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Estimating the Biological Age and the Magnitude of Lifestyle Determinants of Ageing among Nigerian Adults

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Abstract

Considering the various limitations of using chronological age, biological age estimation is becoming increasingly recognized as one of the novel public health and clinical strategies for preventing and controlling the rising global prevalence of noncommunicable diseases (NCDs) and for achieving healthy ageing. The objectives of this study are to estimate the biological age and compare it to the chronological age of Nigerian adults. Also, to score the magnitude of some of the lifestyle determinants of biological age among the study population. This cross-sectional study uses simple random sampling technique to select 82 Nigerian adults for the study, while standardized instruments were used to collect data. The P value for the study was set at 0.05 level of significance. The result of the study noticed poor mean Mediterranean Diet Adherence (MDAQ) score of 7.0 ± 2.28 and mean International Physical Activity (IPAQ) score of 1.3 ± 0.51. There was also suboptimal mean Pittsburgh Sleep Quality Index (PSQI) score of 5.9 ± 3.01, mean Perceive Stress Scale-4 (PSS-4) score of 6.3 ± 2.79, and mean Social Connectedness Scale (SCS) score of 15.2 ± 4.13. Furthermore, the estimated biological age of the respondents (45.9 years, ±10.31), was higher than their chronological age (43.2 years, ±8.92). The study concluded that the magnitudes of the lifestyle determinants of ageing are high enough to result in accelerated biological ageing among the study population. Such development, if not mitigated, may result in a significant increase in the prevalence of NCDs and premature deaths in the near future.

Keywords: *Accelerated Ageing, Biological Age, Chronological Age, Lifestyle determinants of ageing, Health Promotion Intervention.*

Introduction

Ageing can be broadly defined as the progressive, and largely internal, deterioration in an organism, resulting from time-dependent physiological changes, which consequently result in an increased inability to cope with environmental and lifestyle stressors, and may increase the risk of developing different diseases and death [1]. It can be broadly divided into five dimensions: chronological, psychological, social, functional, and biological ageing [1, 2]. Out of these, chronological ageing and biological ageing are the most relevant to public health and medical sciences.

Chronological age simply means the number of calendar years a person has lived since birth. It is the most universally acceptable indicator of ageing [2, 3].

However, it has been argued that chronological age is not an accurate indicator of people's true age, as it does not, in many cases, correlates effectively with people's true bodily functions, behaviours, internal biological processes, health status, and risk of developing many diseases [3, 4]. For instance, a 40-year-old

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individual may have the physical appearance, body functions, and disease presentations of a 60-year-old person, and vice versa (even in twins).

However, biological age has been proposed as an appropriate ageing estimation indicator to replace chronological age, especially for people who are 50 years and above [5]. Biological age can be defined as the physiological performance status of an individual's body that often imperfectly correlates with his/her chronological age [3, 6]. It is a more accurate estimate of an individual's present bodily functionalities, the inner ageing process, the true state of his/her overall health status, vitality, disease state, and life expectancy [7, 8].

It has been argued that better preventive and prognostic results may be achieved if biological age estimation, in addition to chronological age, is used to determine age eligibility when initiating or monitoring the progress of some preventive screening tests (such as breast cancer screening) and promotive health services, especially after prescribing lifestyle changes in the prevention and control of noncommunicable diseases (NCDs) [6-9]. Furthermore, unlike chronological age, which is fixed, and irreversible, biological age can be accelerated or reversed by engaging in some lifestyle practices [10].

Unfortunately, evidence abounds that the prevalence of some lifestyle-related risk factors or lifestyle determinants of biological age (such as unhealthy diets, physical inactivity, obesity, poor sleep, poor stress management, tobacco use, risky alcohol intake, and poor social connectedness), is already on the increase in Nigeria [11, 12].

This suggests that the biological age of Nigerians may also be on the increase, a development that may have negative impacts on the disease profiles, life expectancy, and quality of life of the people.

Consequently, the objectives of this study were to investigate the estimated biological age of Nigerian adults and compared it to their chronological age. It also scores the magnitude of the common lifestyle-related risk factors that may influence the biological age of the study population.

Materials and Methods

Selection of Study Area

This cross-sectional study comprises Nigerian adults (age 20-69 years), selected from the 6 geopolitical zones of Nigeria.

Sample Size Determination

The sample size for this study was 90 participants, which was calculated using the formula,

$$n = \left[\left(Z_\alpha + Z_\beta\right)^{2*} p * q\right] / (p_1 - p_0)^2$$

Where:

n = the desired sample size for the study population.

Z_α = A 95% confidence level of the standard normal distribution as cut-off, which corresponds to 1.96 to account for Type I error.

Z_β = Power of 80% to detect the effect of the study and avoid Type II error, which is set at 0.84.

p = Baseline prevalence from previous studies.

q = 1 – p.

p_1 = The desired prevalence.

p_0 = Baseline prevalence from previous studies.

Here, 167 people responded to an online advertisement for the study from the 6 geo-political zones of Nigeria, they were reduced to 110 after applying the inclusion criteria (age between 20 and 69 years) and exclusion criteria (Nigerians that have resided in the country for more than 6 months), and further to 90 through simple random sampling technique.

Data Collection

After collecting ethical approval from the Health Research and Ethical Committee of the National Hospital Abuja (approval number: NHA/ADMIN/236/V.VII/.), a pilot study was carried out among 10 Nigerian adults residing in

Abuja, Nigeria. Afterward, through an online platform (google forms), the participant's written consent was collected. Subsequently, their data were collected electronically through 6 standardized research instruments: Mediterranean Diet Adherence Questionnaire – MDAQ (r = 0.68) to score diet quality, International Physical Activity Questionnaire (IPAQ) (r = 0.80) to score physical activity level, Pittsburgh Sleep Quality Index (PSQI) Tool (r = 0.83) to score sleep quality, Perceive Stress Scale-4 (PSS-4) Questionnaire (r = 0.82) to score stress perception, Social Connectedness Scale (SCS) Tool (r = 0.92) to score social connectedness level, and the True-Age Assessment Tool (TAAT) was used to estimate the lifestyle-related biological age of the participants. Their Body Mass Index (BMI) was calculated through an online tool (www.health.com/BMI), and their basic demographic data and past medical history were also collected. Some of the instruments were modified to facilitate better understanding for the participants.

Data Analysis

The collected data were subjected to descriptive statistics (frequency count and percentage) and inferential statistics. The data were expressed as mean ± SD, and the results were tested at a 0.05 level of significance. The Statistical Package for Social Science (version 21) was used to analyze the data.

Results and Discussion

This study estimated the biological age of Nigerian adults and compared it to their chronological age. It also scored the magnitude of selected lifestyle determinants of biological age (also called lifestyle-related risk factors) among Nigerian adults. Out of the 90 study participants, only 82 completed the assessment form. The study had slightly more female respondents (54.9%), compared to male respondents (45.1%) (Table 1). This finding is consistent with the available information which suggested that the female gender is usually more concerned or enthusiastic about their health and wellbeing, and often participate more in health-related activities, compared to their male counterpart [13].

Most of the respondents were within the middle age groups of 41-50 years (42.7%) and 31-40 years (28.0%), while only 9.9% and 3.7% were between the younger age group of 20-30 years, and the older age group of 61-69 years, respectively (Table 1). These findings showed that more middle-aged people responded to the online study. This result is also consistent with available studies that suggested that although younger people (30 years and below) tend to visit social media platforms more than others, most of them are less interested in seeking health educational resources or health-related research [14, 15].

More than half of the respondents were married (69.6%), while only 24.4% were single (Table 1). This suggested that married people were more interested in the online study. The result also supported the findings of previous studies which informed that being married may be a protective sociodemographic factor for health, as married people are usually more concerned about their health and wellbeing, compared to single people [16, 17]. Also, the majority (92.7%) of the respondents had either a first degree or post-graduate certificates suggesting they were well-educated (Table 1). Previous studies have also suggested that education positively correlates with health-seeking behaviours and can be a protective sociodemographic factor against accelerated ageing and the development of many chronic NCDs [18].

Table 1. Sociodemographic Characteristics of the Participants

Variables (*n* = 82)	**Frequency**	**%**
Gender		
Male	37	45.1
Female	45	54.9
Age Range (Years)		
20 - 30	8	9.8
31 - 40	23	28.0
41 - 50	35	42.7
51 - 60	13	15.8
61 – 69	3	3.7
Marital Status		
Single	20	24.4
Married	57	69.6
Separated	1	1.2
Divorced	2	2.4
Widowed	2	2.4
Education		
Primary	0	0
Secondary	6	7.3
First Degree	45	54.9
Post Graduate	31	37.8
Geopolitical Zones		
North-West	9	11.0
North-East	4	4.9
North-Central	17	20.7
South-East	12	14.6
South-South	14	17.1
South-West	26	31.7

The past medical history revealed that 24.4% of the respondents had a history of high blood pressure/hypertension, 3.7% were diabetic, and 11.0% had high blood cholesterol (Table 2). These results are like the estimated national prevalence of high blood pressure/hypertension of between 20 – 25% among Nigerian adults [11], but higher than the World Health Organization's (WHO) estimate of 18% among Nigerian adults [12]. The findings of this study also agreed with the International Diabetes Federation's (IDF) estimated 3.7% prevalence of diabetes mellitus among Nigerian adults (20 – 79 years) [19]. But it is slightly lower than the estimated national diabetes mellitus prevalence of 4.3% among Nigerian adults [20]. Likewise, the 11% prevalence of high blood cholesterol among the respondents of this study is lower than the WHO's estimated 16.1% among Nigerian adults (25 years and above) [21]. These findings are significant because multiple studies have demonstrated a linear association and bidirectional relationship between most chronic noncommunicable diseases (such as cardiovascular diseases, diabetes mellitus, dyslipidemia, some cancers, etc.) and accelerated biological ageing [21, 22].

Table 2. Past Medical History of the Respondents

Diseases (*n* = 82)	**Frequency**	**%**
Hypertension	20	24.4
Diabetes Mellitus	3	3.7
High Blood Cholesterol	9	11.0

More than one-third of the respondents were overweight (39.0%), almost another one-third were obese (32.9%), and only 22% were of normal weight (Table 3). These findings are similar to the results of another study which reported an overall prevalence of overweight and obesity of 64% among Nigerian adults [23]. A systemic review also noticed the prevalence of overweight to be from 20.3% to 35.1%, and obesity to be from 8.1% to 22.2% among Nigerian adults [24]. This is also a significant finding because multiple studies have associated high Body Mass Index (BMI), especially truncal obesity, with multicellular assaults and damages that can result in accelerated biological ageing and increased risk of developing most chronic NCDs [25-27].

Table 3. Body Mass Index of the Respondents

BMI (Kg/M^2) (*n* = 82)	**Frequency**	**%**
≤ 18.4	5	6.1
18.5 – 24.9	18	22.0
25 – 29.9	32	39.0
≥ 30	27	32.9

The mean Mediterranean Diet Adherence Questionnaire (MDAQ) score among the respondents was 7.0 (SD = 2.28) (Table 4). This statistically significant ($p < 0.05$) result suggested that the dietary quality of the average respondent is unhealthy or their adherence to a healthy diet is poor. This result is supported by the positional of the Federal Ministry of Health (FMOH) of Nigeria, which informed that the intake of unhealthy foods is on the increase in Nigeria, because of the rising urbanization and globalization phenomena [11, 28]. The mean International Physical Activity Questionnaire (IPAQ) score among the respondents was 1.3 (SD = 0.51) (Table 4). This statistically significant ($p < 0.05$) result suggested that the average respondent is physically inactive. This result is also collaborated by the position of the FMOH of Nigeria, which informed that about 80% of urban dwelling working-class Nigerian adults are either physically inactive or inadequately active [11]. While the WHO stated that about 25% of Nigerian adults (18 years and above) are physically inactive [12].

The mean Pittsburgh Sleep Quality Index (PSQI) score among the respondents was 5.9 (SD = 3.01) (Table 4). This statistically significant ($p < 0.05$) result suggested that the sleep quality of the average respondent was suboptimal and not restorative enough. This finding is supported by the results of a recent study involving 193 Nigerian adults, which revealed that 59% of the participants were sleep deprived [29]. Other studies have also informed that the prevalence of sleep deficit and sleep deprivation is increasing in Nigeria and many developing countries, with detrimental health consequences on the people [30, 31]. Furthermore, a study that uses PSQI to investigate the sleep quality of 79 adults in New Zealand also noticed suboptimal baseline PSQI scores of 6.4 (±2.7) and 4.5 (±2.5) among its intervention and control group participants, respectively [32].

This suggests that the issue of sleep deprivation or poor sleep quality is more likely a global health challenge, affecting both developed and developing countries.

Table 4. The Mean Scores of the Lifestyle Predictors of Biological Age

Scores (*n* = 82)	**Mean**	**SD**	***P* value**
Diet Quality (MDAQ)	7.0	2.28	0.00
Physical Activity (IPAQ)	1.3	0.51	0.00
Sleep Quality (PSQI)	5.9	3.01	0.00
Stress Perception (PSS-4)	6.3	2.79	0.00
Social Connectedness (SCS)	15.2	4.13	0.00

The mean Perceive Stress Scale-4 (PSS-4) score among the respondents was 6.3 (SD = 2.79) (Table 4). This statistically significant ($p < 0.05$) result suggested that the perceived stress level among the respondents is moderately high or that their stress coping skills are suboptimal. This result is not surprising because a recent Bloomberg study categorizes Nigeria as the most stressful country in the world [33]. Also, the Least and Most Stressful Cities Index research report of 2021, placed Lagos (the commercial capital and second most populous city in Nigeria) as the second most stressful city in the world, second only to Mumbai in India [34]. Furthermore, a recent meta-analysis that has 1,763 study population, noticed the prevalence of psychosocial stress at 61.97% among healthcare workers in Nigeria [35].

The mean Social Connectedness Scale (SCS) score among the respondents was 15.2 (SD = 4.13) (Table 4). This statistically significant ($p < 0.05$) result suggested that the social connectedness level among the respondents is fairly good but still suboptimal. This fairly good social connectedness result may be due to the well-documented high value that Africans (particularly Nigerians) placed on social integration with family and friends, and in communal living [36,37]. However, the increasing westernization, technological advancements, insecurity, etc., in Nigeria and many sub-Saharan African countries are fast changing these 'health protective' practices among Africans [37, 38].

All the findings are significant because multiple studies have associated the regular consumption of unhealthy diets [22, 39], physical inactivity or sedentary lifestyle [40], poor or nonrestorative sleep [41, 42], high/chronic stress level or suboptimal stress management [43], and poor social connectedness [22], with increased production of free radicals and proinflammatory cytokines, increased systemic chronic inflammation (SCI), and multicellular damages in the body. All of these often result in accelerated biological ageing and increased risk of developing many chronic NCDs of ageing (such as cardiovascular diseases, diabetes mellitus, some cancers, etc.). They are also associated with a reduced overall quality of life and increased risk of frailty and premature death [39, 44].

The mean chronological or calendar age of the respondents was 43.2 years (SD = 8.92), while their mean estimated biological age was 45.9 years (SD = 10.31) (Table 5). These statistically significant ($p < 0.05$) results suggested that the body functions and functional capacities of the respondents may have significantly declined, and their biological ageing process has accelerated to about 3 years older than their chronological age. This result may not be surprising because the scores of all the evaluated lifestyle determinants of ageing in the respondents were negatively deranged.

There is multiple evidence to suggest that lifestyle determinants of ageing (such as unhealthy diets, physical inactivity, nonrestorative sleep, high or chronic stress, and

social isolation/loneliness) often work synergically to accelerate the ageing process and increase an individual's risk of developing many chronic diseases of ageing and premature death [45].

Table 5. The Mean Chronological and Biological Ages of the Respondents

Scores (Years)	Mean	SD	*P* value
Chronological Age	43.2	8.92	0.00
Biological Age	45.9	10.31	0.00

While protective or healthy lifestyle practices (such as healthy diets, adequate physical activity, restorative sleep, low stress, and good social connectedness) also work synergistically to prevent accelerated biological ageing, promotive healthy ageing, reduce the risk of developing chronic diseases of ageing and premature death, and improve the overall quality of life [39, 46].

Conclusion

This study revealed that not only is there an increasing prevalence of some of the major lifestyle determinants of ageing (unhealthy diets, physical inactivity, nonrestorative or suboptimal sleep, chronic stress, and poor/suboptimal social connectedness) among Nigerians, but the scores or magnitudes of these risk factors are also significantly high. Also, the biological age of the respondents is significantly higher than their chronological age.

These results suggest that the magnitude of the unhealthy lifestyle practices of the target population is significant enough to accelerate their biological ageing process and increase their risk of developing chronic NCDs. These findings should be serious public health concerns in Nigeria as they may negatively impact the health and socio-economic burdens in the country in the nearest future.

Recommendations

1. This study should be replicated with a larger population using more sensitive biological age assessment methods, such as genetic markers or biomarkers of ageing.
2. Researchers should design and validate a culturally sensitive and easy-to-use biological age assessment tool for use during public health and clinical intervention programs.
3. Studies should investigate the effective preventive and control strategies that may be deployed to mitigate the various root determinants (such as environmental, cultural, and economic factors) that may be increasing the prevalence and magnitude of unhealthy lifestyle practices in Nigeria.
4. More studies should investigate the role and relevance of biological age assessment and monitoring in the prevention and control of chronic NCDs and in achieving healthy ageing. The cost-benefit analysis of incorporating scoring of lifestyle-related risk factors and biological age estimation into routine or specific health risk assessments should also be done.
5. Researchers should design evidence-based promotive health intervention programs that use both chronological age and biological age in health risk assessment and monitoring, especially for the high-risk population.

Conflict of Interest

The author declares no conflict of interest.

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