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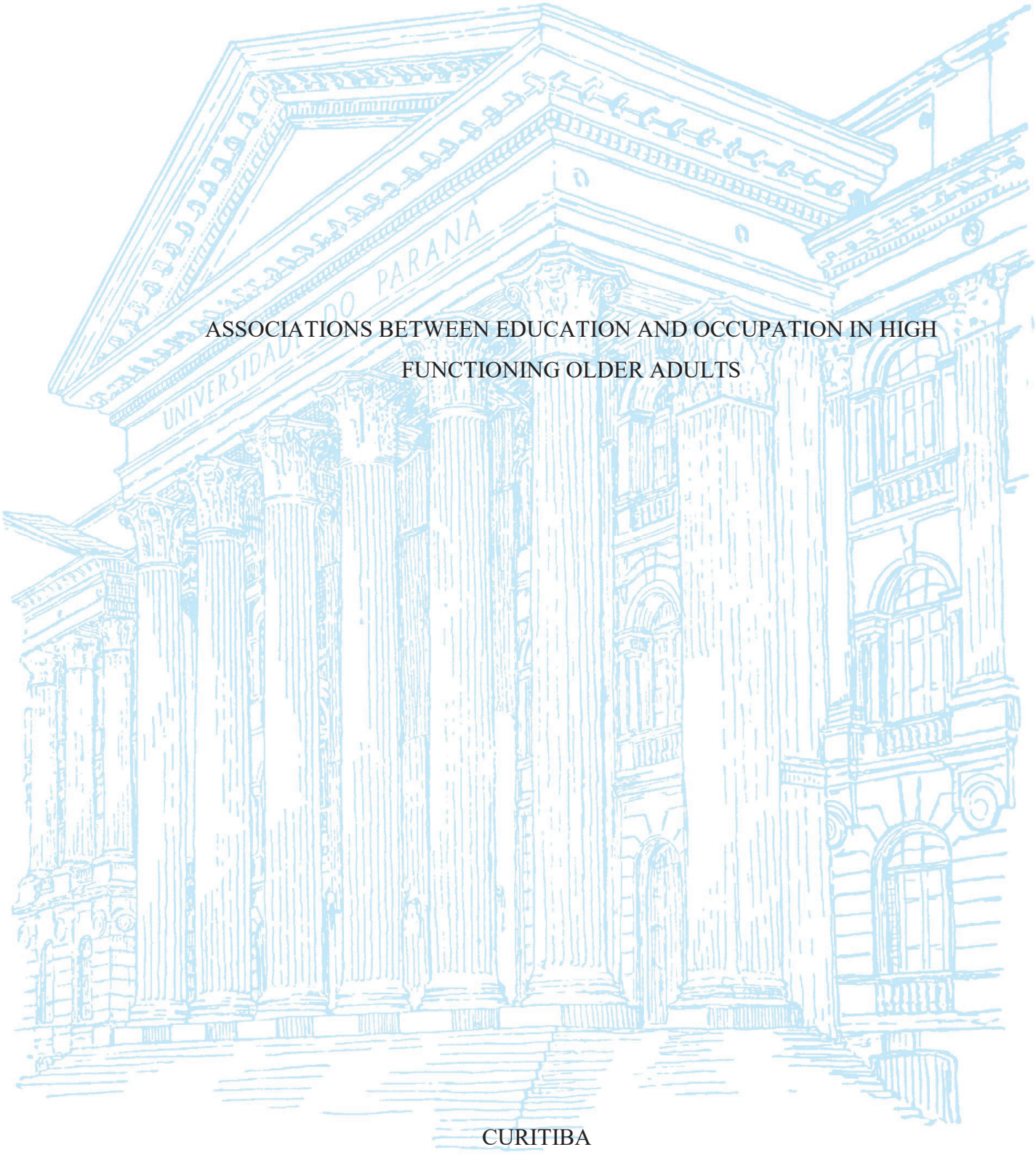

ASSOCIATIONS BETWEEN EDUCATION AND OCCUPATION IN HIGH FUNCTIONING OLDER ADULTS

CURITIBA

2023

GABRIEL SOUSA ANDRADE

ASSOCIATIONS BETWEEN EDUCATION AND OCCUPATION IN HIGH FUNCTIONING OLDER ADULTS

Trabalho apresentado para apreciação de banca examinadora de defesa, como exigência parcial para obtenção do título de Mestre e parte integrante do Programa de Pós-Graduação em Psicologia, linha de Avaliação e reabilitação Neuropsicológica, do Setor de Ciências Humanas da Universidade Federal do Paraná.

Orientador: Prof. Dr. Amer Cavalheiro Hamdan

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Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação PSICOLOGIA da Universidade Federal do Paraná foram convocados para realizar a arguição da Dissertação de Mestrado de **GABRIEL SOUSA ANDRADE** intitulada: **ASSOCIATIONS BETWEEN EDUCATION AND OCCUPATION IN HIGH FUNCTIONING OLDER ADULTS**, sob orientação do Prof. Dr. AMER CAVALHEIRO HAMDAN, que após terem inquirido o aluno e realizada a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.

A outorga do título de mestre está sujeita à homologação pelo colegiado, ao atendimento de todas as indicações e correções solicitadas pela banca e ao pleno atendimento das demandas regimentais do Programa de Pós-Graduação.

CURITIBA, 25 de Agosto de 2023.

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“Olha para dentro. É lá que mora a fonte do bem, e ela vai jorrar sempre se cavares constantemente.” (Marco Aurélio)

RESUMO

Com o envelhecimento da população, faz-se imperativo estudar formas de preservar o funcionamento cognitivo em idosos, especialmente a memória, cujo prejuízo é frequente. Há diversos fatores associados à preservação das funções mnemônicas, tendo os chamados *SuperAgers*, idosos com altas habilidades cognitivas, resultados compatíveis com adultos 20 a 30 anos mais jovens. Para investigar o fenômeno dos idosos com altas habilidades cognitivas, foram elaborados dois artigos, sendo uma revisão sistemática e um estudo com coleta de dados. A revisão sistemática analisou instrumentos e critérios associados à classificação de *SuperAgers*, considerando a falta de consenso relativo à sua classificação. 21 artigos compuseram a análise final deste artigo, tendo sido observado que a maior parte dos estudos consideraram *SuperAgers* idosos a partir de 80 anos. As medidas comumente empregadas foram de memória verbal episódica e de funções executivas, com pouca adaptação de protocolos frente a diferentes contextos socioculturais. Recomendações acerca de pesquisas futuras foram feitas visando uma maior flexibilização dos métodos de pesquisa em contextos socioeconômicos e culturais diversos. Posteriormente, foi conduzida uma pesquisa transversal com coleta de dados visando analisar associações entre idosos com altas habilidades cognitivas e marcadores genéticos, escolaridade formal e a complexidade ocupacional. De uma amostra inicial de 60 participantes, 56 compuseram a amostra final, tendo sido aplicados instrumentos de memória episódica, memória não-verbal, funções executivas e tempo de reação. Foi observado que tanto a escolaridade, quanto a ocupação tiveram correlações significativas com o funcionamento cognitivo. A escolaridade se mostrou mais preditiva de resultados relativos às funções executivas, tendo a complexidade ocupacional sido mais fortemente associada às capacidades cognitivas gerais. Tais resultados são compatíveis com o conceito de reserva cognitiva, sugerindo que a escolaridade é uma importante forma de prevenção da perda cognitiva oriunda da idade e a ocupação, além de também fonte de reserva cognitiva, uma forma de manter os benefícios da escolaridade por meio do exercício das habilidades aprendidas. Recomenda-se que futuras pesquisas busquem compreender a complexa interação entre marcadores genéticos, ocupação e escolaridade por meio de protocolos de pesquisa rígidos, porém adaptados aos contextos socioculturais em questão.

Palavras-chave: Envelhecimento. Saúde do idoso. Avaliação neuropsicológica. Desenvolvimento Humano. Escolaridade. Complexidade ocupacional.

ABSTRACT

Considering the aging of the population, it is imperative to investigate methods for preserving cognitive functioning in older adults, particularly concerning memory, which is commonly affected. The preservation of mnemonic functions is associated with multiple factors, being known as SuperAgers the older adults with high performance in memory tests, comparable to adults 20 to 30 years younger. Two articles were produced to assess the phenomenon of high-performing older adults, being those a systematic review and a data collection study. The systematic review examined instruments and criteria employed for the classification of SuperAgers, considering the lack of a consensus in the field. 21 articles composed the final analysis. It was observed that the majority of the studies considered SuperAgers to be at least 80 years old. The most frequently employed instruments measured episodic memory and executive functions, with little adaptation when applied in varied socioeconomic and cultural contexts. Recommendations regarding future studies were proposed, aiming at the flexibilization of research methods in diverse socioeconomic and cultural contexts. Posteriorly, a cross-sectional data collection study was conducted to analyze the associations between high-performing older adults and genetic markers, formal education, and occupational complexity. Out of an initial sample of 60 participants, 56 composed the final sample. Episodic memory, non-verbal memory, executive functions, and reaction time instruments were administered. It was observed that both education and occupational complexity were correlated with cognitive functioning. Formal education was a greater predictor of executive functioning, while occupational complexity was more strongly associated with general cognitive abilities. The present findings are compatible with the concept of cognitive reserve, suggesting that formal education is an important factor in the prevention of cognitive loss due to age, being the occupation, as well as a promotor of cognitive reserve, also a way of maintaining the benefits of education through the application of the learned abilities. It is recommended that future studies seek to comprehend the complex interaction between genetic markers, occupation, and education with the aid of rigid research protocols adapted for specific sociocultural contexts.

Keywords: Aging. Health of the elderly. Neuropsychological tests. Human development. Education. Occupational complexity.

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LISTA DE SIGLAS

AD – *Alzheimer's Disease*

ANOVA – *Analysis of Variance*

A7 – *Delayed Recall condition of the Rey Auditory Verbal Learning Test*

BCSB – *Brief Cognitive Screening Battery*

BNT – *Boston Naming Test-30*

BVS – Biblioteca Virtual em Saúde da Atenção Primária à Saúde

CEP/CHS – Comitê de Ética em Ciências Humanas em Sociais

CERAD – *Consortium to Establish a Registry for Alzheimer's Disease*

C.I. – *Confidence interval*

CVLT – *California Verbal Learning Test*

df – *Degrees of freedom*

DS – *Digit Span Task*

Exp(β) – *Exponential value of β (value in regression models)*

HPOA – *High Performance Older Adults*

ISCO – *International Labour Organization*

PRISMA – *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*

r – Pearson correlation coefficient

RAVLT – *Rey Auditory Verbal Learning Test*

ROCFT – *Rey-Osterrieth Complex Figure Test*

LabNeuro – Laboratório de Neuropsicologia

LIGH – Laboratório de Imunogenética e Histocompatibilidade

MCI – *Mild Cognitive Impairment*

MMSE – *Mini Mental State Examination*

n – *Sample size*

NA – *Normal Ager*; *Normal Agers*; *Normal Aging*

Neupsilin – Instrumento para avaliação Neuropsicológica Breve

p – *Probability value*

R^2 – *Estimated value of prediction of a model*

SA – *SuperAger*; *SuperAgers*; *SuperAging*

SD – *Standard Deviation*

SVLT – *Shiraz Verbal Learning Test*

SRT – *Selective Reminding Test*

SPOA – *Standard Performance Older Adults*

t – *Student's independent t-test coefficient*

TMT – *Trail Making Test*

TMT-A – *Trail Making Test (Part A)*

TMT-B – *Trail Making Test (Part B)*

TMT-B/A – *Trail Making Test (Part B) divided by Trail Making Test (Part A)*

UFPR – Universidade Federal do Paraná

VFT – *Verbal Fluency Task*

WAIS-III – *Wechsler Adult Inteligence Scale-III*

WMS-III – *Wechsler Memory Scale-III*

$\chi 2$ – *Chi squared coefficient*

ρ_S – *Spearman correlation coefficient*

SUMÁRIO

1 INTRODUÇÃO GERAL

1.1 APRESENTAÇÃO

Com o crescente envelhecimento da população (Kanasi et al., 2016), se faz também crescente a necessidade de compreender os processos envolvidos no envelhecimento humano. Neste processo, o ser humano tende a ter uma redução de suas capacidades cognitivas ao longo do tempo, fenômeno que é influenciado por experiências de vida e fatores biológicos e ambientais (Santos et al., 2009).

Há diversos fatores que influenciam na capacidade cognitiva de idosos, sendo possível citar fatores epidemiológicos, psicológicos, biológicos, ambientais e socioculturais (Santos et al., 2009). Apesar de ser frequente a percepção de declínio cognitivo por parte da população idosa, especialmente em relação à memória episódica, é possível afirmar que o envelhecimento encefálico é um processo complexo e não possui uma correlação perfeita com a idade (Rogalski et al., 2013).

A existência de idosos que atingem os 80 anos com capacidade de memória episódica similar à esperada para adultos décadas mais novos, como o exemplo dos *SuperAgers* (SA), possibilita uma série de questionamentos acerca do próprio processo do envelhecimento. Os SA são classificados como tal por serem idosos com grande capacidade mnemônica, sendo esta similar ao esperado para adultos 20 a 30 anos mais jovens (de Godoy et al., 2020).

Tal conceito não é único na literatura, que descreve também diferentes instrumentos para a classificação de idosos com altas habilidades cognitivas (de Godoy et al., 2020). Foram identificadas associações com fatores genéticos, como em Huentelman et al. (2018), onde foi observado com mais frequência o gene MAP2K3 em participantes com altas habilidades cognitivas. Os efeitos da escolaridade e da ocupação não foram, contudo, suficientemente explorados em idosos com altas habilidades cognitivas.

Por terem resultados significativamente superiores à média esperada para seus pares, o estudo dos idosos com altas habilidades cognitivas pode promover a identificação de fatores que promovam tal padrão de desenvolvimento (Rogalski et al., 2013). Entre os fatores que se relacionam com o declínio cognitivo em idosos, é possível citar a escolaridade e a ocupação (Alvarado et al., 2002). De acordo com Lövden et al. (2020), a ocupação possui efeitos significativos na cognição, tendo a capacidade cognitiva e o trabalho uma relação recíproca.

Desta forma, o presente trabalho objetivou investigar o fenômeno dos idosos com altas habilidades cognitivas, tendo sido elaborados dois artigos. Considerando este campo de

estudo, foi conduzida uma revisão sistemática (seção 2) acerca dos instrumentos e critérios de classificação empregados para classificar um idoso como um SA. Este trabalho foi aceito para publicação no periódico científico *Aging and Health Research*.

Posteriormente, com base na revisão sistemática, foi desenvolvido um projeto de pesquisa para investigar os marcadores genéticos, a ocupação e a escolaridade em idosos com altas habilidades cognitivas. Tal projeto foi concebido em colaboração entre o Laboratório de Neuropsicologia (LABNEURO) e o Laboratório de Imunogenética e Histocompatibilidade, dos departamentos de Psicologia e Genética da Universidade Federal do Paraná (UFPR), respectivamente. O projeto foi aprovado pelo Comitê de Ética em Pesquisa em Ciências Humanas e Sociais (CEP/CHS UFPR; Anexo 1). Tal pesquisa visou investigar a relação entre o alto funcionamento em idosos e marcadores genéticos, a educação formal e a ocupação prévia dos participantes.

Foi realizada uma busca na literatura para avaliação de genes candidatos para investigação, sendo a possibilidade prática e a relevância teórica discutidas entre membros de ambos os laboratórios (LABNEURO e LIGH). Os genes com impacto na citocina atuam por meio da regulação de processos pró e anti-inflamatórios que, em casos pró-inflamatórios, podem promover excitotoxicidade glutaminérgica, acelerando a morte de neurônios (Trenova et al., 2018). Trenova et al. (2018) argumentam que tais polimorfismos relativos a genes associados à citocina não possuem efeito independente, ocorrendo por meio de grandes interações com outros polimorfismos, participando, contudo, de processos implícitos ao declínio da memória episódica em idosos e à inibição da neurogênese (Stacey et al., 2015).

Stacey et al. (2015) argumentam que há necessidade de mudança de foco nos estudos que associam cognição em idosos e genes associados à codificação de citocina para genes associados à sua regulação. Considerando tal necessidade, optou-se pelo gene CR1 para análise, sendo este um regulador (Stacey et al., 2015). As amostras de saliva dos participantes foram coletadas em tubos estéreis de 1,5 mL e mantidas em gelo até chegar ao LIGH. Optou-se pela extração do DNA por meio do método *salting out*, com posteriora genotipagem por PCR.

É importante considerar que não houve tempo hábil para a extração do DNA por parte do LIGH, tendo a parceria deste com o LABNEURO sido firmada visando o longo prazo, com menos de um ano antes do fim do prazo regular do programa de mestrado referente ao presente trabalho. Desta forma, na seção 3 é apresentado um artigo inédito elaborado com base em dados parciais, sem a informação referente aos dados genéticos, embora estes tenham sido coletados junto à testagem cognitiva.

A compreensão dos fatores que possam estar associados a uma maior capacidade cognitiva e consequente qualidade de vida em idosos pode possibilitar a realização de medidas de prevenção e promoção na área da saúde. Adicionalmente, é importante compreender como diferentes fatores, como os anos de estudo da infância à idade adulta, a ocupação durante a vida e fatores genéticos impactam o desenvolvimento humano até idades avançadas.

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2 INSTRUMENTS FOR THE ASSESSMENT OF SUPERAGERS: A SYSTEMATIC REVIEW

Abstract

Age-related cortical atrophy and cognitive decline, especially in memory function, are common among older adults. However, a subset of older adults, known as SuperAgers, exhibit exceptional resilience to these effects, displaying an episodic memory capacity equivalent to or exceeding that of individuals 20 to 30 years their junior. Despite this phenomenon, there is no consensus among researchers regarding the most appropriate instruments and criteria for classifying SuperAgers. To address this gap, we conducted a systematic review of the literature to determine which instruments and classification criteria are most frequently utilized. Our search of PubMed/Medline, Scopus, Web of Science, and PsycINFO yielded results suggesting that SuperAgers are generally defined as individuals aged 80 years or older, with anterograde memory tests based on fixed cut-off values for word list recall, as well as executive functioning tests, serving as the primary classification tools. Given the influence of sociocultural and linguistic factors, as well as differences in the choice of memory tests, it is not recommended to establish a single cut-point in global SuperAging studies.

Keywords: Aging; SuperAgers; health of the elderly; neuropsychological tests; human development.

2.1 INTRODUCTION

With the advance of age, a greater risk of neurodegenerative pathologies emerge[1]. Different pathological processes are associated with different kinds of functional loss[1]. Being the most common cause of dementia, Alzheimer's Disease (AD) is primarily associated with memory loss[2]. Although it is important to consider the effect of pathological processes such as AD, aging itself may promote cognitive decline even in the absence of pathologies[2].

Functional loss due to aging may vary between individuals, and some are more resilient than others[3]. At different intensity and progression rates, some experience relative preservation of their cognitive functioning, even at older ages[4]. The concepts of brain reserve and cognitive reserve were posited to elucidate the origins and mechanisms of inter-individual differences in cognitive performance[5]. Brain reserve, in the context of neural resilience, refers to the greater capacity or volume of the brain to sustain cognitive function despite neuropathology[5,3]. In contrast, cognitive reserve pertains to the attenuation of functional decline despite progressive brain degeneration and is attributed to the acquisition of skills and abilities acquired throughout life[3].

In the case of SuperAgers (SA), it was observed that some older adults can present preserved episodic memory capacity to a similar or superior degree to what would be expected for adults 20 to 30 years younger[4]. The study of SA seeks to identify variables associated with higher cognitive functioning in older adults, such as characteristics related to neural preservation and biomarkers associated with brain or cognitive reserve[6]. In the study of SA, both concepts are employed in empirical and theoretical investigations, being the field of study a promotor of a better understanding of the relations between both kinds of reserve and their impact on daily functioning[6].

The study of Harrison et al.[7] was one of the first empirical studies that employed the term SA. It focused on the effects of aging on brain atrophy, demonstrating that older adults with preserved cognitive functioning also presented higher cortical volume. The authors state that studies in the field of healthy aging may contribute to advances in preventing loss of cognitive function and promote knowledge of pathological processes such as AD. Furthermore, de Godoy et al.[6] observed that SA tend to exhibit greater cortical volume in regions such as the anterior cingulate gyrus and the hippocampus, as well as a connectivity pattern resembling that of younger individuals. However, despite the common assessment of amyloid beta in studies on Alzheimer's disease, overall findings did not reveal a significant association in SA research.

Since the preservation of functionality in older adults is a significant contributor to quality of life and individual autonomy[8], it is important to comprehend which variables might be associated with SA. This field, however, does not present a unified protocol to assess and classify SA and Normal agers and thus faces variations in both instruments and the criteria employed[9]. Given that education is known to have a significant impact on the development of cognitive functions[10], it is imperative to consider this factor not only to mitigate bias but also to tailor research protocols for diverse contexts.

The lack of consensus on the instruments and criteria employed in the classification of SA makes comparing results difficult. Godoy et al.[6] argue that, since the decline of memory functions increases in intensity after the age span of 60–65, differences related to minimum age requirements for SA classification risk promoting bias. The present study aims to identify and analyze commonly used memory assessment instruments in SA, and to compare classification criteria utilized by different authors, such as minimum age, cut-off values for memory tests (when applicable), groups of younger adults for comparison, and the criteria used to compare such groups. To our knowledge, the present study is the first to focus primarily on the methodological aspects of SA research (such as instruments and criteria), being conducted with the intent of facilitating the production of research projects in different socioeconomic contexts.

2.2 MATERIAL AND METHODS

A systematic review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses – PRISMA[11]. The following inclusion criteria were employed: complete articles published in scientific journals; articles published in Portuguese, Spanish, or English; articles that reported data collection in a study with humans; articles that separated the sample into groups, with at least one of the groups composed of older adults either classified as SA or as a different terminology with a similar concept (related to older adults with superior memory). The exclusion criteria were: not describing the instruments used to classify SA; not describing classification criteria of SA; not employing memory tests to classify SA; employing statistical methods that are not replicable in broader contexts, such as methods based on analyzing the standard deviation within the study's own sample, with results that could be inconsistent when compared to samples collected from different contexts.

The databases PubMed/MedLine, Scopus, Web of Science, and PsycINFO were searched on 21/04/2022, with no time restriction. Search terms included both MeSH and non-MeSH words, combined with the descriptors "AND" and "OR", with the use of "*" to allow

for variation in the suffix (such as “old*”, making it possible to obtain results for “old”, “old age”, “older adults”, etc.). The words “superager*”, “supernormal*”, “superior cognition”, “superior function”, “superior neuropsycholog*”, “successful ag*”, “older” and “elder” made up the set of non-MeSH words, while the words “Neuropsychological Tests”, “Memory” and “Aged” made up the set of MeSH words. The complete employed search words were: (“superager*” OR “supernormal*” OR “superior cognition” OR “superior function*” OR “superior neuropsycholog*” OR “successful ag*”) AND (“old*” OR “elder*” OR “Aged”) AND (“Memory” OR “Neuropsychological Tests”). As for PsycINFO, the following filters were employed: “publication type: peer-reviewed”; “population group: human”; “age group: 65 yrs & older”.

After the initial search for studies and removal of duplicates, the first phase of screening was composed of the evaluation of abstracts and verifying the conformity of the studies with the defined inclusion and exclusion criteria. Afterward, the remaining studies were read in full, reapplying the inclusion criteria to define the final set of articles to qualitatively synthesize. Two judges independently evaluated the selected articles. In the absence of consensus, divergences were debated for each article to reduce the risk of bias in article selection. The articles were accessed through the databases. When access to the paper was not possible, the articles’ authors were directly asked for a copy. Out of the articles selected for the final analysis, data related to basic information (authors; year of publication), instruments employed, and classification criteria were extracted.

Finally, quality assessment was conducted with the use of the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2[12]) instrument. QUADAS-2 is divided into four domains, being used to assess the risk of bias in: patient selection (regarding the method of selecting participants); index test (considered to be the test applied to both groups regarding the research question); reference test (considered to be the tests used for group classification and inclusion/exclusion criteria); flow and timing (regarding time intervals between the application of both index and reference tests and participant inclusion). The question “Did patients receive the same index test?” was added to the domain of flow and timing. Two judges assessed the reviewed papers and reached consensus when disagreements occured. Each domain was considered to have either a “low” or “high” risk of bias, deemed “unclear” when insufficient information was available. Concerns regarding applicability were also judged for the first three domains.

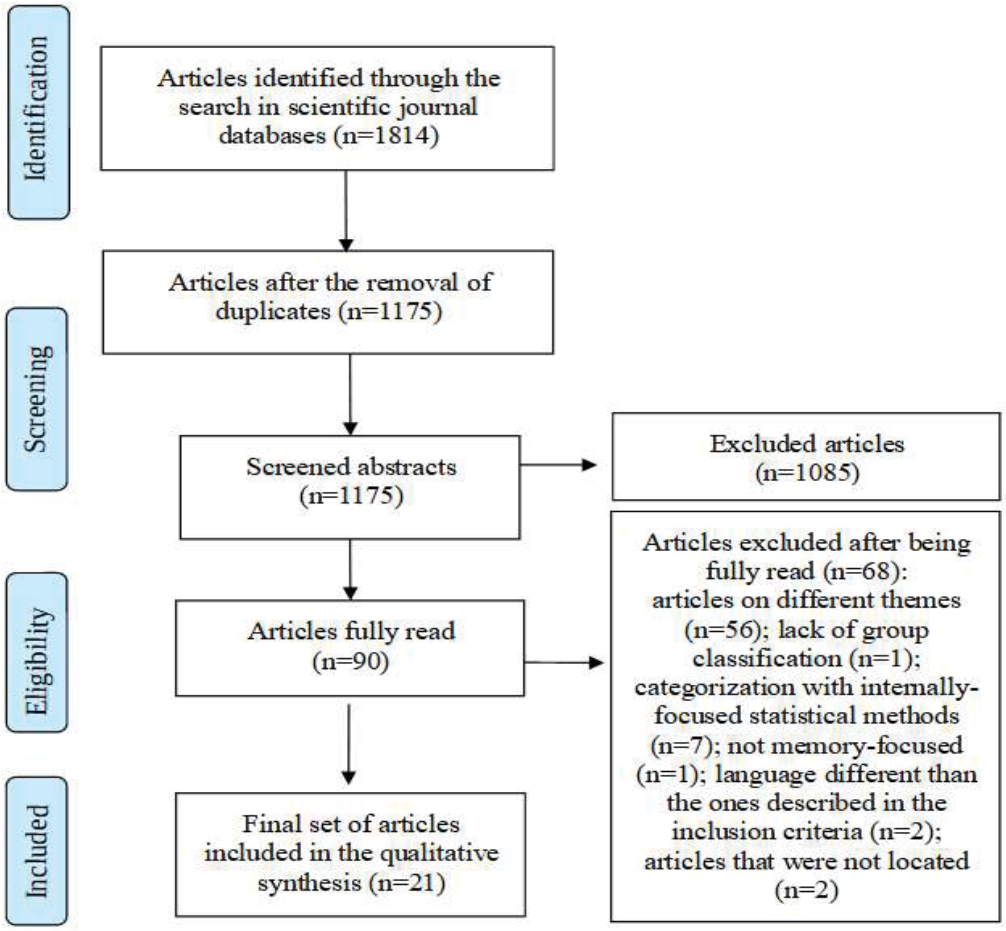
2.3 RESULTS

Figure 2.1 displays the article selection process. Initially, 1814 articles were found: 857 from PsycINFO, 327 from Scopus, 327 from Web of Science, and 303 from PubMed/MedLine. During the first phase of screening, 639 duplicates were removed, resulting in 1175 articles. The resulting articles were then screened by reading their titles and abstracts. Out of the 1175 articles, 1085 were excluded for being related to different themes (such as studies on mental illnesses or therapeutic interventions), not collecting data, or for not being complete articles published in scientific journals and others.

After the screening stage, 90 articles were selected to be read in full. After the reapplication of inclusion and exclusion criteria, 68 articles were excluded from the final qualitative synthesis. Out of the 69 excluded papers, 56 were excluded for not being related to SA or similar concepts. Seven were excluded due to the use of SA classification methods that employed sample-based statistical analysis, such as latent class analysis, which would not allow replication of such criteria in other samples. One study was excluded due to its failure to establish specific criteria for episodic memory scores to classify individuals as SA. Additionally, one study was excluded because it did not describe SA group classification criteria, two for being written in languages different than the ones described in the inclusion criteria (German and Chinese), and two articles were not found, with no reply obtained from the authors until the moment this paper was written.

Finally, 21 articles remained and were included in the final analysis. Out of parsimony, the diverse terms “SuperAger”, “Resilient ager” “SuperNormal”, “Super-cognition” or “Superior cognition” were unified under the concept SA.

Figure 2.1



Flowchart describing article selection process

Table 2.1 presents a brief description of the selected articles in terms of sample, education, and cut-off values for the included memory tests. The oldest article found was published in 2012, while the years with the most frequent publications were 2019 and 2021, each with 5 articles, totaling 10 out of the 21. Most of the studies employed cross-sectional observational methods, with sample sizes varying from 10 to 358 participants. Overall, although the reviewed studies presented replicable, well-described methods, with well-known and well-accepted instruments of measurement, 17 (or about 81%) did not reach 100 participants. The studies were mostly conducted with the use of neuropsychological tasks in association with brain imaging or biomarkers (e.g. genetic markers, amyloid beta).

Table 2.1 *Overview of the studies*

Article	Sample	Mean years of education (SD) for SA / NA	Memory test: cut-off values
Harrison et al., 2012[7]	SA: n=12; mean age=83 years; NA: n=10; mean age=83.5 years; YP: n=14; mean age=57.9 years	14.8 (±2.4) / 17.5 (±2.2)	RAVLT: ≥9
Rogalski et al., 2013[13]	SA: n=5; mean age=88.6 years; NA: n=5; mean age=90.2 years; MCI: n=2	17.2 (±1.8) /14.4 (±2.2)	RAVLT: ≥9
Gefen et al., 2015[14]	SA: n=31; mean age=82.5 years; NA: n=13; mean age=83.7 years; YP: n=21; mean age=58.4 years	15.5 (±2.5) / 16.2 (±3.4)	RAVLT: ≥9
Sun et al., 2016[15]	SA: n=17; mean age=67.8 years; NA: n=23; mean age=66.2 years; YP: n=41; mean age=25.1 years	17.2 (±2.2) / 16.2 (±2)	CVLT: ≥14
Maher et al., 2017[16]	SA: n=31; mean age=83.4 years; NA: n=19; mean age=84.4 years	16 (N/A) / 18 (N/A)	RAVLT: ≥9
Gefen et al., 2018[17]	SA: n=5; mean age=88.6 years; NA: n=5; mean age=86.6 years; MCI: n=5; mean age=92.4 years; AD: n=5; mean age=80.4 years; YP: n=5; mean age=47.8 years	N/A	RAVLT: ≥9
Harrison et al., 2018[18]	SA: n=26; mean age=74.9 years; NA: n=103; mean age=75.9 years; YP: n=64; mean age=24.1 years	17.5 (±1.9) / 16.5 (±2)	CVLT: ≥14
Huentelman et al., 2018[19]	SA: n=56; mean age=83 years; NA: n=22; mean age=82.8 years	15.8 (±2.3) / 17.7 (±1.8)	RAVLT: ≥9
Janeczek et al., 2018[20]	SA: n=5; mean age=90.5 years; NA: n=15; mean age=84.4 years; YP-1: n=8; mean age=41.25 years; YP-2: n=4; mean age=11.1 years	N/A	RAVLT or CERAD word list: ≥9
Dang et al., 2019a[21]	SA: n=172; mean age=71.2 years; NA: n=172; mean age=72.2 years	65.1% ≥12 years for SA and NA (mean. SD N/A)	CVLT: ≥13 for women; ≥12 for men
Dang et al., 2019b[22]	SA: n=179; mean age=68.4 years; NA: n=179; mean age=68.5 years	65.4% ≥12 years for SA and NA (mean. SD N/A)	CVLT: ≥13 for women; ≥12 for men
Gefen et al., 2019[23]	SA: n=5; age range=85–100 years; NA: n=7; age range=70–100 years; YP: n=5; age range=20–60 years	N/A	RAVLT: ≥9
Rogalski et al., 2019[24]	SA: n=10; mean age=85.5 years	17.3 (±2.6)	RAVLT: ≥9
Calandri et al., 2020[25]	SA: n=20; mean age=82.4 years; NA: n=20; mean age=83.3 years	15.8 (±2.6) / 16.3 (±3)	N/A

Kim et al., 2020[26]	SA: n=35; mean age=71 years; NA: n=88; mean age=73 years	9.8 (±3.8) / 10.9 (±3.4)	N/A
Zhang et al., 2020[27]	SA: n=17; mean age=67.8 years; NA: n=23; mean age=66.2 years; YP: n=41; mean age=24.5 years	17.2 (±2.2) / 16.2 (±2)	CVLT: ≥14
Borelli et al., 2021[28]	SA: n=10; NA=10; YP: n=10	12.7 (±4.8)/ 12.9 (±5)	RAVLT: ≥9
de Godoy et al., 2021[29]	SA: n=12; minimum age>80 years; NA: n=13; minimum age>80 years	15.9 (±5.1)/ 14.5 (±3.9)	RAVLT: ≥9
Gefen et al., 2021[30]	SA: n=7; mean age=89.5 years; NA: n=6; mean age=87.8 years	16.3 (±2.4) / 13.5 (7±)	RAVLT: ≥9
Katsumi et al., 2021[31]	SA: n=17; mean age=67.8 years; NA: n=23; mean age=66.2 years; YP: n=41; mean age=24.5 years	17.2 (±2.2) / 16.2 (±2)	CVLT: ≥14
de Souza et al., 2022[32]	SA: n=10; mean age=82.3 years; NA: n=10; mean age=83.5 years; AD: n=10; mean age=78.2 years; YP: n=10; mean age=58.7 years	12.7 (±4.79) / 12.9 (±4.98)	RAVLT: ≥9

Notes. SA: SuperAger. NA: Normal Ager. YP: younger participants. n: sample size. MCI: Mild Cognitive Impairment. AD: Alzheimer's Disease. N/A: not available or not applicable.

In the reviewed articles, the average years of formal education were mostly at or above 12 years for both SA and Normal Agers (NA) groups (89% of the articles that reported education levels). Across all studies that reported the cut-off value for the delayed recall condition of RAVLT, the cut-off value was ≥9 words, irrespective of socioeconomic or educational status. In contrast, the cut-off values for CVLT were adapted by Dang et al.[21, 22], ranging from 12 to 14 words on the delayed recall condition, and were altered based on gender, with lower requirements for male participants.

Tables 2.2 and 2.3 present the frequency of use of the instruments employed in SA classification among the analyzed articles. It is observable that the use of instruments related to memory and executive functions was frequent. All studies used episodic memory tests based on word lists, such as Rey Auditory Verbal Learning Test (RAVLT). As for executive functions, verbal fluency tasks and the Trail Making Test were the most frequently employed. Although alternative terms such as "resilient agers" and "successful agers" were identified, the majority of studies employed the term "SuperAgers" to refer to individuals who perform exceptionally well on memory tests, even if the classification criteria differed from those proposed by the Northwestern SuperAging Program[7].

Table 2.2 *Instruments most frequently used for the assessment of memory in SA*

Employed instruments	Number of articles (proportion)
Rey Auditory Verbal Learning Test (RAVLT)[33]	14 (66%)
California Verbal Learning Test (CVLT)[34]	6 (42%)
Rey-Osterrieth Complex Figure Test (ROCF)[35]	3 (14%)
Logic memory subtest (WMS-II)[36]	1 (0.5%)
Shiraz Verbal Learning Test (SVLT)[37]	1 (0.5%)
CERAD word list[38]	1 (0.5%)

Table 2.3 *Non-memory instruments most frequently used for the assessment of SA*

Employed instruments	Number of articles (proportion)
Trail Making Test (TMT)[39]	17 (80%)
Verbal fluency task[40]	15 (71%)
Boston Naming Test-30 (BNT)[41]	14 (66%)
Mini-Mental State Examination (MMSE)[42]	6 (42%)
Digits subtest (WAIS-III)[43]	5 (24%)
Symbol search subtest (WAIS-III)[43]	4 (2%)
Stroop Test (Victoria)[44]	2 (1%)
EXAMINER Battery[45]	2 (1%)

Normal Agers, comparison groups composed of typically developing older adults, were defined throughout the reviewed studies as participants who reached the criteria defined for SA for all measures but episodic memory. Participants were required to be matched for age and education to the SA group and not to deviate below -1 SD or -1.5 SD compared to the mean expected for their own age and education groups, so as to compare SA with healthy participants. Alternatively, participants were classified as Sub Agers when age-matched to SA and when criteria for the classification as Normal Agers did not apply.

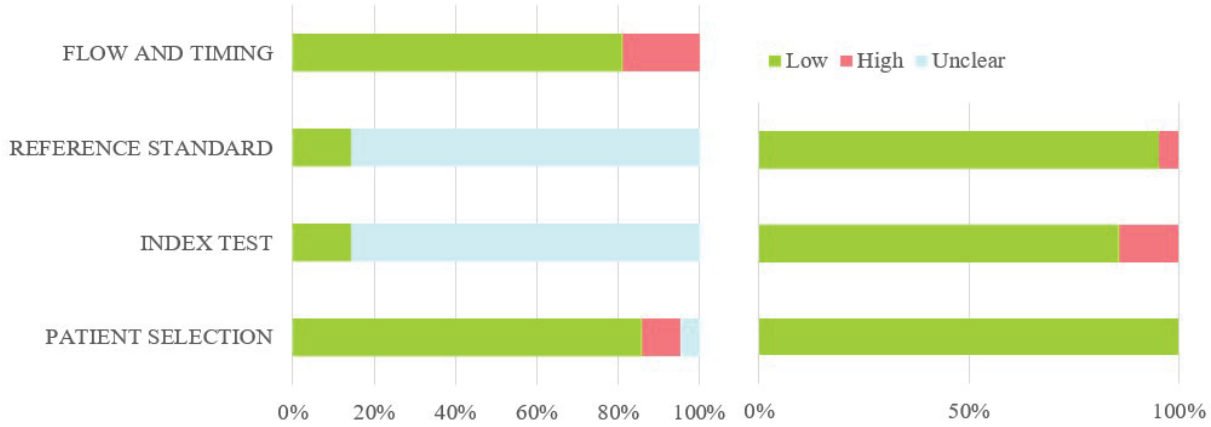
Table 2.4 presents the frequency of use of the different criteria employed for SA classification. Overall, eight different classification protocols were administered. It was observed that most studies (13 or 62%) considered SA participants to be at least 80 years old. Other studies, though, considered 60 years of age as the minimum age requirement. Only two studies (or 9.5%) did not compare SA scores with normative data for younger adults. Comparisons were made between SA and adults aged 18 to 65, and the most frequent comparison was made with adults 20 to 30 years younger, on average.

Table 2.4 *Criteria employed for the assessment of SA*

Age of SA and sample used for comparison	Articles (%)	Criteria employed
≥60 years of age; comparison with 30-34 year olds[21, 22]	2 (9.5%)	SA participants' episodic memory scores were at least equal to the mean expected for 50 to 65-year-olds. Executive functions, vocabulary, and verbal fluency scores were not below -1 SD compared to the mean expected for the participant's age and education group
≥60 years of age; comparison with 18-32 year olds[15, 31]	2 (9.5%)	SA participants' episodic memory scores were not below -1.5 SD compared to the mean expected for 18 to 32-year-olds. Executive functions scores were not below -1 SD compared to the mean expected for the participant's own age and education group
≥60 years of age; comparison with 18-35 year olds[27]	1 (4.7%)	SA participants' episodic memory scores were at least equal to the mean expected for 18 to 35-year-olds. Executive functions scores were not below -1 SD compared to the mean expected for the participant's own age and education group
≥60 years of age; comparison with 45 year olds[26]	1 (4.7%)	SA participants' episodic and non-verbal memory scores were equal to or above the mean expected for 45-year-olds
≥70 years of age; comparison with 18-32 year olds[18]	1 (4.7%)	SA participants' episodic memory scores were at least equal to the mean expected for 18 to 32-year-olds. Executive functions scores were at least equal to the expected mean for the participant's own age and education group. MMSE scores were required to be ≥25
≥80 years of age; comparison with 50-65 year olds[7, 13, 14, 17, 19, 20, 23, 24, 28, 29, 30]	11 (52%)	SA participants' episodic memory scores were at least equal to the mean expected for 50 to 65-year-olds. Executive functions, vocabulary, and verbal fluency scores were not below -1 SD compared to the mean expected for the participant's own age and education group. In de Godoy et al.[29], average MMSE scores, a clinical dementia score of zero, and a score ≥4 on the Functional activity questionnaire were also required for all participants
≥80 years of age; comparison with 50-60 year olds[16, 25]	2 (9.5%)	Maher et al.[16]: SA participants' episodic memory scores were at equal to the average expected for 50 to 60-year-olds; executive functions, vocabulary, and verbal fluency scores were not below -1 SD compared to the mean expected for the participant's own age and education. Calandri et al.[24]: SA participants' episodic memory scores were not below -1 SD compared to the mean expected for 50 to 60-year-olds; executive functions, vocabulary, and verbal fluency scores were not below -1 SD compared to the mean expected for the participant's own age and education group
≥80 years of age; no comparison with younger adults[32]	1 (4.7%)	SA participants' episodic memory scores were ≥+1.5 SD compared to the mean expected for the participant's own age and education group. MMSE scores were at least equal to the mean expected for the participant's age group

Table 2.5 and Figure 2.2 present the risk of bias as assessed through QUADAS-2. It is important to note that QUADAS-2 standards require a blind interpretation of the index test regarding the reference standard. This information was not present in most reviewed papers, granting frequent "Unclear" results, especially regarding these two domains. Patient selection was overall appropriate, with a few exceptions among mostly imaging studies in which convenience samples are very hard to obtain. Flow and timing was the domain most frequently associated with a higher risk of bias, especially when the authors did not present equal reference standard and index tests to all participants, which, together with the use of composite scores to classify SA, also raised concerns regarding applicability.

Figure 2.2



Graphic representation of QUADAS-2 quality assessment

Table 2.5 *QUADAS-2 risk of bias and applicability assessment*

Study	RISK OF BIAS				APPLICABILITY CONCERNS		
	Patient Selection	Index Test	Reference Standard	Flow and Timing	Patient Selection	Index Test	Reference Standard
Harrison et al., 2012[7]	Low	Unclear	Unclear	Low	Low	Low	Low
Rogalski et al., 2013[13]	Low	Unclear	Unclear	Low	Low	Low	Low
Gefen et al., 2015[14]	Low	Unclear	Unclear	High	Low	Low	Low
Sun et al., 2016[15]	Low	Unclear	Unclear	Low	Low	Low	Low
Maher et al., 2017[16]	Low	Unclear	Unclear	Low	Low	Low	Low
Gefen et al., 2018[17]	Low	Low	Low	Low	Low	Low	Low
Harrison et al., 2018[18]	Unclear	Unclear	Unclear	Low	Low	High	High
Huentelman et al., 2018[19]	Low	Unclear	Unclear	Low	Low	Low	Low
Janeczek et al., 2018[20]	High	Unclear	Unclear	High	Low	High	Low
Dang et al., 2019b[21]	Low	Unclear	Unclear	Low	Low	Low	Low
Dang et al., 2019a[22]	Low	Low	Low	Low	Low	Low	Low
Gefen et al., 2019[23]	High	Unclear	Unclear	High	Low	High	Low
Rogalski et al., 2019[24]	Low	Unclear	Unclear	Low	Low	Low	Low
Calandri et al., 2020[25]	Low	Unclear	Unclear	Low	Low	Low	Low
Kim et al., 2020[26]	Low	Unclear	Unclear	Low	Low	Low	Low
Zhang et al., 2020[27]	Low	Unclear	Unclear	Low	Low	Low	Low
Borelli et al., 2021[28]	Low	Unclear	Unclear	Low	Low	Low	Low
de Godoy et al., 2021[29]	Low	Unclear	Unclear	Low	Low	Low	Low
Gefen et al., 2021[30]	Low	Low	Low	High	Low	Low	Low
Katsumi et al., 2021[31]	Low	Unclear	Unclear	Low	Low	Low	Low
de Souza et al., 2022[32]	Low	Unclear	Unclear	Low	Low	Low	Low

2.4 DISCUSSION

This review sought to identify and analyze the instruments used to assess SA and to describe the frequency of use of different instruments and classification criteria. The results evidenced that word-list-based episodic memory tests were the most frequently used to assess episodic memory. The studies also employed measures of executive functions and vocabulary, such as the Trail Making test, verbal fluency tasks, and the Boston Naming Test.

As for SA classification criteria, the most used protocol was the one proposed by Harrison et al.[7], which considered 80 as the minimum age and compared the results with normative data from a sample 20 to 30 years younger. Another frequent measure related to executive functions was employed, which was compared to the participant's peers. Although this was the most common type of classification, other classifications were identified, which considered different minimum age requirements, assessed different functions, and employed different criteria.

The frequency of use of word-list-based memory tests, such as the RAVLT, to assess episodic memory in SA probably occurred due to these instruments being employed in the first data collection study that employed the concept of SA (Harrison et al.[7]), being a major research group in the field (The Northwestern SuperAging Group), as well as being a traditionally employed instrument in neuropsychological assessment[46]. The delayed recall score was used in all reviewed studies, being the key instrument to identify SA. It is important to note that AD, being the most common type of dementia, is typically associated with a decline in anterograde episodic memory functioning, which can be measured by RAVLT or similar tests, such as CVLT or SVLT[2; 47], hence the need to employ instruments that prevent the inclusion of patients that present pathological aging. Since episodic memory is not the only expression of the onset of a neuropathological process and other kinds of neurodegenerations are associated with different symptoms[2], the use of additional instruments to measure executive functions and language abilities was required.

Although word-list-based memory assessments are commonly used to classify SA, this method has been criticized. Goldberg[48] has questioned this classification method, suggesting that the use of word list memory tests might not reflect daily memory functioning but rather individual readiness for the test itself. As an alternative, Borelli et al.[4] proposed the use of the Logical Memory subtest from the Wechsler Memory Scale (WMS-III), which could emulate more ecological contexts. However, the only reviewed study that employed this test used it in the context of a composite score along with a word list memory test, making it untested as a means of classification criteria for SA. While the Logical Memory subtest could

be a possible addition, it cannot serve as a substitute because the concept of SA itself is based on the performance in word-list-based episodic memory tests.

The Northwestern SuperAging Research Program has suggested a cut-off value of ≥9 out of 15 words recalled during the delayed recall of the RAVLT, as this represents the expected mean score for a 50–65-year-old in the American context and is also one standard deviation above the average score for 80-year-olds. This cut-off value was consistently employed across all reviewed studies that provided a specific cut-off value for the RAVLT.

Although the reviewed studies did not show any variability in the cut-off values for the delayed recall of RAVLT, it is worth considering that normative values may vary depending on cultural, socioeconomic, and linguistic contexts. For instance, considering normative values for 50–60-year-olds, Chinese Australians with <12 years of education reached a mean score of 10 words, while the higher education group (≥12) reached 12 words on average[49]. In Brazil, although the average is 10 words[50], evidence suggests that those with >12 years of education evoked an average of 9.5 words[51]. It is also noteworthy that the RAVLT normative data for Brazil is based on a study conducted in a single capital city, risking the skewness of normative data towards a population with higher income and education levels[50].

In a Greek sample consisting of individuals aged 60–78, the lower education group (≤9 years) recalled an average of 4.5 words, while the higher education groups evoked 8 words on average[52]. For a Venezuelan sample, the average number of words recalled by the lower education (≤3 years) group of 50–64 year-olds was 7.6, while the higher education groups recalled an average of 9 words[53]. Considering the Norwegian and Swedish populations, a regression model was developed to take into account education, age, and sex for RAVLT scores[54]. For a 61-year-old male (reference age of the younger adults used as comparison[14, 20, 23]), 6 evoked words would suffice to reach the 50th percentile for a male with 6 years of education. Conversely, a cut-off value of 8 words would be sufficient for those with ≥12 years of education, while the commonly used ≥9 words would be compatible with the most frequently used SA criteria (≥50th percentile for younger adults) for males ≥14 years of education[54], which is higher than the average formal education of 18% of the SA groups in the reviewed studies.

The interpretation of a raw score of 9 words in the delayed recall of RAVLT is, thus, dependent on formal education levels. Hence, given the impact of sociocultural and linguistic factors, as well as variations in the choice of memory tests (e.g. RAVLT, CVLT), it is not recommended to establish a single cut-off value for use in worldwide SA research. Rather, it

is advisable to tailor the cut-off value to the specific population being studied and to the goals of the investigation, especially when examining less malleable biological markers like genetic traits. Moreover, while participants with lower education and fewer word evocations may present inferior overall performance, their scores may still represent a remarkable achievement compared to the average of their own population and therefore merit attention.

Borelli et al.[4] propose the utilization of non-verbal memory tests in studies involving low education levels and developing countries, given their reduced reliance on formal education. However, this approach may potentially compromise the representation of the population under investigation, diverging from the field's intended scope, which focused on episodic memory. The authors also argue that, in developing countries, the minimum age required to classify an older adult as a SA should be considered 75 instead of the most frequently employed 80 years of age, due to lower life expectancy and other cultural and socioeconomic factors.

The Rey-Osterrieth Complex Figure Test (ROCFT) was recommended as a non-verbal alternative as well as the visual memory subtest from WMS-III and the Brief Cognitive Screening Battery (BCSB) [4]. As for episodic memory tests, the RAVLT, the Selective Reminding Test (SRT), and the Logical Memory subtest from the WMS-III battery were recommended[4]. Although the ROCFT is, like other non-verbal psychological tests, still not free of cultural or educational level biases[55], it is possible that a multimodal approach might promote less biased results concerning the study of SA. The impact of education on attention and executive functioning must also be taken into account. The Trail Making Test, an integral part of standard SA classification protocols, is substantially influenced by the number of years of formal education, particularly regarding TMT-B, in both 40–59 and 60–75-year-old samples[56].

Although education and socioeconomic status are robustly associated with healthier aging trajectories, the conduction of studies in developing countries is encouraged to reduce bias, since the variability in cognitive functioning is not explained by education or socioeconomic status alone[57]. Since the cognitive impacts of aging are usually more intense in 80-year-olds in comparison to 60-year-olds[4], the employment of criteria that consider participants under retirement age to be SA might underestimate the effects of aging itself. Such an approach might also overestimate the effects of work and daily activity since younger older adults tend to lead more active lives in labor and other fields, although such factors might also be gender-dependent[58]. Thus, selecting different age spans as a minimum age

requirement to classify SA might imply different a scope of understanding, difficulting the process of comparing results.

The reviewed articles presented evidence that cognitive differences associated with SA are frequently related to diverse brain characteristics, such as connectivity, metabolism, pattern of activation, and volume. Longitudinal studies and the study of biomarkers associated with SA are imperative to understand whether the phenomenon of SA requires such classification. Such questioning intends to discuss whether SA forms a different category, with its own specificities, or if it is observed in a continuum across the population. Thus, whether the phenomenon of SA should be studied as a categorical or scalar variable. All reviewed studies approached the SA field while considering it a categorical variable (a participant either is or is not a SA), but few discussions have been made about the specificities of this population to justify the preference for group design statistical analysis (e.g. ANOVA, logistic regression models) instead of analyzing the continuity of the distribution of memory abilities across the population of older adults (e.g. linear regression models).

Investigating SA might promote a better understanding of how and why older adults seem to experience a diminished effect of aging on their cognitive functioning, thus making it possible to promote protective health measures in adulthood. It is also important to conduct more studies that contemplate low socioeconomic status and low educational level participants since the reviewed studies were mostly conducted on participants of higher socioeconomic and educational status in countries such as the United States.

The present review's findings on the most commonly used instruments and criteria to assess memory abilities in SA are consistent with existing literature. Borelli et al.[9] conducted a systematic review on older adults with exceptional memory capacity and noted that word list memory tests are frequently employed in SA research to classify an older adult as a SA. Likewise, de Godoy et al.[6] conducted a systematic review with similar results regarding the present review's findings on the most frequently used instruments. Thus, the present review's results are representative of the instruments and criteria most commonly employed in the field of SA research.

It should be noted that 47% of the reviewed studies were carried out by the same research group at Northwestern University in the United States. This concentration of studies by a single group may have influenced the methods and outcomes reported. While the Northwestern SuperAging Research Program is noteworthy for its significant and innovative work, it is imperative that research be conducted more widely, particularly among participants with lower socioeconomic status, to enable the generalization of findings. Another factor that

may introduce bias in the studies is the average sample size. Indeed, 81% of the reviewed articles had sample sizes below 100 participants and some presented samples drawn out of convenience or multiple criteria within a single study.

This review has limitations such as not including gray literature (unpublished articles, abstracts, and annals of scientific events), including articles from only four databases, and employing only one set of search words. It is possible to consider, though, that this study allows a better understanding of the variability of instruments and criteria employed in classifying individuals as SA, and promotes an important discussion regarding cut-off values in SA research, thus contributing to the elaboration of future research projects in the field.

2.5 CONCLUSION

In sum, it was observed in this review that the main instruments currently employed for SA classification are anterograde episodic memory tests, commonly the delayed recall of tests based on word lists, used in association with executive functions tests, commonly of semantic access or trail making. In general, those classified as SA obtained at least average results for episodic memory compared to 20–30 younger adults and obtained at least average scores for executive functioning, in comparison with the normative data for their age and education.

Despite the limited variation observed in the cut-off values across the reviewed articles, it is recommended to customize these values based on the specific socioeconomic, cultural, and educational characteristics of the population under study. This is particularly important when investigating biological traits such as genetic markers, which are less susceptible to environmental influence. The field of SA holds significant promise, as the insights gained from this area of research can enhance our understanding of the underlying mechanisms contributing to functional decline in older adults, attributable to both normal aging and pathological processes. The implications of such findings extend beyond the scientific community and may have significant public health benefits, particularly in the areas of preventative care and promotion of healthy aging.

2.6 ACKNOWLEDGEMENTS

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3 ASSOCIATIONS BETWEEN EDUCATION AND OCCUPATION IN HIGH FUNCTIONING OLDER ADULTS

Abstract

Although aging is naturally associated with cognitive decline, some lifestyle factors such as formal education and occupational complexity were shown to promote the preservation of cognitive functions such as memory. This study aimed to assess the associations of both education and occupational complexity with memory functions in a sample of autonomous, healthy older adults. A final sample of 56 participants was tested for executive functions, episodic memory, non-verbal memory, and reaction speed, being classified into groups of high and standard-performing older adults. The lifelong occupations were classified according to the International Standard Classification of Occupations-08 criteria. The results demonstrated a strong correlation between occupational complexity and education, with both adding predictive value to linear regression models predicting memory scores. Education, when compared to occupational complexity, was more robustly associated with executive functioning, while lifelong occupation was a stronger predictor of general mental state. The findings support the concept of cognitive reserve, as both education and occupation were found to be associated with higher cognitive performance in older adults.

Keywords: Aging; health of the elderly; neuropsychological tests; human development.

3.1 INTRODUCTION

Aging is a natural process that affects the brain and its functions, even in the absence of pathological conditions (Merenstein et al., 2021). While episodic memory capacity among older adults is typically below the observed in younger adults on average, some individuals exhibit relatively preserved functioning when compared to their peers of the same age (de Godoy et al., 2020).

The preservation of cognitive functioning in older adults is not solely due to genetic factors (Huentelman et al., 2018) but also to environmental and lifestyle factors, such as formal education, occupational attainment, and engagement in intellectually stimulating activities (Stern, 2009). It has been demonstrated that education provides a robust effect on the lifelong enhancement of general cognitive functions (Ritchie & Ticker-Drob, 2018).

Although reciprocal in nature, both education and occupational complexity may promote varied intellectually stimulating contexts (Lövden et al., 2020). Occupational complexity has been identified as a significant predictor of late-life cognitive functioning, mediating the association between education and cognition (Fujishiro et al., 2019). Since higher occupational complexity typically requires more years of formal education, it is challenging to distinguish the effects of each factor (Baldivia et al., 2008).

The present study aims to investigate the associations of formal education and occupational complexity with memory capacities among autonomous older adults with varied social contexts. The study primarily focused on episodic and procedural memory, although other cognitive functions were investigated, such as reaction speed and general mental state. The main hypothesis is that both occupational complexity and formal education have significant associations with cognitive functioning, but that both may grant different results regarding different cognitive functions.

3.2 MATERIAL AND METHODS

3.2.1 Participants

The study was conducted with 60 community-dwelling older adults with or over 75 years of age, male or female, with no diagnosed neurodegenerative disease in Southern Brazil (see Table 3.1 for demographic data). Participants were recruited through social media, the distribution of flyers (Apêndice 1), the snowball method (Vinuto, 2014), and institutional partnerships (the University, a local church, and private health practice firms). All participants were able to participate in the study in an autonomous manner and were required to score ≥22

on the MMSE (for >4 years of education) or ≥18 (for ≤4 years of education). After the application of the exclusion criteria (MMSE scores), four participants were excluded, totaling 56 participants included in the final analysis.

Table 3.1 Descriptive table of sociodemographic variables

	SPOA	HPOA	t or $\chi 2$	p
N	43	13		
Sex (F/%)	27 / 63	11 / 84	2.18	0.14
Age (M±SD)	82±4.5	78±2.8	3.241	0.002
Education (M±SD)	8±5	12±5.6	2.796	0.007
Skill level (M±SD)	2.1±0.9	3±0.9	2.87	0.006
MMSE (M±SD)	23.4±2.7	26.9±1.8	4.274	<0.001

Note: Skill level was presented on a scale of 1–4. M=mean. SD=standard deviation.

The participants were categorized into high-performance older adults (HPOA) and standard-performance older adults (SPOA). The requirements for the HPOA group involved evoking ≥7 words on the delayed recall trial (A7) of the Rey Auditory-Verbal Learning Test. The criteria of ≥7 words was selected due to being the mean number of words evoked by the Brazilian population over 80 years of age, according to the normative data presented in the manual (de Paula, & Malloy-Diniz, 2018).

3.2.2 Cognitive assessment

A social background questionnaire (Apêndice 2) was applied to assess the participants' sociodemographic variables, health status and history, formal education (measured in years of completed formal education), and lifelong work occupations. It included questions on the history of genetic, psychiatric, and neurological diagnosis, psychoactive drugs, and vision problems, with the aim of excluding participants with a history of neurological diagnosis (e.g. Parkinson's) before administering the cognitive tests.

The work occupations described by the participants were divided into 1–4 skill level groups according to the criteria proposed by the International Labour Organization in the International Standard Classification of Occupations (ISCO-08; International Labour Organization, 2012). Higher skill levels represented more intellectually demanding and specialized occupations, while lower skill levels were related to less specialized, manual occupations.

3.2.2.1 Rey Auditory Verbal Learning Test

The Rey Auditory Verbal Learning Test (RAVLT; de Paula, & Malloy-Diniz, 2018) is an episodic memory test. It involves the fivefold repetition of a list composed of 15 words, being the participant asked to try repeating as many words as possible after each repetition. Posteriorly, a distraction list was read, the original list was repeated for the sixth time and, after an interval (typically 20 minutes), the participant was asked to remember as many words as possible (delayed recall condition). The final trial was to recognize, from a list of 50 words, those that were present or absent from the first list. This instrument was employed because of its importance in the study of HPOA (Borelli et al., 2018).

3.2.2.2 Rey-Osterrieth Complex Figure Test

The Rey-Osterrieth Complex Figure Test (ROCFT; Rey, Oliveira, & Rigoni, 2010) is a nonverbal memory test. It involves two trials, first copying a complex figure on a white paper. After 3 minutes of distraction (a brief talk on healthy aging), the participant was asked to reproduce the same figure by memory. The instrument was employed according to Borelli et al. (2018), who advocated for the use of nonverbal memory tests along with episodic memory tests such as the abovementioned RAVLT, especially in developing countries.

3.2.2.3 Trail Making Test

The Trail Making Test (TMT; Zimmermann, Cardoso, Kristensen, & Fonseca, 2017; Anexo 2) involves producing a trail on a paper that displays several numbers for TMT-A and both numbers and letters for TMT-B. The participant was asked to produce a trail according to the order of the numbers and the alphabetical order, alternating between both in TMT-B. TMT-A involves an attentional demand and TMT-B demands executive functioning due to rule switching.

3.2.2.4 Mini Mental State Examination

The Mini Mental State Examination (MMSE; BVS Primary Healthcare, 2023; Anexo 3) is a screening instrument for general cognitive functioning. It was employed to avoid the inclusion of participants with early signs of neurodegenerative conditions.

3.2.2.5 Digits subtest (Wechsler Adult Intelligence Scale-III)

The digits subtest (DS) is a component of the Wechsler Adult Intelligence Scale-III (WAIS-III; Wechsler, & Nascimento, 2004). It involves episodic and working memory, while

the first part is the repetition of numbers in direct order and the second part involves the repetition of numbers in the inverse order with increasing difficulty.

3.2.2.6 Verbal fluency subtest

A category verbal fluency subtest (VFT; Fonseca et al., 2009) was employed. The task involved the evocation of as many animal names as possible within a minute. Variations of the same animal name were not counted (e.g. lion, lioness).

3.2.3 Data analysis

Data analysis was conducted using PASW Statistics for Windows 18.0 (SPSS Inc., 2009). Descriptive statistics (mean, standard deviation) were conducted to assess the proportion of HPOA among healthy older adults. After categorizing participants into HPOA and SPOA, raw data were converted to z-scores. A confidence interval of 95% was employed and a probability value of $p<0.05$ was employed as a cut-off to reject the null hypothesis. Step-wise linear regression models were elaborated to assess the main background variables that could predict memory scores.

3.2.4 Ethical considerations

This study received approval from the Humanities and Social Sciences' Ethical Committee of the Federal University of Paraná (CEP/CHS UFPR; report number 5.671.035; Anexo 1). All participants gave their written consent (Apêndice 3) before participation.

3.2.5 Proceedings

The mean duration of each participation was about 75 minutes. The testing was conducted in the participant's home or at a nearby clinical practice. After signing the written consent form, participants completed the sociodemographic questionnaire, followed by the cognitive assessment. The testing was done in the following order: RAVLT, ROCFT, TMT, RAVLT (delayed recall and recognition), MMSE, DS, and VFT.

3.3 RESULTS

Table 3.2 presents raw results for the cognitive assessment of HPOA and SPOA groups. Most results granted a significant difference between groups, but not in

executive functioning scores (TMT B/A and inverse order DS). Groups presented significant differences in memory scores, except for the recognition of List A words from RAVLT and DS.

Table 3.2 Performance on the cognitive tasks

	SPOA (M±SD)	HPOA (M±SD)	t or x^2	p
RAVLT				
Total (A1:A5)	27.6±7.2	42.1±7.7	6.23	<0.001
Recognition of List A	11.2±3	12.7±2.4	1.553	0.126
Delayed Recall (A7)	3.6±2.1	9±2	8.084	<0.001
ROCF (M±DP)				
Copy acc.	24±6.8	28.8±4.6	2.376	0.021
Memory acc.	10±4.8	16±4.9	3.889	<0.001
TMT-A	103±63	55±19	4.346	<0.001
TMT-B	258±62	147±83	5.185	<0.001
TMT B/A	3.1±1.1	2.5±0.8	1.594	0.121
DS Direct order	5.8±1.6	6.7±1.4	1.784	0.08
DS Inverse order	3.5±1.8	4.1±1.6	0.981	0.331
VFT	11.3±4.4	15.5±2.9	3.228	0.002

Note: Skill level was presented on a scale of 1–4. M=mean. SD=standard deviation.

Age was moderately correlated with both education (r= -0.41; df=54; p=0.002) and skill level, in which older participants had lower education levels and worked in less intellectually demanding professions (ρ_S= -0.4; df=54; p=0.002). Age was also weakly associated with MMSE scores (r= -0.29; df=54; p=0.03) in which younger participants had higher mental state scores. Education was strongly and positively correlated with skill level (ρ_S=0.78; df=54; p<0.001), being moderately correlated with MMSE scores (r=0.55; df=54; p<0.001).

Delayed recall scores were correlated with ROCFT memory scores (r=0.62; df=53; p<0.001), with no correlation with DS scores. A significant correlation was observed between A7 and both parts of TMT, being moderate for TMT-B (r= -0.52; df=54; p<0.001) and weak

for TMT-A (r= -0.27; df=54; p=0.043), in which faster participants evoked more words. Although A7 was positively correlated with MMSE scores (r=0.58; df=54; p<0.001), the mental state was a stronger predictor of RAVLT total scores (A1–A5; r=0.69; df=54; p<0.001) and of the recognition task (r=0.65; df=54; p<0.001). A7 was also correlated with verbal fluency (r=0.47; df=54; p<0.001). Correlations with years of formal education (r=0.34; df=54; p=0.010), age (r= -0.35; df=54; p=0.009), and skill level (ρ_S=0.34; df=54; p=0.011) were observed, but were classifiable as weak.

Regarding ROCFT memory scores, significant correlations were identified with age (r= -0.37; df=53; p=0.005), education (r=0.38; df=53; p=0.004), and occupational complexity (ρ_S= -0.3; df=53; p=0.026), being RAVLT total scores the strongest predictor (r=0.73; df=53; p<0.001). The remaining cognitive tests were all correlated with ROCFT memory scores, including the DS task in both direct (r=0.45; df=52; p=0.001) and inverse order (ρ_S=0.29; df=52; p=0.034); TMT-A (ρ_S= -0.42; df=53; p=0.001) and TMT-B (ρ_S= -0.49; df=53; p<0.001); MMSE (r=0.57; df=53; p<0.001); verbal fluency (ρ_S=0.34; df=53; p=0.011).

Linear regression models were elaborated to assess the impact of the background variables and MMSE scores on the cognitive tests. Alternate models were elaborated to compare the effects of education and occupational complexity to avoid multicollinearity. Formal education presented a more robust effect on test results in comparison to skill level, both controlled by age and posteriorly by MMSE scores. The models elaborated for A7 and the accuracy of the drawing from memory of the ROCFT are presented in Tables 3.3 and 3.4. Models 1 and 2 were elaborated to compare the impact of education and skill level controlled by age, while models 3 and 4 also controlled for MMSE scores.

Table 3.3 *Different models predicting RAVLT A7 (delayed recall) scores*

Model (A7)	1 (β)	2 (β)	3 (β)	4 (β)
Age	-0.25	-0.25	-0.21	-0.21
Education	0.24		-0.04	
Skill level		0.25		-0.06
MMSE			0.55**	0.6**
R^2	0.17**	0.17**	0.37**	0.37**

Note. * = p<0.05. ** = p<0.01.

Table 3.4 *Different models predicting ROCFT-memory accuracy scores*

Model (ROCFT-M)	1 (β)	2 (β)	3 (β)	4 (β)
Age	-0.25	-0.3*	-0.2	-0.24
Education	0.27		0.03	
Skill level		0.18		-0.13
MMSE			0.51**	0.59**
R^2	0.2**	0.16*	0.37**	0.38**

Note. * = p<0.05. ** = p<0.01.

It is important to note that education and skill level did not present statistically significant effects on either A7 or ROCFT scores when controlled by age. However, the inclusion of either variable granted more predictive value to the models. MMSE was the variable most robustly associated with cognitive performance. Such results, considering the significant correlations found between occupational complexity, education, and cognitive performance, may be attributed to the small sample size of the present study.

The models elaborated for the remaining variables are presented in Table 3.5. While skill level granted slightly better models for TMT-A, A7, and MMSE scores, years of formal education granted slightly better models for inverse order DS and TMT-B, and a highly better model for VFT. Education and skill level did not provide significant results for A7, RAVLT recognition, Direct DS, and TMT B/A after being controlled for age.

Additionally, logistic regression models were elaborated to assess the effect of education and skill level, controlled by age, on the relative odds of being classified as an HPOA. The model including raw years of education was significant (Omnibus; p=0.001; Nagelkerke R^2=0.327) and fit the data (Hosmer and Lemeshow; p=0.928). Although education increased the predictive power of the model, it was no longer significant when age was included in the model. For every additional year of life, the relative odds of being classified as HPOA reduced by 27.4% (Exp(β)=0.762; 0.601 – 0.967; 95% C.I.; p=0.025).

The model including occupational complexity groups was also significant (Omnibus; p=0.003; Nagelkerke R^2=0.37) and fit the data (Hosmer and Lemeshow; p=0.576). Occupational complexity increased the predictive power of the model, but it was also not significant when age was included in the model. For age, every additional year was associated with a 26.7% reduced relative chance of being classified as HPOA (Exp(β)=0.733; 0.563 – 0.956; 95% C.I.; p=0.022). Considering both models, the model including occupational complexity was slightly more predictive of group classification than education.

Table 3.5 *Regression models*

Variable predicted	Age	Education	Skill level	R^2
RAVLT Total	-0.27*	0.37**		0.29**
	-0.29*		0.36**	0.28**
RAVLT Recognition	-0.05	-0.05		<0.01
of list A	-0.05		-0.05	<0.01
TMT-A	0.2	-0.36**		0.23**
	0.2		-0.38**	0.24**
TMT-B	0.25*	-0.51**		0.42**
	0.29*		-0.45**	0.37**
TMT B/A	0.21	-0.99		0.06
	0.23		-0.13	0.06
Direct DS	-0.15	-0.15		0.09
	-0.17		0.17	0.08
Inverse DS	-0.08	0.33*		0.14*
	-0.11		0.29	0.12*
VFT	-0.2	0.46**		0.33**
	-0.31*		0.23	0.2**
ROCFT Copy	-0.22	0.33*		0.22**
accuracy	-0.23		0.34*	0.22**
MMSE	-0.08	0.52**		0.31**
	-0.08		0.57**	0.35**

Note: Data were converted to z-scores prior to the analysis. * = $p<0.05$. ** = $p<0.01$.

3.4 DISCUSSION

The present study aimed to compare the associations of years of formal education and lifelong occupational complexity with the cognitive performance of older adults in memory tests. It was observed that both education and occupational complexity, although highly correlated, promoted significant effects on both episodic and non-verbal memory performance. Executive functioning was more dependent on education than occupation, while

general cognitive functioning was more dependent on occupation. The odds of being classified as an HPOA were higher for both individuals with either higher occupational complexity or years of education, with occupational complexity showing a stronger effect.

The results from the present study support the review by Lövdén et al. (2020), in which both education and occupation were found to be associated with higher cognitive functioning in older adults. The meta-analysis conducted by Ritchie and Ticker-Drob (2018) identified a robust effect of education on the development of cognitive abilities that persists through adulthood, being also consistent with the present results. Occupational complexity was also identified to be an important factor for cognitive reserve in longitudinal studies (Almeida-Meza et al., 2020).

Kremen et al. (2019), however, propose that the cognitive impacts of education may be primarily related to its neurodevelopmental effects in early life, presenting evidence that experiences during adulthood may promote a small, although significant, effect size. It is also important to note that the effects of education may be mediated not only by occupational complexity but also by multiple socioeconomic and background variables, such as race and the quality of education (Fujishiro et al., 2017). Additionally, different types of occupation, independent of complexity, may yield different results (Ribeiro et al., 2013).

Lövden et al. (2020) considered both education and occupation to be important factors associated with cognitive functioning, being both important for the preservation of the brain structures (brain reserve). Formal education may facilitate the entrance into more cognitively demanding occupations, not granting such an enhanced performance among adults who do not apply the knowledge in an occupation (Dekhyatar et al., 2015). Ritchie & Ticker-Drob (2018) hypothesize that initial cognitive gains may emerge from education, but the occupational complexity may be responsible for the maintenance of such enhancement.

Additionally, there is evidence that the effects of education on cognition may be mediated by cognitive status (Jansen et al., 2021), being a hypothesis on why education and occupation ceased to be significant predictors when controlled for age and MMSE scores. An alternate hypothesis is that the small sample size in the present study did not produce enough statistical power to assess the effects of education and occupation.

Considering the results of non-memory cognitive tests, it is possible to hypothesize that verbal and executive functioning skills may be more strongly affected by formal education, while more general abilities are more strongly related to occupational complexity. While cognitive enhancement may emerge from the stimulation related to formal education, lifetime occupation may be important for the maintenance of the effects of education while

also promoting additional cognitive gains due to the different cognitive demands resulting from the occupation itself.

The present study presented some limitations, including small sample size, testing in non-controlled environments, and participants drawn from multiple regions with different socioeconomic backgrounds. Nevertheless, the study was, though, able to investigate differential associations of education and occupation among healthy, autonomous older adults and provided an initial discussion and hypothesis on why both differ regarding their long-term cognitive effects.

Future studies with bigger samples to assess the effects of different groups of occupations within similar education levels are recommended, as well as the investigations of the specific characteristics within each profession that could grant higher or lower cognitive performance. Longitudinal studies and studies controlling for important genetic markers should also be considered.

3.5 CONCLUSION

In sum, it was observed that both education and occupation are important predictors of cognitive functioning in older adults. Although highly correlated, education and occupational complexity granted different effects. Education was more strongly associated with measures of executive functions, while occupational complexity was more influential for measures of general cognitive functioning. Such impacts are coherent when compared to the existing literature. It is possible to hypothesize that both education and occupation may produce different although similar effects on cognitive functioning.

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4 CONCLUSÕES GERAIS

Com base nos estudos apresentados nas seções 2 e 3, é possível afirmar que o campo de estudo do envelhecimento saudável se apresenta como altamente promissor. Suas implicações para a saúde pública seriam relativas à compreensão de fatores associados à resiliência aos sintomas oriundos do envelhecimento ou de processos neurodegenerativos. O presente trabalho visou contribuir com este campo por meio da produção de uma revisão sistemática e de um estudo com coleta de dados.

Primeiramente, foi observado que o estudo dos *SuperAgers* (SA) é voltado ao estudo da memória episódica, porém sem um consenso acerca dos instrumentos e protocolos empregados para sua classificação. Um SA é comumente caracterizado como sendo um idoso acima de 80 anos com memória episódica similar ao que seria esperado para um adulto 20 a 30 anos mais jovem, sendo a memória medida por testes envolvendo listas de palavras. A inclusão de outras medidas como pré-requisitos para a classificação, como as de funções executivas, tipicamente ocorre para evitar a inclusão de idosos não-saudáveis.

Os estudos sobre idosos com altas habilidades cognitivas geralmente visam biomarcadores, havendo importantes efeitos de marcadores genéticos no desempenho cognitivo. É possível, a partir disto, considerar que a variabilidade dos protocolos nesta área de pesquisa possui grandes implicações, pois embora haja a padronização do conceito de SA, este pode ter diferentes significados em contextos socioeconômicos diferentes. Tendo em vista a busca por marcadores genéticos associados ao alto desempenho em testes de memória episódica, o uso de protocolos fixos, não adaptados ao contexto local, pode dificultar, em vez de facilitar, a comparação de resultados ao nível internacional.

Para um idosos com baixa escolaridade, por exemplo, um resultado próximo da média poderia indicar grande preservação de suas capacidades cognitivas, sendo seu contexto sociocultural preditivo de menores resultados. Neste caso, a possibilidade de investigação de seus genes seria indevidamente descartada. Considera-se recomendável, portanto, a adaptação dos protocolos frente ao contexto socioeconômico, cultural e educacional, a depender do intuito da pesquisa.

Tratando-se do estudo transversal, foi possível identificar efeito da educação formal e da complexidade ocupacional sobre o desempenho em quase todas as medidas neuropsicológicas empregadas. Apesar de fortemente correlacionados, os efeitos observados para a educação renderam modelos mais preditivos para medidas de funções executivas,

sendo os efeitos da complexidade ocupacional mais fortes para as capacidades cognitivas gerais. Ambas as variáveis são importantes preditoras do funcionamento cognitivo em idosos.

Recomenda-se que os estudos sobre idosos com altas habilidades cognitivas busque desvincular efeitos ambientais e genéticos, buscando compreender a complexidade do fenômeno do envelhecimento. Faz-se importante a realização de estudos mais amplos acerca das variáveis genéticas, ocupacionais e educacionais, visando compreender suas nuances e interações. Estes estudos devem preferencialmente adotar métodos padronizados e replicáveis de investigação, porém adaptados aos contextos locais.

Finalmente, por meio deste trabalho foi possível fortalecer as bases teóricas para a construção de projetos de pesquisa relacionados a idosos com altas habilidades cognitivas e iniciar o estudo dos marcadores genéticos associados a este campo. O estudo dos marcadores genéticos pode futuramente ampliar a compreensão do processo de envelhecimento, proporcionando maiores possibilidades de ação no âmbito preventivo e, potencialmente no futuro, nos âmbitos da promoção de saúde ou no tratamento de doenças neurodegenerativas ou de déficits cognitivos.

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APÊNDICE 1 – PANFLETO

Você quer nos **ajudar** a entender melhor a **memória** dos **idosos**?

Participe de nossa pesquisa ou indique para um familiar!

Procuramos idosos acima de 75 dispostos a realizar tarefas psicológicas (duração de 45-60 minutos) e ressarciremos seus custos com transporte!

Pesquisador Gabriel Sousa Andrade: 041 99974 - 9198

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APÊNDICE 2 – SOCIAL BACKGROUND QUESTIONNAIRE

Código do Participante: _____

Laboratório de Neuropsicologia (LABNEURO)
Gabriel Sousa Andrade
Amer Cavalheiro Hamdan
Departamento de Psicologia da Universidade Federal do Paraná (UFPR)

Questionário sociodemográfico

Este questionário foi elaborado pelos pesquisadores Gabriel Sousa Andrade e Amer Cavalheiro Hamdan, como parte do projeto de pesquisa "O efeito da escolaridade e da ocupação em SuperAgers".

1. Data de hoje: ___/___/___ **2.** Nome completo: _____

_____

3. Data de nascimento: ___/___/___ **4.** Sexo: ___ **5.** Cidade e estado de nascimento: _____

6. Mão dominante: Destro ☐ Canhoto ☐

7. Você já foi diagnosticado com alguma condição neurológica, psiquiátrica ou genética? Sim ☐ Não ☐ Se sim, qual? _____

8. Você já sofreu alguma lesão na cabeça? Sim ☐ Não ☐
Se sim, por favor descreva: _____

9. Atualmente, você toma algum remédio psicoativo? Sim ☐ Não ☐
Se sim, por favor desvreva qual(is): _____

10. Você possui problemas de visão? Sim ☐ Não ☐
Se sim, sua visão é corrigida para o normal com o uso de óculos ou lentes? Sim ☐ Não ☐

11. Por favor descreva seu mais alto nível educacional e quantos anos de estudo formal (escola e faculdade) você teve (ex: "*Fundamental incompleto, 3 anos*"): _____

_____

12. Quais ocupações (trabalho, profissão) você passou mais tempo exercendo em sua vida? Por quanto tempo? (ex: *"taxista, 20 anos"*)
1)_____
2)_____
3)_____

Muito obrigado por participar!

Laboratório de Neuropsicologia, Universidade Federal do Paraná

APÊNDICE 3 – TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título do Projeto: Marcadores genéticos e memória episódica em idosos com altas habilidades cognitivas
Pesquisador/a responsável: Amer Cavalheiro Hamdan

Pesquisadores assistentes: Gabriel Sousa Andrade; Patrícia Savio de Araujo Souza; Pedro Fernando Wiezel Martins

Local da Pesquisa: Centro de Psicologia Aplicada da UFPR
Endereço: Praça Santos Andrade, 50 (Prédio Histórico) – 1º andar da Psicologia, sala 112

Você está sendo convidado/a a participar de uma pesquisa. Este documento, chamado "Termo de Consentimento Livre e Esclarecido" visa assegurar seus direitos como participante da pesquisa. Por favor, leia com atenção e calma, aproveitando para esclarecer suas dúvidas. Se houver perguntas antes ou mesmo depois de assiná-lo, você poderá esclarecê-las com o pesquisador. Você é livre para decidir participar e pode desistir a qualquer momento sem que isto lhe traga prejuízo algum.

A pesquisa intitulada "Marcadores genéticos e memória episódica em idosos com altas habilidades cognitivas" tem como objetivo compreender a relação entre o idosos com grande capacidade de memória e marcadores genéticos, fatores ambientais e de ocupação prévia.

Participando do estudo você está sendo convidado/a a: preencher um questionário e posteriormente realizar tarefas e testes neuropsicológicos, sendo estes os instrumentos Teste de Aprendizagem Auditivo Verbal de Rey (que envolve a memorização de uma lista de palavras), o teste Figuras Complexas de Rey (que envolve a cópia de uma figura complexa em uma folha de papel), o Teste das Trilhas (que envolve o ligar de pontos em uma folha de papel), o Mini Exame de Estado Mental (que envolve a avaliação de capacidades cognitivas básicas), o subteste dígitos (que envolve a repetição de números) e o subteste de fluência verbal (que envolve a citação de palavras que obedeçam a um critério durante um período de tempo), sendo posteriormente coletado material genético por meio da saliva. O tempo de sua participação na pesquisa será entre 45 a 60 minutos.

Desconfortos e riscos: Visto que a aplicação dos instrumentos será feita de forma presencial, é importante considerar o risco de contágio por doenças devido à proximidade, como a COVID-19. Para minimizar a chance de transmitir o vírus COVID-19 ou qualquer outro tipo de doença aos participantes, o pesquisador, no contato com cada participante, implementará procedimentos de biossegurança. Outro risco é a frustração decorrente da dificuldade para compreender as instruções ou realizar os testes. Caso se apresente, de forma explícita ou implícita, qualquer incômodo relativo à testagem, o pesquisador, que é psicólogo inscrito no Conselho Regional de Psicologia sob o número 08/30527 e atuante no contexto clínico, oferecerá a possibilidade gratuita e imediata de acolhimento da queixa, bem como o lembrará que você pode desistir de sua participação a qualquer momento.
Sigilo e privacidade: Você tem a garantia de que sua identidade será mantida em sigilo e nenhuma informação será dada a outras pessoas que não façam parte da equipe de pesquisadores. Na divulgação dos resultados desse estudo, seu nome não será citado.

Os dados obtidos para este estudo serão utilizados unicamente para essa pesquisa e armazenados pelo período de cinco anos após o término da pesquisa, sob responsabilidade do pesquisador responsável (Resol. 466/2012 e 510/2016).

Sigilo e privacidade: Você tem a garantia de que sua identidade será mantida em sigilo e nenhuma informação será dada a outras pessoas que não façam parte da equipe de pesquisadores. Na divulgação dos resultados desse estudo, seu nome não será citado.

Ressarcimento e Indenização: sua participação será voluntária, não havendo custos, nem remuneração ou ressarcimento relativos à sua participação. Cabe ressaltar que pessoas com 65 anos ou mais são isentas do pagamento da tarifa do transporte público, de acordo com a Lei 10.741/2003.

Contato: Em caso de dúvidas sobre a pesquisa, você poderá entrar em contato com os pesquisadores através do email achamdan@ufpr.br (Amer Cavalheiro Hamdan).

Em caso de denúncias ou reclamações sobre sua participação e sobre questões éticas do estudo, você poderá entrar em contato com a secretaria do Comitê de Ética em Pesquisa em Ciências Humanas e Sociais do Setor de Ciências Humanas (CEP/CHS) da Universidade Federal do Paraná, Subsolo Setor de Ciências Sociais Aplicadas, sala SA.SSW.09, na Av. Prefeito Lothário Meissner, 632- Campus Jardim Botânico, (41)3360-4344, ou pelo e-mail cep_chs@ufpr.br.

O Comitê de Ética em Pesquisa (CEP): O papel do CEP é avaliar e acompanhar os aspectos éticos de todas as pesquisas envolvendo seres humanos. A Comissão Nacional de Ética em Pesquisa (CONEP), tem por objetivo desenvolver a regulamentação sobre proteção dos seres humanos envolvidos nas pesquisas. Desempenha um papel coordenador da rede de Comitês de Ética em Pesquisa (CEPs) das instituições, além de assumir a função de órgão consultor na área de ética em pesquisas.

Este documento é elaborado em duas vias, assinadas e rubricadas pelo pesquisador e pelo/a participante, sendo que uma via deverá ficar com você e outra com o pesquisador.

Esta pesquisa foi submetida ao Comitê de Ética em Pesquisa com seres humanos da UFPR sob o número CAAE nº 61222922.0.0000.0214 e aprovada com o Parecer número 5.671.035 emitido em 28/09/2022.

Consentimento livre e esclarecido:

Após ter lido este documento com informações sobre a pesquisa e não tendo dúvidas informo que aceito participar.

Nome do/a participante da pesquisa:

_____

_____

(Assinatura do/a participante da pesquisa)

Data: ____/_____/_____.

ANEXO 1 – PARECER CONSUBSTANCIADO DO COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE FEDERAL DO PARANÁ - CIÊNCIAS HUMANAS E SOCIAIS

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Marcadores genéticos e memória episódica em idosos com altas habilidades cognitivas

Pesquisador: Amer Cavalheiro Hamdan
Área Temática: Genética Humana:
(Trata-se de pesquisa envolvendo Genética Humana que não necessita de análise ética por parte da CONEP;);
Versão: 2
CAAE: 61222922.0.0000.0214
Instituição Proponente: Universidade Federal do Paraná - Ciências Humanas e Sociais
Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.671.035

Apresentação do Projeto:
Trata-se de projeto de pesquisa intitulado "MARCADORES GENÉTICOS E MEMÓRIA EPISÓDICA EM IDOSOS COM ALTAS HABILIDADES COGNITIVAS", sob a coordenação e orientação da Prof. Dr. Amer Cavalheiro Hamdan, do Programa de Pós-graduação em Psicologia da Universidade Federal do Paraná, com a colaboração e participação de mestranda Gabriel Sousa Andrade; Patrícia Savio de Araujo Souza; Pedro Fernando Wiezel.

O presente estudo visa analisar o efeito de fatores genéticos e ambientais, como a escolaridade e a ocupação, em idosos com altas habilidades cognitivas. Adicionalmente, pretendesse investigar as implicações de diferentes critérios de classificação de Super Agers (SA).

Para o recrutamento serão distribuídos panfletos pelas 10 ruas da cidadania da cidade de Curitiba, Paraná, sendo também procuradas associações comunitárias e religiosas com o fim de encontrar participantes aptos e dispostos. A pesquisa também será divulgada nas redes sociais, no intuito de encontrar potenciais participantes ou pessoas próximas de potenciais participantes. Adicionalmente, será empregado o método "bola de neve", onde um participante poderá indicar outros participantes para integrarem a pesquisa.

Endereço: Subsolo Setor de Ciências Sociais Aplicadas, sl SA.SSW.09, Av. Prefeito Lothário Meissner, 632- Campus
Bairro: Jardim Botânico **CEP:** 80.210-170
UF: PR **Município:** CURITIBA
Telefone: (41)3360-4344 **Fax:** (41)3360-5001 **E-mail:** cep_chs@ufpr.br

A coleta de dados dependências do Centro de Psicologia Aplicada, no campus do Prédio Histórico da UFPR. A coleta terá duração de 45 a 60 minutos e neste tempo, os participantes responderão testes cognitivos e passará por coleta de material genético.
O tratamento das informações será estatístico e fará uso de software para tanto, o método traz o detalhamento dos parâmetros.

Prevê-se a participação de 120 idosos e que os dados coletados (testes cognitivos e material genético) serão armazenados, por no mínimo, 5 anos.

Segundo os pesquisadores, serão inclusos participantes brasileiros acima de 75 anos, alfabetizados e de ambos os sexos. Não serão inclusos participantes que reportarem possuir diagnóstico de doenças neurológicas ou psiquiátricas, bem como participantes que tiverem sua autonomia comprometida ao ponto de não ser possível participar da entrevista e/ou da testagem sem auxílio de acompanhante. Ainda consideram que: não serão inclusos os participantes que obtiverem um escore inferior a 24 na escala do MEEM e os participantes, AS (super agers) ou NA (ditos, normais), não serão inclusos na análise final se obtiverem desempenho inferior a -1 DP da média esperada para sua idade e escolaridade.

Apresenta como relevância social: a compreensão dos fatores que possam estar associados a uma maior capacidade cognitiva e consequente qualidade de vida em idosos pode possibilitar a realização de medidas de promoção de saúde. Adicionalmente, é importante compreender como diferentes fatores, como os anos de estudo da infância à idade adulta, impactam o desenvolvimento humano até idades avançadas.

Objetivo da Pesquisa:
Tem-se como Objetivo da Pesquisa:
Analisar o efeito de marcadores genéticos em idosos com altas habilidades cognitivas.

São tidos pelos pesquisadores como objetivos específicos:
• Analisar associações entre polimorfismos de nucleotídeo único (SNPs) dos genes selecionados após revisão de literatura;

• Analisar o efeito da escolaridade formal em SuperAgers;
• Analisar o efeito da ocupação profissional prévia em SuperAgers;
• Comparar diferentes critérios de classificação para SuperAgers.

Avaliação dos Riscos e Benefícios:

Conforme os pesquisadores, consideram-se como benefícios, que os resultados deste estudo poderão servir como fundamentação teórica para intervenções no sentido da prevenção em saúde pública. Quanto aos participantes, estes serão beneficiados indiretamente, através da promoção de maior conhecimento acerca dos fatores que influenciam a memória em idosos.

Quanto aos riscos, os pesquisadores apontam que consideram que:

" visto que a aplicação dos instrumentos será feita de forma presencial, é importante considerar o risco de contágio por doenças devido à proximidade, como a COVID-19, que está atualmente em estado pandêmico. Outro risco é a frustração do participante em caso de dificuldade para compreender as instruções ou realizar os testes. Considera-se que o risco seja mínimo, visto que, antes da aplicação dos instrumentos, será explicitado que é natural cometer erros em algumas questões. Adicionalmente, a possibilidade será reduzida por serem explicadas brevemente as atividades que serão desempenhadas como parte da pesquisa, fornecendo ao participante a possibilidade de desistir de sua participação a qualquer momento que queira."

Comentários e Considerações sobre a Pesquisa:

Conforme parecer anterior, ressalta-se que, o projeto de pesquisa está bem detalhado e traz as informações pertinentes e consistentes solicitadas no modelo de projeto deste comitê e na Plataforma Brasil.

Considerações sobre os Termos de apresentação obrigatória:

Os termos e os protocolos de testes foram todos apresentados.

Recomendações:

Não se aplicam.

Conclusões ou Pendências e Lista de Inadequações:

Para esta versão, os pesquisadores atenderam as recomendações e fizeram todas as correções solicitadas no TCLE. Sendo assim, considera-se que não há pendências.

UNIVERSIDADE FEDERAL DO PARANÁ - CIÊNCIAS HUMANAS E SOCIAIS

Considerações Finais a critério do CEP:

01 - Solicitamos que sejam apresentados a este CEP, relatórios semestrais (a cada seis meses de seu parecer de aprovado) e final, sobre o andamento da pesquisa, bem como informações relativas às modificações do protocolo, cancelamento, encerramento e destino dos conhecimentos obtidos, através da Plataforma Brasil - no modo: NOTIFICAÇÃO. Demais alterações e prorrogação de prazo devem ser enviadas no modo EMENDA. Lembrando que o cronograma de execução da pesquisa deve ser atualizado no sistema Plataforma Brasil antes de enviar solicitação de prorrogação de prazo.

02 - Importante: (Caso se aplique): Pendências de Coparticipante devem ser respondidas pelo acesso do Pesquisador principal.

Para projetos com coparticipante que também solicitam relatórios semestrais, estes relatórios devem ser enviados por Notificação, pelo login e senha do pesquisador principal no CAAE correspondente a este coparticipante, após o envio do relatório à instituição proponente.

Para TCLE e TALE

Favor inserir em seu TCLE e TALEo número do CAAE e o número deste Parecer de aprovação, para que possa aplicar aos participantes de sua pesquisa.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1989922.pdf	07/09/2022 16:06:02		Aceito
Outros	Carta_pendencias.docx	07/09/2022 16:05:39	Gabriel Sousa Andrade	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_modificado.pdf	07/09/2022 16:03:46	Gabriel Sousa Andrade	Aceito
Folha de Rosto	Folha_de_rosto.pdf	28/07/2022 12:41:46	Amer Cavalheiro Hamdan	Aceito
Projeto Detalhado / Brochura Investigador	Projeto.pdf	27/07/2022 01:38:30	Amer Cavalheiro Hamdan	Aceito
Outros	Questionario.pdf	27/07/2022 01:34:26	Amer Cavalheiro Hamdan	Aceito

Endereço: Subsolo Setor de Ciências Sociais Aplicadas, sl SA.SSW.09, Av. Prefeito Lothário Meissner, 632- Campus
Bairro: Jardim Botânico **CEP:** 80.210-170
UF: PR **Município:** CURITIBA
Telefone: (41)3360-4344 **Fax:** (41)3360-5001 **E-mail:** cep_chs@ufpr.br

UNIVERSIDADE FEDERAL DO PARANÁ - CIÊNCIAS HUMANAS E SOCIAIS

Continuação do Parecer: 5.671.035

Outros	MMSE_teste.pdf	27/07/2022 01:34:02	Amer Cavalheiro Hamdan	Aceito
Outros	Trilhas_teste.pdf	27/07/2022 01:33:41	Amer Cavalheiro Hamdan	Aceito
Outros	Panfleto.pdf	27/07/2022 01:32:53	Amer Cavalheiro Hamdan	Aceito
Declaração de Manuseio Material Biológico / Biorepositório / Biobanco	Termo_de_Guarda_de_Material_Biologico.pdf	27/07/2022 01:32:20	Amer Cavalheiro Hamdan	Aceito
Outros	Termo_Concordancia_LIGH.pdf	27/07/2022 01:32:02	Amer Cavalheiro Hamdan	Aceito
Declaração de concordância	Termo_Concordancia_CPA.pdf	27/07/2022 01:31:07	Amer Cavalheiro Hamdan	Aceito
Outros	Aprovacao_colegiado.pdf	27/07/2022 01:30:49	Amer Cavalheiro Hamdan	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.pdf	27/07/2022 01:27:25	Amer Cavalheiro Hamdan	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

CURITIBA, 28 de Setembro de 2022

Assinado por:
LORIANE TROMBINI FRICK
(Coordenador(a))

Endereço: Subsolo Setor de Ciências Sociais Aplicadas, sl SA.SSW.09, Av. Prefeito Lothário Meissner, 632- Campus
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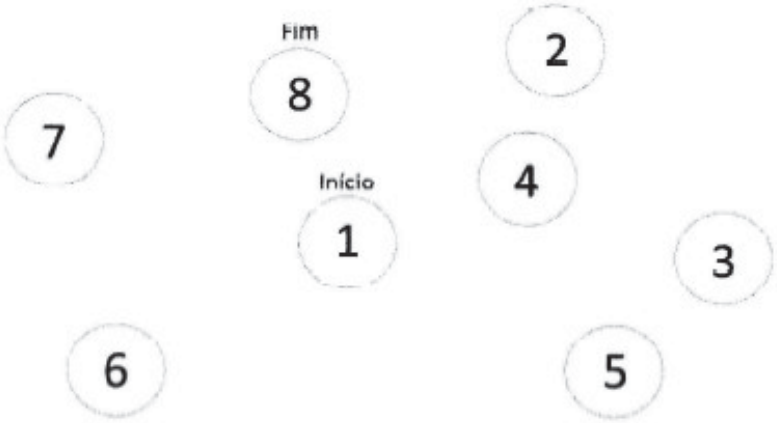
ANEXO 2 – TESTE DE TRILHAS

ANEXO 1

TESTE DAS TRILHAS PROTOCOLO DE APLICAÇÃO

PARTE A – EXEMPLO



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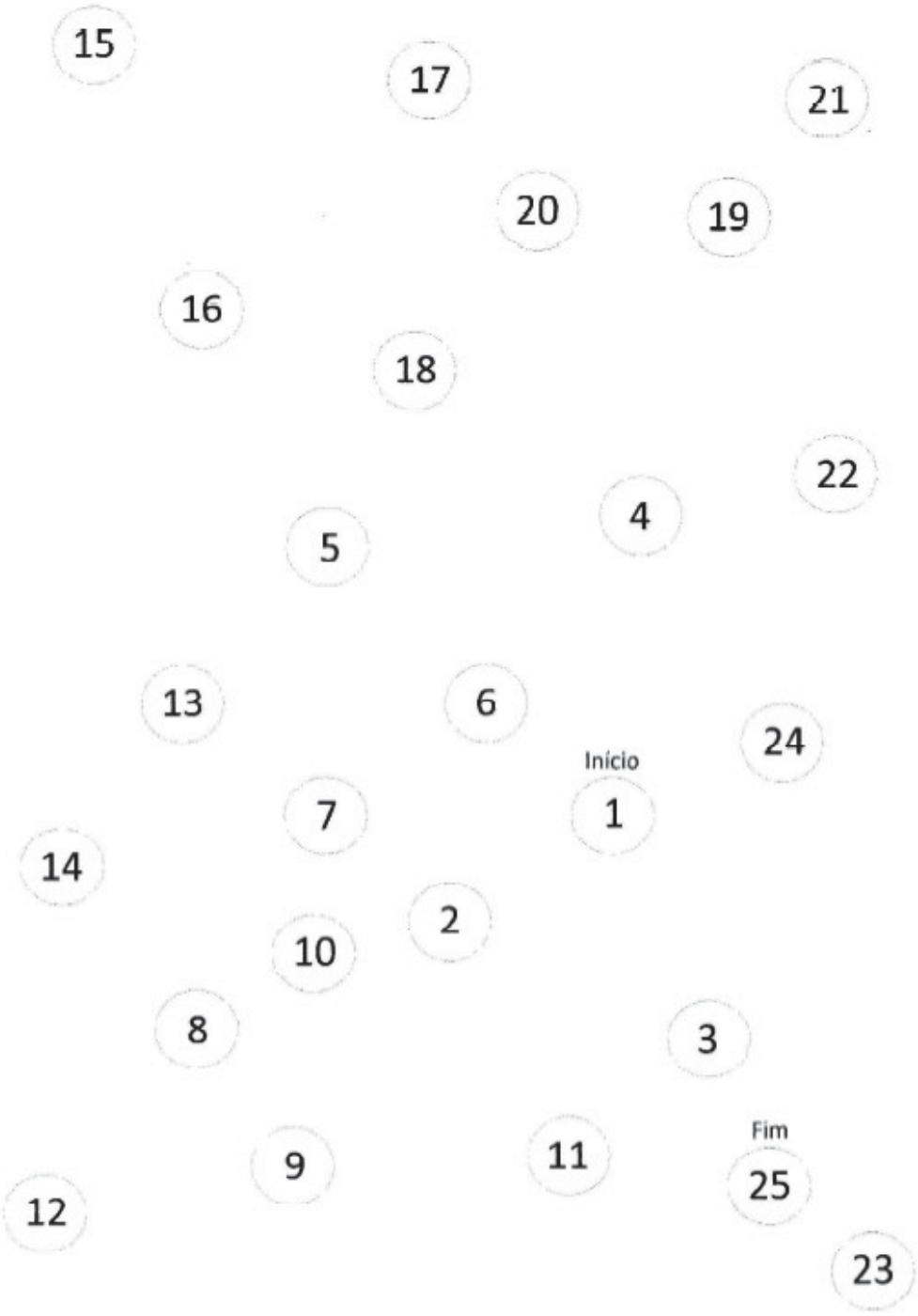
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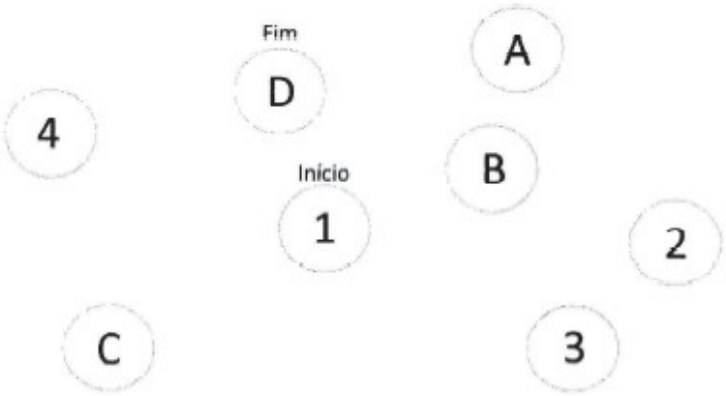
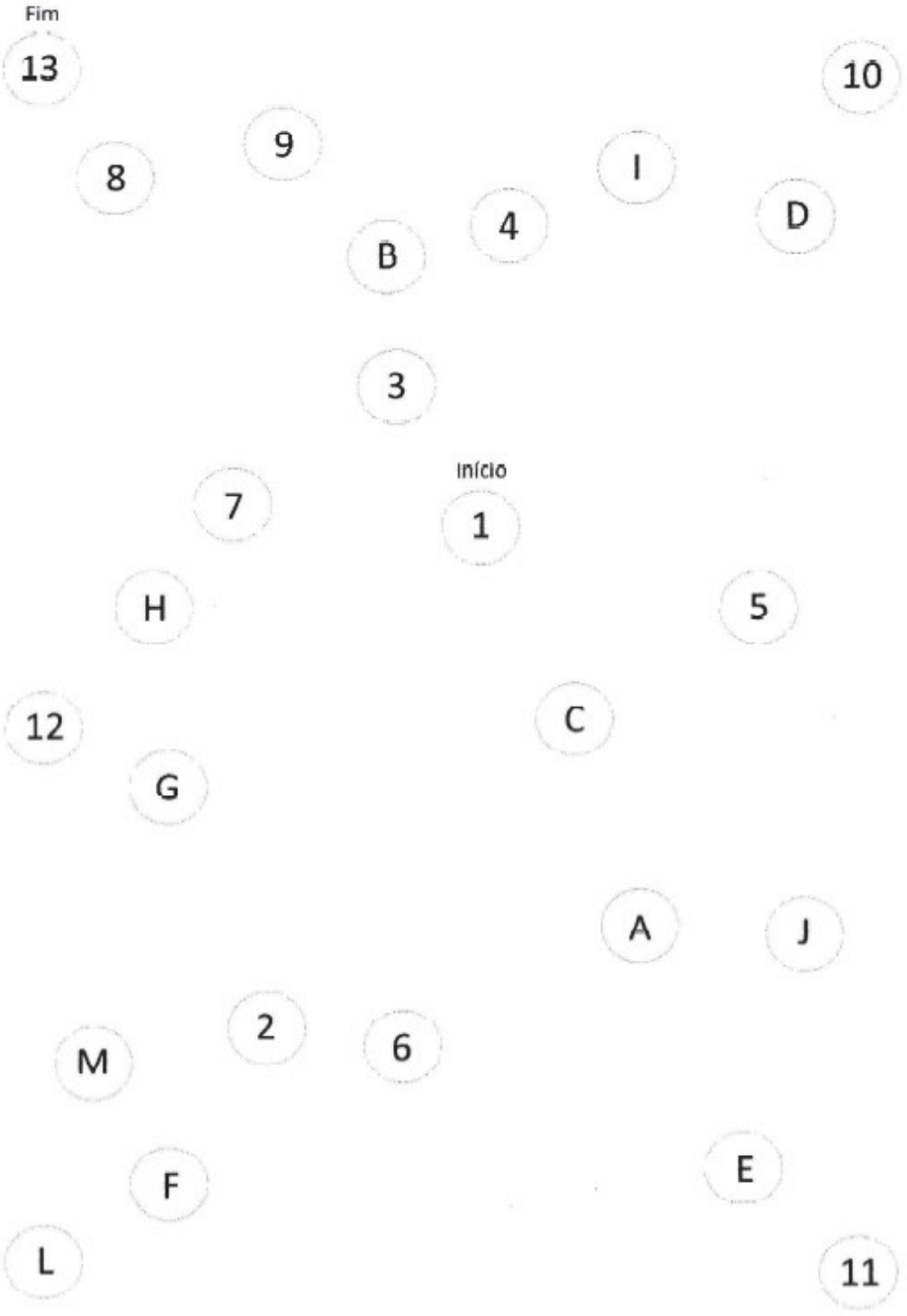
ANEXO 1

TESTE DAS TRILHAS - PROTOCOLO DE APLICAÇÃO

PARTE B – EXEMPLO





ANEXO 3 – MINI EXAME DO ESTADO MENTAL (MEEM)

BVS Atenção Primária em Saúde
Traduzindo o conhecimento científico para a prática do cuidado à saúde

Pesquisar
Coleção da SOF Toda a coleção

Rede Telessaúde Brasil

home > Calculadoras > Mini exame do estado mental

Mini Exame do Estado Mental (MEEM)

Descrição

É o teste mais utilizado para avaliar a função cognitiva por ser rápido (em torno de 10 minutos), de fácil aplicação, não requerendo material específico. Deve ser utilizado como instrumento de rastreamento não substituindo uma avaliação mais detalhada, pois, apesar de avaliar vários domínios (orientação espacial, temporal, memória imediata e de evocação, cálculo, linguagem-nomeação, repetição, compreensão, escrita e cópia de desenho), não serve como teste diagnóstico, mas sim pra indicar funções que precisam ser investigadas. É um dos poucos testes validados e adaptados para a população brasileira.

Uso

Teste de rastreamento e avaliação rápida da função cognitiva

Apresentação do Exame

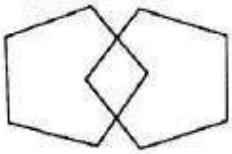
1. Orientação espacial (0-5 pontos):
   Em que dia estamos?
   - ☐ Ano
   - ☐ Semestre
   - ☐ Mês
   - ☐ Dia
   - ☐ Dia da Semana
2. Orientação espacial (0-5 pontos):
   Onde Estamos?
   - ☐ Estado
   - ☐ Cidade
   - ☐ Bairro
   - ☐ Rua
   - ☐ Local
3. Repita as palavras (0-3 pontos):
   - ☐ Caneca
   - ☐ Tijolo
   - ☐ Tapete
4. Cálculo (0-5 pontos):
   O senhor faz cálculos?
   Sim (vá para a pergunta 4a)
   Não (vá para a pergunta 4b)

   4a. Se de 100 fossem tirados 7 quanto restaria? E se tirarmos mais 7?
   - ☐ 93
   - ☐ 86
   - ☐ 79
   - ☐ 72
   - ☐ 65

   4b. Soletre a palavra MUNDO de trás pra frente

- ☐O
- ☐D
- ☐N
- ☐U
- ☐M

5. Memorização (0-3 pontos):
   Peça para o entrevistado repetir as palavras ditas há pouco.
   - ☐Caneca
   - ☐Tijolo
   - ☐Tapete
6. Linguagem (0-2 pontos):
   Mostre um relógio e uma caneta e peça para o entrevistado para nomeá-los.
   - ☐Relógio
   - ☐Caneta
7. Linguagem (1 ponto):
   Solicite ao entrevistado que repita a frase:
   - ☐NEM AQUI, NEM ALI, NEM LÁ.
8. Linguagem (0-3 pontos):
   Siga uma ordem de 3 estágios:
   - ☐Pegue esse papel com a mão direita.
   - ☐Dobre-o no meio.
   - ☐Coloque-o no chão.
9. Linguagem (1 ponto):
   - ☐Escreva em um papel: "FECHE OS OLHOS". Peça para o entrevistado ler a ordem e executá-la.
10. Linguagem (1 ponto):
    - ☐Peça para o entrevistado escrever uma frase completa. A frase deve ter um sujeito e um objeto e deve ter sentido. Ignore a ortografia.
11. Linguagem (1 ponto):
    - ☐Peça ao entrevistado para copiar o seguinte desenho. Verifique se todos os lados estão preservados e se os lados da intersecção formam um quadrilátero. Tremor e rotação podem ser ignorados.



Resultado: 0

Observação para a montagem da calculadora

Soma de todas as caselas, cada uma vale 1 ponto.

Avaliação dos resultados

Normal: acima de 27 pontos

Demência: menor ou igual a 24 pontos; em caso de menos de 4 anos de escolaridade, o ponto de corte passa para 17, em vez de 24.

Escore médios para depressão

Depressão não complicada: 25,1 pontos

Prejuízo cognitivo por depressão: 19 pontos

Público-alvo

Médicos

Área

Saúde do adulto e do idoso

Referências