

Sociodemographic Factors in Older Adults' Gait Speed Decline: A Gender Disaggregate Growth Curve Analysis of the Ibadan Longitudinal Study of Ageing


Journal of Aging and Health
2025, Vol. 0(0) 1–13
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DOI: 10.1177/08982643251329431
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Abstract

Background: Gait speed is an important predictor of older adults' well-being. We estimated the influence of sociodemographic factors on the gait speed decline of community-dwelling older Nigerians. **Methods:** Using the Ibadan Study of Ageing (2007, 2008, and 2009 cycles), we completed a gender disaggregate analysis of sociodemographic influences on participants' gait speed trajectory using mixed-design ANOVA and growth curve analysis. **Results:** At baseline, 53.2% of participants were female, 61.9% were married, with an average age of 75.5 ± 6.8 years and gait speed of 0.96 ± 0.32 m/s. Gender-specific models showed slower gait speed decline in men ($\beta = -0.05, p < .001$) compared to women ($\beta = -0.09, p < .001$). Widowhood ($\beta = -0.07, p = .001$) for women, high socioeconomic status ($\beta = -0.01, p = .009$) for men, and chronic disease burden for women ($\beta = -0.02, p = .010$) and men ($\beta = -0.03, p = .008$) were significant predictors of gait speed decline. **Conclusion:** Addressing culture-related widowhood and women's vulnerabilities, improving health coverage, and promoting lifestyle modifications may mitigate mobility decline among older Nigerians.

Keywords

chronic disease, mobility, Nigeria, social determinants of health, socioeconomic

Introduction

Mobility is vital for quality of life in ageing, as it promotes functional ability and well-being in older adults (Freiberger et al., 2020). Functional capacity in older adults is often characterised by gait speed (Busch et al., 2015), which facilitates social participation, prevents isolation and depression, and enables independence in daily activities (Freiberger et al., 2020; Hirvensalo et al., 2000; Iezzoni et al., 2001). Decreased gait speed tends to increase the rate of falls, hospitalisation, and all-cause mortality in older adults (Hardy et al., 2011; Studenski et al., 1994).

This study was grounded in the Social Determinants of Health (SDOH) framework, which explores how the systems into which individuals are born and live shape their health outcomes (World Health Organization, 2022). While the World Health Organization (WHO) identifies health access, education, economic, social, and environmental factors as key SDOH, demographic factors such as age, gender, marital

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status, and religious affiliation have also been linked to health inequalities within and across populations (Hosseini Shokouh et al., 2017; Karran et al., 2023). Therefore, this study examined the associations between gait speed decline and a broader range of sociodemographic variables including age, gender, marital status, area of residence, education, religious affiliation, religiosity, and socioeconomic status, using data from the Ibadan Study of Ageing (ISA), Nigeria.

Nigeria is the most populous nation in Africa (He et al., 2020). In 2020, Nigeria's 10.9 million older adults aged 60 years and above was the highest in Africa and the 19th in the world, with a projection to rise to 11th in the world (33.2 million) by 2050 (He et al., 2020). Although studies on the sociodemographic determinants of mobility in older adults have been conducted in high-income countries such as the United States (Shumway-Cook et al., 2005) and Canada (Onyeso et al., 2024), the findings may not be transferable to sub-Saharan Africa due to distinct societal contexts. For instance, while inequalities due to gender and marital status are less apparent in Western cultures (Pailhé et al., 2021), in Nigeria, gender roles and stereotypes linked to singlehood can significantly affect ageing experiences (Osinuga et al., 2021; Ude & Njoku, 2017). Moreover, whereas existential anxiety may drive religiosity among Western older adults, religiosity often serves their Nigerian counterparts as a coping mechanism against disease burden, low socioeconomic status, and oppressive cultural practices such as the social isolation of widows (Ede et al., 2023; Ekoh et al., 2023; Ude & Njoku, 2017).

The SDOH context varies across countries and regions (Hosseini Shokouh et al., 2017) because health inequalities are shaped by economic policies, development agendas, social norms, social policies, and political systems (World Health Organization, 2022). The study of gait speed decline among older adults holds particular relevance in Nigeria due to the systemic neglect of older adults in government policies (Mbam et al., 2022). There is financial and social insecurity, limited social amenities, and inadequate health coverage for older Nigerians (Mobolaji, 2024; Tanyi et al., 2018). Though access to healthcare, social and financial security, critical in preserving mobility during old age, have been espoused in the nascent Nigerian National Policy on Ageing (Federal Republic of Nigeria, 2020), its implementation remains limited (Mbam et al., 2022; Mobolaji, 2024). Older adults with stable finances can afford essential health services, medications, balanced diets, mobility aids, tickets to recreational facilities, and social events. (Mobolaji, 2024). This study aligns with the broader objectives of promoting healthy ageing through the lenses of social justice (Rudnicka et al., 2020).

In line with the global efforts to address the life-course socio-determinants of health, stakeholders continue to advocate for the implementation of the World Health Organization's (WHO) Decade of Healthy Ageing (2020–2030) (Rudnicka et al., 2020) and Age-Friendly Cities initiatives (van Hoof & Marston, 2021). Through these initiatives, the WHO supports older adults' participation in all spheres of life, including social, cultural, civic, spiritual, and economic

activities, without prejudice due to sociodemographic inequalities (Beard et al., 2017). The mission of these initiatives includes enhancing mobility in older adults by promoting physical activity, creating age-friendly environments, integrating health and social care, and fostering inclusivity. These initiatives are expected to be nationalised and implemented (Mbam et al., 2022; Tanyi et al., 2018) as governments in sub-Saharan Africa, including Nigeria have started enacting national policies on ageing (Federal Republic of Nigeria, 2020; Saka et al., 2019).

Despite the recognised importance of maintaining mobility for the health and independence of older adults, there is a paucity of literature on the sociodemographic correlates of gait speed decline among older Nigerians. This paper appears to be the first longitudinal analysis of the sociodemographic determinants of gait speed decline among community-dwelling older Nigerians. Previous analyses of ISA focused on the association of habitual gait speed with cognitive functioning (Ojagbemi et al., 2015) and biophysical factors (Sprague et al., 2023). These studies found that slower gait speed was associated with poor cognitive performance (Ojagbemi et al., 2015; Sprague et al., 2023), as well as reduced physical activity, higher body mass index, and history of hypertension, after adjusting for age, gender, and education (Sprague et al., 2023). While Sprague et al. (2023) conducted a cross-sectional analysis of the 2007 wave of ISA, our study completed a longitudinal gender-disaggregated growth curve analysis spanning the three-year follow-up period (2007–2009). In addition to age, gender, and education, we incorporated marital status, area of residence, religious affiliation, religiosity, socioeconomic status, and chronic disease burden, and provided a more in-depth discussion contextualised within the Nigerian setting. We offered policy recommendations to mitigate the risk of mobility impairments and enhance the quality of life for older adults in Nigeria.

Specifically, this study seeks to identify the extent to which factors such as age, gender, marital status, rurality, education level, and economic status are associated with changes in gait speed over time. We hypothesised that (i) there would be a significant gender difference in participants' sociodemographic distribution; (ii) There would be a significant difference in participants' mean gait speed across study cycles (1–3) and categories of selected sociodemographic variables; (iii) There would be a significant linear and quadratic effect of time on gait speed trajectory over the follow-up period; (iv) There would be a significant fixed effect of sociodemographic variables on the gait speed trajectory; and (v) There would be a significant difference in the gait speed changes across individual participants (random slope variance).

Methods

Data Source

This study is a secondary analysis of the Ibadan Study of Ageing (ISA), a community-based prospective observational

study investigating the profile and determinants of successful ageing. The ISA focused on mental health, physical health, functioning, and disability among older Nigerians aged 65 years and above, with baseline data collected between November 2003 and August 2004. The study was conducted across eight Yoruba-speaking states in Nigeria: Lagos, Ogun, Osun, Ondo, Oyo, Ekiti, Kogi, and Kwara (Gureje et al., 2007). These states represented approximately 22% of the Nigerian population at the time of study. A four-stage area probability sampling method was employed to select participants, with the Kish table used to recruit one participant per household if more than one eligible individual (≥ 65 years and fluent in Yoruba) was present. Baseline in-home interviews and physical assessments were conducted on 2149 consenting participants, yielding a response rate of 74.2% (Gureje et al., 2007). The 25.8% non-response rate was attributed to the inability to trace participants using their recorded addresses, unavailability despite multiple attempts, refusal to participate, physical incapacitation, or death (Oladeji et al., 2011).

Gait speed measurements were first recorded in the 2007 cycle of the ISA which comprised 1356 participants, continuing in 2008 ($n = 1044$) and 2009 ($n = 957$). Therefore, this secondary analysis focused on the second to fourth cycles of the ISA, with the 2007 cycle as the baseline for this analysis. Detailed descriptions of the ISA methodology are provided in earlier reports (Bekibele & Gureje, 2008; Gureje et al., 2007). Ethics approval was granted by the University of Ibadan/University College Hospital Joint Ethical Review Board.

Outcome Variable

The primary outcome was habitual gait speed measured in the 2007, 2008, and 2009 data collection cycles. Participants were instructed to walk at their normal pace through a 1-m acceleration zone, a central 3 or 4-m testing zone, and a 1-m deceleration zone, marked on a safe flat surface, without any verbal prompt (Ojagbemi et al., 2015). Gait speed (m/s) was calculated as distance in metres divided by time in seconds (measured with a stopwatch). In each cycle, the participants repeated the procedure twice and the shortest time was recorded (Ojagbemi et al., 2015). Habitual gait speed is one of the most commonly used tools for assessing mobility and functionality among community-dwelling older adults (Soubra et al., 2019). A recent systematic review of the measurement properties of the habitual gait speed test in community-dwelling older adults reported the test has good psychometric and clinimetric properties, including intraclass correlation reliability ($r = 0.72$ – 0.98) and concurrent, convergent, or discriminant validity ($r = 0.79$ – 0.93) (Mehdipour et al., 2024).

Exposure Variables

The explanatory variables were (sociodemographic factors obtained in the 2007 cycle) age, gender, marital status, area of

residence, education, religious affiliation, and socioeconomic status. The number of chronic diseases (arthritis, diabetes, stroke, hypertension, chronic lung diseases, and cancer) was introduced in the regression models as a covariate.

Variable Description

Age (years), habitual gait speed (m/s), years of education, socioeconomic status, and chronic disease count were continuous variables categorised afterwards for descriptive statistics. The categorical variables were age (68–74 years [youngest-old], 75–84 years [middle-old], 85–108 years [oldest-old]), gender (male, female), area of residence (rural, urban [town, city]), marital status (married, single/separated/divorced, widowed), education (secondary and lower, above secondary), socioeconomic status (low, middle, high), religion affiliation (Christian Orthodox, Christian Pentecostal, Muslim, Traditional Religion, Others), religious frequency (more than once weekly, once weekly, once in many weeks), chronic disease status (no, yes), and attrition status (completed, lost).

Data Analysis

The data were analysed using R version 4.4.1, incorporating the tidyverse, psych, lme4, and lmerTest packages. The ISA analytic weight was applied to the dataset before analysis. The chronic disease and socioeconomic status were derived as follows: chronic disease count was a summation of the diagnosis of (value = 1) arthritis, diabetes, stroke, hypertension, chronic lung diseases, and cancer. The chronic disease count was dichotomised into chronic disease status: no (=0) and yes (≥ 1). The socioeconomic status was derived using principal component analysis (PCA) of participants' household possessions at baseline (Vyas & Kumaranayake, 2006). Of the 21 household items, 11 items (bucket, desk telephone, motorbike, gas or electric cooker, bicycle, air conditioner, microwave, personal computer, mobile phone, deep freezer, motor vehicle) were excluded from the model due to having a category with less than 10% in the frequency distribution (Vyas & Kumaranayake, 2006). The factor loadings of the remaining ten items (tape player, clock, radio, electric fan, television, livestock, video cassette recorder, kerosene stove or coal pot, laundry iron, refrigerator) were obtained through PCA with tetrachoric correlation matrix to correct for the binary nature of the data. Each participant's socioeconomic status was calculated as their \sum (item values \times corresponding factor loadings), subsequently categorised into tertiles (low, middle, and high) (Vyas & Kumaranayake, 2006). The PCA showed good model fit indices: Bartlett's Sphericity Test $\chi^2(45) = 6528.47$, $p < .001$, and Kaiser–Meyer–Olkin Measure of Adequacy (KMO) = 0.860.

Participants' sociodemographic characteristics and gait speed were summarised using descriptive statistics: frequency, percentage, mean, and standard deviation. Before the

inferential analysis, the data were tested for assumptions of the statistical tool. The percentage and pattern of missingness did not require multiple imputation procedures (Fox-Wasylyshyn & El-Masri, 2005). Continuous variables were tested for univariate and multivariate outliers using a standardised Z-score $> \pm 3.29$ and Mahalanobis-distance approaches (Garson, 2012; Tabachnick & Fidell, 2013). Normality (skewness test), sphericity (Mauchly's test), homogeneity of variance (Levene's test), linearity (Q-Q plot), and multicollinearity (variance inflation factor < 4) were determined (Garson, 2012; Tabachnick & Fidell, 2013).

For hypothesis I, Pearson's chi-square test (χ^2) was used to test the gender differences in the distribution of the categories of the sociodemographic variables. Hypothesis II was tested using repeated measures mixed-design ANOVA (F) with Bonferroni adjusted post hoc comparison, reporting Greenhouse-Geisser correction where Mauchly's assumption was violated. Hypotheses III to V were tested using maximum likelihood linear and quadratic growth curve analysis (GCA). Given that only 61.7% of participants (837 out of 1356) completed all three data collection cycles, GCA was employed instead of multivariate longitudinal linear regression to avoid listwise deletion of participants with incomplete data and to preserve statistical power (Curran et al., 2010). GCA offers additional advantages of random effects modelling and linear and quadratic curve estimation, which provides a more nuanced understanding of variability in change across participants. Heckman's correction was applied to account for potential selection bias due to attrition. The model fit indices were assessed using the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (BIC), and -2 Log Likelihood ($-2LL$). The alpha level was set at 0.05 for all the inferential statistics.

Results

The ISA commenced in 2003 with a cohort of 2149 participants. However, gait speed data were first collected in 2007 ($n = 1356$), with subsequent follow-ups in 2008 ($n = 1044$) and 2009 ($n = 957$). Therefore, we refer to the 2007, 2008, and 2009 data as cycles 1, 2, and 3, respectively. Only 837 participants completed all three cycles, with attrition primarily attributed to deaths.

Sociodemographic Characteristics

Table 1 shows the gender differences in the distribution of participants' sociodemographic characteristics. A little above half of the participants (53.2%) were within the youngest-old age group (68–74 years), with women having a higher proportion in older groups ($\chi^2 [2] = 19.09, p < .001$). Concordantly, a higher proportion of the women (80.2%) were widowed relative to men (6.7%). The gender difference in marital statuses was significant ($\chi^2 [2] = 820.72, p < .001$). Compared to women, a higher proportion of men had a higher

level of education ($\chi^2 [1] = 29.46, p < .001$), held a higher socioeconomic status ($\chi^2 [2] = 39.69, p < .001$), experienced fewer chronic diseases ($\chi^2 [1] = 7.95, p = .005$), and demonstrated better gait speed ($\chi^2 [1] = 35.74, p < .001$). There were no gender differences in religious affiliation or area of residence.

Sociodemographic Characteristics and Time Interaction in Gait Speed Decline

The gender-aggregated repeated measures mixed-design ANOVA (Table 2) presents the unadjusted main and interaction effects of sociodemographic characteristics and time (cycles) on participants' gait speed. The analysis was further visualised with separate line plots showing the gait speed trajectory across categories of each sociodemographic variable, using estimated marginal means (Figure 1). Table 2 showed a significant gait speed difference between the age groups and within each age group over time. The post hoc analysis showed that those aged 85–108 years had a significantly lower gait speed across the timeline compared to 75–84 years (estimated marginal mean difference [MD] = -0.16 m/s, 95% CI: $-0.24, -0.08, p < .001$) and 68–74 years (MD = -0.24 m/s, 95% CI: $-0.32, -0.16, p < .001$). Those aged 75–84 years also had significantly lower gait speed than younger counterparts aged 68–74 years (MD = -0.08 m/s, 95% CI: $-0.11, -0.04, p < .001$). There was no significant difference in the rate of decline due to age group and time interaction.

There were significant gender differences between and within group, and gender time interactions. Women had a significantly greater gait speed decline than men (MD = -0.13 m/s, 95% CI: $-0.16, -0.09, p < .001$). Similarly, there was a significant effect of marital status, time, and marital status* time interactions in the gait speed trajectory. Widowed participants had a significantly greater decline than their married counterparts (MD = -0.12 m/s, 95% CI: $-0.16, -0.08, p < .001$). Divorced, never married, and separated participants were not included in the comparison due to the extremely small sample size (1.5%).

There were significant between- and within-groups gait speed differences due to area of residence and socioeconomic status, but no significant group* time interactions. The between-groups post hoc analyses showed that both city (MD = -0.05 m/s, 95% CI: $-0.10, -0.01, p = .024$) and town dwellers (MD = -0.09 m/s, 95% CI: $-0.14, -0.05, p < .001$) had lower gait speed than rural dwellers. There was no significant difference between town and city dwellers (MD = -0.04 m/s, 95% CI: $-0.08, 0.00, p = .071$). Participants of high (MD = -0.11 m/s, 95% CI: $-0.18, -0.04, p = .003$) and middle socioeconomic status (MD = -0.05 m/s, 95% CI: $-0.09, -0.01, p = .009$) had lower gait speeds than those of low status. There was no significant difference between participants of high and middle socioeconomic status (MD = -0.06 m/s, 95% CI: $-0.13, 0.02, p = .149$).

Table 1. Participants' Sociodemographic Characteristics (2007 Cycle).

Parameter	Weighted Percentage (%)			χ^2 -statistic	p-value
	Male (n = 635)	Female (n = 721)	Total (n = 1356)		
Age group (years)				19.09	<0.001*
68–74	56.4	48.6	53.2		
75–84	36.8	38.2	37.3		
85–108	6.8	13.2	9.5		
Marital Status				820.72	<0.001*
Married	91.8	18.3	61.9		
Never married/Separated/Divorced	1.5	1.5	1.5		
Widowed	6.7	80.2	36.6		
Area of Residence				5.58	0.60
City	37.2	40.0	38.4		
Town	33.3	36.1	34.4		
Rural	29.5	23.9	27.2		
Education				29.46	<0.001*
Secondary and lower	87.5	97.6	91.0		
Above secondary	12.5	2.4	9.0		
Economic Status				39.69	<0.001*
Low	57.8	73.5	64.2		
Middle	34.1	23.0	29.6		
High	8.1	3.5	6.2		
Religion				5.43	0.246
Christian Pentecostal	7.4	9.8	8.4		
Christian Orthodox	40.1	41.8	40.8		
Muslim	46.3	42.4	44.7		
African Traditional Religion	1.8	1.0	1.5		
Others	4.4	5.0	4.6		
Chronic Disease Status				7.95	0.005*
No	55.4	47.9	52.3		
Yes	44.6	52.1	47.7		
Gait speed (m/s)				35.74	<0.001*
1 m/s and above (normal)	56.5	35.1	48.0		
Below 1 m/s (abnormal)	43.5	64.9	52.0		

Source: ISA 2007 cycle. * = χ^2 -statistic was significant ($p < .05$).

There was no significant between-group effect of level of education and religious affiliation or group ^{*} time interactions in the participants' gait speed.

Multivariate Analysis

Fixed Effects. Table 3 shows the multivariate linear growth curve models for the fixed effects of time and sociodemographic factors on gait speed trajectories. In the combined model, time, age, gender, socioeconomic status, religious affiliation, frequency of religious practice, and the count of chronic diseases demonstrated significant associations with gait speed. The intercept values indicated that baseline gait speed was significantly higher among men ($\beta = 1.97$, 95% CI: 1.70, 2.25, $p < .001$) compared to women ($\beta = 1.55$, 95% CI: 1.35, 1.76, $p < .001$). The β -statistic for the cycle/time in the combined and gender-disaggregated models indicated that gait speed declined significantly across the study period.

However, the disaggregated models showed that men had a slightly slower rate of decline ($\beta = -0.05$, 95% CI: -0.07 , -0.03 , $p < .001$) than women ($\beta = -0.09$, 95% CI: -0.11 , -0.08 , $p < .001$), indicating a gender-specific pattern in mobility trajectory. Increased age was associated with a consistent decline in gait speed in both genders, with each additional year reducing gait speed by a small but significant margin across both women and men ($\beta = -0.01$, 95% CI: -0.01 , -0.01 , $p < .001$).

Marital status had a significant effect only among women, with widows displaying a significant gait speed decline compared to married women ($\beta = -0.07$, 95% CI: -0.11 , -0.03 , $p = .001$). No significant differences were observed for men or in the combined model. Higher socioeconomic status was associated with a faster gait speed decline in the combined ($\beta = -0.01$, 95% CI: -0.01 , -0.00 , $p = .003$) and men's models ($\beta = -0.01$, 95% CI: -0.01 , -0.00 , $p = .009$). Religious affiliation also influenced gait speed

Table 2. Mixed-Design ANOVA for Sociodemographic and Study Cycle Effects on Gait Speed Decline.

Parameter	Partial Eta Squared (η^2_p)	F-statistic (df)	p-value
Age group	.075	21.46 (2, 528)	<.001*
Cycle	.072	41.09 (2, 1056)	<.001*
Age group ^x Cycle	.007	1.84 (4, 1056)	.120
Gender	.079	45.22 (1, 529)	<.001*
Cycle	.169	107.56 (2, 1058)	<.001*
Gender ^x Cycle	.020	10.89 (2, 1058)	<.001*
Marital status	.070	39.70 (1, 525)	<.001*
Cycle	.160	99.83 (2, 1050)	<.001*
Marital status ^x Cycle	.011	5.82 (2, 1050)	.003*
Area of residence	.031	8.36 (2, 528)	<.001*
Cycle	.200	131.69 (2, 1056)	<.001*
Residence ^x Cycle	.008	2.052 (4, 1056)	.085
Education	.002	0.89 (1, 360)	.346
Cycle	.075	29.02 (2, 720)	<.001*
Education ^x Cycle	.009	3.22 (2, 720)	.042*
Socioeconomic status	.025	6.63 (2, 528)	.001*
Cycle	.086	49.99 (2, 1056)	<.001*
Socioeconomic status ^x Cycle	.009	2.28 (4, 1056)	.059
Religion affiliation	.017	2.31 (4, 522)	.057
Cycle	.060	33.33 (2, 1044)	<.001*
Religion ^x Cycle	.014	1.88 (8, 1044)	.059

Source: weighted ISA dataset 2007, 2008, and 2009 cycles. * = F-statistic was significant at $p < .05$.

negatively for Muslims in the combined ($\beta = -0.05$, 95% CI: $-0.07, -0.02$, $p = .001$) and men's models ($\beta = -0.06$, 95% CI: $-0.10, -0.02$, $p = .004$) compared to the Orthodox Christians. Frequency of religious practice, however, was a significant predictor across all models, with greater religious involvement correlating with greater gait speed decline (combined model: $\beta = -0.06$, 95% CI: $-0.09, -0.04$, $p < .001$; women: $\beta = -0.07$, 95% CI: $-0.10, -0.05$, $p < .001$; men: $\beta = -0.07$, 95% CI: $-0.01, -0.04$, $p < .001$). Similarly, chronic diseases significantly impacted gait speed decline across all models, with increased chronic disease burden associated with lower gait speed (combined model: $\beta = -0.03$, 95% CI: $-0.04, -0.01$, $p < .001$; women: $\beta = -0.02$, 95% CI: $-0.04, -0.01$, $p = .010$; men: $\beta = -0.03$, 95% CI: $-0.05, -0.01$, $p = .008$). However, level of education and area of residence were not associated with any statistically significant differences in gait speed across gender groups.

The model fit indices including the AIC and BIC confirmed a good fit for all models, with the combined model achieving the best fit $-2LL = 411.69$ (Table 3). We compared the linear and quadratic growth curve models using the likelihood ratio test (LRT) to determine whether adding a quadratic time component improved model fit. Though there were minimal differences in AIC, BIC, and $-2LL$ between the two models, there was no statistically significant difference ($\chi^2 [1] = 2.409$, $p = .121$), indicating a steady rate of decline in gait speed over time without acceleration in later cycles. Therefore, there was

insufficient evidence to support the addition of a quadratic time term to the model, the linear growth curve model was deemed sufficient to capture the trajectory of gait speed within this cohort.

Random Effects

The random effects analysis highlights individual differences in baseline gait speed and its trajectory across time for each model. The intercept variance \pm standard deviations for the combined model (0.052 ± 0.228 m/s), women model (0.054 ± 0.232 m/s), and men model (0.052 ± 0.228 m/s) showed significant variability in baseline gait speed among individuals. The slightly higher intercept variance in the women's model indicates more variation in initial gait speed among women compared to men. The variance for the linear time component reflects moderate variation in the rate of gait speed decline across individuals (combined: 0.009 m/s, women: 0.010 m/s, men: 0.009 m/s). The negative correlation between intercept and time linear effects (women: -0.83 , men: -0.78) indicated that individuals with higher initial gait speed experienced a faster decline over time, especially among women. The residual variance reflects individual differences unexplained by the model (combined and men: 0.0418, women: 0.0143). Lower residual variance in the women's model suggests that sociodemographic factors accounted for a larger portion of the variance in gait speed decline among women compared to men.

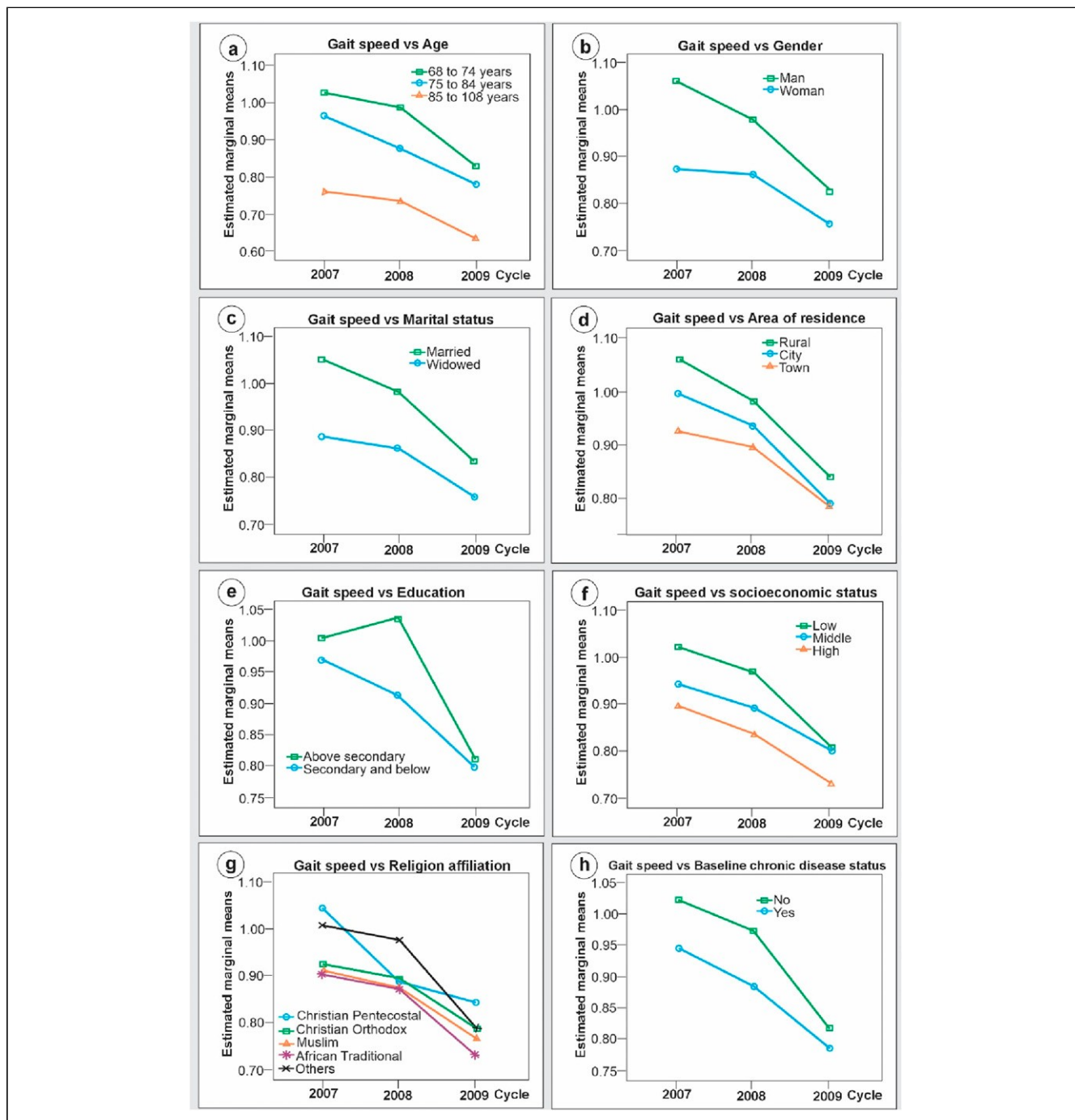


Figure 1. Marginal mean differences in gait speed decline across sociodemographic factors. Source: weighted ISA dataset.

Discussion

Biophysical factors in older adults’ gait speed decline are often researched, but there is a paucity of literature on the social determinants of gait speed trajectory (Onyeso et al., 2023). Therefore, we explored the sociodemographic determinants of gait speed among community-dwelling older adults in Nigeria. The baseline

sociodemographic profile of our study cohort was similar to observations from older adult cohorts from around the world (Sprague et al., 2023). Here, women tended to live longer, had more chronic diseases, and were more likely to be widowed compared with men. On the other hand, men had higher education, greater socioeconomic status, and faster gait speed (Gureje et al., 2007; Sprague et al., 2023).

Table 3. Linear Growth Curve: Fixed Effects of Time and Sociodemographic Factors on Gait Speed Decline.

Variable	Both Gender			Women			Men		
	β -statistic	95% CI	<i>p</i> -value	β -statistic	95% CI	<i>p</i> -value	β -statistic	95% CI	<i>p</i> -value
Intercept	1.85	1.67, 2.02	<.001*	1.55	1.35, 1.76	<.001*	1.97	1.70, 2.25	<.001*
Cycle (time linear) ref: 2007	-0.08	-0.09, -0.06	<.001*	-0.09	-0.11, -0.08	<.001*	-0.05	-0.07, -0.03	<.001*
Gender (ref: men)	-0.07	-0.11, -0.03	.001*	-	-	-	-	-	-
Age (increase in years)	-0.01	-0.01, -0.01	<.001*	-0.01	-0.01, -0.00	<.001*	-0.01	-0.01, -0.01	<.001*
Marital status (ref: married)	-0.02	-0.06, 0.02	.386	-0.07	-0.11, -0.03	.001*	0.06	-0.02, 0.14	.115
Area of residence (ref: rural)	0.00	-0.03, 0.03	1.000	-0.03	-0.07, 0.01	.191	0.01	-0.04, 0.05	.724
Education (ref: \leq secondary)	-0.04	-0.09, 0.01	.138	-0.20	-0.73, 0.33	.452	-0.03	-0.10, 0.03	.294
Socioeconomic status (increase)	-0.01	-0.01, -0.00	.003*	-0.00	-0.01, 0.00	.196	-0.01	-0.01, -0.00	.009*
Religion (ref: Christian Orthodox)	-	-	-	-	-	-	-	-	-
Christian Pentecostal	-0.01	-0.06, 0.05	0.828	-0.05	-0.10, 0.01	.119	.03	-0.05, 0.12	.415
Muslim	-0.05	-0.07, -0.02	0.001*	-0.03	-0.07, 0.01	.095	-0.06	-0.10, -0.02	.004*
Religion frequency (increase)	-0.06	-0.09, -0.04	<.001*	-0.07	-0.10, -0.05	<.001*	-0.07	-0.10, -0.04	<.001*
Chronic diseases count (increase)	-0.03	-0.04, -0.01	<.001*	-0.02	-0.04, -0.01	.010*	-0.03	-0.05, -0.01	.008*
Model fit indices									
2 log Likelihood (-2LL)	411.69			20.88			252.34		
Akaike's Information criterion (AIC)	443.69			50.88			282.34		
Schwarz's Bayesian criterion (BIC)	526.21			116.40			350.62		

Source: weighted ISA dataset. * = Standardised regression coefficient (β) was significant at $p < .05$. Note: There was no significant difference between the linear and quadratic growth curves.

The unadjusted repeated measures mixed-design analysis of variance showed that being older, a woman, widowed, an urban dweller, and of high socioeconomic status predisposes Nigerian older adults to a faster mobility decline. No statistically significant differences were found across religious affiliations and levels of education. However, the multivariate-adjusted gender-disaggregated models show that older age, widowhood, religiosity, and more chronic disease burden were significantly associated with mobility decline in women, while for men it was older age, high socioeconomic status, religiosity, being a Muslim, and more chronic disease burden. Since the effects of age, sex, and multi-comorbidity in older age mobility have been explained in the biophysical models (Ahmed et al., 2016; Boulifard et al., 2019; Sprague et al., 2023), our discussion focused on social factors such as marital status, religiosity, socioeconomic status, area of residence, and education. Notwithstanding, the biological implications of ageing and sex in functioning, intersecting socially constructed factors such as ageism and sexism can deepen inequalities which affect the life-course mobility experiences (Ahmed et al., 2016).

The influences of post-colonisation and globalisation on Nigerian younger generations have led to the erosion of cultural values of respect and empathy for older adults, fostering implicit ageism and reducing community-based

social support for older Nigerians (Tanyi et al., 2018). Ageism involves stereotyping and discrimination against older adults, which can reduce their confidence and lead to social isolation (Achenbaum, 2015). This discrimination restricts supportive environments and opportunities for physical activity, contributing to sedentary lifestyles that may accelerate physical decline and impair mobility and health among older adults (Chang et al., 2020). In Africa, the intersectionality of ageism and sexism disproportionately affects older women due to traditional gendered roles, such as childbearing, childcaring, homemaking, food processing, farming, and other forms of unrecognised and unpaid labour which may contribute to earlier and more severe mobility disabilities in women (Osinuga et al., 2021).

Marital status was found to be a significant determinant of mobility decline, aligning with previous studies that suggested being married positively impacts older adults' mobility (Onyeso et al., 2024; Perkins et al., 2016; Sengupta & Agree, 2002). Our results indicated that widowed older Nigerians experienced a greater decline in gait speed than their married counterparts, particularly among women, highlighting the importance of spousal companionship for maintaining mobility (Hossain et al., 2021). Widowhood, in particular, introduces an additional layer of intersectionality for women. Widowed individuals across different cultures in

sub-Saharan Africa, especially women, often face demeaning culturally prescribed mourning rituals that can extend up to one year, involving social isolation, oppression, deprivation, abuse, economic hardship, and powerlessness (Ude & Njoku, 2017). This situation makes it difficult for widows to access essential care and social services critical to delaying gait speed decline (Perkins et al., 2016). Additionally, psychosocial distresses of widowhood, including grief, anxiety, depression, and isolation (Trivedi et al., 2009) may accelerate mobility decline (Hossain et al., 2021). In the context of the WHO's Decade of Healthy Ageing, stakeholders should broaden discussions to include remedies for older people affected by such oppressive practices (Ude & Njoku, 2017). Unlike biological age and sex at birth, the negative impact of ageism, gender roles, and widowhood are modifiable. By reducing stereotypes about the widowed, older adults who have lost a spouse might be encouraged to find a new partner, cohabit, or live with others to foster companionship.

We found that higher socioeconomic status was significantly associated with greater mobility decline. In contrast, a four-year follow-up longitudinal study in the USA associated higher socioeconomic status with lesser mobility decline (Chen et al., 2012). Other studies suggest that higher socioeconomic status supports better mobility in older age by improving access to healthcare and recreational facilities and reducing the likelihood of engaging in physically demanding manual jobs in midlife (Beltrán-Sánchez et al., 2017; Landsbergis et al., 2003; Shumway-Cook et al., 2005). In Nigerian society, individuals from lower socioeconomic backgrounds often engage in active lifestyles, including farming, fishing, crafting, cycling, and walking as part of activities of daily living, maintaining their mobility through midlife to older age. Conversely, individuals from higher socioeconomic backgrounds experience greater affluence, engage in more sedentary occupations, and adopt less active lifestyles, which have been associated with a higher risk of chronic diseases and mobility limitations (Akarolo-Anthony & Adebamowo, 2014). The context and methods of measuring socioeconomic status are crucial. Instead of a subjective assessment of social status using a ten-rung social ladder (Chen et al., 2012), we calculated the socioeconomic index based on ownership of certain household items, reflecting participants' relative affluence within the cohort. Moreover, higher socioeconomic scores correlated with the prevalence of chronic diseases, suggesting the possibility of a sedentary lifestyle among wealthy Nigerians (Akarolo-Anthony & Adebamowo, 2014). Therefore, we recommend healthcare insurance and social schemes to mitigate the effects of low socioeconomic status on disadvantaged populations and encourage lifestyle modifications among affluent individuals.

High religiosity was associated with greater mobility decline. In the Nigerian context, older adults often believe in supernatural intervention for various life circumstances, including chronic incurable diseases and age-related

disabilities (Ede et al., 2023). Anecdotally, this belief is especially prevalent among women, vulnerable groups such as widows, and individuals with lower educational and socioeconomic status, as observed in this cohort. While religiosity was not explicitly defined in the ISA dataset, it may encompass both spiritual beliefs and social engagement through religious activities, which can help older adults remain active and maintain independence (Kleiber & Genoe, 2012). Religion can also involve physical activities such as dancing, processions, and prolonged sitting, standing, bending, or kneeling, which may have musculoskeletal implications, particularly increased joint load and degeneration among older adults (Nisa et al., 2024). Our findings indicated that older Muslim men experienced more gait speed decline than Orthodox Christians. It remains unclear whether this difference arises from spiritual beliefs, social engagement, specific physical practices associated with Muslim worship (Nisa et al., 2024), or religious marginalisation within the population. Given these findings, it may be beneficial to consider older adults' physical health status and trajectories when advising on worship activities, ensuring routines align with individual health status.

We found no significant effect of educational attainment and area of residence in the multivariate models, while rural dwellers had a lesser decline in the unadjusted model. Similar to our findings, Sprague et al. (2023) analysed secondary datasets from six countries and found higher education associated with better gait speed, except for the ISA dataset which showed no significant result. Another longitudinal study with a four-year follow-up reported that higher education attainment was associated with less mobility decline (Gomes et al., 2023). Notably, 91% of ISA participants had secondary or lower education, which may result in a dominance effect in the model (Tabachnick & Fidell, 2013). Our recent systematic review showed a paucity of literature on the influence of the area of residence on gait speed decline, with contrasting outcomes. For instance, compared to urban residents, rural residence was significantly associated with lower gait speed in bivariate analyses (Lunar et al., 2019) but faster gait speed within a multivariate-adjusted model (Boulifard et al., 2019). While urban living may increase access to health and social services, it can also encourage a more sedentary lifestyle due to reliance on technology and the availability of efficient public transport systems (Keating, 2008; van Hoof et al., 2021). In contrast, rural areas often provide advantages such as neighbourhood safety, social cohesion, informal support networks, natural environments, and food security (Tanyi et al., 2018). Regardless of where one ages, the WHO's Decade of Healthy Ageing (2020–2030) (Rudnicka et al., 2020) and the Age-Friendly Cities initiative (van Hoof et al., 2021) advocate for supportive socio-environmental conditions that enable individuals to maximise their mobility potential and maintain participation in all life activities as they age.

Clinical Significance

Gait speed is often regarded as the ‘sixth vital sign’ in geriatrics due to its strong predictive value for health outcomes such as hospitalisation, disability, and all-cause mortality (Mehdipour et al., 2024). Gait speeds below 1 m/s are associated with an increased risk of falls, speeds below 0.8 m/s predict poor clinical outcomes and speeds at or below 0.6 m/s indicate significant mobility impairment in community-dwelling older adults (Abellan van Kan et al., 2009). Our study revealed that 43.5% of men and 64.9% of women had gait speeds below 1 m/s, with a multivariate-predicted annual decline of 0.08 m/s. These findings highlight the critical need to incorporate gait speed assessments into routine geriatric evaluations, particularly in Nigeria, where a significant proportion of older adults fall below the critical gait speed threshold.

We recommend annual gait speed assessments for adults aged 65 years and above to enable early detection of mobility impairments and facilitate targeted sociomedical interventions. These interventions should include financial and social security measures, as well as improved access to healthcare services such as physiotherapy, structured exercise programmes, and fall prevention initiatives. A proactive approach to mobility assessment and intervention has the potential to enhance health outcomes, reduce disability rates, and improve the overall quality of life among older adults globally.

Policy Implications

There is a need for targeted policy interventions to address sociodemographic factors influencing gait speed decline in older Nigerians. The Nigerian National Orientation Agency and the Federal and States Ministries of Women Affairs should explore gender-sensitive programmes aimed at improving literacy, access to health, and community-based recreational opportunities among women. Moreover, cultural barriers should be addressed through awareness campaigns and legal protections to challenge discriminatory and oppressive practices against women and widows by setting a precedent in the Customary Court of Appeal.

The National Senior Citizens Centre (NSCC) is responsible for coordinating the efforts to address Nigerian older adults’ financial and social insecurities and economic barriers to healthcare via the implementation of the National Policy on Ageing (Federal Republic of Nigeria, 2020). One priority area for NSCC should be an expansion of the National Health Insurance Scheme (NHIS) for total coverage of geriatric care, physiotherapy, fitness activities, and walking aids for older adults. Additionally, integrating chronic disease management into primary healthcare, routine mobility screening, subsidised medication, and lifestyle modification programmes can help mitigate mobility decline in the short term.

In the medium- and long-term, policies should be tailored to improve the walkability of the environments and provide public recreational facilities, especially in rural areas, to encourage physical activity participation among sedentary older adults of all socioeconomic backgrounds. Age-friendly community templates can be adopted from global frameworks such as the World Health Organization’s Age-Friendly Cities and the Decade of Healthy Ageing initiatives. These strategies can enhance mobility, reduce disability rates, and improve the overall quality of life for Nigeria’s ageing population.

Limitations

This secondary analysis has some limitations inherent in the Ibadan Longitudinal Study of Ageing (ISA) design and dataset. Though ISA offers substantial insights into the health of older Nigerians, several limitations impact the interpretation and generalisability of its findings such as sample frame, demographic characteristics of participants, attrition, and follow-up interval. Primarily focused on Yoruba-speaking regions in southwestern and north-central Nigeria, the study’s geographical and cultural scope limits its applicability to other ethnic groups and regions within the country, though analytic weight was applied to account for national variations. Additionally, even with Heckman’s correction, missing data and participant attrition stemming from mortality and loss to follow-up could introduce biases. Reliance on self-reported data for chronic health conditions may not align with clinical assessments, and variables such as education, religious frequency, and household items are susceptible to social desirability which may affect data accuracy. Although ISA has a longitudinal design, the yearly follow-up cycles between 2007 and 2009 limit the ability to observe extended temporal changes essential to ageing research.

Conclusion

Sociodemographic factors such as age, gender, marital status, religiosity, and socioeconomic status influence mobility trajectory among older Nigerians. The findings bring to the fore certain sociocultural realities of ageing within the Nigerian context. While gait speed declines with age across all participants, women tend to have lower baseline values and steeper decline. These gender differences may be attributed to socially constructed women’s roles, such as homemaking and childcare demands, as well as multifaceted feminine deprivations, including unequal access to education, healthcare, social participation, and economic resources. Additionally, widowhood in women emerged as a significant predictor of gait speed decline, potentially linked to oppressive cultural practices such as forced isolation, stereotyping, and restrictions on social engagements during a prescribed period of mourning due to the death of a husband and afterwards.

Men of high socioeconomic status exhibited greater mobility decline. While they could afford healthcare, they are

anecdotally known to lead more sedentary lifestyles, which may contribute to this trend. Chronic disease burden and high religiosity were associated with greater gait speed decline in both genders. Nigerian older adults often resort to supernatural intervention when faced with anxieties resulting from debilitating life-course conditions such as chronic diseases and mobility decline. These findings highlight the nuanced influence of sociodemographic factors on gait speed decline, suggesting a need for targeted interventions that account for these gender-specific trajectories. Future studies should include occupation, retirement status, household and personal income, housing, ethnicity, and dietary patterns.

Acknowledgements

This research was made possible through the use of the Ibadan Longitudinal Study on Ageing dataset. We extend our gratitude to the University of Lethbridge for providing the facilities necessary to conduct this analysis and complete this paper.

Authors' Contributions

OKO, ACO, JV, JD, and OAA contributed to the conception of this study. OKO, ACO, and OAA acquired the data from ISA. OKO, CJA, AO, KMO, ACO, JV, JD, TB, OY, and OAA substantially contributed to the design. OKO, CJA, and OAA performed the statistical analysis. OKO, CJA, and KMO were responsible for drafting the article. AO, KMO, ACO, JV, JD, TB, OY, and OAA contributed to its critical revision. All authors approved the final manuscript for publication.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Ethical Statement

Ethical Considerations

The University of Ibadan/University College Hospital Joint Ethical Review Board approved the original ISA protocol and secondary analyses.

Consent to Participate

All participants signed a written informed consent form before participating in the study. Details about the study are available at <https://portal.dementiasplatform.com.au/crs-directory/isa?form=MG0AV3>.

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Data Availability Statement

The data are available from the Ibadan Study of Ageing, University College Hospital, Ibadan, Nigeria. Researchers who meet

the criteria for access to anonymised ISA data can apply using the link: <https://portal.dementiasplatform.com.au/crs-directory/isa?form=MG0AV3>.

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