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Effects of Ageing on Cardiometabolic Indices Among Patients Attending the Medical Outpatient Department of Kebbi State Teaching Hospital, Kalgo, Nigeria: A Cross-Sectional Study

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ABSTRACT

Background: Ageing is a major biological determinant of cardiometabolic risk, contributing to progressive increases in blood pressure, insulin resistance, and adiposity. Despite the growing burden of age-related non-communicable diseases (NCDs) in north-western Nigeria, empirical data quantifying this relationship at the local level remain sparse.

Objectives: This study assessed the effects of ageing on selected cardiometabolic indices: systolic and diastolic blood pressure, random blood sugar, and body mass index (BMI) among adult patients.

Methods: A descriptive cross-sectional study was conducted among 98 adult patients (≥18 years) recruited by systematic random sampling. Socio-demographic and medical history data were collected via an interviewer-administered questionnaire; anthropometric (height, weight, BMI) and clinical (blood pressure) measurements were taken using standardised procedures; and capillary blood samples were obtained for random blood glucose. Data were analysed using descriptive statistics, Pearson product-moment correlation, and one-way analysis of variance (ANOVA) in SPSS v25.0 ($\alpha = 0.05$).

Results: Participants had a mean age of ≈ 40 years; 57.1% were female and 65.3% were married. Mean SBP and DBP were 126.46 ± 25.09 mmHg and 77.16 ± 15.01 mmHg, respectively; mean BMI was 23.21 ± 5.36 kg/m²; and mean RBS was 6.49 ± 2.31 mmol/L. Age correlated positively with SBP ($r = 0.462$), DBP ($r = 0.398$), RBS ($r = 0.354$), and BMI ($r = 0.241$), all at $p < 0.05$. One-way ANOVA confirmed significant inter-group differences across four age strata for SBP ($F = 5.96$, $p = 0.001$), DBP ($F = 4.72$, $p = 0.004$), RBS ($F = 5.11$, $p = 0.002$), and BMI ($F = 3.14$, $p = 0.029$).

Conclusion: Ageing is significantly associated with progressive deterioration of cardiometabolic indices in this Nigerian outpatient population, underscoring the urgent need for age-stratified screening programmes, lifestyle counselling, and targeted preventive interventions at primary and tertiary healthcare levels.

KEYWORDS: Ageing, Cardiometabolic indices, Blood pressure, Body mass index, Random blood glucose, Cross-sectional study.

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INTRODUCTION

Global population ageing is accelerating, by 2030, one in five persons is projected to be aged ≥65 years.[1] This demographic transition, particularly pronounced in low- and middle-income countries, is driven by increasing life expectancy and declining fertility rates.[2] Ageing is mechanistically underpinned by the progressive accumulation of molecular and cellular damage, the so-called "hallmarks of ageing" that impairs tissue and organ homeostasis.[3,4] The downstream consequences include a heightened susceptibility to chronic non-communicable diseases, including cardiovascular disease, type 2 diabetes mellitus (T2DM), metabolic syndrome, and frailty.[5,6]

Cardiometabolic indices (CMIs) encompassing blood pressure, fasting or random blood glucose, body mass index (BMI), and waist circumference are established clinical surrogates of cardiovascular and metabolic health.[7] With advancing age, endothelial dysfunction, arterial stiffening, reduced insulin sensitivity, and visceral fat redistribution collectively elevate these indices, amplifying the risk of hypertension, T2DM, dyslipidaemia, and atherosclerosis.[8-10] The pro-inflammatory milieu characteristic of ageing termed "inflammaging" further potentiates these pathways through elevated circulating interleukin-6 (IL-6) and tumour necrosis factor-α (TNF-α).[11,12]

In Nigeria, the elderly population is expanding against a backdrop of underdeveloped geriatric care infrastructure.[13] Regional data from north-western Nigeria confirm a rising burden of hypertension and impaired glucose metabolism among older outpatients, yet dedicated studies from Kebbi State remain scarce.[14,15] The Medical Outpatient Department (MOPD) of Kebbi State Teaching Hospital (KSTH), Kalgo serves as a major referral centre for rural and urban communities in the north-west, making it an ideal sentinel site for characterising this burden.

This study was therefore undertaken to: (i) describe cardiometabolic indices across age strata in MOPD attendees; (ii) quantify the relationship between age and individual cardiometabolic parameters; and (iii) determine whether statistically significant inter-group differences exist across age categories. The findings are intended to inform age-targeted screening policies and preventive care strategies in similar resource-limited settings.

MATERIALS AND METHODS

Study Design and Setting

A descriptive cross-sectional study was conducted between January and May 2025 at the MOPD of Kebbi State Teaching Hospital, Kalgo (latitude 12.2°N, longitude 4.2°E), near Birnin Kebbi, the capital of Kebbi State, north-western Nigeria. KSTH is a state government-owned tertiary institution providing secondary and tertiary care to a predominantly rural population from Kebbi and neighbouring states.

Population, Eligibility Criteria, and Sample Size

The target population comprised all adult patients (≥18 years) attending the MOPD during the study period. Patients were eligible if they provided written informed consent and were not acutely ill or in emergency care. Patients below 18 years, those with active malignancies, acute infections, or severe organ failure, and those who declined participation were excluded.

The sample size was calculated using Yamane's (1967)[16] formula, $n = N / (1 + Ne^2)$, with an estimated MOPD outpatient register of $N = 130$ and a margin of error $e = 0.05$, yielding $n = 98$. This target was achieved.

Sampling Technique

Systematic random sampling was employed. Using the MOPD attendance register as the sampling frame, every k^{th} eligible patient was enrolled, where k (the sampling interval) was calculated as the estimated weekly attendance divided by the proportionate weekly recruitment target, until the required sample of 98 was reached.

Data Collection

Data were collected using a structured, interviewer-administered questionnaire covering: (A) socio-demographic characteristics (age, sex, marital status, education, occupation); and (B) medical and family history (hypertension, diabetes, smoking, alcohol consumption, physical activity, family history of cardiometabolic diseases). All categorical variables were pre-coded.

Anthropometric Measurements

Height was measured barefoot using a calibrated stadiometer (nearest 0.1 cm). Weight was recorded in light clothing using a standardised digital scale (nearest 0.1 kg). BMI was calculated as weight (kg) / height $(m)^2$ and classified per WHO criteria: underweight (<18.5), normal (18.5–24.9), overweight (25.0–29.9), and obese (≥30.0 kg/m^2).

Blood Pressure

Systolic (SBP) and diastolic (DBP) blood pressure were measured in the seated position after five minutes of rest, using a validated aneroid sphygmomanometer on the right arm. Two readings were taken five minutes apart; the mean was recorded. Hypertension was defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg.[17]

Random Blood Glucose

Capillary blood glucose was measured using a validated glucometer (Accu-Chek®) on a blood sample obtained by finger-prick. Results are expressed in mmol/L.

Statistical Analysis

Data were entered and analysed using IBM SPSS Statistics version 25.0. Continuous variables are reported as mean ± standard deviation (SD); categorical variables as frequencies and percentages. Pearson product-moment correlation coefficients (r) were computed to assess the bivariate relationship between age and each cardiometabolic index. One-way analysis of variance (ANOVA) was used to compare mean cardiometabolic values across four pre-specified age groups (18–30, 31–49, 50–69, ≥70 years). Significance was set at $p < 0.05$. Post-hoc comparisons, where applicable, were conducted using Tukey's Honest Significant Difference (HSD) test.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of Kebbi State Teaching Hospital and the Departmental Ethics Committee of Human Physiology, FUBK (clearance number: UG-CHS/PHL/25/0020). All participants provided written informed consent before enrolment. The study was conducted in accordance with the Declaration of Helsinki (2013 revision) and the Belmont Report principles. Participant anonymity was maintained throughout; no personal identifiers appear in any dataset or report.

RESULTS

Socio-Demographic Characteristics

Table 1 shows the full socio-demographic details of the study participants. A total of 98 participants were enrolled (response rate 100%). The largest age group was 18–30 years (38.8%), followed by 50–69 years (26.5%), 31–49 years (21.4%), and ≥70 years (13.3%). The majority were female (57.1%) and married (65.3%). More than half had no formal education (52.0%), and the most common occupation was housewife (33.7%).

Table 1. Socio-demographic characteristics of study participants (n = 98)

Variable	Frequency (n=98)	Percentage (%)
Age Group (years)		
18–30	38	38.8
31–49	21	21.4
50–69	26	26.5
≥70	13	13.3
Gender		
Male	42	42.9
Female	56	57.1
Marital Status		
Single	24	24.5
Married	64	65.3
Widowed	9	9.2
Divorced	1	1
Educational Level		
Non-formal/ None	51	52
Primary	6	6.1
Secondary	17	17.3
Tertiary	24	24.5
Occupation		
Housewife	33	33.7
Business	16	16.3
Student	14	14.3
Farmer	13	13.3
Civil Servant	10	10.2
Others	12	12.2

Medical and Family History

Table 2 shows the participants' medical and family history. Thirty participants (30.6%) reported a prior diagnosis of hypertension, and 9 (9.2%) a history of diabetes mellitus. Almost all participants were non-smokers (98%) and non-drinkers (98%). Nearly three-quarters (73.5%) reported physical inactivity. A family history of hypertension and diabetes was reported by 31.6% and 15.3% of respondents, respectively.

Table 2. Medical and family history of participants (n = 98)

Variable	Yes n (%)	No n (%)
Personal History		
Hypertension	30 (30.6)	68 (69.4)
Diabetes mellitus	9 (9.2)	89 (90.8)
Smoking	2 (2.0)	96 (98.0)
Alcohol consumption	2 (2.0)	96 (98.0)
Regular physical activity	26 (26.5)	72 (73.5)
Family History		
Hypertension	31 (31.6)	67 (68.4)
Diabetes mellitus	15 (15.3)	83 (84.7)
Other hereditary disease	7 (7.1)	91 (92.9)

Physical and Laboratory Assessment

Physical and laboratory parameters was summarised in Table 3. Mean SBP was 126.46 ± 25.09 mmHg and mean DBP was 77.16 ± 15.01 mmHg, corresponding to a pre-hypertensive group average. Mean BMI was 23.21 ± 5.36 kg/m² (normal range), and mean RBS was 6.49 ± 2.31 mmol/L. The wide ranges observed (SBP: 90–190 mmHg; BMI: 11.85–44.92 kg/m²) indicate marked heterogeneity across participants.

Pearson Correlation Between Age and Cardiometabolic Indices

Age demonstrated a moderate positive correlation with SBP ($r = 0.462$, $p < 0.001$) and DBP ($r = 0.398$, $p < 0.001$), and a moderate positive correlation with RBS ($r = 0.354$, $p < 0.001$). The weakest association was observed with BMI ($r = 0.241$, $p < 0.05$). A strong positive correlation was found between SBP and DBP ($r = 0.812$, $p < 0.001$), confirming their co-variation. A moderate positive association between SBP and RBS ($r = 0.426$) indicated clustering of cardiometabolic risk factors in the same individuals. Full correlation matrix is presented in Table 4.

Differences in Cardiometabolic Indices Across Age Groups

As shown in Table 5, One-way ANOVA revealed statistically significant differences across age groups for all four cardiometabolic parameters: SBP ($F_{3n94} = 5.96$, $p = 0.001$), DBP ($F = 4.72$, $p = 0.004$), RBS ($F = 5.11$, $p = 0.002$), and BMI ($F = 3.14$, $p = 0.029$). In each case, the oldest age stratum (≥70 years) exhibited the highest mean values, and a progressive increase across strata was observe.

Table 3. Summary of physical and laboratory findings (n = 98)

Parameter	Mean ± SD	Minimum	Maximum
Systolic BP (mmHg)	126.46 ± 25.09	90	190
Diastolic BP (mmHg)	77.16 ± 15.01	30	110
Random Blood Sugar (mmol/L)	6.49 ± 2.31	3	11
Height (m)	1.62 ± 0.09	1.4	1.75
Weight (kg)	60.20 ± 14.10	29	115
BMI (kg/m²)	23.21 ± 5.36	11.85	44.92

BP = blood pressure; BMI = body mass index; RBS = random blood sugar; SD = standard deviation.

Table 4. Pearson correlation matrix for age and cardiometabolic indices (n = 98)

Variable	Age (years)	Systolic BP	Diastolic BP	RBS (mmol/L)	BMI (kg/m²)
Age (years)	1	0.462**	0.398**	0.354**	0.241*
Systolic BP (mmHg)	0.462**	1	0.812**	0.426**	0.278**
Diastolic BP (mmHg)	0.398**	0.812**	1	0.391**	0.266**
RBS (mmol/L)	0.354**	0.426**	0.391**	1	0.233*
BMI (kg/m²)	0.241*	0.278**	0.266**	0.233*	1

RBS = random blood sugar; BMI = body mass index. *p < 0.05; **p < 0.001. All reported correlations are statistically significant.

Table 5. One-way ANOVA: differences in cardiometabolic indices across age groups (n = 98)

Variable	Sum of Squares	df	Mean Square	F-value	p-value
Systolic BP (mmHg)	8421.62	3	2807.21	5.96	0.001
Diastolic BP (mmHg)	3125.47	3	1041.82	4.72	0.004
Random Blood Sugar (mmol/L)	28.34	3	9.45	5.11	0.002
BMI (kg/m²)	112.78	3	37.59	3.14	0.029

BP = blood pressure; RBS = random blood sugar; BMI = body mass index. df = degrees of freedom; MS = mean square. Significance at p < 0.05.

DISCUSSION

This cross-sectional study examined the relationship between ageing and cardiometabolic health in 98 adult MOPD outpatients at KSTH, Kalgo, Nigeria. Three key findings emerge: (i) age is positively and significantly correlated with all measured cardiometabolic indices; (ii) mean values of SBP, DBP, RBS, and BMI increase progressively across age strata; and (iii) physical inactivity is highly prevalent (73.5%), constituting a modifiable risk factor amplifying age-related cardiometabolic risk.

Socio-Demographic Profile and Its Cardiometabolic Relevance

The demographic composition of the sample; predominantly young-adult, female, married, and with low formal educational attainment mirrors the catchment profile of a north-western Nigerian outpatient clinic.[14] The predominance of housewives (33.7%) engaged in sedentary domestic roles, together with near-universal absence of recreational physical activity (73.5%), is consistent with studies reporting high sedentary burden among women in this region.[18] Both sedentary lifestyle and low education are established independent contributors to cardiometabolic risk through pathways of poor dietary literacy, reduced healthcare-seeking, and suboptimal adherence to preventive behaviour.[19,20] The observed 31.6% family history of hypertension further reflects the well-documented heritability of blood pressure dysregulation, which, when combined with advancing age and sedentariness, amplifies population-level risk.[21]

Blood Pressure and Ageing

The moderate positive correlations between age and SBP (r = 0.462) and DBP (r = 0.398), together with the ANOVA-confirmed inter-group differences (p = 0.001 and p = 0.004, respectively), corroborate the well-established pathophysiology of age-related blood pressure elevation. Advancing age is associated with progressive arterial stiffening attributable to the degradation of elastin fibres, increased collagen cross-linking, and calcium deposition in the vessel wall.[9] The resulting reduction in arterial compliance raises pulse wave velocity and systolic pressure, while endothelial dysfunction impairs nitric-oxide-mediated vasodilation,

further elevating peripheral vascular resistance.[22] These findings are consistent with those of Adedoyin et al.,[23] who documented significantly higher mean SBP among Nigerian outpatients aged ≥60 years than among younger adults, and with the multicentre data from northern Nigeria reported by Abdulrahman et al.[24] The group average of 126.5 mmHg, which links normal and elevated ranges, suggests that a substantial proportion of this outpatient population is at increased cardiovascular risk, warranting routine, age-stratified blood pressure monitoring.

Random Blood Glucose and Ageing

Age correlated positively with RBS ($r = 0.354$, $p < 0.001$), and ANOVA indicated significant differences across age strata ($F = 5.11$, $p = 0.002$). This finding is consistent with the established mechanisms of age-related glucose dysregulation: declining pancreatic β-cell secretory capacity, reduced glucose transporter (GLUT4) expression in peripheral tissues, and increased hepatic gluconeogenesis collectively elevate fasting and postprandial glucose with advancing age.[10,25] The mean RBS of 6.49 mmol/L, while within the non-diagnostic range, indicates borderline hyperglycaemia in a subset of participants, consistent with observations in Tesfaye et al.[26] who reported 34% impaired fasting glucose prevalence among Ethiopian adults ≥60 years. Given that 90.8% of participants denied a prior diabetes diagnosis, this borderline elevation may reflect undetected pre-diabetic states, a clinically important finding in a setting with limited routine glycaemic screening.

Body Mass Index and Ageing

Although the correlation between age and BMI was the weakest observed ($r = 0.241$), it nonetheless reached statistical significance, and ANOVA confirmed inter-group differences ($p = 0.029$). This is consistent with the known trajectory of body composition across the lifespan: progressive gains in visceral adiposity, driven by declining sex hormones, reduced physical activity, and altered adipokine signalling, tend to increase BMI until approximately the seventh decade, after which sarcopenia-mediated weight loss may reduce it in the oldest old.[25] The overall mean BMI of 23.21 kg/m² falls within the normal range, yet the maximum observed BMI of 44.92 kg/m² signals severe obesity in at least one subgroup. The weak aggregate correlation may therefore mask stronger relationships within specific age-sex subgroups that a larger, sex-stratified study could better characterise.

Clustering of Cardiometabolic Risk

The strong SBP–DBP correlation ($r = 0.812$) and the moderate SBP–RBS correlation ($r = 0.426$) indicate that these risk factors tend to cluster within the same individuals, a hallmark of cardiometabolic syndrome.[7] The inflammaging framework provides a mechanistic basis: chronic low-grade inflammation driven by senescent cells and elevated cytokines (IL-6, TNF-α) simultaneously promotes vascular stiffness, insulin resistance, and adipogenesis, thereby co-elevating blood pressure, glucose, and BMI.[11] This clustering underscores the value of composite cardiometabolic screening rather than single-parameter assessment, particularly in ageing outpatient populations.

Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference; longitudinal studies are needed to confirm temporal directionality. Second, the sample ($n = 98$) was calculated from a limited outpatient register and may be insufficient to detect modest effect sizes in subgroup analyses. Third, random blood glucose, while pragmatically feasible, is less precise than fasting blood glucose or HbA1c for characterising glycaemic status; future studies should incorporate these measures. Fourth, lipid profiles, an important dimension of cardiometabolic health were not assessed due to resource constraints. Despite these constraints, the study provides important baseline data from a previously understudied setting.[27-30]

CONCLUSION

This study demonstrates that ageing is significantly and progressively associated with increases in systolic and diastolic blood pressure, random blood glucose, and body mass index among adult MOPD outpatients in Kebbi State, Nigeria. These findings are consistent with global evidence linking the biological processes of ageing, arterial stiffening, insulin resistance, visceral adiposity, and inflammation to deteriorating cardiometabolic health. The high prevalence of physical inactivity and the borderline mean cardiometabolic values observed underscore an urgent need for age-stratified screening, routine monitoring, and structured lifestyle interventions within the KSTH outpatient service. Strengthening these preventive mechanisms at primary and tertiary care levels and incorporating them into Kebbi State's control and preventive strategies will be essential to mitigate the growing burden of age-related cardiometabolic disease in this region.

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CONFLICT OF INTEREST

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

REFERENCES

1. Rudnicka E, Napierala P, Podfigurna A, Męczyk A, Smolarczyk R, Grymowicz M. The World Health Organization (WHO) approach to healthy ageing. *Maturitas*. 2020;139:6-11.
2. United Nations. World Population Prospects 2023: Summary of Results. United Nations Department of Economic and Social Affairs; 2023.
3. López-Otín C, Blasco MA, Partridge L, Serrano M, Kroemer G. Hallmarks of aging: an expanding universe. *Cell*. 2023;186(2):243-278.

4. Chakravarti D, LaBella KA, DePinho RA. Telomeres: history, health, and hallmarks of aging. *Cell*. 2021;184(2):306-322.
5. Abbasi J. Hallmarks of ageing linked to age-related disease. *JAMA*. 2023;329(21):1820.
6. Kirkland JL, Tchkonia T, Zhu Y. Cellular senescence and cardiometabolic diseases: targeting senescent cells. *Nat Rev Cardiol*. 2022;19(5):263-275.
7. Alberti KGMM, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome. *Circulation*. 2009;120(16):1640–1645.
8. North BJ, Sinclair DA. The intersection between aging and cardiovascular disease. *Circ Res*. 2012;110(8):1097-1108.
9. Mitchell GF. Arterial stiffness and hypertension in the elderly. *Curr Hypertens Rep*. 2022;24(4):239-245.
10. DeFronzo RA, Ferrannini E, Groop L. Type 2 diabetes mellitus: pathophysiology and risk factors. *Lancet*. 2022;399(10336):1115-1129.
11. Ferrucci L, Fabbri E. Inflammageing: chronic inflammation in ageing, cardiovascular disease, and frailty. *Nat Rev Cardiol*. 2018;15(9):505-522.
12. Franceschi C, Garagnani P, Parini P, Giuliani C, Santoro A. Inflammaging: a new immune-metabolic viewpoint for age-related diseases. *Nat Rev Endocrinol*. 2018;14(10):576-590.
13. World Health Organization. Ageing: healthy ageing and functional ability. 2024.
14. Sani MU, Umar A, Ibrahim S. Health-seeking behaviors and cardiometabolic risk profiles of elderly patients in Kebbi State. *Niger J Prim Care*. 2021;32(3):123-130.
15. Olamoyegun MA, Adebayo RA, Adeleye JO. Glycemic and blood pressure control among elderly Nigerian patients: a review of outpatient records. *West Afr J Med*. 2020;37(4):354-360.
16. Yamane T. *Statistics: An Introductory Analysis*. 2nd ed. Harper and Row; 1967.
17. World Health Organization. Ageing and health. Fact sheet. 2021.
18. Adeloye D, Ige-Elegbede JO, Auta A, et al. Estimating the prevalence, hospitalisation and mortality from non-communicable diseases among elderly population in Nigeria: A systematic review and meta-analysis. *BMJ Open*. 2021;11(5):e042823.
19. Mackenbach JP, Stirbu I, Roskam AJR, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med*. 2008;358(23):2468-2481.
20. Chandola T, Brunner E, Marmot M. Chronic stress at work and the metabolic syndrome: prospective study. *BMJ*. 2006;332(7540):521-525.
21. World Health Organization. *Hypertension*. Fact sheet. 2023.
22. Ungvari Z, Tarantini S, Donato AJ, Galvan V, Csiszar A. Mechanisms of vascular aging. *Circ Res*. 2018;123(7):849-867.
23. Adedoyin RA, Akinpelu AO, Adebayo RA. Cardiometabolic risks in elderly patients attending outpatient clinics in Nigeria. *African Health Sciences*. 2021;21(1):140-147.
24. Abdulrahman MA, Bello RT, Zubair HU. Cardiometabolic health status among ageing adults in northern Nigeria: A multicenter cross-sectional analysis. *Nigerian Journal of Medicine and Public Health*. 2022;4(2):101-109.
25. Palmer AK, Kirkland JL. Aging and adipose tissue: implications for cardiometabolic disease. *J Clin Invest*. 2022;132(3):e158402.
26. Tesfaye A, Tessema G, Abebe Y. Cardiometabolic risk among older adults in Ethiopia: a population-based study. *BMC Geriatr*. 2023;23(1):112.
27. Ben-Shlomo Y, Cooper R, Kuh D. The life course approach to health. In A life course approach to healthy ageing. *Oxford University Press*; 2016; pp. 3–17.
28. Ghebreyesus TA, World Health Organization. *Decade of Healthy Ageing: Baseline Report*. World Health Organization; 2020.
29. López-Otín C, Blasco MA, Partridge L, Serrano M, Kroemer G. The hallmarks of aging. *Cell*. 2013;153(6):1194-1217.
30. Sesti G, Antonelli-Incalzi R, Bonfigli AR, et al. Ageing and cardiometabolic risk: a consensus statement. *Aging Clin Exp Res*. 2023;35:225-238.