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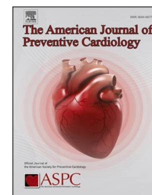
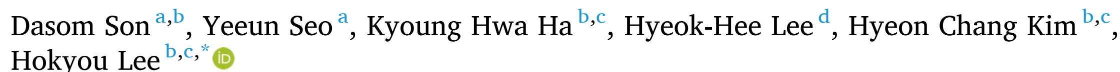


Trends in cardiovascular health based on Life's Essential 8 among Korean adults, 2007–2023



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ABSTRACT

Background: In 2022, the American Heart Association introduced Life's Essential 8 (LE8), an updated framework for assessing cardiovascular health (CVH). This study examined trends in overall LE8 CVH and individual metric scores from 2007 to 2023 in the Korean adult population.

Methods: We conducted a serial, cross-sectional study using data from the Korea National Health and Nutrition Examination Survey (KNHANES; waves 4–9), adults aged ≥20 years. CVH was assessed using LE8 metrics, each scored range of 0–100. The overall score was calculated as the mean of the eight metrics and categorized as low (0-<50), moderate (50-<80), or high (80–100).

Results: There were 76,255 participants, representing 35,494,751 adults. The mean (95% CI) CVH score declined from 68.5 (68.1–68.9) in 2007–2009 to 65.9 (65.5–66.2) in 2016–2018, and returned to 68.5 (68.1–69.0) in 2022–2023. In the most recent period, women had higher mean scores than men (72.8 [95% CI: 72.2–73.3] vs. 64.3 [95% CI: 63.7–64.8]), and adults aged 20–39 years scored higher than those aged ≥70 years (72.5 [95% CI: 72.0–73.1] vs. 64.5 [95% CI: 63.9–65.1]). Trends varied by individual metrics. Sleep health and blood glucose scores remained high. Nicotine exposure, body mass index, blood lipids, and blood pressure scores remained moderate. Diet and physical activity scores remained low. These patterns also differed by sex and age.

Conclusions: Over the 17 years, CVH in Korean adults remained in the moderate range, with a decline through 2018 and full recovery by 2022–2023. Differences by age and sex underscore the need for tailored prevention strategies.

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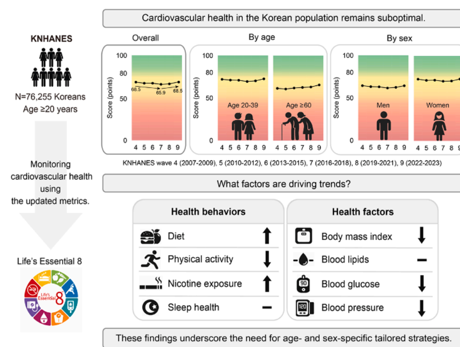

Central illustration. Temporal trends in the CVH score based on the LE8 framework for the Korean adult population. Abbreviations: CVH, cardiovascular health; KNHANES, Korea National Health and Nutrition Examination Survey; LE8, Life's Essential 8.

Introduction

Cardiovascular disease (CVD) is the leading cause of death and a major contributor to the global burden of disease [1,2]. In 2010, the American Heart Association (AHA) introduced Life's Simple 7 (LS7) as a set of metrics to promote and monitor cardiovascular health (CVH) in support of its 2020 Impact Goal. LS7 comprises seven metrics— diet, physical activity, smoking status, body mass index (BMI), blood lipids, blood glucose, and blood pressure (BP)—classified into poor, intermediate, or ideal levels [3]. In 2022, the AHA updated its CVH framework by refining and expanding the definition and quantification of CVH. The updated Life's Essential 8 (LE8) adds sleep health as a new metric and enhances granularity by adopting a 0–100 point-based scoring system to each metric [4].

Understanding national trends in CVH is essential for informing effective CVD prevention strategies. A previous study [5], examining national CVH trends in Korean adults from 2007 to 2018 using the LS7 framework, demonstrated distinct sex- and age-specific patterns in CVH indicators, with younger adults and men exhibiting particularly poorer CVH. Building on this work, there is a need to apply the updated LE8 metrics to assess CVH in the Korean population, with extended study period through 2023 to capture more recent trends. Leveraging nationally representative data, this study aimed to examine trends in overall CVH and its individual metrics using LE8, with comparison with LS7, from 2007 to 2023 by sex and age among adults in Korea.

Methods

Data Source and Study Population

This study used data from the Korea National Health and Nutrition Examination Survey (KNHANES), a nationwide, population-based surveillance system that collects cross-sectional data on health status, behaviors, and diet using a stratified, multistage probability sampling design. Further details of the KNHANES have been described elsewhere [6]. To assess long-term trends, we used data collected over a 17-year period (2007–2023), grouped into 3-year waves (waves 4–9). A total of 133,375 adults aged 20 years or older were initially identified. After excluding individuals with missing data on any LE8 metric, 76,255 participants were included in the final analytic sample.

Evaluation of CVH Using LE8 and LS7 Framework

CVH was assessed using the LE8 framework, which comprises four health behaviors (diet, physical activity, nicotine exposure, and sleep) and four health factors (BMI, blood lipids, blood glucose, and BP).

Diet quality was assessed using the Dietary Approaches to Stop Hypertension (DASH) score, derived from 24-hour dietary recall data available across all KNHANES waves. Six nutrients (protein, fiber, calcium, potassium, total fat, and sodium) were included. Nutrient-specific quintiles were determined from the 5th and 6th KNHANES waves, during which dietary fiber measurement was revised from crude to dietary fiber, and each nutrient was scored from 1 to 5. For total fat and sodium, scoring was reversed due to their inverse associations with CVH. Physical activity was assessed using the Global Physical Activity Questionnaire, based on self-reported duration of engagement in moderate- and vigorous-intensity activities. Weekly minutes were calculated, with vigorous activity weighted twice that of moderate activity. Smoking status was categorized as never, former, or current smoker. Former smokers were scored based on duration of cessation, and current smokers received lower scores. Electronic cigarette users were assigned a maximum of 25 points, and exposure to secondhand smoke at home deducted 20 points. Sleep duration was self-reported as a weighted mean of weekday and weekend sleep hours.

BMI was calculated from measured height and weight, with scoring based on Asian-specific criteria. Blood lipids were measured after ≥8 hours of fasting; non-high-density lipoprotein (HDL) cholesterol was calculated by subtracting HDL cholesterol from total cholesterol. A 20-point deduction was applied for use of lipid-lowering medications. Blood glucose was evaluated using fasting glucose, glycated hemoglobin (HbA1c), and self-reported diabetes status. BP was based on the average of the second and third seated measurements, with a 20-point deduction applied for those on antihypertensive therapy. For all cases where a 20-point deduction is applied, the minimum score is capped at 0. Information on changes across survey years is provided in Table S1.

Each LE8 metric was scored on a scale from 0 to 100, with higher scores indicating healthier state [4]. Detailed scoring algorithms for all eight metrics are provided in Table 1. The overall LE8 score was calculated as the mean value of all eight metrics (range: 0–100) and classified as low (0-<50), moderate (50-<80), or high (80–100) CVH according to the AHA Presidential Advisory [4].

Definitions of LS7 metrics are presented in Table S2. For comparability with LE8, dietary assessment was based on the DASH score, categorized as ideal (≥80th percentile), intermediate (40th–79th percentile), and poor (1st–39th percentile) [7]. The remaining metrics were defined using the same criteria as in the previous study [5]. The LS7 score was evaluated using two approaches: a 0–14 scale, obtained by summing 2 points for ideal, 1 point for intermediate, and 0 points for poor metrics, and a 0–7 scale, defined as the number of ideal metrics.

Statistical Analyses

Demographic characteristics were summarized as proportions with 95% confidence intervals (CI) for categorical variables and means with 95% CI for continuous variables. Trends in mean CVH scores and distributions of overall CVH categories (low, moderate, and high) were visualized across survey waves and stratified by sex and age groups (20–39, 40–49, 50–59, 60–69, and ≥70 years). Survey-weighted linear regression and survey-weighted chi-square tests were conducted to assess differences across survey waves. Weighted Pearson correlation coefficients were calculated to assess the association between LS7 and LE8 scores, using survey design weights.

Age- and sex-standardized mean scores for overall CVH and each LE8 metric were estimated for subgroups defined by residential area, household income, and educational attainment, using the direct standardization method based on the 2005 Korean population. The residential area was classified as metropolitan, urban, or rural according to administrative divisions. Household income was categorized into tertiles: low (<25th percentile), middle (25th–74th percentile), and high (≥75th percentile). Educational attainment was classified as middle school or less (low), middle (high school graduate), or high (college graduate and above).

All analyses accounted for the complex sampling design of

Table 1
Scoring scheme for LE8 metrics in this study.

LE8 metric	Method of measurement	Level	Point
Diet	Self-reported daily intake of a DASH-style eating pattern, score	24	100
		11–23	80
		18–20	50
		15–17	25
		6–14	0
Physical activity	Self-reported minutes of moderate or vigorous physical activity per week, minutes (vigorous physical activity given twice the weight of moderate activities)	≥150	100
		120–149	90
		90–119	80
		60–59	60
		30–59	40
		1–29	20
		0	0
Nicotine exposure	Self-reported use of cigarettes or inhaled NDS (subtract 20 points if exposure to secondhand smoke at home)	Never smoker	100
		Former smoker, quit ≥5 years	75
		Former smoker, quit 1-<5 years	50
		Former smoker, quit <1 year or current using inhaled NDS	25
		Current smoker	0
Sleep health	Self-reported average daily hours of sleep, hours	7-<9	100
		9-<10	90
		6-<7	70
		5-<6 or ≥10	40
		4-<5	20
		<4	0
BMI	Body weight divided by height squared, kg/m^2	<23.0	100
		23.0–24.9	70
		25.0–29.9	30
		30.0–34.9	15
		≥35.0	0
Blood lipids	Calculated by subtracting HDL cholesterol from total cholesterol, mg/dL (If drug-treated level, subtract 20 points)	<130	100
		130–159	60
		160–189	40
		190–219	20
		≥220	0
Blood glucose	FBG, mg/dL or HbA1c, %	No history of DM and FBG <100	100
		No history of DM and FBG 100–125	60
		DM with HbA1c <7.0	40
		DM with HbA1c 7.0–7.9	30
		DM with HbA1c 8.0–8.9	20
		DM with HbA1c 9.0–9.9	10
		DM with HbA1c ≥10.0	0
BP	Systolic or diastolic BP, mmHg (subtract 20 points if treated level)	<120/<80	100
		120–129/<80	75
		130–139 or 80–89	50
		140–159 or 90–99	25
		≥160 or ≥100	0

Abbreviations: BMI, body mass index; BP, blood pressure; DASH, Dietary Approaches to Stop Hypertension; DM, diabetes mellitus; FBG, fasting blood glucose; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; LE8, Life's Essential 8; NDS, nicotine-delivery system.

KNHANES, incorporating survey weights, strata, and clustering. Statistical analyses were conducted using R version 4.3.1 (R Foundation for Statistical Computing).

Results

In the KNHANES samples, there were 76,255 adult participants, representing an estimated 35,494,751 Korean adults. Characteristics of the sample with weighted population numbers are presented in Table 2. From 2007–2009 (wave 4) to 2022–2023 (wave 9), the mean age of participants ranged from 45.2 to 48.8 years, and the proportion of women ranged from 53.5% to 50.4%.

Trends in LE8 CVH Scores

Fig. 1 displays the mean (95% CI) LE8 scores among Koreans across age and sex. The mean (95% CI) score declined from 68.5 (68.1–68.9) in 2007–2009 (wave 4) to 65.9 (65.5–66.2) in 2016–2018 (wave 7) and returned to 68.5 (68.1–69.0) in 2022–2023 (wave 9) (Fig. 1). In the most recent wave (wave 9, 2022–2023), women had higher LE8 scores than men on average (72.8 [95% CI: 72.2–73.3] vs. 64.3 [95% CI: 63.7–64.8]), and adults aged 20–39 years had higher scores than those aged ≥70 years (72.5 [95% CI: 72.0–73.1] vs. 64.5 [95% CI: 63.9–65.1]) (Table S3). According to the cut points suggested by the AHA, mean LE8 scores remained within the moderate CVH range (50-<80) across all age groups and survey waves, without reaching the high CVH range (80–100) at any point during the study period. The proportion of individuals with high CVH declined steadily from 2007 to 2018, then returned to earlier levels, 21.5% in 2022–2023 (Fig. 2, Table S4).

Comparison of LE8 With LS7

When CVH was assessed using the LS7 score over the same period, the mean number of ideal LS7 metrics (95% CI) changed from 3.5 (3.5–3.5) in 2007–2009 to 3.3 (3.2–3.3) in 2016–2018, and then to 3.4 (3.3–3.4) in 2022–2023, showing a trend similar to that observed for LE8 scores (Figure S1, Table S5). When LE8 scores were compared with LS7 scores in the overall study sample of KNHANES waves 4 to 9, the median LE8 scores increased progressively with each level of LS7 score, demonstrating a strong positive correlation (r=0.913, P<0.001) between the two scores (Fig. 3). However, a wide range of LE8 scores was observed with each level of LS7 score. For the 7 metrics common to both CVH scores, the correlation was high in general, with the lowest correlation for lipid metrics (r=0.763; Figure S2). The newly added sleep metric showed relatively low correlations with the other 7 individual metrics (Figure S2).

Trends in Individual LE8 Metric Scores

Trends in individual LE8 metric scores were heterogeneous and differed by sex and age. Individual scores for health behaviors—diet, physical activity, nicotine exposure, and sleep—either improved or remained stable over time, whereas individual scores for health factors—including BMI, blood lipids, blood glucose, and BP—generally declined (Figure 4; Table S6).

Among health factors, diet scores remained persistently low in young adults aged 20–39 years, decreasing from 39.7 (95% CI: 38.6–40.8) to 38.0 (95% CI: 36.6–39.3), whereas the score in other age groups improved steadily. Physical activity scores were the lowest among all metrics, showing a marked decline through 2018, followed by partial recovery in men and women. Physical inactivity was most pronounced among women and worsened with age. Nicotine exposure exhibited the largest sex disparity: women consistently had high scores, while men did not. However, gradual improvements were observed across both sexes—in men, from 36.9 [95% CI: 35.6–38.1] to 55.7 [95% CI: 54.1–57.3], and in women, from 86.7 [95% CI: 85.9–87.6] to 91.7 [95% CI: 90.8–92.6]) (Tables S7 and S8; Figures S3 and S4). Sleep health scores remained stable and in the high range (80–100) throughout the study period but declined to the moderate range (50-<80) among adults aged ≥60 years (Figure 4; Table S6).

Among health factors, BMI scores declined over time, particularly among men aged 50–59 years (from 71.6 [95% CI: 70.0–73.2] to 65.2 [95% CI: 63.2–67.3]). Blood lipid scores worsened, reaching their lowest in middle-aged adults, though modest improvements were seen in older adults of both sexes. Blood glucose scores declined overall, with the lowest scores observed among older men. BP scores slightly declined

Table 2
Baseline characteristics according to KNHANES wave (2007–2023).

Characteristic	IV, 2007–2009 (N = 13,466)	V, 2010–2012 (N = 14,401)	VI, 2013–2015 (N = 12,158)	VII, 2016–2018 (N = 14,187)	VIII, 2019–2021 (N = 12,884)	IX, 2022–2023 (N = 9159)	P-value
Age, years	45.2 (44.7–45.7)	46.0 (45.5–46.5)	46.2 (45.7–46.6)	47.5 (47.1–48.0)	48.3 (47.7–48.8)	48.8 (48.2–49.4)	<0.001
Mean LE8 score	68.5 (68.1–68.9)	67.2 (66.9–67.6)	67.2 (66.9–67.6)	65.9 (65.5–66.2)	66.4 (66.1–66.8)	68.5 (68.1–69.0)	<0.001
Age group, %							<0.001
20–39	40.6 (39.1–42.2)	38.1 (36.6–39.5)	37.1 (35.7–38.5)	34.8 (33.4–36.2)	33.0 (31.6–34.4)	32.3 (30.6–34.0)	
40–49	22.8 (21.7–24.0)	22.1 (20.9–23.2)	21.5 (20.4–22.6)	20.9 (19.9–21.9)	20.2 (19.1–21.3)	18.6 (17.3–19.9)	
50–59	16.9 (16.0–17.7)	19.2 (18.3–20.1)	20.3 (19.3–21.3)	19.7 (18.8–20.6)	20.1 (19.2–21.0)	19.8 (18.7–20.9)	
60–69	11.0 (10.3–11.6)	11.5 (10.8–12.1)	12.3 (11.6–13.0)	13.5 (12.7–14.2)	15.4 (14.5–16.2)	17.3 (16.2–18.4)	
≥70	8.7 (8.1–9.4)	9.2 (8.6–9.9)	8.8 (8.1–9.4)	11.1 (10.4–11.9)	11.4 (10.5–12.2)	12.0 (11.1–12.9)	
Sex, %							<0.001
Men	46.5 (45.7–47.3)	46.7 (45.9–47.6)	47.7 (46.8–48.6)	47.8 (47.0–48.6)	48.4 (47.6–49.3)	49.6 (48.6–50.6)	
Women	53.5 (52.7–54.3)	53.3 (52.4–54.1)	52.3 (51.4–53.2)	52.2 (51.4–53.0)	51.6 (50.7–52.4)	50.4 (49.4–51.4)	
Residential area, %							0.020
Metropolitan	45.1 (42.8–47.4)	45.3 (43.0–47.6)	45.3 (43.1–47.5)	46.2 (43.9–48.5)	44.5 (41.9–47.0)	43.8 (41.2–46.4)	
Urban	34.7 (31.5–38.0)	33.8 (30.5–37.2)	37.6 (34.5–40.8)	39.1 (36.0–42.2)	40.3 (36.8–43.7)	40.2 (36.3–44.1)	
Rural	20.2 (17.0–23.3)	20.9 (17.5–24.2)	17.1 (14.1–20.0)	14.7 (12.0–17.5)	15.3 (12.5–18.1)	16.0 (12.5–19.4)	
Household Income*, %							<0.001
High	16.2 (15.1–17.4)	15.7 (14.6–16.8)	14.0 (12.9–15.1)	15.4 (14.3–16.5)	13.9 (12.8–15.0)	14.4 (13.4–15.5)	
Moderate	53.8 (52.1–55.5)	56.8 (55.2–58.4)	54.9 (53.1–56.7)	52.9 (51.4–54.4)	52.4 (50.7–54.2)	52.4 (50.5–54.3)	
Low	30.0 (28.1–31.8)	27.5 (26.0–29.0)	31.1 (29.2–33.0)	31.7 (30.0–33.4)	33.7 (31.7–35.7)	33.2 (31.0–35.3)	
Education level†, %							<0.001
High	31.4 (30.0–32.9)	29.6 (28.2–31.0)	24.8 (23.5–26.1)	23.3 (22.0–24.6)	19.7 (18.5–21.0)	18.1 (16.8–19.5)	
Middle	39.5 (38.1–40.8)	37.5 (36.2–38.7)	37.5 (36.2–38.8)	34.1 (32.9–35.4)	35.7 (34.4–36.9)	34.2 (32.8–35.5)	
Low	29.1 (27.6–30.5)	32.9 (31.5–34.4)	37.7 (36.2–39.2)	42.6 (40.9–44.2)	44.6 (42.8–46.3)	47.7 (45.8–49.6)	
DASH diet, %							<0.001
Q1, lowest	31.2 (30.2–32.2)	25.6 (24.6–26.7)	25.4 (24.3–26.5)	18.9 (17.9–19.8)	15.8 (14.9–16.7)	15.6 (14.6–16.6)	
Q2	21.1 (20.2–22.0)	28.7 (27.7–29.8)	23.8 (22.7–24.8)	18.2 (17.4–19.0)	16.8 (16.0–17.7)	17.2 (16.2–18.2)	
Q3	21.2 (20.3–22.0)	20.2 (19.3–21.0)	19.2 (18.4–20.0)	20.5 (19.6–21.3)	20.0 (19.2–20.8)	19.5 (18.5–20.4)	
Q4	19.2 (18.3–20.1)	17.4 (16.6–18.2)	14.4 (13.5–15.3)	19.6 (18.9–20.4)	22.0 (21.1–22.8)	20.4 (19.5–21.3)	
Q5, highest	7.3 (6.7–7.9)	8.0 (7.5–8.6)	17.2 (16.3–18.1)	22.8 (21.9–23.8)	25.4 (24.4–26.4)	27.3 (26.1–28.5)	
Physical activity, min/week	450.5 (426.4–474.6)	333.4 (311.0–355.7)	237.7 (222.7–252.7)	129.6 (121.0–138.2)	124.7 (116.5–132.8)	164.4 (154.2–174.5)	<0.001
Smoking status, %							<0.001
Non	55.7 (54.8–56.6)	55.9 (54.9–56.9)	58.4 (57.4–59.4)	58.7 (57.8–59.6)	58.2 (57.2–59.2)	57.7 (56.4–58.9)	
Former	20.1 (19.3–20.9)	20.4 (19.5–21.2)	20.2 (19.4–21.0)	21.8 (21.0–22.6)	23.9 (23.0–24.7)	24.9 (23.9–25.9)	
Current	24.2 (23.3–25.1)	23.7 (22.8–24.7)	21.4 (20.4–22.4)	19.5 (18.6–20.4)	17.9 (17.0–18.8)	17.4 (16.3–18.5)	
Sleep duration, hr/night	6.9 (6.8–6.9)	6.9 (6.8–6.9)	6.8 (6.7–6.8)	7.2 (7.2–7.2)	7.0 (6.9–7.0)	6.9 (6.9–7.0)	<0.001
BMI, kg/m^2	23.6 (23.5–23.7)	23.7 (23.6–23.8)	23.8 (23.7–23.8)	24.0 (23.9–24.0)	24.1 (24.0–24.2)	24.2 (24.1–24.3)	<0.001
Non-HDL cholesterol, mg/dL	138.2 (137.4–139.1)	138.9 (138.1–139.7)	137.3 (136.5–138.1)	141.7 (140.9–142.5)	139.9 (139.1–140.7)	131.9 (130.8–133.0)	<0.001
Fasting glucose, mg/dL	96.4 (95.9–96.9)	96.6 (96.1–97.1)	98.6 (98.1–99.1)	99.7 (99.2–100.2)	100.5 (100.0–101.0)	99.6 (99.0–100.2)	<0.001
HbA1c‡, %	7.3 (7.2–7.4)	5.8 (5.7–5.8)	5.7 (5.7–5.7)	5.6 (5.6–5.7)	5.8 (5.7–5.8)	5.6 (5.5–5.6)	<0.001
SBP, mmHg	115.4 (114.9–115.9)	117.4 (116.9–117.8)	116.4 (115.9–116.8)	117.6 (117.2–118.0)	118.2 (117.7–118.6)	118.0 (117.5–118.5)	<0.001
DBP, mmHg	75.2 (74.9–75.6)	75.5 (75.2–75.8)	75.1 (74.8–75.4)	75.9 (75.6–76.1)	75.4 (75.1–75.6)	74.0 (73.7–74.3)	<0.001

Values are presented as weighted means (95% confidence interval) or proportions (95% confidence interval), as appropriate.
Abbreviations: BMI, body mass index; DASH, Dietary Approaches to Stop Hypertension; DBP, diastolic blood pressure; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; KNHANES, Korea National Health and Nutrition Examination Survey; LE8, Life's Essential 8; Q, quintile; SBP, systolic blood pressure.
[*] Total sample size for household income by KNHANES wave: IV (N = 13,168), V (N = 14,273), VI (N = 12,113), VII (N = 14,162), VIII (N = 12,849), IX (N = 9148).
[†] Total sample size for educational level by KNHANES wave: IV (N = 13,447), V (N = 14,396), VI (N = 12,148), VII (N = 14,177), VIII (N = 12,873), IX (N = 9155).
[‡] Total sample size for HbA1c by KNHANES wave: IV (N = 1307), V (N = 9947), VI (N = 12,158), VII (N = 14,187), VIII (N = 12,884), IX (N = 9159); Between 2007 and 2010, only individuals with a history of diabetes (on antidiabetic treatment) or with fasting glucose ≥126 mg/dL were measured.

(from 74.2 [95% CI: 73.3–75.1] to 73.5 [95% CI: 72.5–74.6]), with men consistently scoring lower than women; however, among older adults, women had lower scores than men (53.2 [95% CI: 50.5–55.8] vs. 51.1 [95% CI: 48.9–53.4]) (Fig. 4, Figures S3 and S4, and Tables S6–S8).

Trends in Socioeconomic Disparities in LE8 Status

After adjusting for age and sex, mean LE8 CVH scores were lower among adults residing in rural areas and those with lower income or educational attainment. Although regional differences were modest, educational disparities in CVH scores were more pronounced (Figure S5; Table S9). Mean scores for individual LE8 metrics differed across socioeconomic subgroups (Tables S10–S12).

Discussion

During the 17-year period from 2007 to 2023, CVH assessed by LE8 declined steadily through 2018 but began to rebound thereafter. The same trend was observed in the LS7 score, which had a strong correlation with the LS8 score. Based on this updated LE8 metric, the CVH of Korean adults remained at a moderate level (50-<80) across all age and sex groups. Over time, health behaviors—including diet, physical activity, nicotine exposure, and sleep—generally improved, whereas health factors—including BMI, blood lipids, blood glucose, and BP—tended to worsen.

The updated LE8 CVH metric provides a meaningful framework for interpreting nationwide changes in lifestyle and clinical health factors. The LE8 CVH score maintained the conceptual foundation of the original LS7, while the inclusion of sleep health and the expanded scoring range

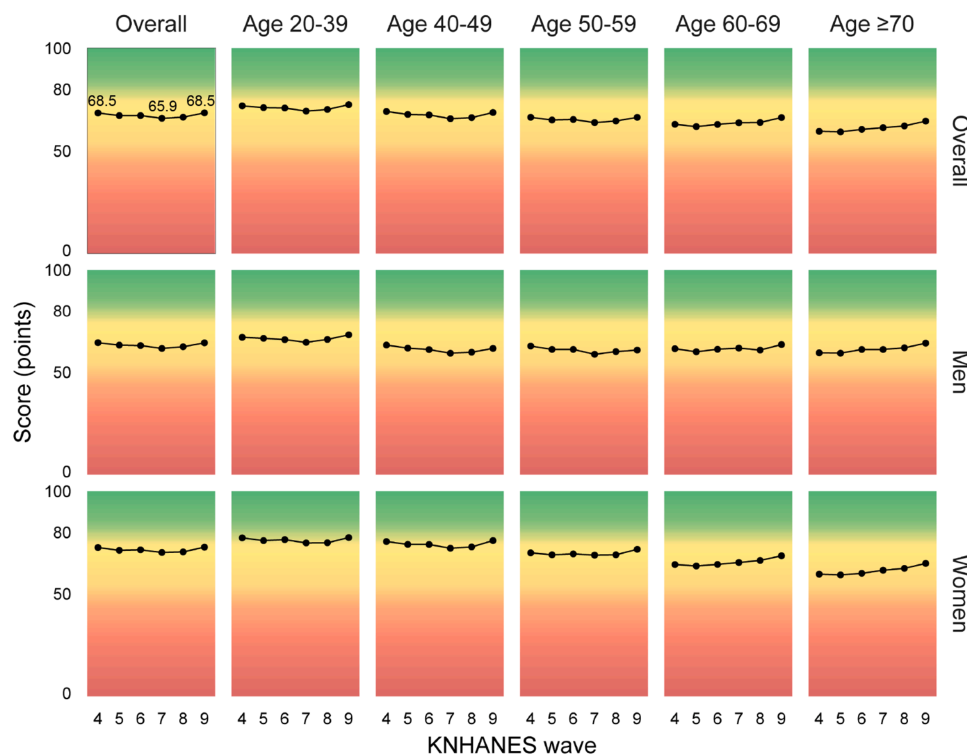

Fig. 1. Mean CVH scores based on LE8 by age and sex, 2007–2023. Each point and vertical error bar represents the weighted mean and 95% confidence intervals, calculated using sampling weights to account for the complex sampling design of KNHANES. Error bars were too narrow to be visible. Each KNHANES wave corresponds to the following years: 4 (2007–2009), 5 (2010–2012), 6 (2013–2015), 7 (2016–2018), 8 (2019–2021), and 9 (2022–2023).
Abbreviations: CVH, cardiovascular health; KNHANES, Korea National Health and Nutrition Examination Survey; LE8, Life's Essential 8.

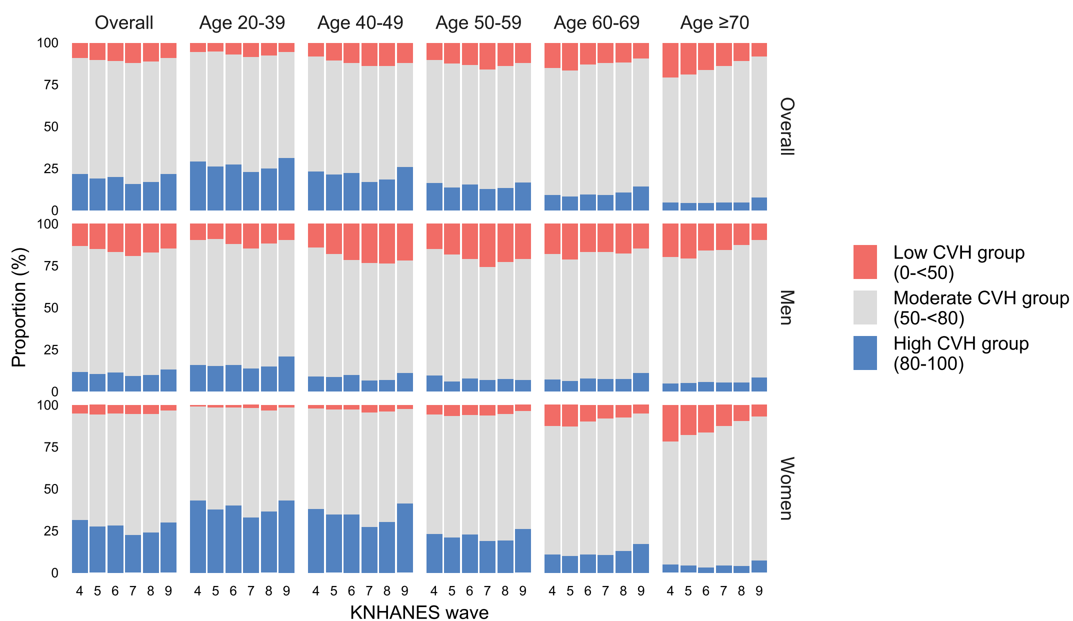

Fig. 2. Proportion of CVH categories based on LE8 by age and sex, 2007–2023. CVH scores were classified as low (0-<50), moderate (50-<80), or high (80–100). Each bar represents the weighted proportion of CVH categories, with estimates accounting for the complex sampling design of KNHANES. Each KNHANES wave corresponds to the following years: 4 (2007–2009), 5 (2010–2012), 6 (2013–2015), 7 (2016–2018), 8 (2019–2021), and 9 (2022–2023).
Abbreviations: CVH, cardiovascular health; KNHANES, Korea National Health and Nutrition Examination Survey; LE8, Life's Essential 8

provides additional informational value [8]. Numerous studies have demonstrated that higher LE8 CVH scores were associated with lower CVD risk and longer life expectancy [9–11]. Recent data indicate that age-adjusted CVD mortality has started to plateau or even rise in some populations [12], highlighting the continued need for preventive efforts. Our findings support that the updated LE8 CVH score is a useful population-level health indicator, which is also the core means for primordial prevention and improvement of CVH.

The recent heightened interest in taking care of health has had a substantial impact on metrics of CVH [13]. In Korea, the recent period

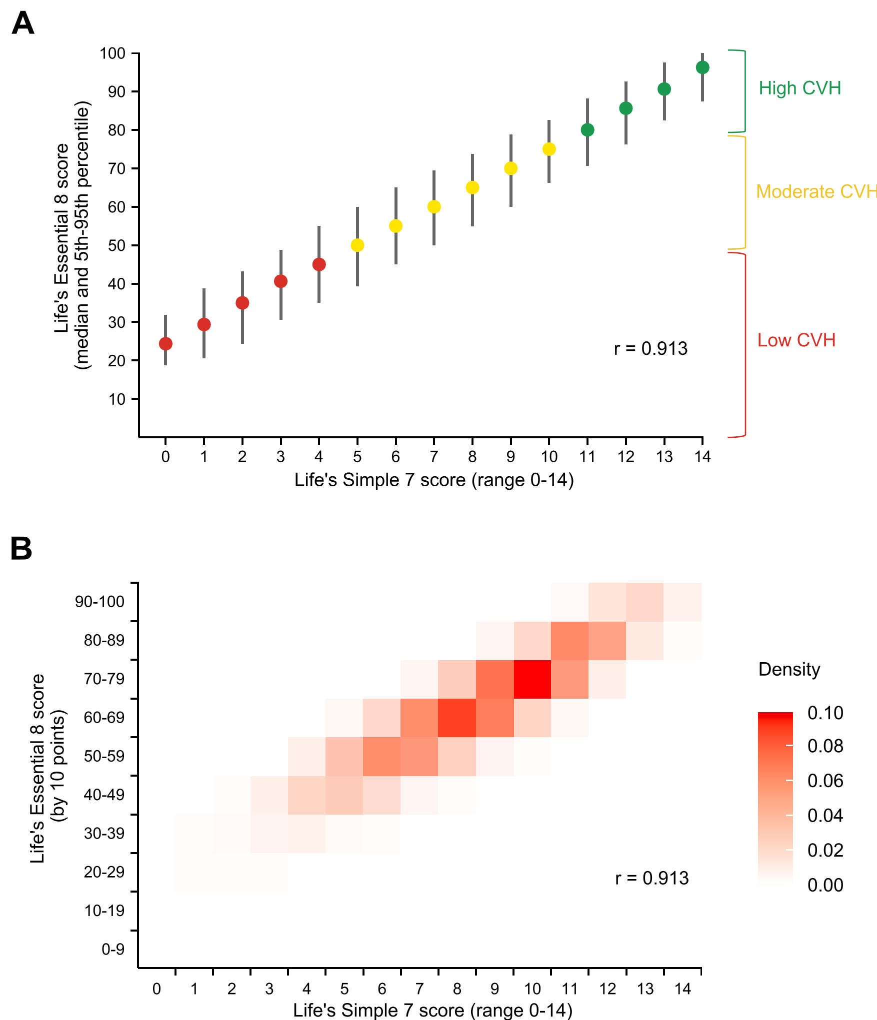

Fig. 3. Distribution of LE8 scores according to each level of LS7 score. (A) Median and 5th–95th percentile LE8 scores according to each level of LS7 score. (B) Distribution of participants across LE8 score intervals and LS7 score levels. All analyses used sampling weights to account for the complex sampling design of KNHANES. The r-value indicates the Pearson correlation coefficient between the two CVH scores.
Abbreviations: CVH, cardiovascular health; KNHANES, Korea National Health and Nutrition Examination Survey; LE8, Life's Essential 8; LS7, Life's Simple 7.

was associated with favorable changes in health behaviors, including reduced smoking prevalence [14], increased intake of beneficial nutrients [15], greater engagement in strength training [16], and stable sleep duration [17]. However, during the same period, the prevalence of obesity, hypertension, and diabetes increased [18]. These national trends align with our findings, which demonstrated improvements in health behaviors beginning in 2019, alongside continued deterioration in clinical health factors. This suggests that the global health concerns and wellness craze may have had an impact on CVH by encouraging healthier lifestyle behaviors [19]. Conversely, clinical health factors, particularly continued exposure to high BMI and high blood sugar, are increasing not only in Korea but also globally [20–22].

While health factors continued to deteriorate among young adults, older adults showed low but gradually improving trends over time. Among young adults, the prevalence of obesity has steadily risen in both sexes, while physical activity and diet quality remain suboptimal. Smoking prevalence also remains high among men, further exacerbating cardiovascular risk [23]. These adverse trends are accompanied by worsening glycemic and lipid profiles. Similar patterns have been observed in other racial and ethnic young adults [24], with the decline in premature CVD mortality reversing in some countries [25,26]. It indicates the threat to CVH remains substantial across younger generations worldwide. In contrast, although older adults had lower overall CVH scores than younger adults, several metrics showed improvements over time. Distinct sex-specific patterns were observed: women demonstrated better control of blood glucose, diet, and smoking, whereas men had more favorable levels of BMI, lipids, BP, physical activity, and sleep. This sex-specific divergence may partly reflect postmenopausal changes in women, including increased body fat, adverse lipid profiles, elevated BP, and sleep disturbances [27–29]. These age-specific findings highlight the need for early identification and intervention in young adults to reduce long-term cardiovascular risk [30–33], and also highlight the potential benefits of sex-specific approaches to improve CVH among older adults [34,35].

Routine monitoring of CVH provides valuable insights into population health trends and informs the development of effective prevention strategies. Maintaining ideal CVH across the life course is strongly associated with a lower risk of CVD [36–38]. Early adoption of healthy behaviors can significantly reduce future cardiovascular risk [39–41]. However, most current guidelines focus primarily on midlife adults, often overlooking younger populations [42,43]. CVH metrics offer a life-course framework that enables early risk detection and sustained prevention. Future strategies should adopt a more inclusive approach to CVH assessment and promotion across all stages of life.

This study has several limitations. First, dietary intake was assessed using a single 24-hour recall, which may not accurately capture habitual dietary patterns. Second, nutrient intake was estimated using a food frequency questionnaire, but only six nutrients consistently available

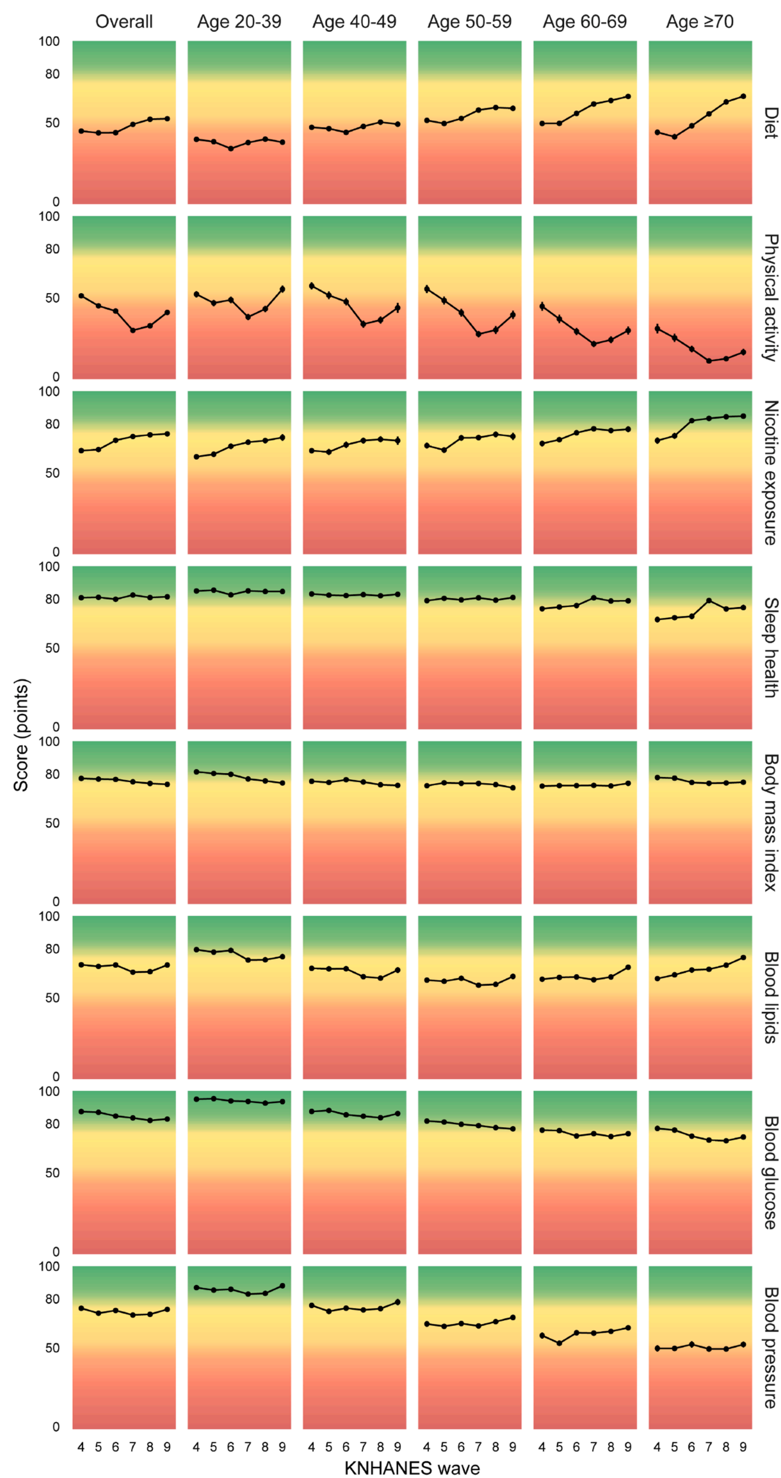

Fig. 4. Mean scores of individual LE8 metrics by age group, 2007–2023. Each point and vertical error bar represents the weighted mean and 95% confidence intervals, calculated using sampling weights to account for the complex sampling design of KNHANES. Error bars were too narrow to be visible. Each KNHANES wave corresponds to the following years: 4 (2007–2009), 5 (2010–2012), 6 (2013–2015), 7 (2016–2018), 8 (2019–2021), and 9 (2022–2023).
Abbreviations: KNHANES, Korea National Health and Nutrition Examination Survey; LE8, Life's Essential 8.

across all survey waves were analyzed to ensure comparability. Third, the use of self-reported data may have introduced recall bias and measurement error. Lastly, changes in measurement protocols and questionnaire content across KNHANES waves, including modifications in dietary fiber assessment, BP devices, HbA1c analytical institutions, and HDL cholesterol assay methods, may have resulted in inconsistencies in CVH classification over time.

In conclusion, CVH among Korean adults declined from 2007 to 2018 but showed sustained improvement to 2023. Despite this recovery, overall CVH remained within the moderate (50-<80) range across all age and sex groups. CVH trends differed substantially by age and sex. These findings underscore the need for targeted, age- and sex-specific strategies at both individual and policy levels to reduce disparities and promote lifelong CVH.

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Data statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The KNHANES is a national de-identified database for public use. The survey was approved by the Korea Centers for Disease Control and Prevention (KCDC) Institutional Review Board for each wave: wave 4 (2007-2009) (2007-02CON-04-P, 2008-04EXP-01-C, and 2009-01CON-03-2C), wave 5 (2010-2012) (2010-02CON-21-C, 2011-02CON-06-C, and 2012-01EXP-01-2C), wave 6 (2013-2015) (2013-07CON-03-4C, and 2013-12EXP-03-5C), wave 7 (2016-2018) (2018-01-03-P-A), wave 8 (2019-2021) (2018-01-03-C-A, 2018-01-03-2C-A, and 2018-01-03-5C-A), wave 9 (2022-2023) (2018-01-03-4C-A, and 2022-11-16-R-A). All participants provided written informed consent.

CRediT authorship contribution statement

Dasom Son: Methodology, Investigation, Formal analysis, Writing – original draft, Visualization. **Yeeun Seo:** Methodology, Investigation, Validation, Writing – review & editing. **Kyoung Hwa Ha:** Investigation, Writing – review & editing. **Hyeok-Hee Lee:** Investigation, Writing – review & editing. **Hyeon Chang Kim:** Conceptualization, Writing – review & editing, Supervision. **Hokyou Lee:** Conceptualization, Writing – review & editing, Supervision, Funding acquisition.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Hokyou Lee reports financial support was provided by National Research Foundation of Korea. Hokyou Lee reports financial support was provided by Korea Medical Institute. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ajpc.2026.101448.

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