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The Beneficial, Formative Role of Lifetime Exposures across Cognitive Domains in Barbados Using Data from the SABE Study

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Article

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Abstract

This study tested the hypothesis that within older Barbadian adults, sex, education, and occupation type lessen age-related cognitive decline. The analyses used a cross-sectional data set from 1325 people collected in the 2006 SABE Study (Health, Well-being, and Aging). Cognition was assessed as scores in each subdomain of the Mini-Mental State Exam. The loss of a single point in each subdomain was predicted by sex, years of education, job type, and their interactions with age. Results demonstrated that age and protective factors affect each cognitive domain differently. High education combined with mentally complex employment helped maintain cognitive performance in later life. Beneficial lifetime exposures are additive, providing combined benefits. Findings provide insight into public policy aiming to minimize the number of adults with cognitive decline and dementia in Barbados and the Caribbean.

Resumé

Cette étude a testé l'hypothèse selon laquelle chez les adultes barbadiens plus âgés, le sexe, le niveau d'études et le type de profession atténuent le déclin cognitif lié à l'âge. Les analyses ont utilisé un ensemble de données transversales provenant de 1 325 personnes et collectées dans le cadre de l'étude SABE de 2006 (Santé, bien-être et vieillissement). La cognition a été évaluée sous forme de scores dans chaque sous-domaine du « Mini-Mental State Exam ». La perte d'un seul point dans chaque sous-domaine a été prédite en fonction du sexe, des années d'études, du type d'emploi et de leurs interactions avec l'âge. Les résultats ont démontré que l'âge et les facteurs de protection influent différemment sur chaque domaine cognitif. Un niveau d'études élevé, combiné à un emploi mentalement complexe, a contribué à maintenir les performances cognitives plus tard dans la vie. Le cumul des expositions bénéfiques tout au long de la vie offre des avantages combinés. Les résultats visent à éclairer l'élaboration de politiques publiques visant à réduire le nombre d'adultes atteints de déclin cognitif et de démence à la Barbade et dans les Caraïbes.

Introduction

Advancing age greatly affects cognitive decline, and it is also one of the most significant risk factors for the future development of Alzheimer's disease (Riedel et al., 2016; Salthouse, 2019). Fortunately, specific lifetime exposures and well-being benefit cognitive performance and offer some protection later in life (Wang et al., 2019). Beneficial lifetime exposures include education, occupational complexity, engagement in leisure activities, greater social networks, socioeconomic status, and bilingualism (Bak et al., 2014; Bielak et al., 2019; Farina et al., 2018; Harrison et al., 2015; Klimova & Dostalova, 2020). In its simplest form, protection delays disease onset, potentially avoiding it entirely. Neurological protection, developed through beneficial lifetime exposures, includes maintaining brain tissue, building neural reserves, or adapting neural functions in response to pathological neural processes.

Studies of the neural protection of lifetime exposures fall into two broad categories: brain reserve and cognitive reserve (Cabeza et al., 2018; Steffener et al., 2014; Stern et al., 2020). The theory of brain reserve describes the accumulation of neural resources due to genetic, environmental, or lifestyle factors to mitigate the adverse effects of aging. The cognitive reserve theory states that the accumulation of functional resources due to genetic, environmental, or lifestyle factors allows brain function to adapt to the adverse effects of aging through functional compensatory resources. Without neural measures, studies of the beneficial effects of lifetime exposures on cognition use age as a predictor.

Beneficial lifetime exposures provide neural and functional protection from aging effects. In addition, they are also directly related to cognitive performance (Correa Ribeiro et al., 2013; Sörman et al., 2021; Steffener et al., 2014) and limit the harmful effects of age on cognitive decline. In this way, beneficial exposures directly influence cognitive performance. Their impact on limiting the influence of age on cognitive performance may be of greater influence on delaying clinically significant cognitive decline (Dekhtyar et al., 2015; González et al., 2013; Wang et al., 2019).

Educational attainment is one of the most explored lifetime exposures related to cognitive performance (Opdebeeck et al., 2016; Rosselli et al., 2022; Stern, 2002, 2009). Greater years of education demonstrate a wide array of benefits, such as higher levels of cognitive performance than those with fewer years of schooling. Higher education also offers indirect effects, including better occupations, better access to healthcare, higher vocabulary skills, et cetera.

The beneficial effects of education and occupation are recognized as critical components of dementia prevention (Livingston et al., 2017). Unfortunately, they are often studied in isolation. In addition, while sex is often a confounder in studies, here it is used to consider the social determinants of gender-based health differences as a consequence of social disadvantage (e.g., education and occupation differences) (Chusseau & Hellier, 2013; Okamoto et al., 2021). Therefore, the current study includes sex alongside education and occupation to investigate the independent effects of each variable on cognitive aging.

In this manner, education, occupation, and sex are used in the current work to identify their joint and independent roles in moderating the effects of age on cognitive performance. These moderating variables are considered formative factors contributing to the protective effects against age-related cognitive decline (Jones et al., 2011). While protective effects are theoretically considered as formed from lifetime exposures, protective effects are often tested more simply as reflective factors (Almeida-Meza et al., 2021). A reflective factor only uses the shared variance between multiple lifetime exposure measures. Therefore, the current study's consideration of formative factors is an important advance in studying cognitive reserve and resilience (Stern et al., 2020).

While the entire world ages, low and middle-income countries, including Latin America and the Caribbean, are aging more rapidly (Ashby-Mitchell et al., 2015). Changes in birth rates and emigration over the twentieth century have resulted in severe changes in the old-age dependency ratio (the ratio of adults 65 and above to those between ages 15 and 64) (Banik & Bhaumik, 2006).

Using data from the Survey on Health, Well-Being and Aging (SABE) in Latin America and the Caribbean, a large-scale study of older adults in the Americas (Pelaez et al., 2006), education positively affected general cognitive performance across multiple countries, including Argentina, Mexico, Uruguay, Chile, and Brazil (Maurer, 2011). However, there was no evidence of beneficial educational effects when using general cognition as the output in the two countries with the highest literacy rates and educational attainment, Barbados and Cuba. Within English-speaking Barbados, based on data collected in 1999–2000, the total life expectancy of older adults was similar to other countries at age 60; however, it dropped to the lowest of all nations by age 80 (Ashby-Mitchell et al., 2015). Worse, Barbados had the smallest length of time free of cognitive impairment. The current work focuses on Barbados to investigate the role of lifetime exposures on cognitive subdomains instead of their amalgamation, a test's total score. Barbados's strong educational system helps limit the cultural confound of studying the relationships between education and cognitive performance (Rosselli et al., 2022).

The SABE study is extremely valuable due to its comprehensive health survey and large samples from seven countries. It is one of the only datasets to provide insight into the aging population in this region of the world. Concerning cognition, a short screening questionnaire was used to provide insight into the presence or absence of cognitive impairment. Screening tool total scores provide no further insight into diagnoses, the nature or severity of cognitive decline, functional limitations, and planning treatment (Roebuck-Spencer et al., 2017). More comprehensive neuropsychological assessments of the various cognitive domains are required for that. While the MMSE screening tool used in the SABE study is a pale substitute for a comprehensive assessment, its subdomain scores provide insight into the aging mind. In addition, screening tools like the MMSE are often the only insight into a patient's cognitive health in locations where neuropsychological testing is not practical due to a rural area or limited access to neuropsychological specialists (Global Engagement Committee of the International Neuropsychological Society, 2023; Hendershott et al., 2017).

The individual cognitive domains of the MMSE screening tool were tested for individual differences' role in the relationship between age and cognitive performance. Within healthy, normal aging, cognitive processing speed typically declines first. It has the most rapid decline, while crystallized intelligence, often measured as vocabulary skills, increases across the lifespan and only declines much later (Salthouse, 2019). Within neurodegenerative disease, memory skills are often the first to show decline (Ashford et al., 1989). Composite total scores, therefore, miss changes in the subdomains and clinically significant subtle changes (Gleason et al., 2009), which may be masked by variability from education and socioeconomic status (Ashford et al., 1989).

The SABE study used an abridged 19-point, nine-question version of the MMSE. Due to the limited range of values for each cognitive subdomain, the dependent variable of the current work was the loss of a single point within a domain. A single-point loss on screening tools has clinical importance when predicting the probability of falling in older adults, where for every point lost on the MMSE, fall risk increases (Gleason et al., 2009). For the Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005), a cognitive screening tool similar to the MMSE, the loss of one or more points in any subdomain for patients with Parkinson's disease predicted a cognitive deficit in that domain when assessed comprehensively (Hendershott et al., 2017). Finally, an item analysis of the MMSE demonstrated the predictive ability of a single-point loss and ranked the individual items based on their ability to predict dementia (Ashford et al., 1989). Results highlight that single-point loss in delayed memory recall and orientation about the date had the best predictive ability.

The research question of the current work is whether, within a sample of older Barbadian adults, sex, years of education, and occupation type decrease the effect of age on cognition across multiple cognitive domains. The hypothesis is that the impact of age on the probability of losing one point in each of the cognitive subdomains of the MMSE tests will decrease with greater education and occupations requiring more mental effect. These effects will differ between the sexes.

Methods

Data

The cross-sectional data for this study are from the SABE in Latin America and the Caribbean (Pelaez et al., 2006). The SABE is a multi-city study conducted in 2006 in seven Latin American and

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Table 1. The sample size was charted against the number of points lost for each cognitive subdomain; only those who lost zero or one point were used to determine the sample size for each statistical test.

	Number of points lost					
	0	1	2	3	4	5
Orient	1,172	133	15	2	3	
Immediate recall	1,312	12	1			
Digit span	976	154	98	46	23	28
Paper	1,249	66	4	6		
Delayed recall	844	312	99	70		
Circle	1,177	148				
Total	569	287	171	110	73	65

Caribbean cities, including Bridgetown, Barbados. The sample collected in Barbados was collected through a multi-stage stratified cluster sampling approach. First, a random sample of households was selected using the national election registry. One individual aged 60 years and older was selected and interviewed within each household. Of the 1,878 households identified with a person above sixty, there was an 80 per cent response rate, with 1,508 interviews conducted. The interview assessed cognitive abilities, sociodemographics, household characteristics, health and functional status, health care utilization, and anthropometry.

The study sample included 1325 older adults with no measured cognitive deterioration and complete data. Complete data means each participant had values for age in years, job type, sex, education in years, and scores on the Mini-Mental State Exam (MMSE) (Folstein et al., 1975). Missing data included 44 for MMSE, 13 for education, and 76 for job type. As in the original study, cognitive deterioration is an MMSE score of 12 or below, accounting for 55 participants.

Dependent variables

The nine-variable, 19-point version of the Mini-Mental State Exam (MMSE) was used in this study (Folstein et al., 1975). The World Health Organization developed this shortened version using regression analysis to identify the questions that best explain cognitive deterioration (Icaza & Albala, 1999). The MMSE consists of six domains: *orientation* assessed with questions about the time (four points), *immediate memory recall* of three words (three points), *working memory* assessed with a reverse digit span of five digits (five points), *executive function* assessed with following three instructions when handed a piece of paper (three points), *delayed memory recall* of the three words from earlier in the exam (three points), and *visuospatial abilities* assessed with the drawing of two intersecting circles (one point). Each dependent variable has its own range of possible values, and the differences between values on these limited scales are likely not uniform. Therefore, each variable was ordinal. Furthermore, focus was placed on losing a single point on each scale. This focus limits the number of people included in each analysis; however, the majority of people lost either zero or one point in each subdomain, see Table 1. The result was that each dependent variable was considered binomial using only participants with either zero loss or one point.

Independent variables

The independent variables consisted of age, years of education, job type, and sex. The mean age was 71.82 years, with a standard deviation of 7.81 years and a range of 60 to 97 years. The mean years of education were 5.39 years, with a standard deviation of 3.44 years and a range of 0 to 20. There were multiple modes in the data, with 25 people having zero years of education, 112 having one year, 318 having three years, 529 having five years, 170 having ten years, and 29 having 15 years. Assessment of job type used self-description of jobs mainly requiring physical effort (n = 897), requiring mental effort (n = 216), or a mixture of the two (n = 212). Work primarily involving physical effort included labourers, agricultural workers, and service workers. Physical effort occupation is used as the reference category in analyses. Work primarily involving mental effort included professionals, executives, and office workers. Mixed work included sales clerks, nurses, and laboratory technicians. The sex of participants included 786 females and 539 males.

Data analysis

Binomial logistic regression was performed for each cognitive domain to predict the probability of losing one point in each subdomain using the Jamovi v1.6 software package (Jonathon Love, 2019). As mentioned above, the small cell effects in losing more than one point on a scale make multinomial regression non-feasible. Therefore, results demonstrate the probability that a person loses one point in a subdomain. A priori tests of the linearity of the continuous predictor variables, education and age, were tested using the Box–Tidwell test (Box & Tidwell, 1962). In addition, collinearity statistics were assessed for any collinearity between the predictors in the models. The continuous variables, age and years of

Table 2. Logistic regression parameter estimates for the three nested models and each cognitive domain.

	Intercept	Age	Edu	Men Occ	Mix Occ	Sex	Age: Edu	Age: Men	Age: Mix	Age: Sex
Orient	−2.33***	0.041***	−0.15***	−0.27	−0.027	0.078				
Immediate	–	–								
Working	−1.95***	0.029**	−0.099**	−0.73*	−0.78**	0.38*				
Exec Func	−2.94***	0.066*	0.13***	−1.20*	0.083	0.082	0.0081	−0.0046	0.014	−0.097**
Delayed	−0.84***	−0.0077	−0.061**	−0.44*	−0.23	−0.098				
VisuoS	−2.31***	0.086***	−0.13***	−0.83*	−0.60*	0.20				

Notes: A negative parameter indicates a decreased probability of losing one point. Men Occ (Men) refers to mental effort versus physical effort. Mix Occ (Mix) refers to mixed effort versus physical effort. Sex refers to male versus female. *p < .05; **p < .01; ***p < .001. Orient = Orientation; Immediate = Immediate memory recall; Working = working memory; Exec Func = Executive function; Delayed = Delayed memory recall; VisuoS = Visuospatial.

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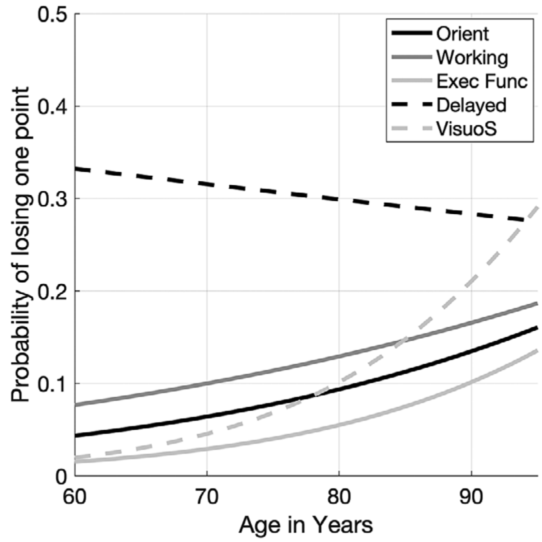

Figure 1. Line plot showing the age effects on the probability of losing one point for each domain. The immediate recall task did not show a significant age effect and is not shown.

education, were mean-centred to remove collinearity arising when forming interaction terms.

For each cognitive domain, a series of three nested models were compared. The first step included age alone; the second added the covariates of education, job type, and sex. The third step added the interaction of age and each of the three covariates. The most complicated model was selected if it was significant using the overall Chi-squared model test, had the smallest AIC, and represented a significantly better model than the less complex model using the Chi-squared test for model comparison. If the most complicated model was not selected, the model with only the main effects compared to the model, including only the age effect using the same criteria, was used.

Once a model was selected, the variables were assessed for significance using omnibus likelihood tests. Model coefficients were estimated for significance using the Wald statistic, and probabilities of cognitive decline were assessed to interpret results. Female sex and physical effort job type were the reference categories in each regression model.

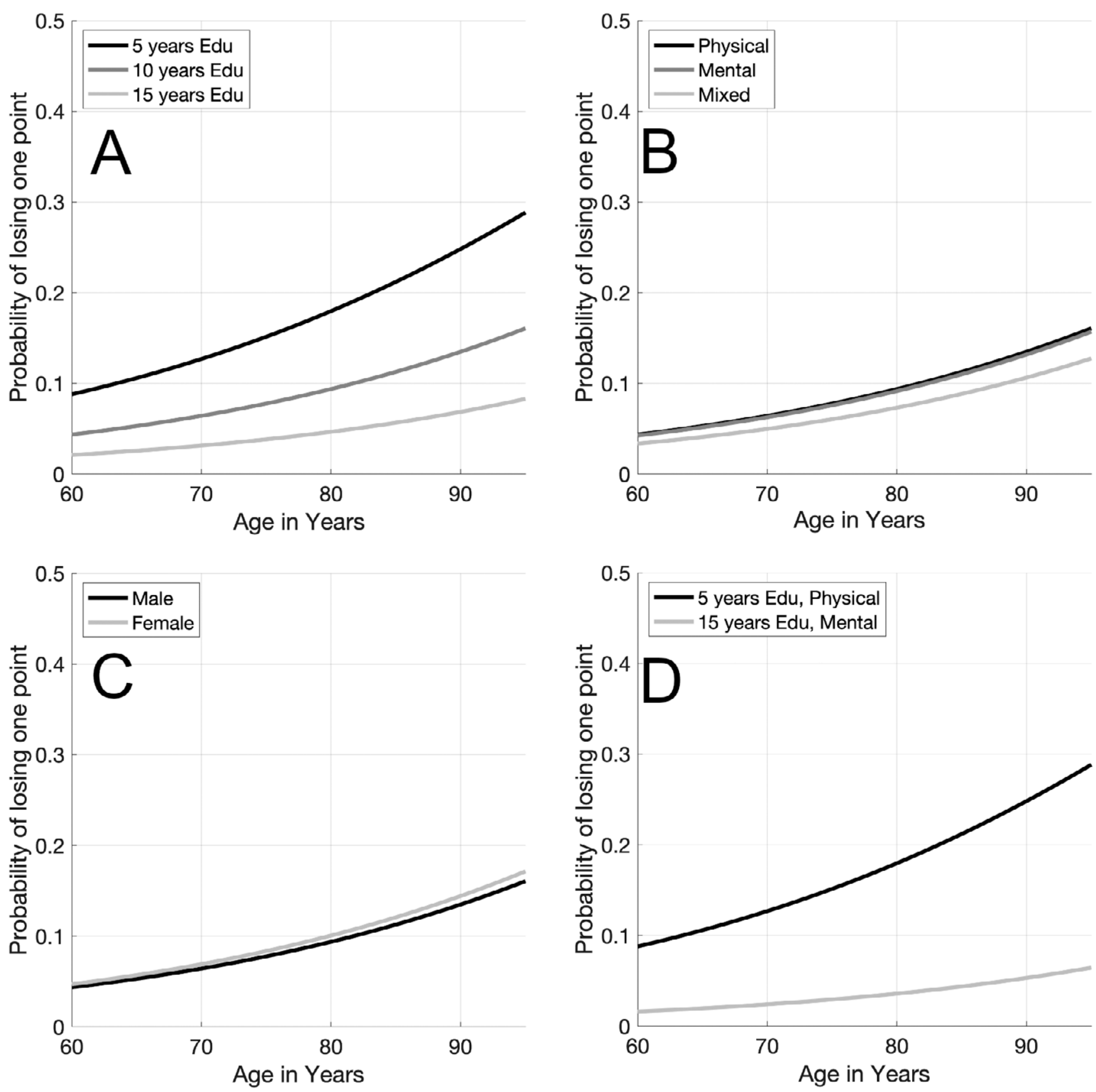

Figure 2. Probability of losing one point on the orientation subscale. Panel A shows the variability across years of education, B) across job types, C) across sex, and D) the combination of the significant effects of education and job type.

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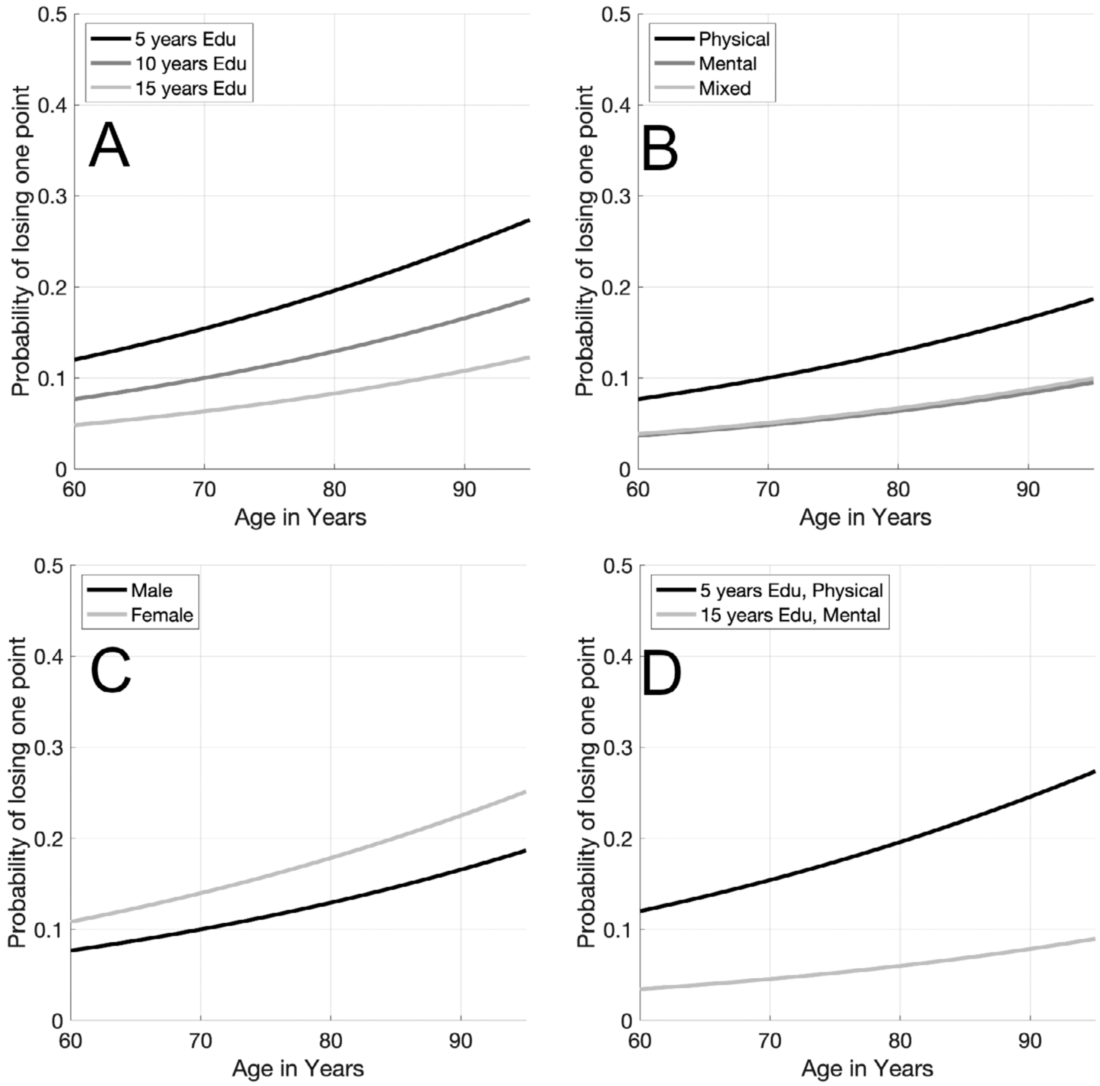

Figure 3. Probability of losing one point on the working memory task. Panel A shows the variability across years of education, B) across job types, C) across sex, and D) the combination of the significant effects of education, job type, and sex.

Results

Table 2 shows the results from the six binomial logistic regression models. The overall results are briefly described here. Detailed descriptions of each result are included in the Supplementary Material. The model predicting executive function was the only domain where the model, including the interaction terms, was significant. The models predicting orientation, working memory, delayed memory recall, and visuospatial skills were significant, including age and lifetime exposure variables. No model was significant when predicting immediate memory recall.

The size of the age effect varied between each cognitive domain; see Figure 1. This figure plots the probability of each cognitive domain losing one point in the next year. All domains demonstrate significant positive age effects except for immediate and delayed memory recall. Therefore, the probability that they will lose one point increases every year the older someone is.

Education significantly negatively affected orientation, working memory, delayed memory recall, and visuospatial domains. Therefore, those participants with more years of education had a lower probability of losing one point. The executive function domain demonstrates a significant positive effect of education where more years of education was related to a greater probability of losing one point. The impact of job type was significant for working memory, executive function, delayed memory recall, and visuospatial. In all four domains, more mental effort within one's job is related to significantly better cognitive scores than mainly requiring physical effort. The mixed job type was significantly better for the working memory and visuospatial tasks than the physical effort types. Sex significantly modulated the age effect on executive function. Sex also demonstrated a significant main effect on the working memory domain, where females had a higher probability of losing one point. These effects are plotted for each domain in Figures 2–6. There is no plot for immediate memory recall because of the lack of significant relationships.

Discussion

The results of this study demonstrate that age, education, job type, and sex all differ in their impact on cognitive performance. Advancing age is negatively related to task performance in different

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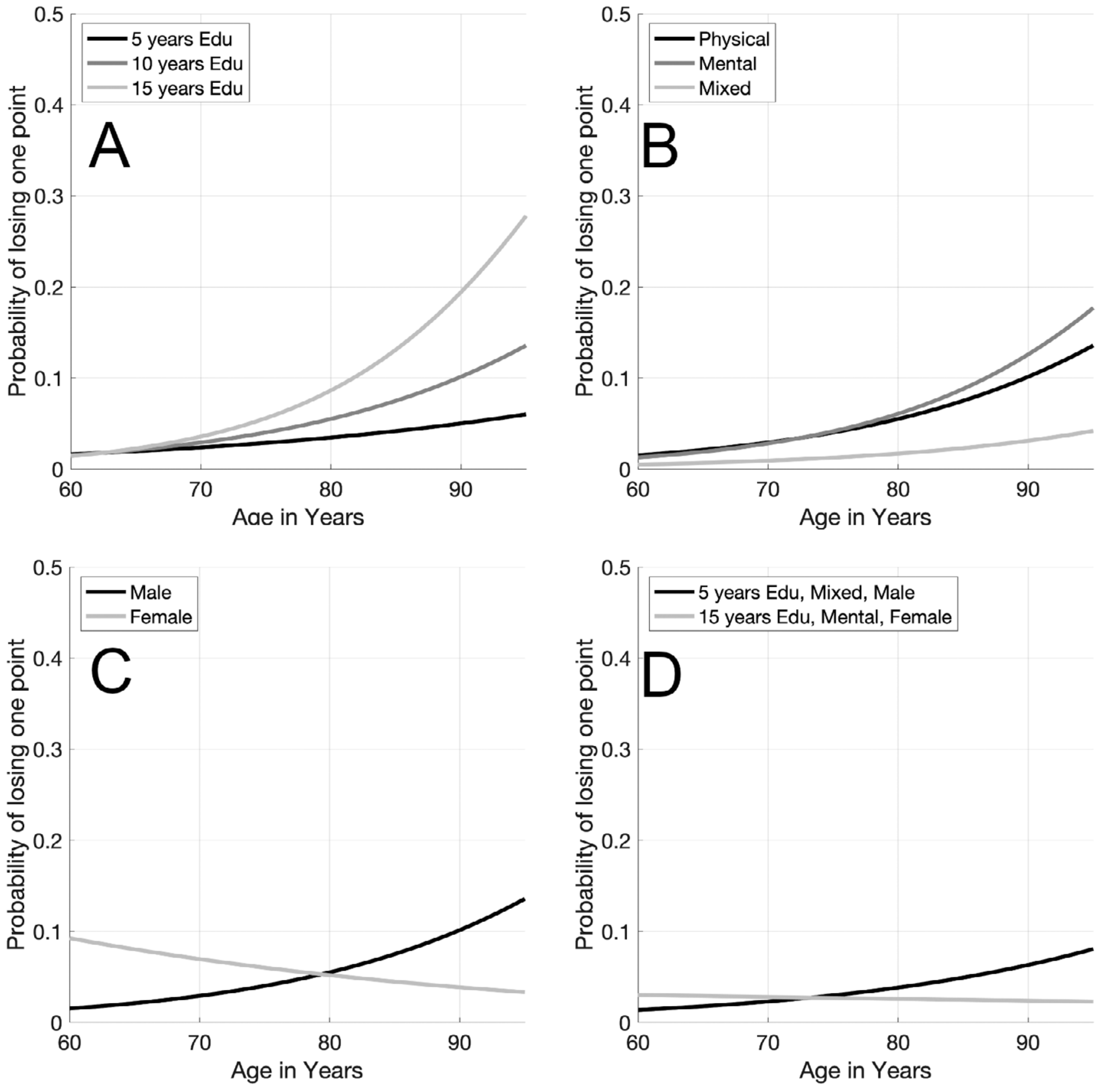

Figure 4. Probability of losing one point on the executive function task. Panel A shows the variability across years of education, B) across job types, C) across sex, and D) the combination of the significant effects of education, job type, and sex.

magnitudes across the cognitive domains. Greater education demonstrated positive, negative, and no effects. Greater engagement in mental effort during work showed consistent positive benefits compared to jobs relying more on physical exertion. Sex displayed significant effects in one domain and altered the age effect in another. The results demonstrate variations in how age and lifetime exposures affect cognitive performance and the presence of additive beneficial effects among the exposures.

The effect of age demonstrated large variability across the cognitive domains. There was no significant effect of age in the immediate memory recall domain; compared to visuospatial abilities, assessed with the ability to draw circles, the probability of losing one point increased by 50 per cent over thirty years. The wide range of age effects demonstrated here and elsewhere (LaPlume et al., 2022) reflect the considerable individual variation in cognitive abilities and the likely differences in neural decline underlying cognition. However, it is also important to consider physical aging effects, such as arthritis, which were not controlled for in this study.

The effects of education also varied across the different domains. More years of education significantly decreased the probability of losing one point on orientation, working memory, delayed memory recall, and visuospatial tasks. In a Brazilian sample using a similar version of the MMSE, education was positively related to the orientation and visuospatial tasks and negatively associated with the delayed memory recall task (Laks et al., 2010). More education significantly negatively affected the executive function within the current sample. Those with more years of education had an increased probability of losing one point. This counterintuitive finding is not novel and supports the theory of cognitive reserve (Stern, 2012). Cognitive reserve is the concept that lifetime exposures allow the brain to functionally compensate for the adverse effects of aging and maintain cognitive performance. Unfortunately, this benefit comes with the downside that once cognitive decline begins, it is more rapid in those with the most significant beneficial exposures (Helzner et al., 2007). Within this sample of older adults from Barbados, executive function had declined before participants engaged in the current study.

The differing directions of relationships between education, executive function, and other domains reflect the complexity of understanding educational effects (Staekenborg et al., 2020). It is possible that education provides a scaling effect and increases cognitive capacity in various domains. Therefore, cognitive decline

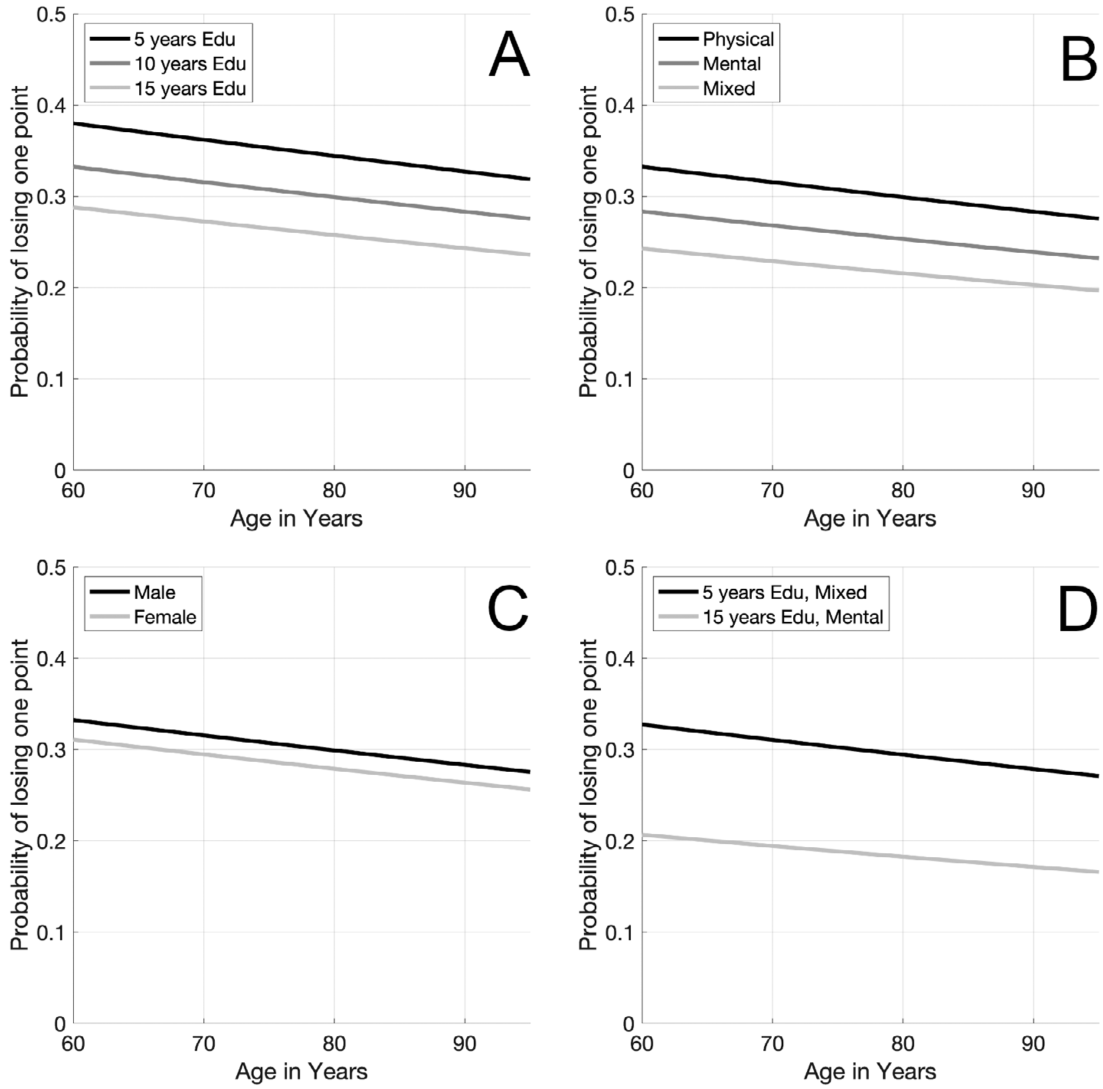

Figure 5. Probability of losing one point on the delayed memory task. Panel A shows the variability across years of education, B) across job types, C) across sex, and D) the combination of the significant effects of education and job type.

may occur; however, in the presence of more education, the brief cognitive assessments used here do not capture the decline due to ceiling effects. For executive function, this change of capacity does not appear to occur.

Another important consideration with the use of years of education as a factor is that it needs to address the type and quality of education and historical changes to educational systems. In Barbados, the education system was structured according to the British model. School is similar for all students until age 11. Students are streamed into different academic institutions at this age based on a standardized assessment called the Common Entrance Examination. The education system in Barbados also experienced significant developmental changes starting in 1967, including expanded access at primary and secondary levels and the establishment of tertiary institutions (Prepared by the Planning Research and Development Unit of the Ministry of Education, Youth Affairs and Culture, 2000). Therefore, education coded as years is a measure that ignores the effects of history, quality, type, and student stratification based on standardized test scores of academic proficiency. Future work will look at how stratification based on age 11 skills translates to the probability of a cognitive decline in late life.

High levels of mental effort required within a job were beneficial to working memory, executive function, delayed memory recall, and visuospatial skills. Similar findings also demonstrate slower post-retirement cognitive decline (Fisher et al., 2014). Performance in executive function, delayed memory recall, and working memory were significantly greater for jobs entirely reliant on mental effort. In contrast, there was a beneficial mental effort dose-effect the performance in the visuospatial domain. For the working memory domain, the mental effort and mixed job types had similar benefits to physical effort. High occupational complexity related to healthy patterns of brain structure supports this result (Habeck et al., 2020; Spreng et al., 2011).

The literature debates the mechanisms underlying occupational complexity's benefits. One idea is that high mental effort helps with physiological brain maintenance and the development of neural reserves (Cabeza et al., 2018). Another theory is that the social support and engagement required for managerial and high-mental

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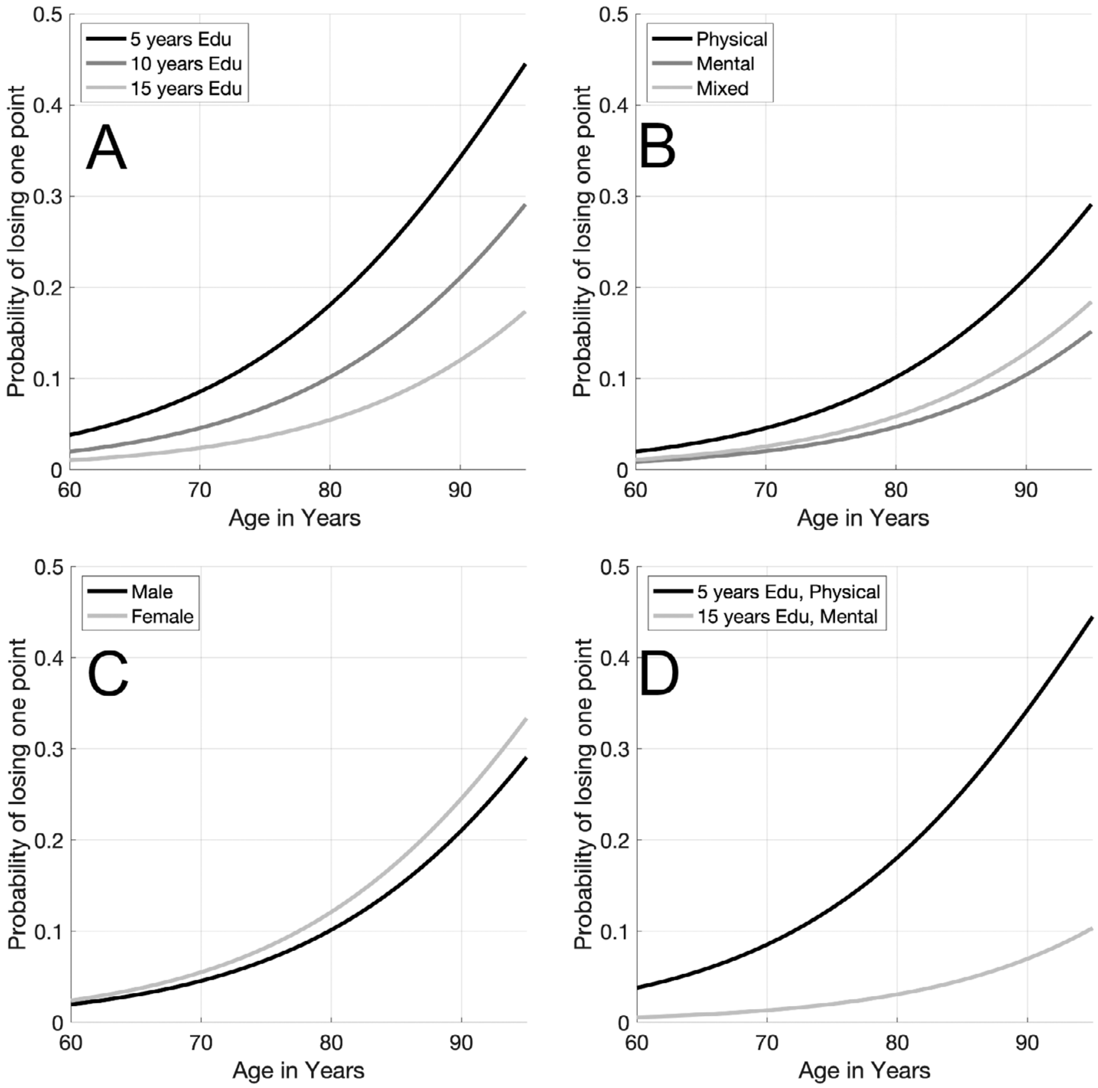

Figure 6. Probability of losing one point on the visuospatial task. Panel A shows the variability across years of education, B) across job types, C) across sex, and D) the combination of the significant effects of education and job type.

effort employment are essential for later-life cognitive functioning (Smart, 2015).

The current work uses gross labelling of job types with three categories, thereby oversimplifying the effects of occupation on one's life and aging. Future directions will use information about the duration and specific occupational activities (Gadermann et al., 2014; Peterson et al., 1999). Such an approach will provide a more detailed and nuanced look at occupational demands and whether they serve as cognitive training regimens leading to maintained brain and cognitive health in later life (Habeck et al., 2020).

There was a significant sex effect on working memory, where females had a greater probability of losing one point on the digit span working memory task than males. In executive function, sex effects show the males with an increasing likelihood of losing one point as they age, whereas the females do not display this increase. Taken in context with the other lifetime exposures, males have a rapid increase in the probability of losing one point as they age, which is not lessened by the beneficial effects of education and job type. On the other hand, the females do not demonstrate a rapid increase in the probability of losing one point as they age, even for the lower educated, physically effort-based workers.

The current analyses employed sex, education, and job type in the same model, allowing the examination of individual and additive effects between factors. Additive effects are evident in all cognitive domains with significant findings. Therefore, the lifetime exposures utilized in this work demonstrate interrelations with each other, where their combinations provide greater cognitive benefits than anyone alone. Future work will investigate the additive effects to explore the optimal recipe for healthy aging.

Interestingly, the additive lifetime exposure effects finding addresses a concern in the cognitive reserve literature. Cognitive reserve is the concept that lifetime exposures decrease the negative impact of age and disease-related pathology on cognitive performance. An open question is how combinations of lifetime exposures should be modelled and studied. Should their common effects of lifetime exposures be reflected in a global measure of cognitive reserve (Nucci et al., 2012), or do individual contributions of various lifetime exposures combine to form cognitive reserves (Jones et al., 2011)? The findings demonstrate additive effects between education, job type, and sex.

The mechanisms underlying the beneficial effects of lifetime exposures include brain and cognitive reserve concepts. The idea is

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that the experiences one encounters due to sex, education, and employment provide individuals with the neural and cognitive support structures to minimize the adverse effects of aging and neural disease on cognitive performance. This minimization may be physiological, such that specific exposures decrease the negative impact of age on brain tissue or that brain tissue is better maintained (Cabeza et al., 2018; Steffener et al., 2014). The impact of lifetime exposures may also provide the means for someone to develop cognitive skills that transfer to better test performance. The current work focused on identifying factors that moderate the age effects themselves. Only sex with the test of executive function altered the age effects in the present sample. The rest of the factors used in this study directly altered cognitive performance. The result is that clinically relevant age-related declines in cognitive performance are delayed.

Within Barbados, high levels of education are an important source of pride for the nation. Among the seven nations that participated in the more extensive SABE study, people in Barbados and Cuba had the highest years of education (Maurer, 2011). The current work demonstrates the value of this focus. Higher education decreases the probability of cognitive decline with advancing age. Higher education allows for more significant job opportunities where the jobs exist. Unfortunately, on an island such as Barbados, job opportunities may still be limited to those relying on physical effort, even for individuals with advanced degrees. Despite any limitations, the current results demonstrate that the two factors beneficially combine to lessen age-related cognitive decline for people with high education and employment requiring high mental effort.

Another factor that could benefit Barbados is the widespread use of the Bajan dialect and English. Therefore, the conduction of daily life involves repeated switching between the two and is considered a form of bilingualism (Oschwald et al., 2018), with active engagement having beneficial cognitive effects (Bialystok, 2015). Although not addressed due to a lack of questions about language use in the study, future work will explore whether using a dialect provides cognitive benefits. Greater understanding in this domain offers public policy insight into preserving local dialects' cultural and cognitive benefits.

Previous use of this data led to an increased understanding of Barbadians' cognitive impairment-free life expectancy (Ashby-Mitchell et al., 2015). It is important to remember that the SABE data was collected in 1999–2000. In the over two decades since collecting this data, Barbados has made concerted efforts to increase the public understanding of age-related dementias, partly through participation in the November Alzheimer's disease awareness month. The number of centenarians in Barbados is steadily increasing. Replicating and expanding the SABE study in Barbados would evaluate how recent public policy changes have modified cognitive performance in older Barbadians.

One considerable limitation of this work was the 19-point MMSE as a cognitive assessment tool. The MMSE was designed as a screening tool for dementia, and although it assesses multiple cognitive domains, it does so in a limited fashion. Future directions involve more comprehensive cognitive assessments with tools that do not have strong ceiling effects as with the MMSE. Expanded cognitive assessments allow more nuanced and detailed assessments of cognitive differences across ages, occupations, education, and sex.

Despite a relatively large sample size of over 1,300 participants, more than this number is needed to address additional interesting questions. Modelling included three moderating variables: sex, job type, and years of education. The dataset also includes measures of engagement in exercise, social, and artistic leisure activities. An ideal analysis would consist of a wide array of lifetime exposures to identify patterns of lifestyles that have the most significant benefit for minimizing the effects of age on cognition. However, much larger sample sizes are needed to ensure adequate sample sizes in all cells of such a model. For instance, 45 per cent of the current sample stated they exercised regularly. Within the context of delayed memory recall, the factor with the most number of people demonstrating a decline, eight male participants with intellectual jobs, reported that they exercise regularly. For immediate memory recall, there are no participants in that cell. For these reasons, the current analyses utilized limited lifetime exposures.

For these same reasons, the current analyses focused on losing one point as a dependent variable and used binomial logistic regression. Using the entire scale with ordinal or multinomial logistic regression allows for using the whole sample. The use of ordinal logistic regression assumes the same effects across all levels of cognitive performance. This assumption needed revision due to the limited range of possible values. An even greater motivation for the current approach is the same small cell effect mentioned above. The number of people losing a single point compared to the loss of no points had the largest sample sizes. The number of individuals with a loss of more than one point, where possible, was small, making multinomial logistic regression problematic.

The current work did not test for sex, education, and job type interactions. Evidence shows that being female limits one's access to educational opportunities, leading to lower-status job types (Mandel & Semyonov, 2006). This sex effect predicts a higher probability of losing points on cognitive assessments for females than males as people age. Unfortunately, the sample size and variability in the MMSE cognitive assessment limit the ability to explore such effects.

Conclusion

There is a lack of information about cognitive decline in the Caribbean. This study demonstrated that significant findings were found even within the limited scope of the MMSE cognitive screening tool. Age is not a universal negative process affecting all aspects of cognitive performance. In addition, adverse age effects may be minimized or delayed through fixed and modifiable lifetime exposures. Of great interest is that the benefits of lifetime exposures are additive, providing combined benefits. Follow-up studies with detailed assessments of cognitive function and beneficial lifetime exposures will provide insight into the prevalence of cognitive decline in Barbados. They will identify people's beneficial lifetime exposures, providing insight into public policy planning for handling increases in adults with cognitive decline and dementia.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S0714980824000242.

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