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Association of primary lifetime occupational cognitive complexity and cognitive decline in a diverse cohort: results from the KHANDLE study

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Abstract

INTRODUCTION: Higher occupational complexity has been linked to favorable cognitive outcomes, but rarely examined in racially and ethnically diverse populations.

METHODS: In a diverse cohort (N=1,536), linear mixed-effects models estimated associations between main lifetime occupational complexity and domain-specific cognitive decline (z-standardized). Occupational complexity with data, people, and things were classified using the Dictionary of Occupational Titles.

RESULTS: For occupational complexity with data, highest tertile (versus lowest) was associated with higher baseline executive function (β=0.11; 95% confidence interval [CI] 0.00–0.22) and

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Consent Statement
This study was approved by the KPNC Institutional Review Board. All KHANDLE participants provided written informed consent.

Conflicts of Interest
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slower annual rate of decline (β=0.03; 95% CI 0.01–0.06), and higher baseline semantic memory (β=0.14; 95% CI 0.04–0.25). Highest tertile of occupational complexity with people was associated with higher baseline executive function (β=0.29; 95% CI 0.18–0.40), verbal episodic memory (β=0.12; 95% CI 0.00–0.24), and semantic memory (β=0.23; 95% CI 0.12–0.34).

DISCUSSION: In a diverse cohort, higher occupational complexity is associated with better cognition. Findings should be verified in larger cohorts.

Keywords

Cognitive functioning; Cognitive decline; Cognitive reserve; Occupational complexity; Work environment; Risk factors; Longitudinal cohort study

1 Background

An increasing body of research suggests that intellectually stimulating activities during adulthood, such as complex work environments, are associated with better cognitive outcomes among older adults.[1–3] The "cognitive reserve" hypothesis posits that intellectual engagement improves the ability to compensate for age-related neuronal damage and helps maintain brain function in the presence of pathology.[4–6] The potential protective effect of occupational complexity is especially interesting, given that most individuals spend a substantial part of their adult years working. Yet, few studies have examined occupational complexity in relation to cognitive aging. These studies primarily examine occupational complexity across 3 domains of complexity with data, people and things, based on the Dictionary of Occupational Titles (DOT).[7] In a cross-sectional study of a nationally representative sample of Swedish older adults,[8] primary lifetime occupational complexity with data and people were independently associated with higher Mini Mental State Examination (MMSE) scores. In another sample of Swedish adults, complexity with data and people were also associated with better performance in executive tasks (updating and switching, respectively).[9] Similar findings were found in the Lothian birth cohort, where complexity with data and people were associated with better cognitive performance at age 70.[2] In comparison, among a sample of older Brazilian adults, complexity with data and things were independently associated with higher MMSE scores, but no associations were found for complexity with people.[10] Two studies also examined occupational complexity with cognitive decline.[11,12] In a sample of older adults from the Swedish Adoption/Twin Study of Aging, authors found that, although complexity with data and people were associated with cognitive performance, only complexity with people was associated with rate of cognitive change.[11] Similarly, using data from the Midlife in the United States (MIDUS) study, authors found higher levels of pre-retirement occupational complexity with people associated with less decline post-retirement.[12] Furthermore, findings from the Swedish Adoption/Twin Study of Aging show that complexity with people was further associated with a reduced risk of AD and all types of dementia.[13] However, most prior studies have assessed cognition at a single time point only, which is insufficient to conclude whether occupational complexity protects against cognitive decline.[14] Without repeated cognitive assessments, it is also difficult to assess whether associations are due to effects of intellectual engagement on cognition or if higher mental ability influences occupational opportunities or the complexity of work-related activities.[14,15] Most of the existing evidence are based on smaller European samples, and very few studies assessing occupational complexity and cognitive outcomes have included racially and ethnically diverse samples, or examined whether associations varied across race and ethnicity.[16] This is a major evidence gap, as structural racism affects both employment opportunities (i.e., occupational segregation)[17,18] and experiences of cognitively enriching work environments, which may lead to differential associations between occupational complexity and cognitive outcomes by race and ethnicity. Black and Latino individuals often do not have jobs commensurate with their educational levels, are more likely to spend time looking for employment and accumulate fewer job-related skills over the course of adulthood and thus may have less opportunity to benefit from work-based intellectually stimulating activities.[19] In contrast, resource substitution theory posits that the relationship between occupational complexity and cognition may be more pronounced for Black or Latino individuals, as compared to White individuals, as racial minorities are likely to have less access to alternative socioeconomic resources such as power, authority, and earnings (and be more dependent on the limited resources available).[20] Thus, we hypothesize that race and ethnicity interacts with occupational complexity and cognitive function.

To address this research gap, we aimed to examine the associations of three domains of occupational complexity (data, people, and things) of individuals' main lifetime occupation with late-life cognitive function and change across three domains (executive function, verbal episodic memory, and semantic memory) in a diverse cohort of individuals aged 65 and older.

2 Methods

2.1 Study Population

The Kaiser Healthy Aging and Diverse Life Experiences (KHANDLE) cohort (N=1,712) consists of approximately equal proportions of Asian, Black, Latino and White community-dwelling adults residing in the San Francisco Bay and Sacramento areas of Northern California. KHANDLE aims to examine how lifecourse factors influence late-life brain health and cognitive decline in a racially and ethnically diverse cohort. KHANDLE-eligible participants were long-term members of Kaiser Permanente Northern California (KPNC), an integrated health care delivery system, who previously participated in the KPNC Multiphasic Health Checkups (MHC) during 1964–1985, spoke English or Spanish, and were 65 years and older. KHANDLE exclusion criteria included electronic medical record diagnosis of dementia or other neurodegenerative diseases, or presence of a health condition that would impede participation in study interviews (e.g., hospice activity, history of end stage renal disease, dialysis, severe chronic obstructive pulmonary disease, or congestive heart failure hospitalizations). Three interview cycles were completed from March 2017 to June 2021. The first two interview cycles were conducted in-person, and the third cycle of interviews were conducted by phone due to the COVID-19 pandemic.

For this study, we excluded individuals who did not report race or ethnicity or who reported Native American race due to small numbers (n=3), those who could not be assigned codes (n = 164) due to missing, incomplete, or non-gainful occupational information (i.e., homemakers), and those completely missing cognitive measures (n=9). Non-gainful occupations were excluded as the DOT defines occupational complexity for gainful employment only.[21] The remaining 1,536 individuals constitute our final analytic sample (Figure S1 in Supplement). This study was approved by the KPNC Institutional Review Board. All KHANDLE participants provided written informed consent.

2.2 Occupational Complexity Measures

Individuals responded to open-ended survey items during Wave 1 of data collection about their "main lifetime occupation" job title and task specification. The self-reported occupation was assigned an occupation code according to the 1970 U.S. Census occupational classification scheme by at least two trained independent coders. Any discrepancies found across the coders were reviewed and resolved by a third independent reviewer. Audio recordings of the original interviews were reviewed as needed to assist in occupational coding decisions. Main lifetime occupation codes were linked to occupational complexity scores published in the DOT (4th edition).[6,22] Occupational complexity scores for each domain (ranging 0–6 for data; 0–8 for people; 0–7 for things) were then reverse-coded so that higher scores indicate higher complexity (complexity score details provided in Table 1). As an example, for the occupational category "Judges," the assigned scores (reverse-coded) are 5 for occupational complexity with data, 8 for occupational complexity with people, and 0 for occupational complexity with things, indicating that the occupation mostly involves "coordinating" data, "mentoring" people, and "handling" things. Average complexity was 3.9 (± 1.3) for occupational complexity with data, 3.0 (± 2.0) for people, and 1.9 (±2.0) for things. In comparison, average complexity for these same complexity domains were 3.3 (± 1.9), 6.2 (± 2.0), and 4.5 (± 2.6) in a large sample of the U.S. labor force in 1971.[13,23] Individuals were assigned to low, medium, and high categories according to the tertile distribution of the pooled sample for each occupational complexity domain. For occupational complexity with data, scores in the lowest tertile ranged 0.0–3.2, middle tertile 3.3–4.6, highest tertile 4.7–6; for people, lowest tertile: 0.0–1.9, middle tertile: 2.0–3.6, highest tertile: 3.7–8.0; and for things, lowest tertile: 0.0–0.2, middle tertile: 0.3–2.9, highest tertile: 3.0–6.8.

2.3 Cognitive Measures

We used a subset of the Spanish and English Neuropsychological Assessment Scales (SENAS) tests to measure three cognitive domains (executive function, verbal episodic memory, and semantic memory) across the three interview cycles. SENAS is a battery of cognitive tests that has previously undergone extensive development for valid comparisons of cognitive aging across diverse racial, ethnic, and linguistic groups.[24–28] The SENAS measures for these three domains provide comprehensive measurement of multiple cognitive domains and sensitive measurement across the full spectrum of cognitive function without appreciable floor or ceiling effects.[29] Visual-spatial ability was not routinely measured in KHANDLE due to time-constraints.

Executive function composite scores were obtained using component tasks of category fluency (animals, supermarket test), phonemic (letter) fluency and working memory (digit span backward, visual span backward, list sorting).[30] Verbal episodic memory composite scores were derived from a multi-trial word-list learning test.[24] Semantic memory composite scores were derived from verbal (object naming) and non-verbal (picture association) tests.[24] Further details on the administration procedures, measure development and psychometric characteristics of SENAS have been extensively described elsewhere.[24,25,30] Raw scores for each domain were z-standardized using the full KHANDLE sample mean and standard deviation at Wave 1. Cognitive assessments during Wave 3 occurred by phone due to the COVID-19 pandemic, and we were unable to assess semantic memory in Wave 3 due to its use of visual prompts.

2.4 Covariates

We obtained baseline sociodemographic information on age (in years), sex (male or female), self-reported race and ethnicity (categorized as Asian, Black, Latino, and White), and educational attainment from Wave 1. We assessed childhood socioeconomic conditions using both maternal and paternal educational attainment (each categorized as less than ≤12 years versus >12 years), and exposure to adverse childhood experiences (ACEs). Age, sex, race and ethnicity, and educational attainment have well-established associations with cognitive impairment.[31] Socioeconomic differences in childhood have potential consequences for later life cognition, where childhood socioeconomic status is linked to childhood advantages and disadvantages (e.g., ACEs) that may directly affect individuals' cognitive development, and thus later life cognition.[32] For race and ethnicity, participants who reported Latino ethnicity were categorized as Latino, and otherwise assigned based on race reported (Asian, Black, or White). Participants who did not report Latino ethnicity and reported multiple races were assigned a primary race following a hierarchy based on historical marginalization in the United States (in the order of Black, Asian, White).[33] Education was self-reported as the highest level of education completed and categorized as high school or less, technical/trade education or some college, college graduate and above. Individuals were asked whether they experienced each of nine ACEs when they were age 16 years or younger: parents separated or divorced; parents remarried; witnessed domestic violence; substance abuse by family member; loss of job by parent; parent had to go to jail; serious illness of family member; death of mother; and death of father. A composite ACE score was constructed as count of number of ACEs ever experienced, ranging from 0 (no ACE ever experienced) to 9 (experienced every ACE). Given the small number of participants who reported more than 4 ACEs, ACE scores were further categorized as 0, 1, 2, 3, or 4+ ACEs.[34] Interview mode is an indicator of whether the interview was conducted by phone or in-person to account for potential bias due to phone effects.

2.5 Statistical Analysis

Missingness overall was around 24%. We imputed missing covariates using multiple imputation by chained equations, and main analyses are applied to 30 imputed datasets.[35] We implemented linear mixed-effects models to examine the longitudinal associations of each occupational complexity measure (i.e., occupational complexity with data, people, or things; lowest tertile as reference group) with domain-specific (i.e., executive function, verbal episodic memory, or semantic memory) annual rate of cognitive change. Models allowed for random intercepts and included baseline age, time since baseline (in years), sex, race and ethnicity, educational attainment (with high school or less as reference group), maternal education, paternal education, ACE score, and an interaction term for each occupational complexity measure and time since baseline. As executive function and verbal episodic memory were conducted both in-person and by phone, all models for executive function and verbal episodic memory included an indicator for interview mode. We used model constraints to adjust for practice effects, based on prior analyses in this cohort.[36] We investigated potential effect modification by race and ethnicity by: a) replicating the main analyses within each racial and ethnic group; and b) by adding multiplicative interaction terms with each occupational complexity measure in the pooled analyses. We used the fitted models to predict mean cognition over time for each occupational tertile, and plotted the corresponding trajectories averaged across all other baseline covariates. All analyses were conducted using R statistical software, version 4.1.1 (R Project for Statistical Computing).

3 Results

The final analytic sample (n=1,536) consisted of 24% Asian, 27% Black, 20% Latino, and 29% White participants (Table 2). The average length of follow-up was 2.4 years (range: 0–4.2 years). The average age of participants at baseline was 76 years, 59% were females, and 50% had attained college or higher education. Compared to individuals excluded from the analyses, those included in the analyses were younger (76.0 versus 77.9 years), more likely to self-identify as non-Hispanic Black (26.7% versus 18.8%), and have college education or above (49.6% versus 35.2%; Table S1). The distributions across each occupational complexity domain by race and ethnicity were significantly different (data $p < 0.0001$; people $p=0.002$; things $p=0.02$). Distributions of the tertiles of occupational complexity for each race and ethnicity subgroup is illustrated in Figure 1. Black and Latino individuals were disproportionately categorized in the lowest complexity tertile for complexity with data (22% Asian, 37% Black, 39% Latino, and 26% White) and for complexity with people (24% Asian, 33% Black, 33% Latino, and 25% White), while Asian individuals were disproportionately categorized in the lowest complexity tertile for complexity with things (32% Asian, 28% Black, 28% Latino, 29% White).

3.1 Occupational Complexity with Data

In adjusted models, the middle and highest tertiles of occupational complexity with data (versus lowest) were associated with higher baseline executive function (β 0.14 SD units; 95% CI 0.03, 0.24 and β 0.11; 95% CI 0.00, 0.22, respectively) and slower rates of decline (β 0.06 SD units/year; 95% CI 0.03, 0.08 and β 0.03; 95% CI 0.01, 0.06, respectively). The middle and highest tertiles of occupational complexity with data (versus lowest) were not significantly associated with baseline verbal episodic memory nor decline (Figure 2, Table S2). The middle and highest tertiles of occupational complexity with data (versus lowest) were associated with higher baseline semantic memory (β 0.22; 95% CI 0.12, 0.33 and β 0.14; 95% CI 0.04, 0.25, respectively), but not associated with decline. We found statistically significant interactions between occupational complexity with data and race and ethnicity with respect to semantic memory, such that among individuals in the middle and highest tertiles (versus lowest), Asian individuals (versus White) have higher baseline semantic memory (β 0.37; 95% CI 0.10, 0.64 and β 0.33; 95% CI 0.06, 0.60, respectively), and among individuals in the highest tertile (versus lowest), Latino individuals (versus White) have higher baseline semantic memory (β 0.35; 95% CI 0.07, 0.62). No statistically significant associations were found for executive function nor verbal episodic memory. Stratified analyses by race and ethnicity are provided in Tables S3–S6.

3.2 Occupational Complexity with People

In adjusted models, the middle and highest tertiles of occupational complexity with people (versus lowest) were associated with higher baseline executive function (β 0.15; 95% CI 0.04, 0.25 and β 0.29; 95% CI 0.18, 0.40, respectively) but not associated with decline (Figure 2, Table S7). The highest tertile of occupational complexity with people (versus lowest) was associated with higher baseline verbal episodic memory (β 0.12; 95% CI 0.00, 0.24), but not significantly associated with decline. The middle and highest tertiles of occupational complexity with people (versus lowest) were associated with higher baseline semantic memory (β 0.15; 95% CI 0.05, 0.25 and β 0.23; 95% CI 0.12, 0.34, respectively), but not associated with decline. We found statistically significant interactions between occupational complexity with people and race and ethnicity with respect to semantic memory, such that among individuals in the middle and highest tertiles (versus lowest), Latino individuals (versus White) have higher baseline semantic memory (β 0.27; 95% CI 0.004, 0.55 and β 0.31; 95% CI 0.03, 0.59, respectively), but not for executive function nor verbal episodic memory. Stratified analyses by race and ethnicity are provided in Tables S8–S11.

3.3 Occupational Complexity with Things

In adjusted models, middle and highest tertiles of occupational complexity with things (versus lowest) were not associated with baseline executive function nor decline (Figure 2, Table S12). The middle and highest tertiles of occupational complexity with things (versus lowest) were not associated with lower baseline verbal episodic memory. Compared with the lowest tertile, the middle tertile was associated with slower decline (β 0.06; 95% CI 0.02, 0.10), but the highest tertile was not associated with decline. Middle and highest tertiles of occupational complexity with things (versus lowest) was not associated with baseline semantic memory nor decline. We found a statistically significant interaction between occupational complexity with things and race and ethnicity with respect to semantic memory, such that among individuals in the highest tertile (versus lowest), Asian individuals (versus White) have lower baseline semantic memory (β −0.27; 95% CI −0.53, −0.008), but not for executive function nor verbal episodic memory. However, in race and ethnicity-stratified analyses, no associations were statistically significant (Tables S13–16).

4 Discussion

In this racially and ethnically diverse cohort of older adults, higher occupational complexity with data was associated with higher baseline executive function and semantic memory and slower decline for executive function. As an example, individuals categorized in occupations with highest occupational complexity with data (ranging: 4.7–6.0), versus those with lowest complexity with data (ranging: 0.0–3.2), had a mean difference of 0.11 SD units higher in executive function. Higher occupational complexity with people was associated with higher baseline cognition across all domains. Only the middle tertile of occupational complexity with things, but not the highest, was associated with slower decline in verbal episodic memory. This study expands our understanding of the associations between specific types of occupational complexity and domain-specific cognitive change over time.

Our findings are consistent with prior studies demonstrating that higher occupational complexity with data and people were associated with better levels of cognitive performance in later life.[2,8,9,11] Among studies that examined cognitive change,[4,11,12] only higher occupational complexity with people was found to be associated with slower cognitive decline. Although most prior studies did not report any significant associations for occupational complexity with things and cognitive outcomes, one study based in Brazil had found higher occupational complexity with data and things were associated with better cognitive performance in later life, while finding no significant associations for occupational complexity with people.[10] Inconsistent findings related to occupational complexity with things may be due to its low predictive ability and low reliability, compared to the other occupational complexity measures.[13,22] Studies assessed cognition using varying methods, which may also contribute to incomparable results across studies. Very few studies have examined the association between dimensions of occupational complexity and specific cognitive domains. One cross-sectional study found that occupational complexity with data and people were associated with lower error rates in performance of executive tasks.[9] In comparison, we found that higher occupational complexity with data (but not higher occupational complexity with people) was associated with slower decline in executive function, and that higher occupational complexity with things (for middle tertile only) was associated with slower decline in verbal episodic memory. These differences observed in cognitive function by levels of occupational complexity may also have important consequences for other health outcomes, such as stroke or mortality.[37,38]

For occupational complexity with data and people, a greater proportion of Black and Latino individuals were categorized in jobs with lowest complexity. In general, the association between each occupational complexity measure and cognitive domains did not significantly differ by race and ethnicity, except for some relationships across occupational complexity measures and semantic memory. It is possible that we were underpowered to precisely estimate differences in associations of occupational complexity and rate of decline by race and ethnicity. Future research on larger-scale, diverse populations are needed to further examine these issues.

A limitation of this study is that, although the DOT has been widely used to determine occupational complexity,[7] it assigns scores according to occupational titles and does not capture individual variability within the same occupational title.[12] Due to possible nondifferential exposure misclassification, this type of job-exposure matrix approach to classifying occupational experiences may underestimate the magnitude of effect of occupational conditions.[39,40] We were also unable to assess occupational duration, which may be an important factor to determine whether there is a dose-response effect in the association between occupational complexity and cognition.[2] For semantic memory, we only had two waves of data and may be limited in capturing cognitive change longitudinally and may also be more susceptible to measurement error. We investigated three domains of occupational complexity on three cognitive domains, potentially increasing the risk of false-positive results. However, we chose not to adjust for multiple comparisons. Rather, the 'significance' of our findings is based on the strength and consistency of the associations observed across related outcomes.[41] Individuals who reported non-gainful occupational information (i.e., homemakers) were excluded, but may still be involved in unpaid/informal labor that may involve a range of skillsets. Although we incorporate indicators of early-life social conditions, we were unable to adjust for potentially confounding health factors in mid-adulthood, and there may be some residual confounding. Finally, although we found some significant associations between occupational complexity with things and slower rate of decline in verbal episodic memory, this observation may be a spurious finding given that occupational complexity with things has been shown to have low predictive ability and reliability.[42]

There are several strengths of this study. First, we have longitudinal cognitive data, which provides us with a baseline assessment of cognition and allows us to assess cognitive change over time in relation to occupational complexity, as well as the direction of the association. Although our study captures cognitive decline over a relatively short follow-up period, the study is still ongoing and planned follow-up assessments will allow us opportunities to further understand longer-term effects of occupational complexity on cognitive decline. Pre-existing differences in childhood cognitive ability may lead to higher education and better access to jobs with higher occupational complexity.[14] Our findings on occupational complexity with data on slower rate of decline in executive functioning is most relevant in this context. We also partially addressed this concern by controlling for educational attainment, which may be an indicator for an individual's prior cognitive abilities and is usually completed before entering the workforce.[8] Our study also has a diverse racial and ethnic composition that better represents the diversifying workforce in the U.S.[16] and the populations disproportionately burdened by dementia and cognitive health inequalities.[43–45] We were also able to examine specific domains of occupational complexity in relation to domain-specific cognitive decline. The heterogeneity present in our results highlights the need to distinguish across types of occupational complexity, as well as different cognitive domains, to better understand the occupational complexity-cognition relationship.

Our sample is composed of long-term members of Kaiser Permanente Northern California and results may not be generalizable to non-KPNC members and those without health insurance, since inclusion into the KHANDLE cohort was based on health insurance plan membership. Our findings may have limited generalizability to the broader U.S. population, especially younger adults who have experienced changes in work culture or work-related values, as well as changes in work environments brought on by the COVID-19 pandemic (i.e., remote work). Nevertheless, our comprehensive work on three domains of occupational complexity in association with cognitive aging across domains may help guide strategies to modify work environments to better support cognitive functioning in late life. Further research is warranted to better understand the pathways through which different types of occupational complexity may differentially affect domain-specific cognitive functioning in late life to create work environments that promote cognitive health.

In conclusion, we found that higher occupational complexity with data and people were associated with different cognitive domains in this racially and ethnically diverse longitudinal cohort of older adults. More studies on diverse populations are needed to build on these findings to better understand lifecourse social drivers of cognitive aging.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

CI	Confidence Interval
DOT	Dictionary of Occupational Titles
KHANDLE	Kaiser Healthy Aging and Diverse Life Experiences
KPNC	Kaiser Permanente Northern California
MHC	Multiphasic Health Checkups
SENAS	Spanish and English Neuropsychological Assessment Scales
ACEs	Adverse Childhood Experiences

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Research in Context

Systematic Review:

We examined literature on occupational complexity, mental work demands and late-life cognition and dementia. Prior studies did not include diverse samples or consider race and ethnicity in their analyses, nor examined specific types of occupational complexity on domain-specific cognitive outcomes. Relevant work is discussed and cited.

Interpretation:

This study expands prior research by examining the associations between types of occupational complexity on domain-specific cognitive decline in a racially and ethnically diverse cohort. Overall, higher occupational complexity with data and people were differentially associated with better baseline cognition and slower decline. We found partial support for higher occupational complexity with things and slower decline in verbal episodic memory only. Occupational complexity scores varied across race and ethnicity, but most associations did not significantly differ.

Future Directions:

Further studies in larger diverse populations are needed to examine longitudinal associations between occupational complexity and late-life cognitive function.

Highlights

- Few studies examined occupational complexity on cognition in diverse populations.
- Racial and ethnic minorities disproportionately exposed to lower occupational complexity.
- Occupational complexity with data and people associated with better cognition.

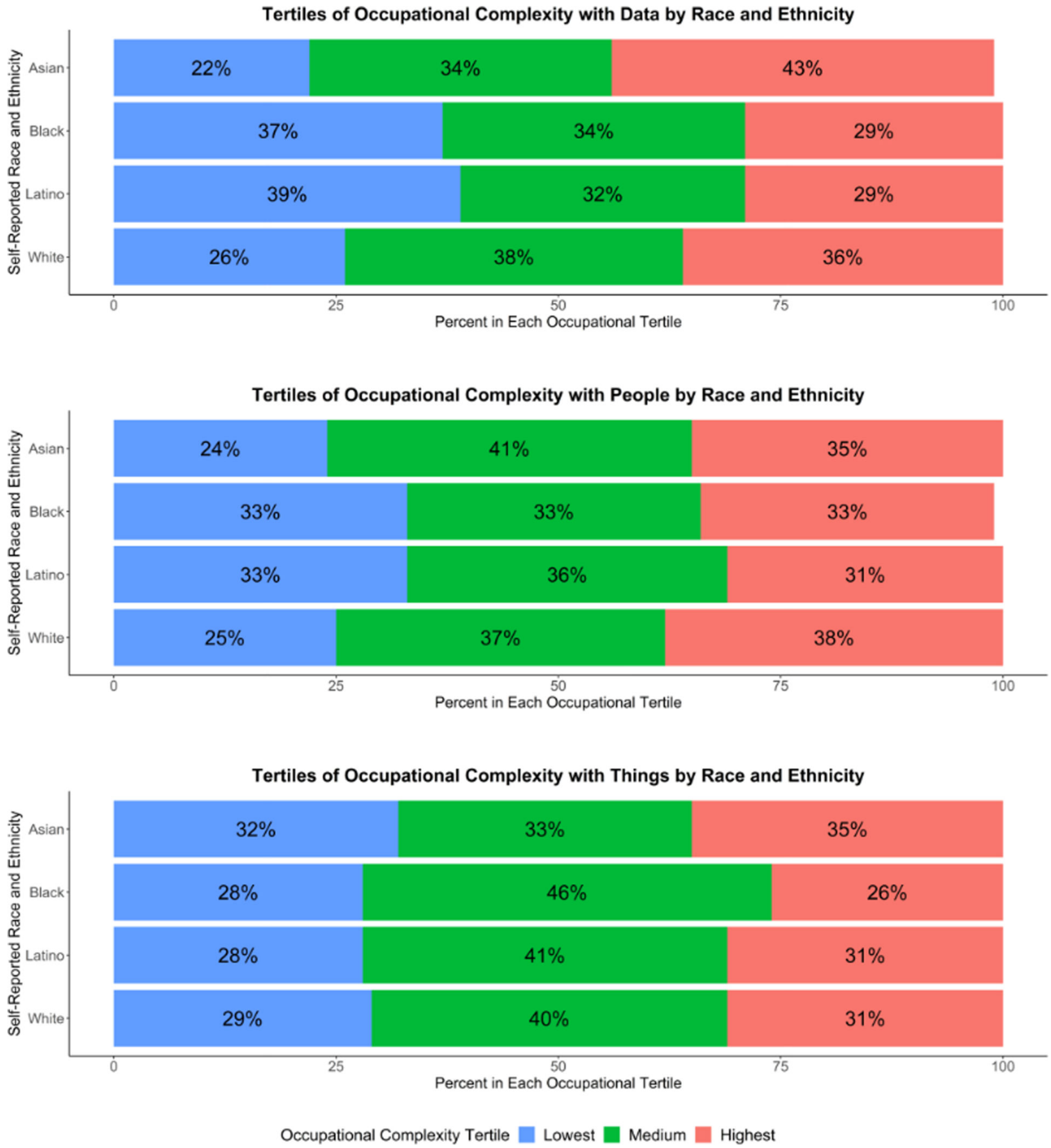

Figure 1.

Tertiles of Occupational Complexity (with Data, People, and Things) for Self-Reported Main Lifetime Occupation, by Race and Ethnicity

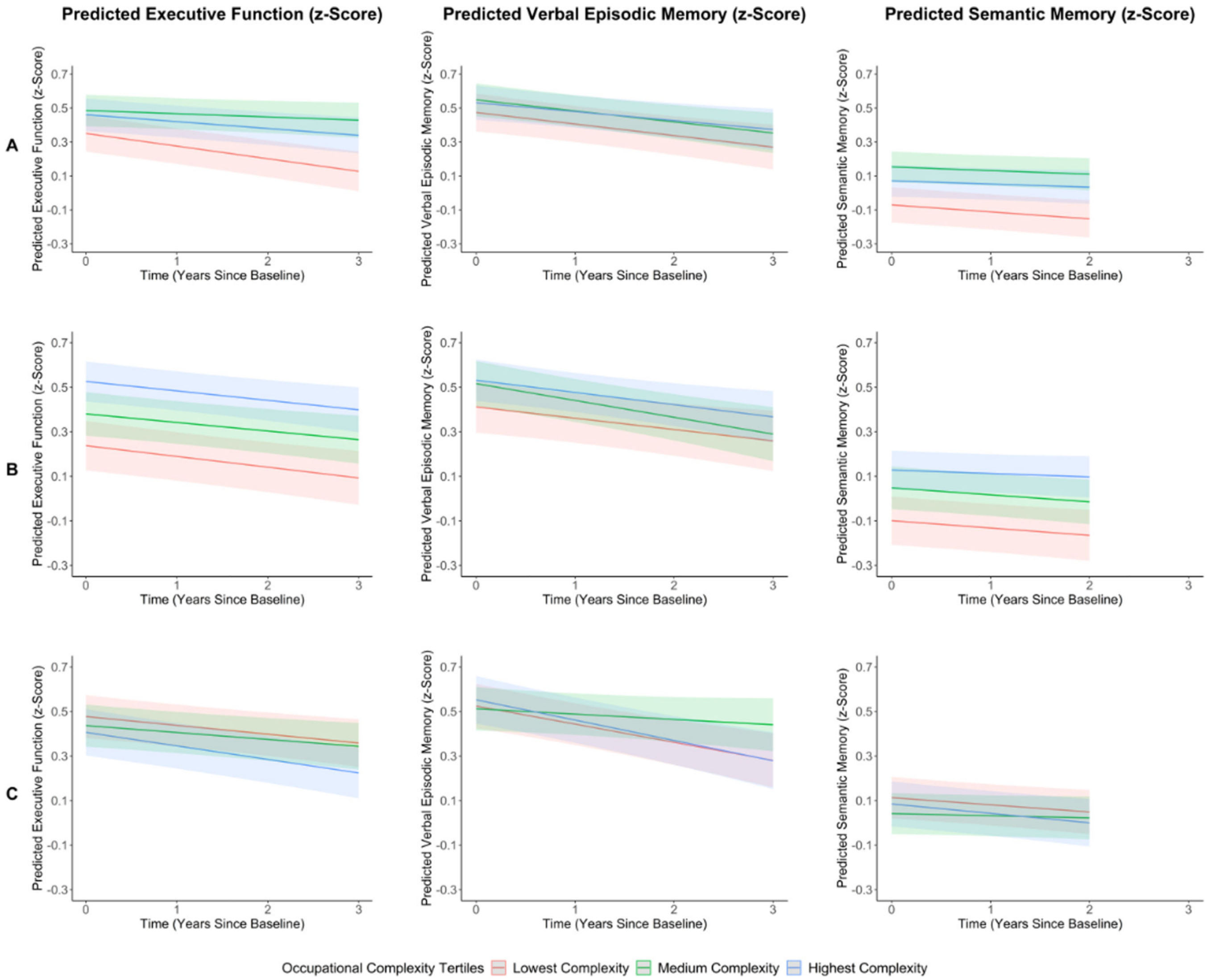

Figure 2.

Predicted Domain-Specific Cognitive Trajectories by Tertiles of Occupational Complexity Scores (Data, People and Things)

Trajectories represent predicted marginal means of z-scores for each cognitive domain (executive function, verbal episodic memory, semantic memory) over time, across tertiles of occupational complexity (**Panel A:** data, **Panel B:** people, **Panel C:** things). Models are adjusted for baseline age, time since baseline, sex, race and ethnicity, educational attainment, maternal education, paternal education, ACE score, and the interaction term for each occupational complexity measure and time. All models include random intercepts and are adjusted for practice effects. Models for executive function and verbal episodic memory include an indicator for interview mode. Models for semantic memory were only available across two time points.

Table 1.

Rating Scales* of Occupational Complexity Levels in Relation to Data, People, and Things, Based on the *Dictionary of Occupational Titles (DOT), 4th Edition*

Data	People	Things
6 Synthesizing	8 Mentoring	7 Setting-Up
5 Coordinating	7 Negotiating	6 Precision Working
4 Analyzing	6 Instructing	5 Operating-Controlling
3 Compiling	5 Supervising	4 Driving-Operating
2 Computing	4 Diverting	3 Manipulating
1 Copying	3 Persuading	2 Tending
0 Comparing	2 Speaking-Signaling	1 Feeding-Offbearing
	1 Serving	0 Handling
	0 Taking Instructions-Helping	

*The ratings have been reversed for this study, so that a higher score reflects greater complexity (i.e., for Data, “Synthesizing” was recoded from 0 to 6).

Table 2:

Descriptive Statistics for KHANDLE* Analytical Sample at Baseline, Overall and Stratified by Racial and Ethnic Group

	Overall Sample	Asian Individuals	Black Individuals	Latino Individuals	White Individuals
Individuals, n (%)	1,536	373 (24.3)	410 (26.7)	306 (19.9)	447 (29.1)
Occupational Complexity†					
Complexity with Data, n (%)					
Lowest Complexity	486 (31.6)	85 (22.8)	157 (38.3)	123 (40.2)	121 (27.1)
Medium Complexity	528 (34.4)	129 (34.6)	138 (33.7)	98 (32.0)	163 (36.5)
Highest Complexity	522 (34.0)	159 (42.6)	115 (28.1)	85 (27.8)	163 (36.5)
Complexity with People, n (%)					
Lowest Complexity	456 (29.7)	91 (24.4)	145 (35.4)	107 (35.0)	113 (25.3)
Medium Complexity	566 (36.9)	155 (41.6)	138 (33.7)	105 (34.3)	168 (37.6)
Highest Complexity	514 (33.5)	127 (34.1)	127 (31.0)	94 (30.7)	166 (37.1)
Complexity with Things, n (%)					
Lowest Complexity	448 (29.2)	119 (31.9)	112 (27.3)	87 (28.4)	130 (29.1)
Medium Complexity	612 (39.8)	122 (32.7)	188 (45.9)	123 (40.2)	179 (40.0)
Highest Complexity	476 (31.0)	132 (35.4)	110 (26.8)	96 (31.4)	138 (30.9)
Sociodemographic Characteristics					
Age (in years), mean (SD)	76.0 (7.1)	75.5 (7.0)	75.5 (7.1)	75.9 (6.6)	76.9 (7.5)
Females, n (%)	906 (59.0)	197 (52.8)	274 (66.8)	177 (57.8)	258 (57.7)
Highest Degree in Education, n (%)					
High School or Less	280 (18.2)	35 (9.4)	83 (20.2)	93 (30.4)	69 (15.4)
Trade or Some College	495 (32.2)	80 (21.5)	187 (45.6)	111 (36.3)	116 (26.0)
College and Above	762 (49.6)	258 (69.2)	140 (34.2)	102 (33.3)	262 (58.6)
Maternal Education Level‡, %					
≤ 12 Years	75.8	77.0	79.7	87.0	63.5
> 12 Years	24.2	23.0	20.3	13.0	36.5
Paternal Education Level‡, %					
≤ 12 Years	68.6	54.6	86.9	76.9	57.7
> 12 Years	31.4	45.4	13.1	23.1	42.3
Childhood ACE score‡, %					
0	30.3	43.7	24.4	21.8	30.5
1	25.5	27.1	25.2	21.9	26.9
2	19.9	18.1	20.3	23.4	18.7
3	12.3	6.7	15.8	14.8	12.0
4 or more	12	4.4	14.4	18.1	11.9

*KHANDLE = Kaiser Healthy Aging and Diverse Life Experiences

†Occupational complexity measures were assessed as tertiles per occupational complexity measure in the pooled sample

‡ Maternal education level, paternal education level, and childhood ACE scores are presented in percentages, as these descriptive statistics are imputed using multiple imputation by chained equations (applied to 30 datasets)