Health Prob Civil. 2026, Volume 20, Issue 4
ISSN 2353-6942, eISSN 2354-0265

PART II. PHYSICAL ACTIVITY OF SOCIAL AND PROFESSIONAL GROUPS

Health-promoting behaviors, physical activity, and health control perceptions among physical education and social science students in 2016 and 2026: implications for public health

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A. Study design/planning
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C. Data analysis/statistics
D. Data interpretation
E. Preparation of manuscript
F. Literature analysis/search
G. Funds collection

Tables: 2
Figures: 0
References: 27
Submitted: 2026 Jan 21
Accepted: 2026 Feb 5
Published Online: 2026 Feb 11

Abstract

Background. The university period critically influences the formation of health-related lifestyles. This study aimed to assess changes in health-promoting behaviors, physical activity, and the sense of health control among students over a decade (2016 vs. 2026), examining differences between physical education and social science students.
Material and methods. The study involved two groups of students (N=752) surveyed in 2016 and 2026, employing purposeful sampling. Data were collected using the International Physical Activity Questionnaire (IPAQ), the Health Behavior Inventory (HBI), and the Multidimensional Health Literacy Scale (MHLC). Body Mass Index (BMI) was also calculated.
Results. By 2026, a significant increase in sedentary time was observed (from 212.6 to 318.6 min/day; $p<0.001$). Social science students exhibited a substantial decrease in physical activity (intense exercise: 720 to 240 MET-min/week; moderate: 708.9 to 300 MET-min/week). Both cohorts experienced increased BMI, more notably among social science students. A significant decrease in MHLC-I intensity, indicating a weakened sense of health control, was also noted.
Conclusions. The observed increases in sedentary behavior and BMI, coupled with a decline in internal health locus of control by 2026, underscore the urgent need for targeted health promotion programs within academic environments.

Keywords: sedentary behavior, longitudinal studies, health behavior, physical activity, students

Shpakau A, Sokołowska D, Gacek MK, Modzelewski R, Szpakow A, Baj-Korpak J. Health-promoting behaviors, physical activity, and health control perceptions among physical education and social science students in 2016 and 2026: implications for public health. Health Prob Civil. 2026; 20(4): 469-479. https://doi.org/10.29316/hpc/217811

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Introduction

The university period critically influences the formation of health-related lifestyles, with health-promoting behaviors, including physical activity (PA), being crucial for long-term quality of life [1]. Public health research consistently highlights unfavorable trends among young adults, such as increasing overweight and obesity, coupled with persistently low levels of PA and intensified sedentary behaviors [2]. Prolonged sitting, even among physically active individuals, is a recognized risk factor for various health issues [3-5]. These concerning trends are partly driven by changes in educational processes, the digitalization of daily life, and the growing role of screen-based technologies [6]. Indeed, recent findings by Radičuks et al. [7] further underscore the critical influence of digital technologies and online learning environments on the PA levels and overall health outcomes of students.

Comparative analyses between different student groups, particularly those with distinct educational profiles like physical education (PE) and social sciences (SOC), can offer valuable insights into variations in health profiles [8]. PE students, trained as health promoters, often serve as a reference group, while SOC students, though influencing health behaviors in their professional practice, are less frequently targeted in health promotion [9].

Psychosocial determinants, such as health locus of control (HLC), play an increasing role in explaining health disparities. Individuals with a strong internal HLC are more likely to engage in health-promoting behaviors, while an external HLC is associated with a passive approach to prevention [10]. Integrating HLC dimensions with somatic parameters and health-promoting behaviors provides a comprehensive understanding of observed trends.

Despite a growing body of research, several gaps persist. Many studies are cross-sectional, limiting trend assessment, and decade-long changes using comparable methodologies are scarce [11]. Furthermore, research often focuses solely on PA, underestimating the independent impact of sedentary behavior, even among those meeting activity guidelines [12,13]. Few studies integrate somatic parameters, movement, sedentary behaviors, health practices, and multidimensional HLC within a single model across distant time points. Finally, research rarely addresses differences between fields of study, particularly the long-term persistence of health advantages in PE students or the strategic targeting of SOC students for health promotion.

Aim of the work

This study aimed to address the identified gaps by assessing changes in health-promoting behaviors, PA, and HLC in two comparable cohorts of PE and SOC students over a ten-year period (2016 vs. 2026). The analysis considered differences between these student groups and highlighted the implications of these changes for public health.

The selection of PE students and SOC students for this comparative study was deliberate, aiming to investigate health-promoting behaviors across distinct academic profiles. PE students, by virtue of their specialized curriculum, professional aspirations, and personal interests, inherently represent a group with higher baseline levels of PA and a more conscious approach to health. This positions them as a referential group or a "benchmark" against which the behaviors of other student populations, particularly those where PA is not a core educational component, can be compared. Conversely, SOC students were chosen as a more representative sample of the general student population, allowing for broader insights into health behaviors within a less specialized academic context. This comparative approach not only highlights existing

differences but also informs the development of targeted health promotion interventions. Furthermore, the future professional roles of graduates from both disciplines often involve significant influence on the health behaviors of various population groups, underscoring the relevance of understanding their own health practices.

Materials and methods

Study design and participants

This study employed a sequential (time-lag) design, comparing two independent cross-sectional cohorts of students from 2016 and 2026. This design allows for the assessment of secular trends within the academic population, acknowledging that observed differences reflect group-level rather than individual-level changes, thus limiting direct causal inferences. Data collection in both years occurred during the same winter semester to ensure comparability.

The study included N=752 students from Poland, divided into four subgroups based on educational domain and assessment year: PE and SOC (pedagogy, sociology, psychology, economics). Subgroups were PE 2016 (N_1=157), PE 2026 (N_2=146), SOC 2016 (N_3=230), and SOC 2026 (N_4=219). Recruitment was conducted at the same academic institutions, ensuring environmental consistency. Samples were independent, consisting of different student cohorts with no repeated participation. This deliberate choice of contrasting academic disciplines aimed to provide a comprehensive understanding of health behaviors, with PE students serving as a referential group representing a potentially higher baseline of health-oriented practices.

Inclusion criteria included: active student status (PE or SOC programs), age ≥18 years, voluntary informed consent, and complete completion of research instruments. Exclusion criteria involved: consent withdrawal, substantial missing data (e.g. for BMI calculation, incomplete questionnaires), or demographic inconsistency. All the students were informed about the study's aims, confidentiality, and their right to withdraw. Questionnaires were completed independently under standardized conditions.

Variables and research instruments

Sociodemographic and anthropometric data: gender, age, self-reported body height, and body weight were collected. Body Mass Index (BMI; kg/m^2) was calculated as a continuous variable and categorized by the WHO criteria [14].

PA and sedentary behavior: the International Physical Activity Questionnaire (IPAQ, short form, Polish adaptation) was used to assess vigorous-intensity activity, moderate-intensity activity, walking, and sitting time during a typical week. Activity time (min/week) and energy expenditure (MET·min/week) were calculated, classifying participants into low/moderate/high IPAQ categories. Sitting time (min/day) was analyzed separately.

Health-related behaviors: the Health-Related Behavior Inventory (HBI) by Z. Juczyński (24 items, Likert scale) measured overall health-promoting behaviors and four subscales: proper dietary habits, preventive behaviors, positive mental attitude, and health practices. Higher scores indicate more frequent engagement.

HLC: the Multidimensional Health Locus of Control (MHLC) questionnaire (Polish adaptation) assessed three dimensions: Internal (I) – belief in personal control, Powerful Others (P) – influence of others (e.g. physicians), and Chance (C) – role of random factors. Higher scores reflect stronger beliefs in a given factor's influence. Internal Health Locus of Control (IHLC) (I) was emphasized as a potential predictor.

Statistical analysis

Analyses were performed using STATISTICA 13 PL (StatSoft, Poland). Due to non-normal distributions, non-parametric methods were primarily used for comparative analyses. Quantitative variables were described with arithmetic mean (M), standard deviation (SD), median (Me), and interquartile range (IQR). Mann-Whitney U tests compared independent cohorts (2016 vs. 2026) for quantitative variables. Qualitative variables (e.g. BMI, IPAQ categories) were compared using the χ^2 test. Spearman's rank correlation coefficient (ρ) assessed associations between quantitative variables. Statistical significance was set at $p<0.05$. Correlation analyses were exploratory, and the results were interpreted with caution.

Results

In the group of PE students, no statistically significant differences were found between the 2016 and 2026 cohorts with regard to age, gender distribution (53 women [33.8%] in 2016 vs. 44 [30.1%] in 2026), or body height ($p>0.05$). In 2026, however, significantly higher body weight and BMI were observed. The level of PA, assessed using the IPAQ (vigorous activity, moderate activity, walking, and total PA), was comparable in both groups ($p>0.05$). In contrast, a significant increase in sitting time was recorded, from a mean of 163 to 221 min/day ($p<0.001$) (Table 1).

Table 1. Characteristics of PE students in 2016 and 2026: anthropometric data, PA, HBI, and MHLC

Variable	2016 (N_1=157) M (SD); Me (IQR)	2026 (N_2=146) M (SD); Me (IQR)	Z	*p*-value
Age [years]	21.0 (1.6); 21.0 (2.0)	21.1 (1.5); 21.0 (2.0)	-0.65	0.513
Height [m]	1.80 (0.10); 1.80 (0.11)	1.80 (0.10); 1.80 (0.12)	-0.93	0.355
Body weight [kg]	71.3 (13.8); 72.0 (19.0)	75.2 (14.1); 74.0 (21.0)	-2.33	0.020
BMI [kg/m^2]	22.6 (3.1); 22.4 (3.8)	23.6 (3.3); 23.1 (3.6)	-2.67	0.008
IPAQ (MET-min/week)				
Vigorous	2871.5 (1807); 2880 (2920)	2970.4 (2852); 2160 (2640)	1.30	0.195
Moderate	1334.5 (865); 1152 (1224)	1505.6 (1574); 840 (1520)	1.33	0.182
Walking	1231.7 (644); 1188 (264)	1154.9 (745); 1040 (470)	1.24	0.214
Total	5437.7 (2266); 5316 (871)	5630.9 (3779); 4641 (1551)	1.01	0.312
Sitting time [min/day]	162.7 (74.5); 168.6 (163)	220.7 (152.7); 200 (240)	-1.94	0.052
HBI (points)				
Total HBI score	79.7 (13.4); 81.0 (18.1)	79.4 (13.7); 80.0 (20.0)	0.28	0.780
Proper dietary habits	3.2 (0.7); 3.2 (1.0)	3.3 (0.7); 3.3 (1.0)	-1.72	0.085
Preventive behaviors	3.3 (0.6); 3.3 (0.83)	3.3 (0.8); 3.3 (0.83)	-0.17	0.862
Positive mental attitude	3.6 (0.8); 3.7 (1.2)	3.6 (0.7); 3.5 (0.83)	0.71	0.481
Health-promoting behaviours	3.2 (0.7); 3.3 (1.0)	3.1 (0.7); 3.2 (1.2)	1.41	0.159
MHLC (points)				
Powerful others (PHLC)	4.4 (0.7); 4.3 (0.83)	4.5 (0.8); 4.7 (0.83)	-2.39	0.017
Internal (IHLC)	3.8 (1.1); 4.0 (1.7)	3.3 (1.0); 3.2 (1.3)	4.25	<0.001
Chance (CHLC)	3.5 (1.0); 3.5 (1.2)	3.5 (1.0); 3.4 (1.3)	-0.05	0.963

Notes: M – mean, SD – standard deviation, Me – median, IQR – interquartile range. Comparisons between 2016 and 2026 were performed using the Mann-Whitney U test (Z statistic); $p<0.05$ was considered statistically significant.

The assessment of psychosocial determinants demonstrated stability of the overall health behavior index and its subscales among PE students, with no statistically significant changes observed. In contrast, significant differences were found in the dimension of HLC. Students from the 2026 cohort obtained significantly lower scores on the Internal control scale (p<0.001) and significantly higher scores on the Powerful Others scale (p=0.017) compared with their peers from 2016. These findings suggest a weakening of beliefs in personal influence over one's own health in favor of attributing responsibility to external factors (other people, professionals) in the 2026 cohort.

Among students of SOC programs, no statistically significant differences were observed with respect to age, gender distribution (129 women [56.1%] in 2016 vs. 117 [53.4%] in 2026), or body height (p>0.05). As in the PE group, the 2026 cohort demonstrated higher body weight and BMI values.

Particularly concerning changes were observed in the domain of PA. Compared with the 2016 group, students from the 2026 cohort exhibited significantly lower levels of vigorous PA (median decreased from 720 to 240 MET-min/week; p<0.001) and moderate PA (p=0.007). This resulted in a reduction in total PA (p=0.049). At the same time, daily sitting time increased by more than 60 minutes (p<0.001) (Table 2).

Table 2. Characteristics of SOC students in 2016 and 2026: anthropometric data, PA, HBI, and MHLC

Variable	2016 (N_3=230) M (SD); Me (IQR)	2026 (N_4=219) M (SD); Me (IQR)	Z	p-value
Age [years]	21.2 (2.0); 21.0 (2.0)	21.5 (1.8); 21.0 (3.0)	-2.83	0.005
Height [m]	1.7 (0.1); 1.7 (0.55)	1.7 (0.1); 1.7 (0.14)	-0.41	0.680
Body weight [kg]	68.2 (13.2); 67.0 (20.1)	71.6 (15.4); 70.0 (24.1)	-2.10	0.036
BMI [kg/m^2]	22.7 (3.1); 22.5 (3.8)	23.8 (4.2); 22.9 (5.9)	-2.25	0.024
IPAQ (MET-min/week)				
Vigorous	1211.1 (1326); 720 (1800)	893.4 (1884); 240 (1080)	6.34	<0.01
Moderate	708.9 (790); 360 (920)	752.8 (1342); 300 (824)	2.70	0.007
Walking	659.7 (617); 396 (240)	951.1 (1267); 495 (340)	-1.70	0.089
Total	2579.7 (1981); 2101 (792)	2597.2 (3270); 1702 (1122)	1.96	0.049
Sitting time [min/day]	212.6 (65.3); 240 (91.4)	318.6 (206); 300 (360)	-4.42	<0.01
HBI (points)				
Total HBI score	75.9 (13.2); 75.0 (18.5)	73.8 (14.6); 75.0 (18.1)	0.91	0.364
Proper dietary habits	3.1 (0.8); 3.0 (1.2)	3.0 (0.8); 3.0 (1.2)	0.36	0.717
Preventive behaviors	3.1 (0.7); 3.2 (1.1)	3.1 (0.8); 3.2 (1.2)	0.16	0.872
Positive mental attitude	3.3 (0.7); 3.3 (1.0)	3.2 (0.7); 3.2 (1.1)	1.30	0.194
Health-promoting behaviours	3.1 (0.7); 3.2 (1.1)	3.0 (0.7); 3.0 (1.3)	2.18	0.030
MHLC (points)				
Powerful others (PHLC)	4.3 (0.8); 4.3 (1.2)	4.1 (1.0); 4.2 (1.5)	1.18	0.236
Internal (IHLC)	3.5 (1.0); 3.5 (1.5)	3.3 (1.1); 3.3 (1.7)	2.07	0.038
Chance (CHLC)	3.4 (0.9); 3.4 (1.3)	3.5 (1.0); 3.5 (2.7)	-1.11	0.266

Notes: M – mean, SD – standard deviation, Me – median, IQR – interquartile range. Comparisons between 2016 and 2026 were performed using the Mann–Whitney U test (Z statistic); p<0.05 was considered statistically significant.

The absence of significant differences in the mean values of vigorous and moderate PA, accompanied by high variance, suggests increasing polarization of behaviors within the studied group (the simultaneous presence of extremely active and inactive individuals). The only parameter that showed a significant

increase was transport-related activity (walking). A critical phenomenon observed was a significant prolongation of sitting time. The increase in sedentary behavior, correlated with higher body weight and BMI values (body weight and total PA: ρ=−0.198 and ρ=-0.203, respectively), constitutes a significant risk factor for the development of metabolic diseases.

Analysis of the HBI revealed no significant changes in the overall score or in the categories of dietary habits and mental attitude. This suggests a discrepancy between declared attitudes (which remained stable) and objective health indicators (which deteriorated). However, a significant decline was noted in the health-promoting behaviors subscale. Changes were also observed in the psychological domain – in 2026, a significant decrease in the IHLC scale (p<0.001) was recorded, which may indicate a weakening of perceived personal agency.

Discussion

The aim of the study was to evaluate health-promoting behaviors, including PA and psychosocial determinants of health, in two cohorts of students (PE vs. SOC programs) examined in 2016 and 2026. Analysis of the empirical material revealed a dichotomy of ongoing processes: stabilization of the declarative domain was accompanied by a marked regression in objective indicators, manifested by increased BMI and intensified sedentary behavior. These phenomena align with the broader paradigm of adverse civilization-related changes affecting contemporary academic populations [15,16].

Particular attention in the comparative analysis is drawn to the significant increase in body weight and BMI observed in both study groups over the ten-year period. Although mean somatic parameters did not exceed overweight thresholds, the dynamics of their increase were statistically significant. These observations are consistent with global trends observed among young adults [17]. In light of previous studies [18-20], the academic environment appears obesogenic, promoting weight gain through dietary changes, stress, and deregulation of lifestyle patterns.

Notably, the upward trend in BMI also affected PE students, a group whose educational profile implies higher health awareness. This observation is consistent with reports suggesting that the pressure of an obesogenic environment may outweigh educational effects, even in physically active populations [21]. Among SOC students, the increase in BMI closely coincided with a marked regression in intense PA.

When interpreting the observed differences between PE and SOC students, it is crucial to recognize the distinct roles these groups play within our comparative framework. PE students were intentionally included as a referential group, representing a population whose academic training, professional aspirations, and personal ethos are intrinsically linked to PA and health promotion. Therefore, direct comparisons of absolute levels of PA or health consciousness should not be interpreted as an assessment of equivalent populations but rather as an examination of how a less specialized group (SOC students) aligns with or deviates from a standard set by a highly health-oriented population (PE students). This approach allows us to identify potential gaps and areas where interventions might be most effective in the general student body, informed by the practices of those professionally engaged with health.

Evaluation of PA levels using the IPAQ revealed a deepening divergence in behavioral patterns between the studied groups. Unlike PE students, who despite some fluctuations, maintained relative stability in activity levels, SOC students demonstrated a reduction in vigorous PA. This observation is supported by findings reported by Bergier et al. [22], who identified students of non-sport universities as a high-risk population in terms of insufficient physical stimulation.

Particularly concerning is the phenomenon observed even among PE students, referred to in literature as the "active couch potato". This concept indicates that meeting PA guidelines (e.g. through training) does not fully offset the negative metabolic effects of prolonged sitting during the remainder of the day [5]. The substantial increase in sitting time among SOC students, along with a significant rise also observed in the PE group, reflects the consequences of the digital transformation of lifestyle. This phenomenon fits the concept of "sedentary behavior among physically active individuals" (active couch potato), which is increasingly recognized as a challenge even for athletic populations. According to previous analyses [5,23], engaging in physical training may be insufficient to fully compensate for the metabolic consequences of prolonged sitting. This mechanism may explain the observed increase in body weight among PE students despite the maintenance of training activity.

In the domain of health behaviors and HLC, a dissociation between declarative and behavioral domains was observed. Although the overall HBI score remained stable, suggesting unchanged levels of knowledge and declared attitudes, detailed analysis revealed significant shifts in the structure of results. In 2026, a statistically significant decline was observed in the health-promoting behaviors subscale, along with a decrease in IHLC. This indicates erosion of personal agency and difficulties in translating theoretical knowledge into everyday practice [24].

An interesting finding is the relative stability of health-related psychological resources, including sense of coherence and the overall level of health-promoting behaviors measured by the HBI, despite the deterioration of somatic and behavioral indicators. This may suggest that internal beliefs regarding meaningfulness, comprehensibility, and manageability of life, as well as declared concern for health, are not fully sufficient buffers against the pressure of a sedentary-promoting environment [25]. The observed differences in MHLC profiles between PE and SOC students (with a relatively higher internal locus of health control among physical education students) are consistent with earlier studies indicating that choosing a field related to PA is associated with stronger perceived agency in health matters and greater readiness to engage in health-promoting behaviors [26].

A decline in perceived agency (locus of control) within the academic population is increasingly discussed in health psychology. Analyses by Twenge et al. [27] indicate that the "iGen" generation exhibits a stronger tendency toward an external locus of control, which correlates with passivity in health-related behaviors. In the present study, the convergence of IHLC scores at a lower level in both groups in 2026 suggests a dominant role of macro-social determinants (systemic uncertainty, stress) over educational profile. These conclusions correspond with findings by Rogowska et al. [16], documenting a general decline in students' mental well-being, resulting in reduced motivation to engage in active health-promoting behaviors [22].

The results of our study have important practical implications. They indicate that "traditional" PE programs at universities may be insufficient in the face of contemporary lifestyle-related threats. There is a need to implement interventions aimed at interrupting prolonged periods of sitting (so-called activity breaks) and strengthening health-related agency, particularly among social science students, who in 2026 appear to constitute a high metabolic risk group. From a public health perspective, the findings underscore the necessity of implementing multilevel health promotion interventions within the academic environment. In addition to traditional forms of health education, especially targeted at students of non-sport disciplines, it seems justified to introduce structural solutions limiting sedentary behavior. Of particular importance may be the integration of PA and health management components into curricula

of programs unrelated to physical culture, which could enhance students' sense of agency in health while simultaneously reducing environmental barriers.

Study limitations

The collected data should be interpreted with caution due to their self-reported nature, which constitutes a standard limitation of population-based studies. Nevertheless, the magnitude of the observed effects, particularly the sharp increase in sedentary behavior and BMI, suggests that the identified trends reflect genuine behavioral changes rather than merely estimation errors resulting from the applied methodology.

The gender distribution (predominance of men in PE programs and women in SOC programs) may also have influenced somatic and behavioral differences. Health behavior data were obtained via self-report, which is common in population studies but carries the risk of biases such as underreporting body weight and sitting time and overreporting PA levels. Although self-report bias may be directional, the consistency of methodology across both time points allows for reliable inference regarding the direction of changes.

Despite these limitations, the consistency of the observed changes, their scale, and their consistency with the results of other population studies increase the credibility of the conclusion that the health profile of students is deteriorating, especially in fields other than PE, i.e. non-sports fields.

Conclusions

1. Comparative analysis of 2016 and 2026 revealed a significant increase in sitting time in both study groups, accompanied by relative stability of overall PA levels and an increase in BMI. Particularly unfavorable trends were observed among SOC students, including a marked decline in vigorous PA, regression in health-promoting behaviors, and a reduction in the IHLC.
2. Greater dynamics of change were observed among SOC students, whereas changes among PE students were minimal. These findings indicate an urgent need to implement multidimensional preventive programs in the academic environment. Such programs should focus not only on promoting sport participation but primarily on reducing sedentary behavior and strengthening responsibility for health, taking into account the specific educational profiles of students.

Disclosures and acknowledgements

The authors declare no conflicts of interest with respect to the research, authorship, and/or publication of this article.

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

The study followed the Declaration of Helsinki and was approved by the Ethical Committee of the Medical University of Białystok (Nr R-I-002/424/2016). Informed consent was obtained from all the individuals included in the study.

Artificial intelligence (AI) was not used in the creation of the manuscript.

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