European Journal of Mental Health
https://doi.org/10.5708/EJMH.21.2026.0051

RESEARCH ARTICLE

Examination of Self-Rated Health, Psychological Well-Being and Cardiovascular Health Risks – 10-Year Follow-Up of the Budakalász Epidemiological Study in Hungary

Blanka EHRENBERGER [1], Zsófia OCSOVSZKY [1], Alexandra ASSABINY [1], József OTOHAL [1], Magor PAPP [4], Éva BORENSZKI-GUTÁSI [2], Zsolt BAGYURA [1], and Márta CSABAI [1,3]

Affiliations
[1] Semmelweis University, Heart and Vascular Center, Budapest, Hungary
[2] Semmelweis Health Promotion Center, Budapest, Hungary
[3] Károli Gáspár University of the Reformed Church, Budapest, Hungary
[4] Semmelweis University, Institute of Preventive Medicine and Public Health, Budapest, Hungary

Correspondence
Blanka EHRENBERGER
Semmelweis University, Heart and Vascular Center, Budapest, Hungary
1122 Budapest Városmajor street 68. Hungary
Email: ehrenberger.blanka@phd.semmelweis.hu

History
Received: 16 April 2025
Accepted: 29 January 2026
Published: 26 February 2026

Citation
Ehrenberger, B., Ocsovszky, Z., Assabiny, A., Otohal, J., Papp, M., Borenszki-Gutási, É., Bagyura, Z., & Csabai, M. (2026). Examination of self-rated health, psychological well-being and cardiovascular health risks: 10-year follow-up of the Budakalász Epidemiological Study in Hungary. *European Journal of Mental Health, 21*, e0051, 1–13. https://doi.org/10.5708/EJMH.21.2026.0051

Introduction: Self-rated health (SRH) predicts morbidity and mortality; however, its long-term trajectories and associations with psychological well-being (PWB), health behaviors, and cardiovascular risk remain understudied in Central and Eastern Europe.
Aim: To describe 10-year changes in cardiovascular risk, health behaviors, PWB, and SRH, and to examine how SRH relates to PWB, health behaviors, and cardiovascular risk in a non-clinical Hungarian adult sample.
Methods: Adults from Budakalász who participated in a cardiovascular screening in 2012 were invited to follow up in 2023. The analysis included 170 participants aged 45–65 years without major cardiovascular events. SRH was assessed with a single global item. Anthropometric and laboratory measures, FINDRISK and Framingham risk scores, health behaviors, and a four-item PWB score derived from the Short Form (36) Health Survey (SF-36)were included. Non-parametric tests, independent sample *t*-tests, and Spearman correlations were applied.
Results: Over the 10-year period, SRH showed a modest overall decline, with approximately one-quarter of participants reporting deteriorated SRH, more than half remaining stable, and a minority improving. SRH trajectories were not consistently associated with changes in PWB, cardiovascular risk, or health behaviors. Cross-sectionally, SRH was moderately correlated with PWB but only weakly related to health behaviors. Anthropometric data and cardiovascular risk scores increased, whereas fasting glucose, HbA1c%, and fruit and vegetable consumption improved, and physical activity shifted toward lower intensity.
Conclusions: SRH was closely aligned with PWB over 10 years but largely decoupled from objective cardiovascular risk and health behaviors, supporting SRH as a psychologically grounded subjective health construct relevant for cardiovascular prevention.

Keywords: psychological well-being, cardiovascular disease, self-rated health, medical status, health behavior

ISSN 1788-7119 (online)

Introduction

Cardiovascular disease (CVD) remains the leading cause of death worldwide despite substantial progress in prevention and treatment. According to the European Society of Cardiology (ESC), mortality from CVD has fallen by more than 50% in European countries over the past three decades, yet it continues to account for over 1.6 million female and 1.5 million male deaths each year (Timmis et al., 2024). In Hungary, CVD is particularly burdensome, representing 40% of all deaths in 2021 (OECD & European Observatory on Health Systems and Policies, 2023).

Increasing evidence indicates that the development and progression of cardiovascular disease are shaped by both non-modifiable risk factors—such as age, sex, or genetics—and modifiable factors, including smoking, physical inactivity, and, most notably for the present study, mental health status. Psychosocial factors such as chronic stress, anxiety, depression, low social support, and low socioeconomic status are independent and potentially modifiable risk factors contributing to CVD risk (Dennison et al., 2018; Yusuf et al., 2004; Yusuf et al., 2020). National and international guidelines increasingly highlight the importance of these factors (Albus et al., 2019; Jancsó et al., 2022; Lawton et al., 2021; McDonagh et al., 2021; Pogosova et al., 2015; Szabados et al., 2022; Visseren et al., 2021), recognizing that preserving mental well-being is a key element in maintaining cardiovascular health.

Recent research suggests that psychological well-being (PWB) may be a long-term predictor of subjective health perception (Benyamini et al., 2013), making it a critical starting point for health-conscious behavior. Individuals with higher PWB are more likely to appraise their overall health positively, which can shape how they evaluate disease risk and respond to early symptoms (Whyne et al., 2023). In this way, PWB may indirectly contribute to preventing cardiovascular diseases by supporting individuals' health-related attitudes and supporting the adoption of positive health behaviors (e.g., healthy eating or physical activity; Boehm, 2021; World Health Organization, 2006). The examination of self-rated health (SRH) is particularly important. Although this area has been relatively under-researched, it may play a crucial role in the development and maintenance of health-related behaviors (Manderbacka et al., 1999). Attitudes toward one's health, such as perceived disease risk or the importance attributed to health maintenance, can strongly influence behavioral decisions, including engagement in physical activity or dietary habits (Kwak et al., 2022; Wu et al., 2013). Thus, PWB may contribute to cardiovascular protection both by enhancing these subjective appraisals of health and by fostering the behaviors that follow.

Beyond these indirect effects, PWB may also exert direct benefits on physical health. A growing body of scientific evidence supports the role of PWB as a protective factor in preventing cardiovascular diseases (Kubzansky et al., 2018). For example, a large-scale longitudinal follow-up study found that optimistic women had a 38% lower risk of mortality due to heart disease (Kim et al., 2011); however, optimism is not typically considered a component of psychological well-being and was not measured in this study. Positive emotions can also buffer the cardiovascular consequences of stress and negative mood, accelerating recovery from adverse emotional states (Fredrickson & Levenson, 1998; Ostir et al., 2001). Different aspects of PWB, such as positive affect (Fredrickson & Levenson, 1998; Ostir et al., 2001) and overall PWB (Keyes, 2005), have thus been linked to improved cardiovascular outcomes.

The Budakalász Epidemiological Study: Health Behavior and Psychological Well-Being

Between 2012 and 2014, the Budakalász Epidemiological Survey (BES) was conducted to assess cardiovascular health in the adult population of Budakalász, a suburban settlement near Budapest (Bagyura et al., 2014). At the request of the local mayor, a comprehensive cardiovascular screening was carried out. In the 2019 seven-year follow-up, Ocsovszky et al. (2023) examined changes in health behavior among participants at medium and high cardiovascular risk using the same test battery as the present study. They employed a health behavior index developed by the research team that incorporated measures of health consciousness, avoidance of risky behaviors, and adherence to medication. Health consciousness was assessed through indicators such as SRH, intensive physical activity, and fruit and vegetable consumption. The results demonstrated a significant improvement in participants' health consciousness, which was positively associated with health-adapted social support and PWB, while negative associations were observed with perceived stress and hopelessness.

Aims of the Study

The objectives of the study were (1) to describe 10-year changes in cardiovascular risk indicators (anthropometric measures, laboratory parameters, FINDRISK and Framingham score), SRH, and psychological well-being in a community-based, non-clinical Hungarian sample; (2) to examine how health behaviors (smoking, alcohol consumption, physical activity, fruit and vegetable intake) changed over the same 10-year period; (3) to investigate cross-sectional associations between PWB, SRH, and health behaviors, including whether changes in SRH over time (deteriorated/sustained/improved) are linked to changes in medical status, health behavior, and PWB.

Methods

Participants and Study Design

Baseline

The present study is a follow-up component of a larger longitudinal project, the Budakalász Epidemiological Survey (Ocsovszky et al., 2023), initiated in 2012, aiming to develop a primary prevention-oriented cardiovascular risk communication protocol. In 2012, a total of 2,430 residents of Budakalász, representing approximately 30% of the local population (41.2% male, with a mean age of 54.8 years), were enrolled. All residents of Budakalász aged 20 years and above were invited to participate, without any additional eligibility restrictions.

Follow-Up

While cardiovascular risk assessment was a core objective of the 2023 follow-up, the current analysis focuses specifically on psychological well-being and self-rated health outcomes. In 2023, a 10-year cardiovascular follow-up screening was conducted by recontacting the same participants who had participated in the 2012 study and were recruited through their general practitioners.

Eligibility for the 2023 follow-up required prior participation in the 2012 baseline survey, age between 45 and 65 years at the time of follow-up, and the absence of major cardiovascular events within the preceding 10 years. The age range was selected because individuals aged 45–65 years represent the population at highest risk for incident cardiovascular disease, while simultaneously allowing for control of age-related confounding in cardiovascular risk estimation. Participants with established cardiovascular disease were excluded, as they are considered inherently high-risk and fall outside the scope of primary prevention, which constituted the central aim of the overarching Budakalász project. Additional exclusion criteria included severe cardiovascular conditions, diabetes with organ damage, selected chronic non-communicable diseases, and any medical condition deemed by the attending physician to preclude active participation.

The substantial reduction in sample size is attributable to several factors. Natural attrition occurred, as a proportion of participants did not attend the 10-year follow-up examination. Participant mortality or severe illness further contributed to attrition; however, detailed information on these outcomes was unavailable, as participant recall was conducted by general practitioners, and the research team did not have access to individual-level medical records.

All participants completed demographic, health, and psychological questionnaires and underwent laboratory and anthropometric assessments (height, weight, waist, and hip circumference, Body Mass Index (BMI), total cholesterol, fasting glucose, and HbA1c%). The risk of type 2 diabetes was estimated using the FINDRISK score, and cardiovascular risk was assessed using the Framingham Risk Score (Dawber et al., 1951).

Participants received detailed written and verbal information and signed an informed consent form. After obtaining informed consent, all participants underwent the same laboratory and anthropometric assessments as those in the baseline survey during the physical examination. The questionnaire consisted of two parts: the first section, completed jointly with the study investigator, collected data on demographics and lifestyle habits (including smoking, alcohol consumption, diet, and physical activity), while the second section was self-administered, addressing psychological and self-rated health questions.

Sample Size (Exclusion and Attrition)

Of the 2,430 participants enrolled at baseline in 2012, a total of 170 individuals met all inclusion criteria, participated in the 2023 follow-up assessment, and provided complete data for the present analysis. The total sample consisted of 58 men (34.1%) and 112 women (65.9%), with a mean age of 56.83 (SD = 6.34) years in 2023. Due to missing data from the 2012 survey, sample sizes varied across certain analyses. 79 participants (46.5%)

had completed at least primary education, while 91 (53.5%) held a higher education degree. Marital status changed over the 10-year follow-up period. During the 2012–2014 assessment, of the 168 individuals for whom follow-up data were available, 144 participants (84.7%) were married, 11 (6.5%) were single, and 13 (7.7%) were separated, divorced, or widowed. By 2023, 137 participants (80.6%) were married, 11 (6.5%) remained single, and 22 (12.9%) became separated, divorced, or widowed; this represented a significant change (χ^2 =36.33; $p < .001$). In 2012 and 2023, 60% of the participants were employed full-time. However, the proportion of individuals receiving disability pensions or of old-age pensioners rose from 1.8% to 12.4% (χ^2 = 8.13; p = .042) over the same period.

The study was approved by the Scientific and Research Ethics Committee (TUKEB) of the Medical Research Council, Hungary (approval number: BMEÜ/2437-2/2022/EKU).

Measurements

Medical Status - Cardiovascular Risk Assessment

Cardiovascular risk among the participating residents of Budakalász was assessed using the Framingham Risk Score, which predicts an individual's 10-year cardiovascular risk based on risk factors identified in the Framingham Heart Study (Dawber et al., 1951). Participants were assigned to one of three risk classifications: low risk (risk score < 10%), intermediate risk (risk score 10–20%), or high risk (risk score > 20%). However, in our analyses, the Framingham risk score was used as a continuous variable rather than as categories.

Self-Rated Health (SRH) and Health Behavior

Questions related to SRH and health behavior were selected from a questionnaire developed by the Hungarian Center of Social Sciences (HCSS), a measurement tool comprising 128 items. We only used the 5 items which were relevant to our study and contained questions about self-rated health (1 item) and health behavior (4 items). The Hungarian Central Statistical Office used this questionnaire during the European Health Interview Survey (EHIS; KSH, 2010).

For measuring SRH, we used only one question, with responses recorded on a 5-point Likert scale. The key question assessing self-rated health was "How would you rate your general health status?" (1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = very good).

The HCSS questionnaire also includes questions that explore health behavior. The questionnaire has the following themes:

1) frequency of vegetable and fruit consumption: "How often do you consume fresh fruits and raw vegetables?" (1 = two or more times a day; 2 = once a day; 3 = at least four times a week; 4 = at least once a week; 5 = less than once a week; 6 = never);
2) smoking habits: "Do you smoke currently?" (1 = yes; 0 = no);
3) alcohol consumption: "In the past 12 months, have you consumed any alcoholic beverages?" (1 = never; 2 = once a month or less; 3 = 2–4 times a month; 4 = 2–3 times a week; 5 = 4–6 times a week; 6 = every day); "How often do you consume six or more drinks on one occasion?" (0 = never; 1 = less than monthly; 2 = monthly; 3 = weekly; 4 = daily or almost daily);
4) regularity of physical exercise (intensive physical activity: hours/week; moderate physical activity: hours/week; walking: hours/week).

Assessment of Psychological Well-Being (PWB)

A PWB score was created to assess psychological well-being based on four items from the abbreviated version of the SF-36 (36-Item Short Form Survey) questionnaire (Ware & Sherbourne, 1992; Hungarian validation: Czimbalmos et al., 1999). The four items assessed the frequency of the following feelings over the past two weeks: "...felt calm and peaceful?", "...had a lot of energy?", "...felt happy?", and "...felt tired?". Responses ranged from 1 = "none of the time" to 5 = "all of the time". Higher scores indicate better psychological well-being. Internal consistency was acceptable (Cronbach's α = .75).

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 28.0 (IBM Corp., Armonk, NY, USA).

To account for the increased risk of Type I error due to multiple statistical testing, a Bonferroni correction was applied; therefore, $p < .003$ was considered statistically significant.

Preliminary analyses were conducted using independent-samples *t*-tests to compare baseline characteristics of those who did ($N = 170$) and did not ($N = 2,430$) participate in the follow-up.

Changes between 2012 and 2023 were examined with the Wilcoxon signed-rank test. Associations with PWB and the other medical and health behavior variables were explored using Spearman's rank correlation coefficients for both years. Based on changes in SRH, participants were classified into three groups (deteriorated, sustained, improved), and group comparisons across these categories were conducted using Kruskal–Wallis analysis of variance, followed by Dunn–Bonferroni post hoc tests when significant differences emerged. For the comparison of the SRH groups with respect to changes between 2012 and 2023, we created change variables by subtracting the 2012 values from the 2023 data for each individual, thereby capturing changes over time.

While non-parametric procedures were preferred for the smaller sample sizes to ensure validity, we employed independent samples *t*-tests for the larger comparison (preliminary analysis; $N > 2000$). This decision is justified by the Central Limit Theorem, which ensures that parametric tests remain robust and provide reliable estimates of mean differences with larger observation numbers.

Results

Preliminary Analyses

We conducted preliminary statistical analyses using the original 2012 dataset ($N = 2,430$) to examine potential differences between those who participated only in the baseline study ($N = 2,260$) and those who also took part in the follow-up assessments ($N = 170$, in 2012 and 2023, respectively). At baseline, in 2012, the mean age of those who participated only in 2012 was 56.83 ($SD = 15.09$) and 46.83 ($SD = 6.34$) for those who returned in 2023. The differences between these groups are presented in Table S1. We found a significant difference in the sex distribution of the participants: among men, 57 of the original 1,000 (one record missing) took part in the 2023 survey (5.7%), whereas among women, 113 of the original 1,428 participated (7.9%; $\chi^2 = 4.42$; $p = .036$).

Table S1 presents the main differences between participants who participated only in 2012 and those who participated in both 2012 and the follow-up. It is important to note that participants who only took part in the baseline study had significantly poorer anthropometric measures and laboratory results, as well as a significantly higher mean Framingham risk score, than those who also participated in 2023. Interestingly, their self-rated health was significantly better ($p = .001$) than that of those who participated in both 2012 and the follow-up.

10-Year Changes in Cardiovascular Risk Indicators, Health Behaviors, Self-Rated Health, and Psychological Well-Being

We examined the change in medical status indicators, PWB measures, and health behavior variables under investigation between 2012 and 2023. The results are presented in Table 1.

Body weight, waist circumference, hip circumference, BMI, and average Framingham and FINDRISK scores all showed significant increases over the 10 years ($p < .001$), each with a large effect size (Table 1). In contrast, mean HbA1c% and fasting blood glucose levels significantly decreased, with HbA1c% showing a medium effect size and fasting blood glucose showing a large effect size. Physical activity levels were generally maintained, but changes in exercise intensity were observed: intensive physical activity declined, while the number of hours spent walking increased significantly, albeit with a small effect size ($p = .002$). No significant change was found in PWB ($p = .179$).

We found that SRH declined ($p = .022$). At the individual level, 45 individuals (26.5%) reported a decline, while the SRH of 94 individuals (57.1%) remained stable, and for 26 individuals it improved (15.3%). Regarding health behavior, at the group level, there was a significant increase in fruit and vegetable consumption ($p < .001$, medium effect size). An increased consumption was reported by 47.6% of participants; in contrast, 25 participants (14.7%) reported a decrease, and 62 participants (36.5%) reported no change. Vegetable and fruit consumption significantly increased (i.e., a significant decrease was observed in the corresponding variable, as the variable was coded such that a higher value indicated less frequent consumption). We found a significant increase in the quantity of alcohol consumption (p = .002, small effect size). Specifically, 28.8% of the participants reported drinking more often, with an average of 6 drinks/occasion. Additionally, the consumption quantity of 62 participants (37.1%) remained unchanged, while 57 participants (34.1%) reported a decrease. However, no significant change was observed in the overall frequency of alcohol consumption. Smoking habits remained unchanged, with 143 participants (85.1%) identifying as non-smokers and 25 (14.9%) as smokers in both years.

Table 1. Changes in Medical Status and Self-Rated Health Factors, Psychological Well-Being, and Health Behaviour Between 2012 and 2023

	N	*M(SD)*				*Z*	Effect size *(r)*	*p*
		2012		2023				
Anthropometric data								
Weight (kg)	170	76.87	(16.61)	80.39	(17.35)	−6.63	.51	**< .001**
Waist circumference (cm)	170	93.48	(12.95)	99.01	(14.30)	−7.35	.56	**< .001**
Hip circumference (cm)	79	103.28	(8.99)	108.71	(11.53)	−5.45	.61	**< .001**
BMI	169	26.76	(4.81)	27.89	(5.12)	−6.27	.49	**< .001**
RRsys (Hgmm)	169	128.51	(16.17)	129.18	(17.02)	−0.69	.05	.300
Objective health								
Cholesterol (mmol/l)	170	5.54	(0.94)	5.58	(0.94)	−1.39	.11	.245
HbA1c% (mmol/l)	168	5.57	(0.42)	5.43	(0.73)	−5.52	.43	**.002**
Glucose (mmol/l)	170	5.69	(1.02)	4.78	(1.02)	−8.94	.69	**< .001**
FINDRISK score	166	7.68	(4.50)	13.44	(4.35)	−10.87	.84	**< .001**
Cardiovascular risk								
Framingham score	169	7.35	(7.31)	11.71	(9.05)	−9.73	.75	**< .001**
Psychological status								
Well-being score*	168	13.71	(1.73)	13.55	(2.45)	−0.61	.05	.179
Physical activity								
Intensive physical activity (hours/week)	70	4.91	(7.24)	2.59	(4.12)	−2.68	.32	.012
Moderate physical activity (hours/week)	82	5.07	(7.74)	3.52	(6.84)	−2.85	.31	.079
Walking (hours/week)	120	2.89	(3.79)	5.22	(8.46)	−2.71	.25	**.002**
Self-rated health*	168	3.89	(0.72)	3.75	(0.74)	−2.29	.18	.022
Health behaviour								
Fruit & vegetable consumption**	168	2.20	(0.78)	1.82	(0.96)	−4.69	.36	**<.001**
Alcohol consumption frequency (occasion/week or month)*	168	2.73	(1.35)	2.86	(1.23)	−0.92	.07	.359
Alcohol consumption quantity (more than 6 drinks/week or month)*	168	0.01	(0.46)	0.30	(0.66)	−3.05	.24	**.002**
Smoking *	168	25	(14.8)	25	(14.8)	–	–	.796

Note. p < .003.
*In these cases, higher Mean scores are better (see variable labeling in measurements).
**In this case lower Mean score is better, since variables are labeled: (1 = two or more times a day; 2 = once a day; 3 = at least four times a week; 4 = at least once a week; 5 = less than once a week; 6 = never).

Correlations Between Self-Rated Health, Psychological Well-being, and Health Behavior

We examined which variables were associated with PWB. In both 2012 and 2023, a significant and moderate, positive correlation was found between SRH and PWB ($\rho_{(2012)} = .27$; $p < .001$; $\rho_{(2023)} = .32$; $p < .001$). In 2012, intensive physical activity was significantly, moderately correlated with PWB ($\rho_{(2012)} = .22$; $p < .001$); however, this correlation was no longer observed in 2023. In 2023, fruit and vegetable consumption was weakly associated with PWB ($\rho_{(2012)}$ = -.12; p < .001). Regarding fruit and vegetable consumption, a negative correlation indicates that higher PWB is associated with greater fruit and vegetable consumption, since lower scores reflect higher levels of consumption. The correlations are presented in Table 2.

Group-Based Analysis of Self-Rated Health Changes and Related Health and Psychological Indicators

To assess changes in SRH, we created groups based on the number of individuals whose SRH deteriorated, remained stable, or improved between 2012 and 2023. Data from 168 individuals were available for this analysis. SRH declined in 45 participants (26.5%), remained unchanged in 97 participants (57.1%), and improved in 26 participants (15.3%).

No significant differences were found between the groups regarding the magnitude of 10-year changes in anthropometric variables, cardiovascular risk, and type 2 diabetes risk, as presented in Table 2. Similarly, there were no significant differences in the changes in laboratory results among the groups. Additionally, no significant difference was found in the age distribution across the three groups (p = .415).

Regarding changes in health behavior, we found no significant differences between the SRH groups (Table 2). PWB differed between the groups (p = .012); however, due to the Bonferroni correction, this change cannot be considered significant. Participants who reported improved SRH also demonstrated improved PWB compared to those whose SRH deteriorated (median = -1 vs. 2; p = .009). The results are also summarized in Table 2.

Table 2. Kruskal-Wallis Analysis of Medical Status and Psychological Changes in Relation to SRH

Variable	*N*	*ΔM(SD)*			*H-statistic*	*p*
		Deteriorated	Sustained	Improved		
Weight change	168	2.40 (8.63)	4.19 (6.25)	3.01 (10.80)	3.23	.198
Waist circumference change	168	4.80 (8.21)	6.41 (8.19)	3.77 (9.98)	4.49	.106
Hip circumference change	77	2.63 (8.20)	6.36 (5.87)	8.56 (7.87)	5.13	.077
BMI change	167	0.86 (7.87)	1.39 (2.18)	0.98 (4.22)	3.47	.176
RRSys change	167	3.95 (16.50)	0.15 (17.80)	−2.50 (14.70)	4.37	.113
Cholesterol change	168	−0.20 (0.92)	0.14 (0.92)	0.11 (1.09)	4.78	.092
HbA1c% change	166	−0.06 (0.82)	−0.17 (0.56)	−0.12 (0.63)	0.59	.742
Glucose change	168	−0.84 (1.55)	−0.91 (1.13)	−0.95 (1.22)	0.36	.833
FINDRISK change	166	5.71 (4.02)	5.64 (3.93)	6.23 (4.24)	0.41	.813
Framingham score change	167	4.63 (5.47)	4.3 (4.44)	4.34 (5.24)	0.67	.714
Age	168	56.98 (6.54)	55.87 (6.30)	57.73 (5.95)	1.76	.415
Well-being change	168	−0.80 (2.17)	−0.19 (2.50)	0.92 (2.78)	8.92	.012
Fruit & vegetable consumption change	168	−0.46 (0.99)	−0.34 (0.91)	−0.38 (1.20)	1.76	.415
Intensive physical activity change	70	-2.21 (10.60)	−2.42 (7.08)	−2.00 (8.12)	2.23	.329
Moderate physical activity change	82	-1.50 (14.44)	−1.06 (5.82)	−3.83 (15.80)	0.86	.652
Walking change	120	2.43 (8.13)	2.31 (9.45)	2.22 (9.86)	0.46	.796
Alcohol consumption frequency change	167	-0.11 (0.89)	0.14 (1.25)	0.23 (1.17)	2.13	.345
Alcohol consumption quantity change	160	0.14 (0.52)	0.19 (0.66)	0.00 (0.76)	0.20	.904
Smoking habits change	168	0.00 (0.21)	0.20 (0.28)	−0.04 (0.44)	0.81	.666

Discussion

In our study, we analyzed how the medical status and SRH of individuals participating in the Budakalász Epidemiological Study changed between 2012 and 2023, and what variables were associated with PWB.

Although 170 of the original 2,430 participants attended the 2023 follow-up screening, it is important to note that those who did not participate had significantly worse objective risk profiles yet subjectively rated their health as better. This discrepancy may reflect age-related differences in health evaluation, whereby older individuals perceive objectively poorer health as normative. In addition, non-participation in follow-up screening may indicate lower health engagement or awareness, which can contribute to more favorable SRH despite an elevated objective risk.

Our main finding was that PWB was the only variable consistently associated with SRH health in both 2012 and 2023. Similar to the research by Benyamini et al. (2000), our study confirmed the relationship between SRH and PWB. Although the differences in PWB changes across SRH trajectory groups did not remain statistically significant after Bonferroni correction, the observed pattern was consistent with our a priori hypothesis. Participants whose SRH improved over time tended to report higher PWB scores compared to those with stable or deteriorating SRH. We acknowledge that the conservative nature of the Bonferroni adjustment reduces the risk of Type I error; however, the consistency in the direction and magnitude of the association across analyses strengthens confidence in the substantive relevance of the SRH-psychological well-being link, even in the absence of strict statistical significance after multiple testing correction. This interpretation is further supported by the broader pattern of findings, which show that trajectories of self-rated health closely track changes in PWB, but not changes in objective measures or health behavior. This pattern suggests that SRH is primarily shaped by subjective experiences and evaluations of life, highlighting its psychologically grounded nature and implying that improvements in psychological well-being may enhance perceived health even in the absence of objective risk reduction. This finding is consistent with the 2010 study by Guindon and Cappeliez, which examined the factors contributing to SRH. Their results indicate that while medical status measures such as medical data and functional health (e.g., the maintenance of physical activity) affect health evaluation, self-rated health perception extends beyond these factors. It is influenced by various elements, including mood, self-image, and expectations.

Our results indicate that the Framingham score showed a significant deterioration, which may be partially attributed to ageing. The FINDRISK score also increased significantly within the population, likely due to changes in specific components of the FINDRISK assessment, such as BMI, waist circumference, and physical activity levels. While the average body weight, waist and hip circumference, and BMI increased, the distribution of BMI categories remained relatively unchanged, as most participants were already classified as overweight in 2012. Despite the worsening of objective risk scores and anthropometric parameters, improvements in certain laboratory values, such as blood glucose and HbA1c%, provide a more nuanced perspective. This suggests that the population's overall health status has not unequivocally declined; in fact, certain metabolic parameters have improved.

In our study, we found that participants' SRH deteriorated between 2012 and 2023. In parallel, we observed positive changes in certain aspects of health behavior: the proportion of individuals consuming vegetables and fruits significantly increased, while the number of those who frequently consume large amounts of alcohol decreased. Additionally, regular physical activity remained stable, with only a change in intensity. The frequency of smoking and alcohol consumption did not change significantly; however, 85.12% of the population does not smoke, while nearly one-third (27.6%) of participants consume alcohol on a weekly or daily basis. One possible explanation for this discrepancy is that the categorized response options do not sharply distinguish between different frequencies of alcohol consumption, potentially distorting the accurate differentiation of consumption patterns. For a long time, there was no consensus regarding alcohol consumption and cardiovascular diseases. However, according to the WHO, even consuming 100g of alcohol per week increases the risk of cardiovascular diseases (Arora et al., 2022). This is particularly important because Whitman et al. (2015) found that subjective beliefs about alcohol consumption are significantly associated with drinking habits, suggesting that subjective perceptions can influence behavior.

This implies that only weak and inconsistent links were found between SRH and health behaviors. This suggests that small or moderate behavioral changes may not be salient enough for individuals to revise their overall health judgment. We also believe that PWB can influence perceptions of health in the long term, but it is possible that mental well-being alone is not sufficient to bring about long-term changes in health behavior; it may be a more complex process. In addition, our sample consisted of healthy individuals, among whom good health behavior was already observable at baseline. Therefore, in our future research, we would like to place greater emphasis on investigating long-term, sustainable changes in health behavior as well.

Strengths and Limitations

To our knowledge, this is the first study to examine decade-long changes in cardiovascular risk, health behavior, SRH, and PWB within a Hungarian population. The 10-year longitudinal design provides valuable insight into the temporal stability of the association between SRH and PWB, allowing for the examination of within-person changes over time. These findings can inform cardiovascular prevention efforts by highlighting the relevance of SRH as an accessible indicator of how individuals perceive their health and risk, beyond objective medical parameters.

Several limitations should be acknowledged. First, both the FINDRISK and the Framingham Risk Score intrinsically increase with age, even if all other risk factors remain unchanged. In our cohort, part of the observed increase in cardiovascular risk over the 10-year follow-up is therefore likely to reflect age-related progression rather than deterioration in modifiable risk factors.

Second, the study sample was shaped by both the initial inclusion criteria and substantial attrition during follow-up, and these processes should be clearly distinguished. Due to the inclusion criteria applied at the 2023 follow-up, the analyzed sample represents a relatively healthier population, as participants who experienced a cardiovascular event during the 10-year follow-up period and older individuals were excluded. This selection, however, is methodologically justified. The Framingham cardiovascular risk score is not applicable to individuals with a prior cardiovascular event and, in older age groups, cardiovascular risk estimates are strongly driven by age alone. As outlined in the Methods section, cardiovascular risk assessment is particularly relevant in the 45–65-year age group, as this population represents a critical window for preventive interventions. Additionally, as shown in Table S1, the largest effect sizes were observed between participants included only in 2012, and those attending the follow-up were observed for age and Framingham risk score. As these variables were also explicitly restricted at follow-up, the resulting selection is unlikely to have introduced substantial additional distortion beyond the expected attenuation of age- and risk-related variability.

Third, several measurement-related limitations warrant consideration. Self-rated health was assessed using a single-item measure, and psychological well-being was measured using a brief questionnaire, which may not fully capture the complexity of these constructs. In addition, medication use and treatment adherence were not assessed, which may have influenced laboratory values and cardiovascular risk estimates.

Fourth, methodological decisions may have affected sensitivity to change. Categorizing SRH trajectories for the Kruskal-Wallis test likely resulted in information loss and reduced statistical power. Moreover, the use of difference scores rather than modeling follow-up outcomes while adjusting for baseline values may have limited sensitivity to baseline heterogeneity.

Finally, cardiovascular risk factors and health behaviors were entered into the analyses individually, despite potential interrelationships among them. More complex multivariable or latent-variable modeling approaches could better reflect the underlying structure of these processes. Furthermore, demographic variables were not explicitly modeled as moderators or covariates in the longitudinal analyses, which may have obscured important subgroup differences. Future studies should address these limitations using more comprehensive measurement and modeling strategies.

Conclusion, Implications, and Future Directions

In conclusion, psychological well-being and self-rated health demonstrated a robust and enduring association throughout the observation period, underscoring the central role of subjective psychological processes in how individuals assess their health over time. Together, these findings have important implications for preventive strategies that traditionally focus solely on objective risk factors. Our results highlight the relevance of self-rated health as a meaningful, psychologically grounded indicator that is more closely aligned with changes in psychological well-being than with cardiovascular risk or health behaviors. This suggests that cardiovascular prevention efforts may benefit from explicitly addressing patients' psychological well-being and health perceptions alongside biomedical risk reduction. In clinical practice, this may involve supporting patients in understanding and integrating medical risk information into their subjective assessments of health.

In Central and Eastern European populations, where cardiovascular risk remains high, the observed decoupling between self-rated health and objective risk may contribute to the underestimation of personal vulnerability. This underscores the need for culturally sensitive health communication strategies that bridge the gap between medical indicators and lived experience.

Future research should apply advanced longitudinal methods, such as structural equation modeling, to better capture latent processes and reciprocal pathways linking psychological well-being, self-rated health, and health behaviors. In addition, employing multiple approaches to assess psychological well-being could yield a more nuanced understanding of population mental health and its role in shaping perceived health.

Acknowledgement
The authors would like to thank Prof. Dr. Béla Merkely for supporting their project and making the research possible, as well as the Health Promotion Centre volunteer students at Semmelweis University's valuable assistance in data collection, which greatly supported their research.

Funding
This study was financially supported by Project no. RRF-2.3.1-21-2022-00003 with the support provided by the European Union. TKP2021-NKTA-46 has been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the TKP2021-NKTA-46 funding scheme.

Author contribution
Blanka EHRENBERGER: conceptualization, design, methodology, formal analysis, interpretation, writing original draft, writing review and editing
Zsófia OCSOVSZKY: conceptualization, design, methodology, investigation, project administration, interpretation, writing review and editing
Alexandra ASSABINY: conceptualization, design, methodology, investigation, interpretation, writing review and editing
József OTOHAL: conceptualization, investigation, writing review and editing
Magor PAPP: investigation, project administration, writing review and editing
Éva BORENSZKI-GUTÁSI: investigation project administration, writing review and editing
Zsolt BAGYURA: conceptualization, design, methodology, investigation, data management, interpretation, supervision, writing review and editing
Márta CSABAI: conceptualization, design, methodology, interpretation, supervision, writing review and editing

Declaration of interest statement
The authors have no conflicts of interest to disclose.

Ethical statement
This manuscript is the authors' original work.
All participants engaged in the research voluntarily and anonymously.
Their data are stored in coded materials and databases without personal data.
The studies involving human participants were reviewed and approved by Medical Research Council, approval number: BMEÜ/2437-2/2022/EKU.

Data availability statement
Datasets presented in this article are available from the corresponding author upon reasonable request.

Declaration on using artificial intelligence in research and manuscript preparation
The authors have not used AI technologies in their research or the preparation of this manuscript.

ORCID
Blanka EHRENBERGER https://orcid.org/0009-0006-2444-6527
Zsófia OCSOVSZKY https://orcid.org/0000-0002-7586-7368
Alexandra ASSABINY https://orcid.org/0000-0003-1021-7572
József OTOHAL https://orcid.org/0009-0008-1026-7901
Magor PAPP https://orcid.org/0009-0007-3439-5089
Éva BORENSZKI-GUTÁSI https://orcid.org/0009-0007-5285-1914
Zsolt BAGYURA https://orcid.org/0000-0001-8120-2322

References

Albus, C., Waller, C., Fritzsche, K., Gunold, H., Haass, M., Hamann, B., Kindermann, I., Köllner, V., Leithäuser, B., Marx, N., Meesmann, M., Michal, M., Ronel, J., Scherer, M., Schrader, V., Schwaab, B., Weber, C. S., & Herrmann-Lingen, C. (2019). Significance of psychosocial factors in cardiology: Update 2018. *Clinical Research in Cardiology*, *108*, 1175–1196. https://doi.org/10.1007/s00392-019-01488-w

Arora, M., ElSayed, A., Beger, B., Naidoo, P., Shilton, T., Jain, N., Armstrong-Walenczak, K., Mwangi, J., Wang, Y., Eiselé, J.-L., Pinto, F. J., & Champagne, B. M. (2022). The impact of alcohol consumption on cardiovascular health: Myths and measures. *Global Heart*, *17*, Article 45. https://doi.org/10.5334/gh.1132

Bagyura, Z., Kiss, L., Édes, E., Lux, Á., Polgár, L., Soós, P., Szenczi, O., Szelid, Z., Vadas, R., Józan, P., Bagdy, G., & Merkely, B. (2014). Cardiovascular screening programme in the Central Hungarian region: The Budakalász Study. *Orvosi Hetilap*, *155*(34), 1344–1352. https://doi.org/10.1556/oh.2014.29969

Benyamini, Y., Idler, E. L., Leventhal, H., & Leventhal, E. A. (2000). Positive affect and function as influences on self-assessments of health: Expanding our view beyond illness and disability. *Journal of Gerontology*: *Series B, 55(2)*, 107–116. https://doi.org/10.1093/geronb/55.2.P107

Boehm J. K. (2021). Positive psychological well-being and cardiovascular disease: Exploring mechanistic and developmental pathways. *Social and Personality Psychology Compass*, *15*(6), Article e12599. https://doi.org/10.1111/spc3.12599

Czimbalmos, Á., Nagy, Z., Varga, Z., & Husztik, P. (1999). Páciens megelégedettségi vizsgálat SF-36 kérdőívvel, a magyarországi normálértékek meghatározása [Patient satisfaction survey using the SF-36 questionnaire and determination of normal values in Hungary]. *Népegészségügy, 80*(1), 4–19.

Dawber, T. R., Meadors, G. F., & Moore Jr., F. E. (1951). Epidemiological approaches to heart disease: The Framingham Study. *American Journal of Public Health*, *41*(3), 279–286. https://doi.org/10.2105/AJPH.41.3.279

Dennison, R. A., Feldman, A. L., Usher-Smith, J. A., & Griffin, S. J. (2018). The association between psychosocial factors and change in lifestyle behaviour following lifestyle advice and information about cardiovascular disease risk. *BMC Public Health*, *18*, Article 731. https://doi.org/10.1186/s12889-018-5655-7

Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition and Emotion*, *12*(2), 191–220. https://doi.org/10.1080/026999398379718

Guindon, S., & Cappeliez, P. (2010). Contributions of psychological well-being and social support to an integrative model of subjective health in later adulthood. *Ageing International*, *35*, 38–60. https://doi.org/10.1007/s12126-009-9050-7

Jancsó, Z., Csenteri, O., Szőllősi, G. J., Vajer, P., & Andréka, P. (2022). Cardiovascular risk management: The success of target level achievement in high- and very high-risk patients in Hungary. *BMC Primary Care*, *23*, Article 305. https://doi.org/10.1186/s12875-022-01922-5

Keyes, C. L. M. (2005) Chronic physical conditions and aging: Is mental health a potential protective factor? *Ageing International* 30, 88–104. https://doi.org/10.1007/BF02681008

Kim, E. S., Park, N., & Peterson, C. (2011). Dispositional optimism protects older adults from stroke: The Health and Retirement Study. *Stroke*, *42(10)*, 2855–2859. https://doi.org/10.1161/STROKEAHA.111.613448

KSH [Hungarian Central Statistical Office]. (2010). *European Health Interview Survey (EHIS), 2009. Statistical Reflection, 14*(4). https://www.ksh.hu/docs/eng/xftp/stattukor/eelef09.pdf

Kubzansky, L. D., Huffman, J. C., Boehm, J. K., Hernandez, R., Kim, E. S., Koga, H. K., Feig, E. H., Lloyd-Jones, D. M., Seligman, M. E. P., & Labarthe, D. R. (2018). Positive psychological well-being and cardiovascular disease: JACC health promotion series. *Journal of the American College of Cardiology*, *72*(12), 1382–1396. https://doi.org/10.1016/j.jacc.2018.07.042

Kwak, S., Lee, Y., Baek, S., & Shin, J. (2022). Effects of subjective health perception on health behavior and cardiovascular disease risk factors in patients with prediabetes and diabetes. *International Journal of Environmental Research and Public Health*, *19(13)*, Article 7900. https://doi.org/10.3390/ijerph19137900

Lawton, J. S., Tamis-Holland, J. E., Bangalore, S., Bates, E. R., Beckie, T. M., Bischoff, J. M., Bittl, J. A., Cohen, M. G., DiMaio, J. M., Don, C. W., Fremes, S. E., Gaudino, M. F., Goldberger, Z. D., Grant, M. C., Jaswal, J. B., Kurlansky, P. A., Mehran, R., Metkus, T. S. Jr., Nnacheta, L. C., …, & Zwischenberger, B. A. (2021). 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: A Report of the American College of Cardiology/American Heart Association Joint Committee on clinical practice guidelines. *Circulation, 145(3),* e18–e114. https://doi.org/10.1161/CIR.0000000000001038

Manderbacka, K., Lundberg, O., & Martikainen, P. (1999). Do risk factors and health behaviours contribute to self-ratings of health? *Social Science & Medicine*, *48*(12), 1713–1720. https://doi.org/10.1016/S0277-9536(99)00068-4

McDonagh, T. A., Metra, M., Adamo, M., Gardner, R. S., Baumbach, A., Böhm, M., Burri, H., Butler, J., Čelutkienė, J., Chioncel, O., … ESC Scientific Document Group. (2021). 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure: Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) with the special contribution of the Heart Failure Association (HFA) of the ESC. *European Heart Journal, 42*(36), 3599–3726. https://doi.org/10.1093/eurheartj/ehab368

Ocsovszky, Z., Martos, T., Otohal, J., Berényi, B., Merkely, B., Csabai, M., & Bagyura, Z. (2023). A cardiovascularis rizikóbecslés és az egészségmagatartás kapcsolata pszichoszociális tényezők tükrében [Relationship between cardiovascular risk assessment and health behavior in the light of psychosocial factors]. *Orvosi Hetilap*, *164*(4), 119–131. https://doi.org/10.1556/650.2023.32685

OECD & European Observatory on Health Systems and Policies. (2023). *State of health in the EU: Magyarország Egészségügyi országprofil 2023 [Hungarian healthcare country profile 2023]*. European Commission. https://health.ec.europa.eu/document/download/e5c2e963-4ddc-421b-8291-32f845460f17_en?filename=2023_chp_hu_hungarian.pdf&prefLang=hu

Ostir, G. V., Markides, K. S., Peek, M. K., & Goodwin, J. S. (2001). The association between emotional well-being and the incidence of stroke in older adults. *Psychosomatic Medicine*, *63*(2), 210–215. https://doi.org/10.1097/00006842-200103000-00003

Pogosova, N., Saner, H., Pedersen, S. S., Cupples, M. E., McGee, H., Höfer, S., Doyle, F., Schmid, J.P., & von Känel, R. (2015). Psychosocial aspects in cardiac rehabilitation: From theory to practice. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation of the European Society of Cardiology. *European Journal of Preventive Cardiology, 22*(10), 1290–1306. https://doi.org/10.1177/2047487314543075

Szabados, E., Sándor, B., & Pálfi, A. (2022). 2021. évi ESC-irányelvek a szív-és érrendszeri betegségek megelőzéséről a klinikai gyakorlatban [2021 ESC Pocket Guidelines on cardiovascular disease prevention in clinical practice]. *Cardiologia Hungarica*, *52*, 60–72.

Timmis, A., Aboyans, V., Vardas, P., Townsend, N., Torbica, A., Kavousi, M., Boriani, G., Huculeci, R., Kazakiewicz, D., Scherr, D., Karagiannidis, E., Cvijic, M., KapłonCieślicka, A., Ignatiuk, B., Raatikainen, P., De Smedt, D., Wood, A., Dudek, D., Van Belle, E., Weidinger, F., & ESC National Cardiac Societies. (2024). European Society of Cardiology: The 2023 Atlas of cardiovascular disease statistics. *European Heart Journal, 45*(38), 4019–4062. https://doi.org/10.1093/eurheartj/ehae466

Visseren, F. L. J., Mach, F., Smulders, Y. M., Carballo, D., Koskinas, K. C., Bäck, M., Benetos, A., Biffi, A., Boavida, J.M., Capodanno, D., Cosyns, B., Crawford, C., Davos, C. H., Desormais, I., Di Angelantonio, E., Franco, O. H., Halvorsen, S., Hobbs, F. D. R., Hollander, M., … Williams, B. (2021). 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice: Developed by the Task Force for cardiovascular disease prevention in clinical practice with representatives of the European Society of Cardiology and 12 medical societies with the special contribution of the European Association of Preventive Cardiology (EAPC). *European Heart Journal, 42*(34), 3227–3337. https://doi.org/10.1093/eurheartj/ehab484

Ware Jr, J. E., & Sherbourne, C. D. (1992). The MOS 36-ltem short-form health survey (SF-36): I. Conceptual framework and item selection. *Medical Care, 30*(6), 473–483.

Whitman, I. R., Pletcher, M. J., Vittinghoff, E., Imburgia, K. E., Maguire, C., Bettencourt, L., Sinha, T., Parsnick, T., Tison, G. H., Mulvanny, C. G., Olgin, J. E., & Marcus, G. M. (2015). Perceptions, information sources, and behavior regarding alcohol and heart health. *The American Journal of Cardiology*, *116*(4), 642–646. https://doi.org/10.1016/j.amjcard.2015.05.029

Whyne, E. Z., Woo, J., & Jeon-Slaughter, H. (2023). The effects of subjective wellbeing and self-rated health on lifetime risk of cardiovascular conditions in women. *International Journal of Environmental Research and Public Health*, *20*(14), Article 6380. https://doi.org/10.3390/ijerph20146380

World Health Organisation. (2006). *Physical activity and health in Europe: Evidence for action*. https://iris.who.int/items/e6cdad6d-6cbc-489b-8972-d869941c8829

Wu, S., Wang, R., Zhao, Y., Ma, X., Wu, M., Yan, X. & He, J. (2013). The relationship between self-rated health and objective health status: A population-based study. *BMC Public Health*, *13*, Article 320. https://doi.org/10.1186/1471-2458-13-320

Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., Varigos, J., & Lisheng, L., & INTERHEART Study Investigators (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. The Lancet, 364(9438), 937–952. https://doi.org/10.1016/S0140-6736(04)17018-9

Yusuf, S., Joseph, P., Rangarajan, S., Islam, S., Mente, A., Hystad, P., Brauer, M., Kutty, V. R., Gupta, R., Wielgosz, A., AlHabib, K. F., Dans, A., Lopez-Jaramillo, P., Avezum, A., Lanas, F., Oguz, A., Kruger, I. M., Diaz, R., Yusoff, K., … Dagenais, G. (2020). Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): A prospective cohort study. The Lancet, 395(10226), 795–808. https://doi.org/10.1016/S0140-6736(19)32008-2

Supplementary Tables

Table S1. Differences in Medical Status and Self-Rated Health Factors, Psychological Status, and Health Behaviour Between Adults Who Participated Only in 2012 And Adults Who Participated in Both Years

	Participated only in 2012		Participated in both 2012 and 2023				
	N	*M(SD)*	*N*	*M(SD)*	*t*	Effect size *(d)*	*p*
Age	2252	56.83 (15.09)	170	46.83 (6.34)	17.10	.67	**< .001**
Anthropometric data							
Weight	2240	78.82 (16.64)	170	76.87 (16.61)	1.49	.12	.138
Waist circumference	2238	97.95 (13.27)	170	93.48 (12.95)	4.24	.33	**< .001**
Hip circumference	976	106.01 (8.99)	79	103.28 (8.99)	2.29	.27	.015
BMI	2239	28.07 (5.23)	170	26.76 (4.81)	3.39	.25	**< .001**
RRsys	2237	135.73 (19.31)	170	128.51 (16.17)	5.51	.38	**< .001**
Objective health							
Cholesterol	2231	5.49 (1.14)	170	5.53 (0.94)	−0.66	−.45	.57
HbA1c%	2202	5.76 (0.75)	170	5.57 (0.41)	5.25	.26	**< .001**
Glucose	170	5.98 (1.55)	170	5.69 (1.02)	3.37	.19	**< .001**
FINDRISK score	1947	9.05 (4.50)	166	7.68 (4.50)	3.23	.30	**< .001**
Cardiovascular risk							
Framingham score	2234	16.01 (13.23)	169	7.35 (7.31)	13.78	.67	**< .001**
Psychological status							
Well-being score	1275	13.14 (2.50)	168	13.71 (1.73)	−1.68	−.18	.090
Physical activity							
Intensive physical activity (hours/week)	622	5.80 (9.95)	70	4.91 (7.24)	0.92	.91	.355
Moderate physical activity (hours/week)	1140	8.93 (13.17)	82	5.07 (7.74)	2.62	.30	.004
Walking (hours/week)	1618	3.88 (5.81)	120	2.89 (3.79)	1.83	.17	.067
Self-rated health	2225	3.68 (1.49)	168	3.89 (0.72)	−3.21	−.14	**< .001**
Health behaviour							
Fruit & vegetable consumption	2225	2.17 (0.86)	168	2.20 (0.78)	−0.52	−.04	.597
Alcohol consumption frequency	2225	2.81 (1.59)	168	2.73 (1.35)	0.62	.05	.535
Alcohol consumption quantity	2225	0.92 (0.87)	168	0.96 (0.63)	−0.59	−.48	.549
Smoking	2225	0.16 (0.36)	168	0.15 (0.35)	−0.31	−.25	.795

Note. bold: $p < .003$, RRsys = systolic blood pressure, BMI = Body Mass Index.

Table S2. Correlations Among Psychological Well-Being and Health Behaviour Variables

		Subjective-rated health	Intensive physical activity (hours/week)	Moderate physical activity (hours/week)	Walking (hours/week)	Fruit & vegetable consumption	Alcohol consumption frequency	Alcohol consumption quantity
Psychological well-being 2012	*N*	170	170	170	170	170	169	166
	ρ	.275*	.222*	.094	.163	.036	.084	.023
Psychological well-being 2023	*N*	170	170	170	170	170	169	166
	ρ	.321*	.100	.090	.157	-.120	-.066	.048

Note: ρ = Spearman's rho correlation value * $p < .003$.