercise scale. PNTS - Psychological Need Thwarting Scale. PASCQ - Physical Activity State of Change Assessment.

Discussion

This study aimed to systematically review existing physical literacy assessment attempts in adults. We found 31 studies, published from 2016 to 2022 and seven—from which only three were original—explicit physical literacy assessment instruments. Measurement properties were reported to a limited extent. The lack of available instruments led to a repeated utilization of self-constructed combined assessments. Most research was concentrated in China and published in the English language.

Since the completion of data collection for this review, additional physical literacy assessments have emerged, demonstrating the increasing research interest in this area. For instance, the *Évaluation de la Littératie Physique* (Gandrieau et al., 2023)—an assessment instrument for emerging adults—has been developed, and a Persian version of the Perceived Physical Literacy Instrument has been validated in adults (Samadi et al., 2022). These recent developments highlight the need for ongoing review and synthesis of physical literacy assessment measures to keep up with the evolving field.

Definition Alignment and Domains Rationale

In «Physical literacy throughout the life course» Whitehead (2010) describes physical literacy as an expression of fundamental capability based on monism philosophy: to develop physical literacy is to develop an embodied interaction with the world. Physical literacy domains—physical, cognitive, and affective—are highly interdependent, but, as stated by Whitehead, “monism does not prohibit attention being paid to the different dimensions that together comprise what it means to be human”. From this viewpoint, physical literacy assessment based on the assessment of discrete domains seems rational and practical. Essiet (2021) suggested that tool developers may consider combining items from different scales and perform psychometric testing. Chen (2020) criticized this approach and argued that it is impossible and makes no sense to break up physical literacy into independent components merely for measurement and maintain the monism premise.

While debate remains, studies included in the current review approached measurement in two different ways: by defining domains and assessing them discretely (through pre-validated or self-constructed instruments) and by defining domains as sub-scales after factorial analyses. The evolution of the Perceived Physical Literacy Instrument is a particularly interesting example of the latter. The original version of the instrument defined 3 domains: knowledge and understanding, self-expression and communication with others, sense of self and self-confidence (Sum et al., 2016); the simple Chinese version defined other 3: motivation, confidence and physical competence, interaction with the environment (Ma, Sum, Hu, et al., 2020); the senior version yet another 3: attitude, ability, and sociality (C. Y. Liu et al., 2022). These versions were validated in different age groups: adults, young adults, and older adults. Does this discrepancy between domains indicate a need for varying physical literacy definitions, or just our inability to ask the right questions to assess physical literacy throughout life?

Studies that pre-defined domains faced another limitation, as the instruments they adopted were developed for an entirely different purpose rather than to measure physical literacy. For instance, motivation for engaging in sports activities measured by the Sport Motivation Scale and motivation to take part in physical activity for life are two completely different entities. The test of Gross Motor Development is a robust assessment of fundamental movement skills for children between the ages of 3 to 10 years and 11 months (Rey et al., 2020), but can it assess physical competence as a contextualized capability in adults, especially in older adults or people with disability? This common use of instruments borrowed

from other contexts is an oversimplification of the concept and will not result in a better understanding of physical literacy.

In her work, Whitehead consistently discourages assessments that establish levels or comparisons with other individuals (Whitehead, 2010, 2019a; Whitehead & Murdoch, 2013) and advocates for an assessment that allows charter individual progress and provides insight on possible improvement. However, no assessment included in the current review stated improvement purposes, and no study provided longitudinal data on physical literacy development with aging. Can an individual become more physically literate at an older age? Is it possible for a person who develops a disability to maintain physical literacy? Is assessment that creates feedback, which is then used to improve performance, a preferable approach to align with the physical literacy holistic definition? To answer these questions, we call for further qualitative and quantitative research that includes longitudinal data and compares different age groups, contexts, and assessment approaches.

Assessment Types

We found a fair use of both objective and subjective measures to assess different physical literacy attributes.

Objective measures, such as energy expenditure and step tracking, measure physical activity behavior and are easily obtained from wearable devices throughout the life course. In alignment with the physical literacy philosophical foundation, these measures embrace all movement and permit tracking individual's progress. Ma (2022) described a novel method to assess physical competence through speech evaluation. With an obvious potential to be integrated into a wearable device application, this kind of solution may become a future method of physical literacy assessment.

Practical tasks, frequently adapted from instruments developed for children, were used to assess motor performance and physical fitness. Assessed skills may not reflect a diversity of movement requirements during different stages of life (Hulteen et al., 2017), nor account for individual context. In the previous review by Edwards (2018), most assessments in the physical domain evaluated physical competence, fundamental movement skills, and motor capacities in isolation instead of in applied settings. This consistency indicates a lack of progress in the understanding of what practical assessments could be applied conforming to physical literacy philosophy.

One of the premises that underpin the concept of physical literacy is based on an appreciation of the different modes through which the embodied dimension is lived (Whitehead, 2010). The subjective perception of capabilities could be more valuable to describe one's physical literacy and allows to avoid levels and standards. Studies included in the current review adopted pre-validated and self-constructed subjective measures to assess every domain. We found that self-constructed questionnaires were the most common assessment used, which signalizes an urgent need for further instrument development and validation. Self-perception, self-expression, and self-confidence—the key concepts of physical literacy as defined by Whitehead—were assessed through pre-validated scales. All explicit physical literacy assessment instruments were questionnaires (apart from Ma's speech database which only assesses the physical domain). Despite the availability of questionnaire-based instruments for different physical literacy domains and attributes, it is not yet clear if such a complex holistic concept can be fully captured using exclusively subjective measures, or whether a combination of subjective and objective measures would be more appropriate.

Usability and Trustworthiness

We found that assessments' measurement and usability characteristics were generally insufficiently reported. This lack of data makes it impossible to provide a comparison and make conclusions about the instruments' quality and feasibility. We call for researchers to include all relevant information when creating, validating or applying physical literacy instruments. Reporting the time required for completion is essential, especially for assessments combining different scales and instruments. Practical tasks and objective measures are more time-consuming, and often require special equipment and trained staff. Studies included in the current review reported equipment and staff prerequisites of practical tasks, but only one reported the time needed to complete the assessment.

Poor measurement properties' reporting can be partially explained by the common use of self-constructed scales. With a lack of invariance and temporal stability evidence even for validated instruments, it is unclear if those provide accurate results, especially over time.

We believe there is an opportunity for physical literacy researchers to create new instruments that could be reused and provide solid data. A recent review of physical literacy concept implementation in Europe demonstrated that the development of standardized assessment instruments may constitute an important step in intensifying physical literacy activities (Carl et al., 2023). There is an urgent need for psychometric testing studies, that compare different assessments and re-test over time. Careful reporting of feasibility

characteristics and providing information on the intended use of the instrument is essential to bring closer the universal adoption of the physical literacy concept.

Public Health Agenda

We were not able to identify if any of the existing physical literacy assessments for adults is appropriate for large-scale/epidemiological studies. First, there is still no agreement between researchers on what constitutes the best way to capture such a complex multidimensional concept as physical literacy, or what attributes should be measured. Second, existing instruments lack validity and reliability data.

The first instrument validated in adults, Perceived Physical Literacy Instrument (Sum et al., 2016), has already been adapted for three languages and different populations, probably due to its simplicity and a one-fits-all approach. Further validation studies, especially longitudinal ones, are needed to understand if the Perceived Physical Literacy Instrument may be adopted for epidemiological studies and provide valuable insight into public health.

Strengths and Limitations

This systematic review on physical literacy assessments in adults provides valuable insights to the field. Firstly, the study offers a comprehensive review of existing assessment methods, providing an up-to-date and nuanced understanding of the available tools and their psychometric properties. This detailed analysis of assessment tools can help researchers, practitioners, and policy-makers make informed decisions about which tools are most appropriate for their specific contexts and purposes.

Additionally, the study provides a useful discussion of the definition and conceptualization of physical literacy, highlighting the importance of a holistic and context-dependent understanding of the construct. This discussion helps to clarify the meaning of physical literacy, its relevance to adult populations and can inform the development of more comprehensive and effective assessments.

Furthermore, the review contributes to the field by identifying gaps and limitations in current assessments of physical literacy in adults. For example, the study points out the need for further research on the psychometric properties and feasibility of different assessment instruments. Moreover, the study also identified a lack of progress in the understanding of how different types of assessments could provide better understanding of physical literacy. We suggest that a more comprehensive and integrated approach may be necessary. These

insights can guide future research and development efforts to improve physical literacy assessments in adults.

To our best knowledge this is the first physical literacy assessment review to include studies in a non-English language. Apart from avoiding a language bias (Pieper & Puljak, 2021), we believe this inclusion is essential to provide information on how the physical literacy concept is being adopted around the world and how assessments are being culturally adapted. This can lead to more effective promotion of physical literacy concept and better outcomes for individuals and communities worldwide.

We adopted a holistic interpretation of physical literacy, which may have introduced a potential bias into our research. This bias stems from the fact that our analysis was grounded in a particular understanding of the concept of physical literacy, which may not be shared by all researchers in the field. Furthermore, our reliance on this holistic interpretation may have influenced our analysis of the data, potentially overlooking relevant aspects of physical literacy assessments that do not fit within this framework. We believe that in the importance of considering physical literacy as a multifaceted construct that goes beyond the simple measurement of different attributes and hope to inspire further research into the development of comprehensive and valid measures of physical literacy in adults.

CAPÍTULO 2

Validation of the Portuguese Version of the Perceived Physical Literacy Instrument*

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Abstract

Background. The Perceived Physical Literacy Instrument (PPLI) has been the most adopted physical literacy instrument designed for adults to date, already translated to four languages. Despite its popularity, limited evidence exists regarding its psychometric properties. The aim of this study was to translate and cross-culturally adapt PPLI to the Portuguese language, and to analyze the psychometric properties of the Portuguese version in a sample of Portuguese speaking adults.

Methods. The study sample was composed by 434 participants (70% females) with a mean age of 28.7 ± 12.0 . Confirmatory Factor Analysis was used to assess psychometric properties of the scale. Additionally, instrument assumptions between sexes through invariance testing were examined. Finally, concurrent validity, test-retest reliability, and test-retest agreement analyses were performed to gather additional evidence.

Results. The results of the present study generally supported the measurement model. The 9-item, 3-factor model presented a good fit to the data and adequate construct validity ($\chi^2 = 82.859$ (24), $p < 0.001$, CFI = 0.948, TLI = 0.922, SRMR = 0.049, RMSEA = 0.075). Additionally, the scale presented concurrent validity. Some issues arose with measurement invariance and over-time consistency.

Conclusions. Considering the lack of validated instruments, we suggest a fair use of PPLI-PT to assess physical literacy in adults. This study contributes to the validation of the PPLI by providing evidence of its psychometric properties in the Portuguese-speaking adult population and facilitates comparative analysis with previous and future studies utilizing the PPLI instrument.

Introduction

Physical inactivity has been a major public health concern during the last decades (Pate et al., 1995; World Health Organization, 2018). Despite significant advancements in the field, it seems that existing frameworks provide a limited rationale for complex and dynamic physical activity behavior (Rhodes et al., 2019), as physical activity rates remain insufficient globally (World Health Organization, 2022). The holistic concept of physical literacy, which links together different theories, emerged to bring to light previously undetected factors (Cairney et al., 2019).

Physical literacy is a multidimensional construct that has been defined and interpreted in various ways, one of the most common being “the motivation, confidence, physical

competence, knowledge and understanding to maintain physical activity throughout the life course” (Edwards et al., 2017; Whitehead, 2010). The concept encompasses a cluster of domains conceptually linked together, potentially providing a comprehensive framework. Domains are defined differently within each distinct physical literacy interpretation, commonly including affective, physical, cognitive, behavioral, and social domains (Cornish et al., 2020; Edwards et al., 2018; Keegan et al., 2019). However, its complex nature makes collecting empirical physical literacy data challenging (De Dieu & Zhou, 2021) and constrains assessment development and further concept adoption.

Since its original creation, physical literacy concept has been linked to physical education, and most of the assessment instruments in this field were developed for children (De Dieu & Zhou, 2021; Edwards et al., 2018; Y. Liu & Chen, 2020; Shearer et al., 2021). As very few instruments are available, physical literacy measurement in adults still heavily relies on self-constructed combined assessments, and even those lack validity and reliability data (Boldovskaia et al., 2023).

The first instrument to assess physical literacy in adults—Perceived Physical Literacy Instrument (PPLI)—was developed in 2016 (Sum et al., 2016) through a comprehensive literature review, focus group interviews, and content analysis. After reliability and validity testing, the final version of PPLI resulted in 9 items covering three dimensions of physical literacy: sense of self and self-confidence (encompasses self-management skills and self-perception of physical fitness), self-expression and communication with others (self-perception of social and problem-solving skills), and knowledge and understanding (attitude towards physical activity and awareness about its benefits for health). The instrument was originally designed as a self-report questionnaire to measure physical education teachers' perception of their own physical literacy. PPLI has been the most adopted physical literacy instrument designed for adults to date, probably due to its simplicity and one-fits-all approach (Boldovskaia et al., 2023). It was validated in simplified Chinese (Ma, Sum, Hu, et al., 2020), Turkish (Munusturlar & Yildizer, 2020), Persian (Mohammadzadeh et al., 2021) and Spanish (López-Gil et al., 2023) languages and applied in a variety of contexts.

So far, no physical literacy assessment instrument for adults has been validated in Portuguese language. Considering the growing interest of local researchers, the potential application of PPLI for large-scale studies in Portugal, or national participation in international surveys, the purpose of the current study was to 1) translate and cross-culturally adapt PPLI to the Portuguese language; and 2) analyze the psychometric properties of the Portuguese

version of the Perceived Physical Literacy Instrument (PPLI-PT) in a sample of Portuguese speaking adults.

Methods

Participants and Data Collection

For this study, we collected data from a sample of 434 Portuguese-speaking adults aged between 18 and 72 years old.

Data collection was performed between October and December 2022 using Qualtrics online platform. A link to the survey was distributed through social networks and between university students. Data were collected anonymously from anyone willing to participate. To be eligible, participants had to be over 18 years and speak Portuguese. No other criteria were specified. Participants were required to provide informed consent before assessing the survey. After completing the survey participants were invited to a follow-up study, and asked to provide an email contact if they were willing to participate. The second survey, designed to test the instrument reliability across time, was distributed automatically after two weeks. One hundred seventy-two contacts and 73 answers to the second survey were collected.

The present study was developed under the goals of the LusofonAtiva project (ILIND/F+/EI/02/2020), which obtained approval from the ethics committee of Lusófona University, and followed the Helsinki declaration and later amendments related to Human research.

PPLI Translation Procedures

We sought consent from the author of the original PPLI by email and received permission to develop a Portuguese version. Following Brislin's (1980) recommendations, we adopted the committee approach methodology to ensure an adequate translation and adaptation of the PPLI from English to Portuguese: 1) preliminary translation by a professional translator; 2) expert panel; 3) final review (syntax and grammar check). During the expert panel phase, six physical activity and physical literacy experts were asked to independently evaluate the proposed translation in terms of semantics and terms usage, and to provide an alternative translation when necessary. The final versions of items were accepted when approved by at least 5 of 6 experts. In case of disagreement, the final decision was made by consensus between the authors.

Measures

The original PPLI (Sum et al., 2016) consists of 18 items, covering three dimensions of physical literacy: sense of self and self-confidence, self-expression and communication with others, and knowledge and understanding (Table 7). All items are measured on a 5-point Likert scale (1: strongly disagree to 5: strongly agree). The Portuguese version was labeled PPLI-PT (A3 File).

Table 7
Perceived Physical Literacy Instrument

	Item
PPLI1	I possess adequate fundamental movement skills
PPLI2	I am physically fit, in accordance with my age
PPLI3	I am able to apply learnt motor skills to other physical activities
PPLI4	I have a positive attitude and interest in sports
PPLI5	I appreciate myself or others doing sports
PPLI6	I am able to apply PE knowledge in the long run
PPLI7	I possess self-management skills for fitness
PPLI8	I possess self-evaluation skills for health
PPLI9	I am willing to do sports for better health
PPLI10	I have strong communication skills
PPLI11	I have strong social skills
PPLI12	I am confident in wild/natural survival
PPLI13	I am capable in handling problems and difficulties
PPLI14	I have a mindset for lifelong sports
PPLI15	I can turn doing sports into an on-going habit of life
PPLI16	I establish friendship through sports
PPLI17	I am aware of the benefits of sports related to health
PPLI18	I aspire to know the current sports trend

Note. In bold are items included in the final version of PPLI

To test the concurrent validity of PPLI-PT, we employed three additional measures: body mass index (BMI), lifestyle physical activity (i.e., daily physically active choices), and total weekly physical activity.

BMI (Kg/m^2) was calculated based on self-reported body mass (Kg) and height (m). Lifestyle physical activity was assessed via two questions regarding physically active choices in daily life: 1) Indicate how frequently in the last month you climbed stairs instead of using elevators or escalators (e.g., in your building, in a shopping mall, at work, etc.); 2) Indicate how frequently in the last month you chose to stand in situations where you could be sitting (e.g., while talking on the phone, while waiting in public places or for transport, etc.). These items were measured on a 5-point scale (1: never to 5: always when possible), and a total score was calculated (2-10). The Portuguese version of the International Physical Activity Questionnaire Short-Form (IPAQ-SF) (Craig et al., 2003) was used to assess participants' physical activity. The IPAQ-SF is composed of 9 items and calculates time spent in physical activity weekly, based on the number of days/week and average time/day spent walking and doing moderate/vigorous physical activity. Total weekly energy expenditure is estimated in metabolic equivalents (MET), considering time spent in physical activity and its intensity. IPAQ-SF also measures the time spent sitting on week and weekend days. The data were treated accordingly to the guidelines (The IPAQ Group, 2015).

Statistical Analysis

Prior to analysis, we inspected the database for errors or imprecisions. Descriptive statistics, including mean and standard deviation, were calculated for the studied variables. PPLI-PT items were examined for normality of distribution through skewness and kurtosis analysis. Skewness values between -2 and $+2$ and kurtosis between -7 and $+7$ were considered threshold values (Gravetter & Wallnau, 2014). All analyses were developed using IBM SPSS Statistics 26 and IBM SPSS Amos 23.

Confirmatory Factor Analysis

To test the construct validity of the PPLI-PT, we performed a confirmatory factor analysis (CFA). No exploratory factor analysis was conducted as three factors of the original PPLI had been established accordingly to the physical literacy theory proposed by Whitehead (Whitehead, 2010). The items were thus expected to load onto predetermined theoretical factors.

Convergent Validity. The items related to a specific factor should converge or share a high proportion of variance. First, high loadings on a factor indicate that they converge on a common point. To ensure validity, all factor loadings should be statistically significant, and standardized loading estimates of each item should be 0.5 or higher, and ideally, 0.7 or higher (Hair et al., 2019). Second, the Average Variance Extracted (AVE)—the mean variance

extracted for the items loading on a factor—should be 0.5 or higher (Hair et al., 2019). The third indicator of convergent validity is Composite Reliability (CR) coefficient, which was calculated using the Raykov formula. A CR value of 0.7 or higher suggests good composite reliability (Hair et al., 2019; Raykov et al., 2015).

Discriminant Validity. High discriminant validity provides evidence that a factor is unique and captures some phenomena other measures do not. To meet the validity criteria, AVE estimates should be greater than the square of the correlation between two factors (Hair et al., 2019).

Model Diagnostics. To test the model fit, we used maximum likelihood estimation and examined the values of the normed Chi-square, Standardized Root Mean Square Residual (SRMR), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA). Low chi-square relative to degrees of freedom ($\chi^2/df < 2$ for a good fit, 2.0-5.0 for an acceptable fit) with an insignificant p-value, TLI and CFI values > 0.9 , and RMSEA and SRMR < 0.08 were used as cut-off values (Byrne, 2016; Hair et al., 2019; Marsh et al., 2004).

Multi-group Invariance

To examine the equivalence of the measurement model between sex, we performed a multi-group analysis. First, we examined whether the measurement model presented a good fit to the data for each group. Second, for invariance testing, model respecification between groups verified whether (i) the same number of factors was present in both groups and remained associated with the same items (configural invariance); (ii) the model factors had similar factor loadings in both groups (metric invariance); (iii) latent and observable means were valid in both groups when means were compared (scalar invariance); and (iv) comparison between observable items was supported (residual invariance). The Chi-square difference was analyzed to determine significance. The following criteria were used to accept measurement invariance between groups: configural invariance with ΔCFI less than 0.01; metric invariance with $\Delta SRMR$ less than 0.03 and $\Delta RMSEA$ less than 0.015; scalar invariance with $\Delta SRMR$ less than 0.01, and $\Delta RMSEA$ less than 0.015 (F. F. Chen, 2007; Cheung & Rensvold, 2009).

Concurrent validity

We performed a correlational analysis between PPLI-PT factors, BMI, total physical activity, and lifestyle physical activity. It was expected that three factors would be positively

associated with the amount of physical activity, lifestyle physical activity, and negatively associated with BMI.

Test-retest reliability and agreement

Reliability and agreement were assessed independently following Berchtold's recommendations (Berchtold, 2016). The capacity of the measurement to differentiate between respondents when measured twice under the same conditions was examined by a correlational analysis, with reliability assumed with correlation estimates above 0.7. The capacity of the measurement applied twice on the same respondents under the same conditions to provide strictly identical results (i.e., agreement) was examined by Lin's concordance correlation coefficient (Lin, 1989), accepting values of ≥ 0.90 for moderate agreement (McBride, 2005).

Results

One hundred twenty-seven males and three hundred and two females participated in this study. Overall, female participants were younger, less active, and presented lower BMI (Table 8). Seventy percent of participants had BMI in a normal range, 18% were overweight, and 6% were classified as obese.

Table 8

Descriptive statistics of the sample

	Age (Years)	BMI (Kg/m ²)	Total weekly physical activity (MET)
Mean $\pm$ SD	28.7 $\pm$ 12.0	23.3 $\pm$ 3.9	3481 $\pm$ 2775
Mean (male)	32.7 $\pm$ 12.4**	23.9 $\pm$ 3.1*	4219 $\pm$ 3155**
Mean (female)	27.1 $\pm$ 11.5**	23.0 $\pm$ 4.2*	3204 $\pm$ 2561**

Note. SD: Standard Deviation; * = $p < 0.05$; ** = $p < 0.001$

The sample size ($n = 434$) was sufficient to perform CFA according to recommendations (Hair et al., 2019). No missing values were detected. Descriptive statistics of PPLI-PT items are available in Table 9. The skewness and kurtosis values of 15 of 18 items ranged between -2 to $+2$ and -7 to 7 , respectively, and can be considered as approximating a normal distribution (Gravetter & Wallnau, 2014). Three items (PPLI-PT1, PPLI-PT17, PPLI-PT9) did not meet skewness and kurtosis requirements for normal distribution. Considering the requirement of 3 items per factor for model saturation and recommendations to avoid models with fewer than 3 items per factor (Bollen, 2014; Hair et al., 2019), we decided to proceed with these items, in order to maintain the original structure.

Table 9*Descriptive statistics of PPLI-PT items*

	Skewness	z-value	Kurtosis	z-value
PPLI-PT1	-3.017	-25.66	10.102	42.959
PPLI-PT2	-1.042	-8.86	0.267	1.134
PPLI-PT3	-1.727	-14.688	3.509	14.922
PPLI-PT4	-1.315	-11.18	1.126	4.789
PPLI-PT5	-1.451	-12.345	1.61	6.845
PPLI-PT6	-0.993	-8.444	0.273	1.163
PPLI-PT7	-0.861	-7.326	0.196	0.833
PPLI-PT8	-1.08	-9.186	1.493	6.347
PPLI-PT9	-2.163	-18.394	5.03	21.388
PPLI-PT10	-0.721	-6.132	0.079	0.337
PPLI-PT11	-0.857	-7.292	0.407	1.731
PPLI-PT12	-0.221	-1.882	-0.862	-3.667
PPLI-PT13	-0.713	-6.063	0.598	2.541
PPLI-PT14	-1.197	-10.177	1.055	4.487
PPLI-PT15	-0.944	-8.031	0.005	0.02
PPLI-PT16	-0.732	-6.227	-0.511	-2.173
PPLI-PT17	-3.927	-33.398	19.863	84.467
PPLI-PT18	-0.588	-4.999	-0.466	-1.98
Multivariate			167.092	64.864

Model fit statistics are presented in Table 10. The original 18-item model of PPLI-PT didn't present an adjusted fit. We proceeded by testing the 9-item model, adopted from the original PPLI. The final model Chi-square was 82.859 with 24 degrees of freedom, with normed Chi-square ($\chi^2/df = 3.45$) within the acceptable 2.0 – 5.0 range. RMSEA and SRMR values were below the 0,08 cut-off value, and CFI and TLI values exceeded 0.9, providing additional support for model fit. The CFA results suggested the final PPLI-PT model provided a good fit and was suitable to proceed to further examination.

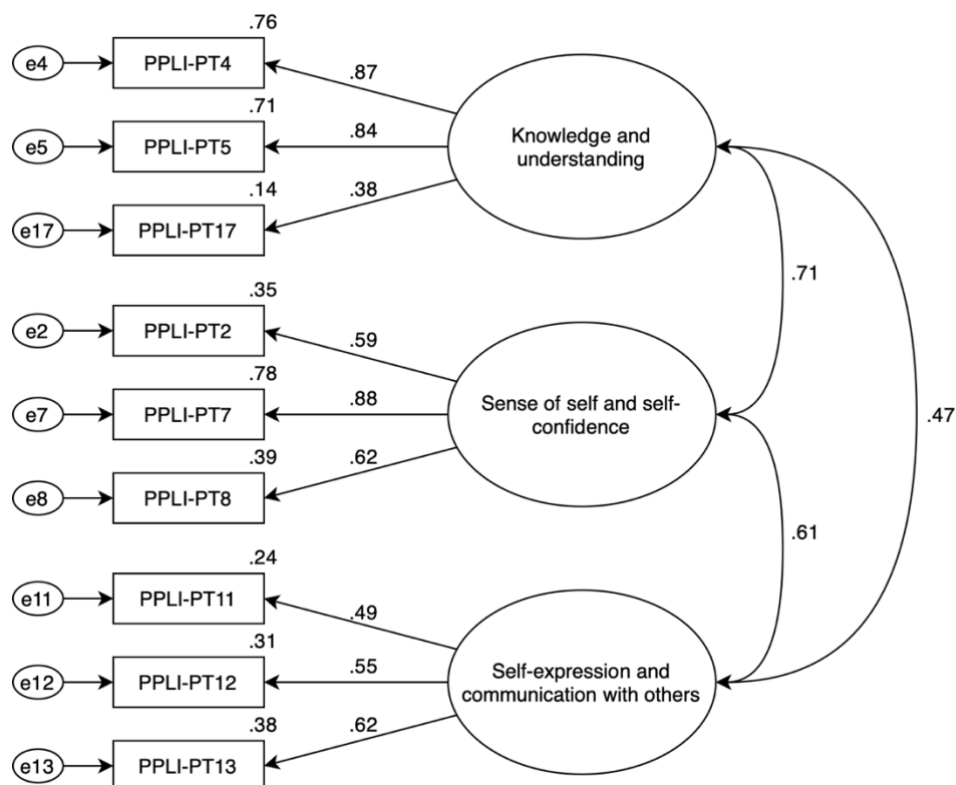
Table 10
PPLI-PT goodness-of-fit statistics

Model	χ^2	df	CFI	TLI	SRMR	RMSEA
Original PPLI	-	-	0.950	-	-	0.038
Original PPLI-PT	947.367	135	0.767	0.736	0.085	0.118
Final PPLI-PT	82.859	24	0.948	0.922	0.049	0.075
Male	42.406	24	0.957	0.935	0.055	0.078
Female	70.111	24	0.935	0.902	0.057	0.080

Note. χ^2 = Chi-square; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Squared Error of Approximation.

All factor loadings of the final PPLI-PT were statistically significant ($p < 0.05$) (Figure 2). Two items (PPLI-PT17 and PPLI-PT11) presented loading estimates lower than recommended 0.5 for adequate construct validity (0.38 and 0.49 respectively) (Hair et al., 2019). However, factor loadings of 0.4 may be justified if acceptable values are obtained on other indices (Hair & Alamer, 2022), therefore we decided to proceed with the analysis.

Figure 2
PPLI-PT factor structure



The CR for two of the three factors was above the 0.7 value required to ensure reliability (Table 11) and was 0.571 for the Self-expression and communication with others factor. However, CR of 0.6 may be considered acceptable for factors containing few items (Hair et al., 2019). The same factor was the only one to present AVE estimate below the required 0.5 for convergent validity. As all factor loadings for this factor were above 0.5 (or barely above in the case of PPLI-PT7) and significant ($p < 0.05$), convergent validity was assumed. The square root of AVE exceeded the corresponding squared correlation estimate between all three factors, providing evidence for discriminant validity.

Table 11
Convergent and discriminant validity analyses

Factors	CR	AVE	$\sqrt{\text{AVE}}$	KU	SS	SE
KU	0.758	0.540	0.730	*	<i>0.223</i>	<i>0.510</i>
SS	0.745	0.510	0.710	0.714	*	<i>0.367</i>
SE	0.571	0.310	0.560	0.472	0.606	*

Note. CR = Composite Reliability Coefficient; AVE = Average Variance Extracted; $\sqrt{\text{AVE}}$ = Square root of Average Variance Extracted; *Italic* = Squared Correlation; KU = Knowledge and understanding; SS = Sense of self and self-confidence; SE = Self-expression and communication with others.

Since the 9-item, 3-factor measurement model provided a good fit to the data, we proceeded with sex multigroup invariance procedures. The separate models for males and females presented acceptable levels of model fit (Table 10), as did the common baseline model ($\chi^2 = 112.559$, $df = 48$, $\text{RMSEA} = 0.056$, $\text{CFI} = 0.943$, $\text{SRMR} = 0.062$), indicating configural invariance (Table 12). The test for metric invariance involved constraining each matching loading to be equal across groups. The value of $\Delta\chi^2$ was 6.981 with 6 degrees of freedom, which indicated a nonsignificant difference, $\Delta\text{CFI} = 0.001$, $\Delta\text{SRMR} < 0.001$, and $\Delta\text{RMSEA} = 0.003$. Thus, full metric invariance was verified. Full scalar invariance was not achieved (required $\Delta\text{CFI} < 0.01$), therefore the analysis of residual invariance could not be performed.

Table 12*Multigroup invariance analyses between sex*

Model tested	Model fit measures						Model differences				
	χ^2	df	p	RMSEA	CFI	SRMR	$\Delta\chi^2$	Δdf	$\Delta RMSEA$	ΔCFI	$\Delta SRMR$
Configural Invariance	112.559	48	<0.001	0.056	0.943	0.062	*	*	*	*	*
Metric Invariance	119.540	54	<0.001	0.053	0.942	0.062	6.981	6	0.003	0.001	<0.001
Scalar Invariance	149.068	63	<0.001	0.057	0.924	0.090	36.509	15	0.001	0.019	0.028
Residual Invariance	167.837	69	<0.001	0.058	0.913	0.108	55.278	21	0.002	0.030	0.046

Note. χ^2 = Chi-Squared; df = Degrees of Freedom; RMSEA = Root Mean Squared Error of Approximation; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual.

The results of the concurrent validity analyses were consistent with the theoretical assumptions (Table 13). As expected, the higher amount of physical activity was associated with higher physical literacy. Higher BMI was linked to lower scores in Knowledge and understanding and Sense of self and self-confidence. We also verified a positive correlation between lifestyle physical activity and all three physical literacy factors.

Table 13
Concurrent validity analyses

Factors	BMI (kg/m ²)	Total physical activity (MET)	Lifestyle physical activity
KU	-0.125**	0.273**	0.115*
SS	-0.326**	0.313**	0.203**
SE	0.018	0.194**	0.102*

Note. * = $p < 0.05$; ** = $p < 0.001$; KU = Knowledge and understanding; SS = Sense of self and self-confidence; SE = Self-expression and communication with others.

The test-retest reliability and agreement results are available in Table 14. Four items of the final PPLI-PT (PPLI-PT7, 8, 13, 17) and Self-expression and communication with others factor did not achieve the cut-off value ($r > 0.7$), indicating overall inadequate test-retest reliability. One tail lower border of Lyn's Coefficient of Concordance was lower than 0.9 for all items, indicating a poor level of agreement.

Table 14*Test-retest reliability and agreement analysis*

	First survey		Second survey		r	α	ρ_c	95% CI (1 tail)
	M	SD	M	SD				
PPLI-PT1	4.68	0.73	4.70	0.66	0.499**			
PPLI-PT2	4.00	1.07	4.07	1.12	0.860**		0.854	>0.793 or <0.898
PPLI-PT3	4.41	0.81	4.25	0.81	0.684**			
PPLI-PT4	4.20	1.01	4.42	1.03	0.816**		0.815	>0.738 or <0.871
PPLI-PT5	4.34	0.93	4.66	0.73	0.729**		0.726	>0.620 or <0.805
PPLI-PT6	3.90	1.13	4.05	1.09	0.738**			
PPLI-PT7	3.92	1.00	4.10	0.95	0.644**		0.638	>0.509 or <0.739
PPLI-PT8	4.09	0.85	4.22	0.79	0.640**		0.635	>0.505 or <0.736
PPLI-PT9	4.55	0.80	4.79	0.47	0.585**			
PPLI-PT10	3.87	0.95	3.86	1.17	0.788**			
PPLI-PT11	3.87	0.95	3.82	1.06	0.857**		0.852	>0.790 or <0.898
PPLI-PT12	3.17	1.20	3.21	1.12	0.806**		0.806	>0.726 or <0.865
PPLI-PT13	4.09	0.75	4.07	0.82	0.622**		0.606	>0.472 or <0.713
PPLI-PT14	4.14	0.98	4.29	1.05	0.823**			
PPLI-PT15	3.87	1.17	4.16	1.09	0.764**			

PPLI-PT16	3.65	1.29	3.85	1.14	0.831**			
PPLI-PT17	4.82	0.51	4.82	0.48	0.365**		0.319	>0.161 or <0.462
PPLI-PT18	3.57	1.20	3,66	1.26	0.668**			
KU	4.46	0.68	4.13	0.84	0.810**	0.727-0.721	0.810	>0.731 or <0.867
SE	3.71	0.70	3.70	0.76	0.499**	0.530-0.617	0.810	>0.732 or <0.867
SS	4	0.79	4.63	0.62	0.812**	0.724-0.846	0.830	>0.759 or <0.882

Note. M = Mean; SD = Standard Deviation; r = Correlation; α = Cronbach's Alpha; ** = $p < 0.001$; ρ_c = Lin's Concordance Correlation Coefficient; CI = Confidence interval; KU = Knowledge and understanding; SE = Self-expression and communication with others; SS – Sense of self and self-confidence; In bold items included in final PPLI-PT.

Discussion

The present study aimed to translate and cross-culturally adapt the Perceived Physical Literacy Instrument to the Portuguese language and to analyze the psychometric properties of the PPLI-PT in a sample of Portuguese-speaking adults. After assessing the factorial structure, confirmatory factor analysis was performed to verify the construct validity. Additionally, instrument assumptions between sexes through invariance testing were examined. Finally, concurrent validity, test-retest reliability, and test-retest agreement analyses were performed to gather additional evidence. The results of the present study generally supported the measurement model. This study contributes to the validation of the PPLI by providing evidence of its psychometric properties in the Portuguese-speaking adult population and facilitates comparative analysis with previous and future studies utilizing the PPLI instrument.

Similar to the original study, the initial model of 18 items did not present an adjusted fit and a 9-item, 3-factor model of PPLI (Sum et al., 2016) was tested. The final model of PPLI-PT contained the same items as the original PPLI (Sum et al., 2016), confirming that the 9 items represent the best-adjusted model for the assessment. The model fit statistics suggested that the estimated model reproduces the sample covariance matrix reasonably well, similar to the original scale (Sum et al., 2016). Further, we provided evidence of acceptable construct validity of PPLI-PT in terms of convergent and discriminant validity. Two items presented low standardized factor loadings, 0.38 and 0.49 (PPLI-PT17: I am aware of the benefits of sports related to health; PPLI-PT11: I have strong social skills). Factor loadings represent how much of the participant's response to an item is due to the factor. Although it is recommended for factor loadings to exceed 0.5, or, ideally, 0.7 (Hair et al., 2019), no hard rules exist, and the acceptable strength of the factor loading depends on the theoretically assumed relationship between the item and the factor (Knekta et al., 2019). PPLI factors—Knowledge and understanding, Sense of self and self-confidence, and Self-expression and communication with others—were defined by original authors based on the literature available in 2016 (Sum et al., 2016). Indeed, the more recent review identified physical elements (e.g., fundamental motor skills, motor competence, motor ability, fitness), psychological elements (e.g., motivation, confidence), cognitive (e.g., knowledge, understanding, attitude, and valuing physical activity), behavioral elements (physical activity, sedentary behavior), social elements (interaction with others), reading/interacting with the environment, and a focus on the lifelong journey as the most commonly presented elements (Martins et al., 2021). Item PPLI-PT17 (I am aware of the benefits of sports related to health) represents the cognitive domain of physical literacy and is an essential part of the knowledge required to maintain physical activity.

The low factor loading of this item may also be explained by the conceptual difference between it and the two other items of Knowledge and understanding factor (PPLI-PT4: I have a positive attitude and interest in sports; and PPLI-PT5: I appreciate myself or others doing sports), which are more inter-related. Item PPLI-PT11 (I have strong social skills) represents the ability to communicate and interact, highlighted by previous research as the central idea of physical literacy (Jurbala, 2015). Conceptual distance between items may also be an issue in this factor. Despite some low factor loadings, we considered the PPLI-PT factor structure satisfactory, taking into account the good performance of model on other indices (Hair & Alamer, 2022).

Our results supported limited invariance between sex. The models for both sexes showed an adjusted fit, configural invariance, and full metric invariance. Full scalar and full residual invariance were not achieved; thus, the model is not invariant. A study that validated PPLI in adolescents stated full sex invariance (Sum, Cheng, et al., 2018), but their conclusions were based on Comparative Fit Index only, which may not be sufficient (Putnick & Bornstein, 2016). No invariance measurement testing in adults was done with the original PPLI nor its adaptations to compare our findings. It should be mentioned that the male and the female groups in our sample were significantly different in age, in total physical activity and BMI, which may have affected our results. Further investigation is required to find the source of non-invariance.

We also examined the concurrent validity of the PPLI-PT against BMI, total physical activity measured by IPAQ, and lifestyle physical activity (active choices). Considering the nature of physical literacy, we expected participants with higher scores to be more physically active and present lower BMI. Consistently with previous studies that employed PPLI (Choi et al., 2018; Ma, Sum, Huang, et al., 2020), all three PPLI-PT factors were associated with higher levels of physical activity. BMI was negatively associated with Knowledge and understanding and Sense of self and self-confidence. It may be argued that self-management skills for fitness and self-evaluation skills for health, which comprise the latter factor, are essential for effective weight management. Future research should explore the causality of these associations. All three factors of PPLI-PT were positively associated with active choice ability. As defined by Whitehead, a physically literate individual “is perceptive in 'reading' all aspects of the physical environment, anticipating movement needs or possibilities and responding appropriately to these, with intelligence and imagination”. Active (conscious, autonomous, informed, and value-congruent) choice is a complex behavior that may rely on different aspects of physical literacy, explaining the associations.

Issues emerged regarding PPLI-PT over-time consistency. We verified overall inadequate test-retest reliability and poor level of test-retest agreement. By definition, physical literacy is a journey, and in her work, Whitehead advocates for an assessment that allows chartering individual progress and provides insight on possible improvement (Whitehead, 2010, 2018, 2019a), which makes over-time consistency, and especially test-retest agreement, crucial. Contrasting with our study, Persian PPLI adaptation showed adequate test-retest reliability both in adolescents (Mohammadzadeh et al., 2021) and adults (Samadi et al., 2022), but the agreement analysis was not performed. Further investigation is required to provide evidence on PPLI-PT over-time consistency.

Developing physical literacy in adults may be a powerful strategy to enhance lives. Its educational and pedagogical implications provide the opportunity to challenge traditional exercise practices in adults (Almond, 2013). To develop new programs and policies it is important to find appropriate assessment methods. It is not yet clear if physical literacy assessments in adults should differ (and if yes, how?) from those in children and adolescents. Three factors of PPLI-PT are three key attributes of physical literacy, as defined by Whitehead (Whitehead, 2010). These factors are interrelated between them and also with three core capability attributes: motivation, confidence, and physical competency. Although not age-specific, these components may have particular meanings for adults. For example, acquired knowledge and experience resulting from previous behavior may explain the high variability in physical activity in the older population (McAuley et al., 2007). Physically literate individuals could transfer knowledge to different conditions in the changing course of their life, and make independent, evidence-based decisions to improve their lives and those of their families (Ennis, 2015). Self-expression and communication with others allow adults to be taught and to teach more effectively (Ibrahim et al., 2019; Van der Vleuten et al., 2019), enhancing among other things movement skills acquisition. Also, social communication opportunities are known to improve physical activity participation (Kanamori et al., 2015). Sense of self and self-confidence as a part of physical literacy brings a notion that there is far more to our embodiment than 'its' object form (Whitehead, 2010). In adults, it may help to overcome body image issues, which are a strong deterrent to participation in physical activity (Sabiston et al., 2019). Thus, considering potential implications on adults' general well-being and quality of life, we encourage further investigation of PPLI factors in relation to other metrics, in and outside of physical activity science.

Our study had some limitations. First, total physical activity measured in metabolic equivalents of our sample was higher compared with other recent Portuguese studies (Antunes et al., 2020; Teixeira et al., 2019). Seventy percent of our sample presented BMI in the normal

range, contrasting with 41% (Instituto Nacional de Estatística, 2019) in a general Portuguese population. Regarding invariance analysis, the differences in total physical activity, age, and BMI between groups may have affected our results. It is unclear if the lack of invariance is due to the assessment being conceptualized in a similar manner between males and females or due to true differences in the samples. Future investigation may consider accessing the factorial structure of PPLI independently in each sex and evaluating PPLI-PT invariance with a more heterogeneous and representative sample. Second, there is limited evidence on convergent validity, discriminant validity, invariance, and over-time consistency available to this instrument, making comparing our results problematic. Further psychometric testing and validations, including invariance measurements and latent mean analysis, are crucial to verify possible issues, allowing for possible adjustments. A longitudinal invariance and test-retest agreement analyses could provide an increase in the robustness of the instrument.

Our results provided evidence for the PPLI-PT use in the Portuguese population. The model presented a good fit to the data in a large sample and adequate construct validity. Invariance measurement and concurrent validity analyses add some confidence in the robustness of our findings. PPLI-PT didn't present an adequate over-time consistency, however, considering the lack of validated instruments, we suggest a fair use of PPLI-PT in studies. Further validation is needed to reinforce our results. Future investigation of the relationship between the PPLI-PT factors and other metrics may help to identify the determinants of complex physical activity behavior and effectively support adults in their physical literacy journey.

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Conclusão geral

Os objetivos da presente dissertação foram rever sistematicamente os instrumentos e métodos reportados na literatura referentes à avaliação da literacia física em adultos, e de forma informada pela revisão, selecionar um instrumento apropriado para ser adaptado para português. A escala *Perceived Physical Literacy Instrument* (PPLI) foi então traduzida, adaptada e validada numa amostra de 434 adultos portugueses. Não diminuindo a importância da exploração filosófica do conceito de literacia física, para a elaboração deste trabalho foi adotada a abordagem instrumental, com foco na aplicação prática.

A revisão sistemática procurou analisar as formas de avaliação da literacia física em adultos, reportadas na literatura, face ao seu alinhamento com o conceito e às propriedades psicométricas. Sete instrumentos de avaliação explícitos foram encontrados, dos quais três foram originais. Foi detetada uma discrepância relativa aos domínios e atributos medidos, mostrando uma aparente falta de acordo sobre o que deve ser avaliado e como deve ser implementada essa avaliação. A falta de instrumentos validados levou a uma utilização frequente de escalas combinadas autoconstruídas, marcada pela adoção de ferramentas desenvolvidas com propósitos totalmente diferentes. As características psicométricas das avaliações foram, em geral, insuficientemente relatadas, o que impossibilitou a comparação dos instrumentos ao nível da sua qualidade e viabilidade. Não foi, assim, possível identificar se alguma das avaliações existentes é apropriada para estudos epidemiológicos de grande escala.

Além de ser abrangente e incluir as investigações mais recentes, a revisão sistemática desenvolvida no estudo I foi a primeira do género a considerar artigos publicados em língua não inglesa. Este carácter inclusivo permitiu chegar a uma imagem mais nítida sobre a adoção geográfica e o desenvolvimento mundial do conceito de literacia física.

Com base nos resultados da revisão, para ser traduzido e adaptado para português foi escolhido o PPLI, o primeiro instrumento de avaliação da literacia física validado em adultos. O PPLI demonstrou estar bem alinhado com a definição holística de literacia física comparativamente com os outros instrumentos incluídos na revisão e é até à data o instrumento mais adotado, existindo mais quatro versões localizadas (em chinês, chinês simplificado, turco e persa). O PPLI avalia três dimensões da literacia física: sentido de si e autoconfiança (engloba habilidades de autogestão e autopercepção da aptidão física), autoexpressão e comunicação com os outros (autopercepção das habilidades sociais e da capacidade de resolução de problemas) e conhecimento e compreensão (atitude em relação à atividade física e consciencialização dos seus benefícios para a saúde).

Considerando as limitações identificadas na revisão sistemática, o estudo II procurou realizar uma validação exaustiva das características psicométricas da escala *Perceived Physical Literacy Instrument Portuguese Version* (PPLI-PT), incluindo a invariância entre sexos, e a confiabilidade e a concordância ao longo do tempo, sendo o primeiro estudo a realizar essas análises para um instrumento de avaliação da literacia física em adultos. No geral, os resultados forneceram evidências robustas para o uso adequado de PPLI-PT na população portuguesa.

Atualmente, a avaliação da literacia física em adultos oferece muitas oportunidades de investigação. Ainda não há acordo entre os investigadores sobre qual é a melhor maneira de captar um conceito multidimensional tão complexo como o de literacia física, ou quais são os atributos que devem ser medidos. Os instrumentos existentes carecem de evidências de validade, confiabilidade e invariância, para serem considerados confiáveis. No seu trabalho, Whitehead desencoraja consistentemente as avaliações que estabelecem níveis ou comparações com outros indivíduos (Whitehead, 2010, 2019b; Whitehead & Murdoch, 2013) e defende uma avaliação que permita a monitorização do progresso individual e forneça informações sobre possíveis melhorias. No entanto, nenhuma avaliação incluída na revisão sistemática declarou propósitos de desenvolvimento pessoal e nenhum estudo forneceu dados longitudinais sobre a evolução da literacia física com a idade. Podemos avaliar a literacia física com a mesma escala durante toda a vida do indivíduo? Será possível um indivíduo tornar-se mais letrado fisicamente numa idade mais avançada? É possível para uma pessoa que desenvolve uma deficiência física ou mental manter a sua literacia física? A avaliação que fornece feedback para melhorar o desempenho será uma abordagem mais alinhada com a definição da literacia física? Os métodos existentes de avaliação da literacia física em adultos ainda não permitem responder a estas perguntas. São necessárias mais pesquisas qualitativas e quantitativas que incluam dados longitudinais e comparem diferentes faixas etárias, contextos e abordagens de avaliação.

A escala ora validada tem várias implicações práticas. Primeiro, PPLI-PT pode ser considerada uma medida válida de literacia física generalizada independente do contexto, que é particularmente útil para adultos, comumente envolvidos em diferentes atividades físicas por vezes não comparáveis entre si. Segundo, o instrumento pode ser usado para avaliar a eficácia dos programas de intervenção que visam promoção de um estilo de vida ativo. Terceiro, na perspetiva de saúde pública, os profissionais envolvidos na promoção de atividade física devem considerar o uso da escala PPLI-PT para avaliar a literacia física em diferentes populações. Os resultados fornecerão uma melhor compreensão da literacia física e das necessidades de intervenção em diferentes contextos. A investigação que relaciona a

literacia física com outras métricas poderá ajudar a identificar os determinantes do comportamento complexo da atividade física e apoiar eficazmente os adultos na sua jornada de literacia física. A validação inicial da escala PPLI-PT demonstrou algumas limitações. Nomeadamente, não foi verificada a invariância entre sexos, e não foi atingida a adequada estabilidade temporal do instrumento. São necessários mais estudos de validação para obter evidências mais robustas e encontrar as possíveis origens dessas limitações.

Perante a «pandemia» atual de inatividade física explorar os conceitos alternativos, como o de literacia física, parece ser um alvo ambicioso de investigação. A presente dissertação demonstrou que embora o método mais adequado de avaliação da literacia física ainda esteja por descobrir, e as soluções existentes necessitem de mais evidências, existe crescente interesse na implementação prática do conceito, sendo aceite o seu potencial contributo no desenvolvimento do ser humano.

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Apêndices

Apêndice 1 – List of extracted items

Apêndice 2 – Quality assessment summary

Apêndice 3 – Perceived Physical Literacy Instrument Portuguese Version

Apêndice 1 – List of Extracted Items

General information:

1. Autor, year, and language
2. Publication type
3. Study design

Content description:

1. Age group (adults or older adults)
2. Country
3. Physical literacy definition adopted
4. Physical literacy domains assessed
5. Measurement used
6. Type of measurement
7. Setting
8. Strengths of assessment in relation to physical literacy (when specified)
9. Limitations of assessment in relation to physical literacy (when specified)

Measurement properties:

1. Sample size, gender, and age
2. Validity (type of validity, comparison measure, validity results when specified)
3. Reliability (time between test and retest and reliability results when specified)
4. Responsiveness (type of responsiveness, responsiveness results when specified)

Assessment feasibility:

1. Staff required (quantity and qualification)
2. Equipment required
3. Assessment time
4. Assessment administration format (online, on site, observation, questionnaire, practical task, etc.)
5. Adaptability

Apêndice 2 – Quality Assessment Summary

	Title	Selection bias	Study design	Data collection methods	Global rating
1	Acoustical Analysis of Speech Under Physical Stress in Relation to Physical Activities and Physical Literacy (Ng, 2022)	Weak	Weak	Moderate	Weak
2	Are You Better Than a 12-Year-Old Student? A Pilot Study to Explore Physical Literacy in Preservice Physical Education Teachers (Chen, 2020)	Moderate	Weak	Weak	Weak
3	Assessing Factor Structure of Perceived Physical Literacy Scale for Physical Education Teachers for Turkish Sample (Munusturlar, 2020)	Moderate	Weak	Strong	Moderate
4	Assessing factor structure of the simplified Chinese version of Perceived Physical Literacy Instrument for undergraduates in Mainland China (Ma, 2020)	Moderate	Weak	Strong	Moderate
5	Association between physical literacy and physical activity: A multilevel analysis study among chinese undergraduates (Ma, 2020)	Moderate	Weak	Moderate	Moderate
6	Associations between previous sport and exercise experience and physical literacy elements among physically inactive Danes (Elsborg, 2021)	Strong	Weak	Moderate	Moderate
7	Construction and validation of a perceived physical literacy instrument for physical education teachers (Sum, 2016)	Moderate	Weak	Strong	Moderate
8	Developing physical literacy through online physical education in community college (Stroffolino, 2021)	Weak	Moderate	Moderate	Moderate
9	Differences in perceived physical literacy between teachers delivering physical education in schools: classroom teachers vs physical education teachers (Yildizer, 2021)	Moderate	Weak	Strong	Moderate
10	Early childhood education and care: Do we need to develop the physical literacy of educators? (Buckler, 2020)	Moderate	Weak	Moderate	Moderate

11	Effect of sport education on students' perceived physical literacy, motivation, and physical activity levels in university required physical education: a cluster-randomized trial (Choi, 2020)	Strong	Strong	Moderate	Strong
12	Effects of physical education continuing professional development on teachers' physical literacy and self-efficacy and students' learning outcomes (Sum, 2018)	Moderate	Strong	Strong	Strong
13	Examining the Effectiveness of a Pilot Physical Literacy-Based Intervention Targeting First-Year University Students: The PLUS Program (Kwan, 2019)	Moderate	Moderate	Moderate	Moderate
14	Examining the relationships among university students' physical self-perceptions, motor skill proficiency, and physical activity behavior within the framework of physical literacy (Arnett, 2017)	Moderate	Weak	Moderate	Moderate
15	Exploring the Level of Physical Fitness on Physical Activity and Physical Literacy Among Chinese University Students: A Cross-Sectional Study (Zhang, 2022)	Moderate	Weak	Moderate	Moderate
16	Holistic physical exercise training improves physical literacy among physically inactive adults: A pilot intervention study (Holler, 2019)	Moderate	Strong	Moderate	Strong
17	Perception of physical literacy among secondary school physical education teachers (Cheng, 2021)	Weak	Weak	Moderate	Weak
18	Physical Competence, Physical Well-Being, and Perceived Physical Literacy among Older Adults in Day Care Centers of Hong Kong (Huang, 2022)	Moderate	Weak	Moderate	Moderate
19	Physical education content alignment with physical literacy outcomes into early adulthood (Simonton, 2022)	Moderate	Weak	Weak	Weak
20	Physical Literacy Dimensions in University Students and their Relations with Present and Past Physical Activity: An Exploratory, Observational Study (Souza, 2022)	Moderate	Weak	Weak	Weak

21	Preservice Physical Education Teachers' Perceived Physical Literacy and Teaching Efficacy (Choi, 2021)	Moderate	Weak	Strong	Moderate
22	Primary care and physical literacy: A non-randomized controlled pilot study to combat the high prevalence of physically inactive adults in Austria (Holler, 2021)	Moderate	Strong	Moderate	Moderate
23	Psychometric Validation of Senior Perceived Physical Literacy Instrument (Liu, 2022)	Moderate	Weak	Strong	Moderate
24	Relation between perceived barrier profiles, physical literacy, motivation and physical activity behaviors among parents with a young child (Ha, 2020)	Weak	Weak	Strong	Weak
25	Relationship Among Physical Literacy, Mental Health, and Resilience in College Students (Ma, 2021)	Strong	Weak	Strong	Moderate
26	Reliability of Czech version of Questionnaire towards self-perception of physical literacy in undergraduate students (Vašíčková, 2020)	Weak	Weak	Strong	Weak
27	Temporal precedence of physical literacy and basic psychological needs satisfaction: A cross-lagged longitudinal analysis of university students (Wang, 2020)	Moderate	Moderate	Strong	Moderate
28	The Effects of Exergame Training on Community-Dwelling Seniors' Physical Literacy: A Randomized Controlled Trial (Campelo, 2020)	Strong	Strong	Weak	Moderate
29	The influence of a customized continuing professional development programme on physical education teachers' perceived physical literacy and efficacy beliefs (Sum, 2020)	Moderate	Moderate	Weak	Moderate
30	Validation of a Speech Database for Assessing College Students' Physical Competence under the Concept of Physical Literacy (Ma, 2022)	Weak	Weak	Moderate	Weak
31	Validity Evaluation of the College Student Physical Literacy Questionnaire (Lou, 2022)	Strong	Weak	Strong	Moderate

Apêndice 3 – Perceived Physical Literacy Instrument Portuguese Version

PPLI-PT versão original

- 1 Possui adequadas habilidades motoras fundamentais
 - 2 Considerando a minha idade, estou em boa condição física
 - 3 Sou capaz de utilizar as habilidades motoras aprendidas em outras atividades físicas/desportivas
 - 4 Tenho uma atitude positiva e interesse em atividades físicas/desportivas
 - 5 A prática das atividades físicas/desportivas é algo que eu valorizo em mim e nos outros
 - 6 Sou capaz de aplicar os conhecimentos adquiridos na Educação Física ao longo do tempo
 - 7 Tenho competências de gestão da minha condição física
 - 8 Tenho competências de avaliação da minha saúde
 - 9 Estou disposto a praticar atividades físicas/desportivas para melhorar a minha saúde
 - 10 Tenho fortes competências de comunicação
 - 11 Tenho fortes competências sociais
 - 12 Confio na capacidade de sobreviver num ambiente natural ou selvagem
 - 13 Sou capaz de lidar com problemas e dificuldades
 - 14 Para mim praticar as atividades físicas/desportivas é uma forma de estar na vida
 - 15 Consigo integrar as atividades físicas/desportivas nos meus hábitos de vida
 - 16 Faço amizades através das atividades físicas/desportivas
 - 17 Estou consciente dos benefícios que a prática de atividades físicas/desportivas tem para a saúde
 - 18 Procuro conhecer as tendências atuais na área da atividade física/desportiva
-

PPLI-PT versão final

O questionário é aplicado utilizando a escala Likert de 5 pontos (1: discordo fortemente, 5: concordo fortemente).

	Item	Fator
PPLI-PT4	Tenho uma atitude positiva e interesse em atividades físicas/desportivas	Conhecimento e compreensão
PPLI-PT5	A prática das atividades físicas/desportivas é algo que eu valorizo em mim e nos outros	
PPLI-PT17	Estou consciente dos benefícios que a prática de atividades físicas/desportivas tem para a saúde	
PPLI-PT2	Considerando a minha idade, estou em boa condição física	Autopercepção e autoconfiança
PPLI-PT7	Tenho competências de gestão da minha condição física	
PPLI-PT8	Tenho competências de avaliação da minha saúde	
PPLI-PT11	Tenho fortes competências sociais	Auto-expressão e comunicação com os outros
PPLI-PT12	Confio na capacidade de sobreviver num ambiente natural ou selvagem	
PPLI-PT13	Sou capaz de lidar com problemas e dificuldades	