



# Health locus of control in relation to physical activity and health behaviours among nursing students – a comparative study of two cohorts (2016 vs 2026)

Umiejscowienie kontroli zdrowia w odniesieniu do aktywności fizycznej i zachowań zdrowotnych wśród studentek pielęgniarstwa: badanie porównawcze dwóch kohort (2016 vs 2026)

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## Abstract

**Objective.** To evaluate differences in self-reported physical activity, health behaviours, and health locus of control among female nursing students, and to analyze the associations between these variables across two cohorts (2016 and 2026).

**Materials and Method.** This cross-sectional study included 473 female students (2016: N=230; 2026: N=243). Data were collected using the International Physical Activity Questionnaire (IPAQ), the Health Behaviour Inventory (HBI), and the Multidimensional Health Locus of Control (MHLC) scales.

**Results.** The 2026 cohort demonstrated significantly lower levels of physical activity and health-promoting behaviours compared to the 2016 cohort. The 'Powerful Others' locus of control dimension was significantly lower in 2026 ( $p < 0.001$ ), while the 'Internal' and 'Chance' dimensions remained unchanged. In 2016, health behaviours correlated exclusively with the 'Powerful Others' dimension ( $\rho = 0.18$ ). In contrast, in 2026, they significantly correlated with both the 'Internal' ( $\rho = 0.32$ ;  $p < 0.001$ ) and 'Powerful Others' ( $\rho = 0.29$ ;  $p < 0.001$ ) dimensions. No correlations were found between MHLC dimensions and physical activity in either group.

**Conclusions.** The more recent cohort exhibits higher levels of sedentary behaviour, poorer health habits, and a decreased reliance on medical authorities. The transition in 2026 to a dual model, where health behaviours are associated with both internal agency and external support, highlights the need for educational interventions that integrate patient autonomy with trust in professionals, alongside the promotion of physical activity.

## Key words

health locus of control, physical activity, health behaviours, IPAQ, nursing students

## Streszczenie

**Wprowadzenie i cel pracy.** Ocena różnic w samoocenie aktywności fizycznej, zachowaniach zdrowotnych i umiejscowieniu kontroli zdrowia u studentek pielęgniarstwa oraz analiza powiązań między nimi w dwóch kohortach (2016 i 2026).

**Materiał i metody.** Badaniem przekrojowym objęto 473 studentki (2016: N = 230; 2026: N = 243). Zastosowano Międzynarodowy Kwestionariusz Aktywności Fizycznej (IPAQ), Inwentarz Zachowań Zdrowotnych (IZZ) i Wielowymiarową Skalę Umiejscowienia Kontroli Zdrowia (MHLC).

**Wyniki.** Kohorta 2026 wykazała istotnie niższy poziom aktywności fizycznej i zachowań zdrowotnych niż kohorta 2016. Wymiar kontroli zdrowia „wpływ innych” był w 2026 roku istotnie niższy ( $p < 0,001$ ), natomiast wymiary „wewnętrzny” i „przypadek” nie uległy zmianie. W 2016 roku zachowania zdrowotne korelowały wyłącznie z wymiarem „wpływ innych” ( $\rho = 0,18$ ). W 2026 roku korelowały już istotnie z oboma wymiarami: „wewnętrznym” ( $\rho = 0,32$ ;  $p < 0,001$ ) i „wpływem innych” ( $\rho = 0,29$ ;  $p < 0,001$ ). Nie wykazano korelacji między wymiarami MHLC a aktywnością fizyczną w obu grupach.

**Wnioski.** Nowsza kohorta przejawia wyższy poziom zachowań sedentarynych, słabsze nawyki prozdrowotne i mniejsze poleganie na autorytetach medycznych. Przejście w 2026 roku do dualnego modelu (gdzie zachowania zdrowotne wiążą się zarówno ze sprawczością wewnętrzną, jak i zewnętrznym wsparciem) podkreśla potrzebę interwencji edukacyjnych łączących samodzielność pacjenta z zaufaniem do profesjonalistów, przy jednoczesnym promowaniu aktywności fizycznej.

## Słowa kluczowe

umiejscowienie kontroli zdrowia, aktywność fizyczna, IPAQ, zachowania prozdrowotne, studentki pielęgniarstwa

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## INTRODUCTION

Lifestyle, encompassing physical activity, dietary habits, and daily health-maintenance practices, is a fundamental factor associated with health outcomes at both individual and population levels. Recent years have witnessed significant shifts in the lifestyles of young adults, exacerbated by global health challenges, such as the COVID-19 pandemic, leading to an increase in sedentary behaviors [1–3]. Extensive research consistently demonstrates that regular physical activity and the adoption of health-promoting behaviours significantly reduce the risk of non-communicable chronic diseases, enhance psychological well-being, and contribute to a higher quality of life [2–4]. These behaviours hold particular importance for young adults, especially among female students in medical programmes, who are poised to play a strategic role in health education and in shaping patient attitudes in the future [5, 6].

A widespread phenomenon among young people is the ‘pandemic of physical inactivity’, characterized by a range of unfavourable lifestyle patterns. Studies among Polish university students highlight a decline in self-reported physical activity levels and an increase in sedentary behaviours [2, 7–9], alongside negative changes in dietary habits [9, 10]. The COVID-19 pandemic further exacerbated these behavioural modifications. Its long-term repercussions, including restricted access to sports facilities, the transition to remote learning, and increased screen time, fostered unfavourable behavioural patterns and intensified symptoms of stress and lowered mood within this demographic [11–13]. Such changes may profoundly impact the lifestyles of nursing students, who also face the demanding clinical education environment and often juggle studies with paid employment, contributing to limited leisure time and behaviours conducive to burnout [14].

From a scientific perspective, the health locus of control (HLC) is a crucial construct associated with health-promoting behaviours. Derived from social learning theory, HLC refers to individuals’ beliefs about the sources of influence over their own health status. Conventionally, HLC distinguishes between beliefs in internal control (health resulting from personal actions), and external control, which can be attributed to ‘powerful others’ (e.g., medical personnel) or to ‘chance’ (e.g., luck) [15–17]. Theoretical and empirical evidence consistently indicates that a higher level of internal HLC is associated with more frequent engagement in health-promoting behaviours, better adherence to medical recommendations, and greater personal responsibility for health [16–19]. Conversely, a predominance of external HLC beliefs is often associated with passivity, poorer therapeutic adherence, and an increased propensity for risk behaviours [10, 18].

In the context of nursing education, the understanding of HLC is particularly salient. As future healthcare professionals, nursing students are expected not only to possess substantive knowledge, but also to demonstrate a strong sense of perceived urgency regarding their own health. Their personal lifestyle and health attitudes form the bedrock of credibility for educational interventions they will undertake in future patient care [6, 19, 20]. Studies suggest that health behaviours and self-reported physical activity levels among nursing students are associated with factors such as burnout, well-being, and health-related beliefs [21].

Despite the extensive literature on the impact of the COVID-19 pandemic on student populations, there is a distinct lack of comparative studies examining the differences in health behaviours, physical activity, and health locus of control among nursing students over a decade-long perspective. To bridge this gap, the present study aimed to compare the physical activity levels, health-promoting behaviors (HBI), and multidimensional health locus of control (MHLC) between two independent cohorts of undergraduate nursing students assessed in 2016 (pre-pandemic) and 2026 (post-pandemic recovery). By evaluating these distinct time points, the study attempts to determine how the cumulative global and educational transformations of the past decade have reshaped the health paradigms of future healthcare professionals.

## MATERIALS AND METHOD

**Study participants and procedure.** A repeated cross-sectional study design was applied. The study included two independent groups of third-year undergraduate nursing students evaluated during the academic years 2015–2016 and 2025–2026. A purposive convenience sampling method was employed, based on the availability of respondents during scheduled classes. The study involved nursing students from higher education institutions located in the Podlaskie Province in northeast Poland. Data obtained from two independent cohorts from the same institutions were analyzed: 230 participants surveyed in 2016 and 243 participants in 2026.

Participation in the study was anonymous and voluntary. Prior to questionnaire administration, participants were informed about the aim of the project, confidentiality principles, and their right to withdraw at any stage without providing a reason. Informed consent was a prerequisite for inclusion in the study. Data collection was conducted during scheduled classes on university premises. Students completed the electronic survey questionnaires independently in the presence of a research team member, ensuring standardized measurement conditions.

Inclusion criteria comprised: active enrollment as a third-year nursing student at one of the participating institutions, age  $\geq 18$  years, and the full completion of the research instruments. Exclusion criteria: lack of consent to participate, incomplete key questionnaires (IPAQ, HBI, MHLC), or missing socio-demographic data. Both cohorts were comparable in terms of basic sociodemographic variables (age, year of study), enabling a reliable comparative analysis.

The study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from the Bioethics Committee of the Medical University of Białystok (Approval No. R-I-002/424/2016) and from the Bioethics Committee of the District Medical Chamber in Kraków (Approval No. 96/KBL/OIL/2026).

**Data collection instruments.** Socio-demographic data (including age, year of study, family situation, and educational status) were collected using a custom-designed questionnaire. The obtained information was utilized to characterize the study sample and to ensure comparability between the cohorts.

**International physical activity questionnaire (IPAQ – short version).** Physical activity levels were assessed using the short version of the International Physical Activity Questionnaire (IPAQ) in the Polish adaptation by Biernat et al. [2]. This standardized and widely used self-report instrument itemises respondents' recall of time spent in vigorous- and moderate-intensity physical activity, walking, and sitting during the week preceding the survey. Results were converted into MET-min/week using standard metabolic equivalent coefficients (8.0 METs for vigorous activity, 4.0 METs for moderate activity, and 3.3 METs for walking), allowing respondents to be categorized into low, moderate, or high physical activity levels. In the adopted research model, IPAQ indicators were treated as outcome variables. The reliability of the IPAQ has been widely established across various populations. In the present study, the internal consistency for the IPAQ sub-dimensions demonstrated acceptable levels (Cronbach's alpha for walking = 0.84, moderate activity = 0.83, and vigorous activity = 0.82).

**Health-related behaviour inventory (HBI).** The overall intensity of health-promoting behaviours was measured using the Health Behaviour Inventory (HBI) developed by Juczyński [17]. The questionnaire consists of 24 items rated on a 5-point frequency scale ranging from 1 ('almost never') to 5 ('almost always'). The total score reflects the general level of engagement in health-promoting behaviours, while the instrument's structure allows for the analysis of four distinct subdomains: proper dietary habits (PDH), preventive behaviours (PB), positive mental attitude (PMA), and health practices (HP). In the analysis, the overall HBI score served as a key outcome variable representing general lifestyle quality. Scores for the four subscales were calculated separately by summing-up the points assigned to the relevant items (six items per subscale) and dividing by six, yielding a mean score ranging from 1–5. Higher scores indicate a greater frequency of health-promoting behaviors in a given domain. The HBI has consistently demonstrated robust psychometric properties. In the present study, the overall internal consistency of the HBI was high (Cronbach's alpha = 0.89), and its subscales also showed strong reliability (e.g., proper dietary habits  $\alpha = 0.88$ , preventive behaviours  $\alpha = 0.90$ ).

**Multi-dimensional health locus of control scale (MHLC).** Health locus of control was treated as an independent (explanatory) variable and measured using the Multidimensional Health Locus of Control (MHLC) scale, adapted into Polish by Juczyński [17] and based on Wallston's conceptual framework [15, 16]. The instrument distinguishes three dimensions of control: Internal (I), reflecting the belief that health depends on one's own actions; Powerful Others (P), reflecting the belief in the decisive role of medical professionals or other people; and Chance (C), reflecting the belief that health is determined by random factors or luck.

To assess overall tendencies, aggregated scores for each MHLC subscale were calculated as the sum of points from the six items assigned to the respective dimension. Due to the non-normal distribution of the data, the median (Me) and interquartile range (IQR) were used to summarize these aggregated scores for reporting. Higher values indicate stronger beliefs in the role of the respective factor in determining health status. The MHLC scale is

a well-validated instrument widely used in health behaviour research. In the present study, the internal consistency for its dimensions was satisfactory: Internal ( $\alpha = 0.81$ ), Powerful Others ( $\alpha = 0.80$ ), and Chance ( $\alpha = 0.81$ ).

**Data analysis procedure.** Statistical analyses were performed using STATISTICA 13 PL software (StatSoft, Poland). In the first stage, the distributions of the analyzed variables were tested for normality. As the distributions deviated from normality (for all categories and the overall scores), non-parametric methods were applied for between-group comparisons. For quantitative variables, descriptive statistics were calculated, including the median (Me) and interquartile range (IQR). Arithmetic mean (M) and standard deviation (SD) were also assessed but not used for reporting due to non-normal distributions.

The Mann-Whitney U test was employed to compare variables, including individual MHLC items and aggregated scales, between the 2016–2026 cohorts. To account for multiple comparisons in the MHLC analyses and control for Type I error, p-values for both item-level and aggregated scale comparisons were adjusted using the Benjamini-Hochberg False Discovery Rate (FDR) method. The direction of the observed changes between the cohorts was determined by the sign of the Z-statistic from the Mann-Whitney U test:  $Z > 0$  indicates a decrease in the 2026 cohort relative to 2016, whereas  $Z < 0$  signifies an increase. Effect sizes ( $r$ ) are reported as absolute values to indicate the magnitude of the difference, while the direction of the difference is indicated by the sign of the Z-statistic. Effect sizes were interpreted as small ( $0.1 \leq r < 0.3$ ), medium ( $0.3 \leq r < 0.5$ ), and large ( $r \geq 0.5$ ).

Additionally, correlation analyses between physical activity levels, health behaviours, and dimensions of health locus of control were conducted using Spearman's rank correlation coefficient ( $\rho$ ). The strength, direction, and significance of these relationships were evaluated, with the general level of statistical significance for all analyses set a priori at  $p < 0.05$ .

## RESULTS

**Characteristics of the study cohorts.** The study was limited to female nursing students to ensure sample homogeneity, reflecting the specific demographic profile of this academic programme and the overwhelming predominance of women in the profession. A total of 473 valid questionnaires were analyzed from two independent cohorts: 2016 ( $n=230$ ) and 2026 ( $n=243$ ). The studied cohorts were comparable in terms of age ( $Z = -1.27$ ;  $p = 0.205$ ), confirming their comparability for all subsequent analyses. Table 1 presents a comprehensive summary of the basic socio-demographic parameters, physical activity indicators, and health-promoting behaviors for both groups.

**Changes in physical activity, health behaviours, and health locus of control (2016 vs. 2026).** Total self-reported physical activity was significantly lower in the 2026 cohort compared to 2016 (median: 1350 vs. 1851 MET-min/week;  $Z = 3.13$ ;  $p = 0.002$ ). This overall decline was paralleled by significant reductions in both vigorous ( $Z = 7.49$ ;  $p < 0.001$ ) and moderate ( $Z = 2.88$ ;  $p = 0.004$ ) physical activity. Conversely, walking activity demonstrated a significant increase over the decade ( $Z = -2.37$ ;  $p = 0.05$ ). Correspondingly, daily sedentary time

**Table 1.** Characteristics of the studied cohorts (2016 vs. 2026): socio-demographic data, physical activity (IPAQ), and health behaviours (HBI)

Domain / Variable	2016 (n=230)	2026 (n=243)	Mann-Whitney U test (Z)	p	Direction of change (2026 vs. 2016)*
Socio-demographic characteristics					
Age Me (IQR)	22.0 (4.0)	23.0 (6.0)	-1.27	0.205	↔
Physical activity (IPAQ, self-reported) [MET-min/week]					
Vigorous physical activity, Me (IQR)	640 (1320)	160 (720)	7.49	<0.001	↓
Moderate physical activity, Me (IQR)	480 (800)	320 (720)	2.88	0.004	↓
Walking, Me (IQR)	396 (594)	562 (759)	-2.37	0.05	↑
Total physical activity, Me (IQR)	1,851 (2,655)	1,350 (2,141)	3.13	0.002	↓
Sitting time (self-reported)	205.7 (137)	300 (360)	-5.93	<0.001	↑
IPAQ category: low, n (%)	31 (13.5)	58 (23.9)			↑
IPAQ category: moderate, n (%)	64 (27.8)	72 (29.6)	$\chi^2=10.2$	0.006	↑
IPAQ category: high, n (%)	135 (58.7)	113 (46.5)			↓
Health-promoting behaviours (HBI)					
Overall HBI score (points), Me (IQR)	80.0 (18.0)	76 (20.0)	2.48	0.013	↓
Preventive behaviours, Me (IQR)	3.3 (1.0)	3.2 (1.2)	3.40	<0.001	↓
Health-promoting practices, Me (IQR)	3.3 (1.0)	3.3 (1.1)	-1.55	0.121	↔
Positive mental attitude, Me (IQR)	3.5 (1.0)	3.3 (1.3)	2.24	0.025	↓
Proper dietary habits, Me (IQR)	3.3 (1.0)	3.0 (1.3)	3.44	<0.001	↓

Note: Direction indicates higher (↑), lower (↓), or no difference (↔) in 2026 compared to 2016

increased significantly from a median of 205.7 minutes in 2016 to 300.0 minutes in 2026 ( $Z = -5.93$ ;  $p < 0.001$ ). Furthermore, the proportion of students classified within the low physical activity category (IPAQ) rose substantially from 13.5% to 23.9% ( $\chi^2 = 10.2$ ;  $p = 0.006$ ).

Regarding health-promoting behaviours, the overall Health Behaviour Inventory (HBI) score decreased significantly from a median of 80.0 points in 2016 to 76.0 points in 2026 ( $Z = 2.48$ ;  $p = 0.013$ ). Analysis of the HBI subscales revealed further significant reductions in preventive behaviours ( $Z = 3.40$ ;  $p < 0.001$ ), positive mental attitude ( $Z = 2.24$ ;  $p = 0.025$ ), and proper dietary habits ( $Z = 3.44$ ;  $p < 0.001$ ).

Analysis of the aggregated dimensions of the Multidimensional Health Locus of Control (MHLC) scale revealed a significant shift solely in the Powerful Others domain. Specifically, the belief that health outcomes are controlled by external figures, such as medical professionals or family members, significantly decreased in the 2026 cohort compared to 2016 ( $Z = 4.05$ ;  $p < 0.001$ ). Conversely, no statistically significant differences were observed between the two cohorts regarding the internal health locus of control ( $Z = -1.26$ ;  $p = 0.21$ ), or the belief that health is determined by Chance ( $Z = 1.34$ ;  $p = 0.18$ ).

**Changes in health locus of control (2016 vs. 2026).** At the aggregated scale level, the Powerful Others dimension demonstrated a significant decrease in the 2026 cohort ( $Z = 4.05$ ;  $p < 0.001$ ,  $r = 0.19$ , small-to-medium effect), whereas the overall Internal ( $Z = -1.26$ ;  $p = 0.21$ ,  $r = 0.06$ ) and Chance ( $Z = 1.34$ ;  $p = 0.18$ ,  $r = 0.06$ ) dimensions showed no statistically significant changes. However, an item-level analysis of the MHLC scale (Table 2) provided more nuanced insights into these cohorts' shifting perceptions.

Within the Internal dimension, despite the lack of overall scale changes, specific beliefs regarding personal agency in health decisions and recovery significantly increased.

The 2026 cohort reported higher agreement with Item 1: 'When I get sick, how quickly I recover depends on my own behaviour' ( $Z = -2.96$ , adjusted  $p = 0.007$ ,  $r = 0.14$ ), Item 6: 'I myself decide about my health' ( $Z = -7.04$ , adjusted  $p < 0.001$ ,  $r = 0.32$ , medium effect), and Item 12: 'My health mainly depends on what I myself do' ( $Z = -4.33$ , adjusted  $p < 0.001$ ,  $r = 0.20$ ). Conversely, beliefs strictly linking personal fault to illness or guaranteeing health through preventive care significantly declined, as evidenced by decreases in Item 8: 'When I am sick, it is my fault' ( $Z = 3.15$ , adjusted  $p = 0.004$ ,  $r = 0.15$ ), Item 13: 'If I take care of myself, I can avoid illness' ( $Z = 2.07$ , adjusted  $p = 0.047$ ,  $r = 0.10$ ), and Item 17: 'If I take appropriate actions, I will remain healthy' ( $Z = 3.16$ , adjusted  $p = 0.004$ ,  $r = 0.15$ ).

For the Powerful Others dimension, the overall scale reduction was consistently reflected across multiple specific items. The 2026 cohort exhibited significantly lower reliance on external figures, showing decreased agreement with Item 7: 'Other people influence whether I get sick or stay healthy' ( $Z = 3.54$ , adjusted  $p = 0.001$ ,  $r = 0.16$ ), Item 10: 'Doctors decide about my health' ( $Z = 3.23$ , adjusted  $p = 0.004$ ,  $r = 0.15$ ), Item 14: 'When I recover, it is usually thanks to other people who provide me with good care' ( $Z = 5.82$ , adjusted  $p < 0.001$ ,  $r = 0.27$ ), and Item 18: 'For my health, I can only do what the doctor advises me' ( $Z = 2.73$ , adjusted  $p = 0.001$ ,  $r = 0.13$ ).

Finally, while the aggregated Chance dimension showed no significant difference, specific fatalistic views significantly decreased. The 2026 cohort demonstrated lower agreement with Item 4: 'Most of what affects my health happens by chance' ( $Z = 3.18$ , adjusted  $p = 0.004$ ,  $r = 0.15$ ), and Item 15: 'No matter what I do, I will probably get sick anyway' ( $Z = 2.08$ , adjusted  $p = 0.047$ ,  $r = 0.10$ ).

Spearman's rank correlation analysis revealed distinct patterns of associations among MHLC dimensions (Internal, Powerful Others, and Chance), the Health Behaviour

**Table 2.** Comparison of MHLC scores between the 2016 and 2026 cohorts

MHLC Dimension / Item description	2016	2026	Mann-Whitney U test		Effect size (r)
	Me (IQR)	Me (IQR)	Z	Adjusted p-value (FDR)	
Aggregated dimensions					
Internal HLC (I)	26.0 (6.0)	27.0 (8.0)	-1.26	0.21	0.06
Powerful Others (P)	23.5 (8.0)	20.0 (10.0)	4.05	<0.001	0.19
Chance (C)	23.0 (9.0)	22.0 (8.0)	1.34	0.18	0.06
1. When I get sick, how quickly I recover depends on my own behaviour (I)	5.0 (4.0)	5.0 (3.0)	-2.96	0.007	0.14
2. If I'm going to get sick, I will get sick regardless of what I do (C)	4.0 (5.0)	4.0 (5.0)	-1.06	0.303	0.05
3. Maintaining regular contact with a doctor is the best way to avoid illness (P)	4.0 (4.0)	4.0 (5.0)	0.60	0.569	0.03
4. Most of what affects my health happens by chance (C)	5.0 (4.0)	4.0 (4.0)	3.18	0.004	0.15
5. Whenever I feel unwell, I consult a doctor (P)	3.0 (5.0)	3.0 (4.0)	1.17	0.268	0.05
6. I myself decide about my health (I)	4.0 (2.5)	5.0 (3.0)	-7.04	<0.001	0.32
7. Other people (e.g., doctors, nurses, family, friends) influence whether I get sick or stay healthy (P)	3.0 (5.0)	3.0 (4.0)	3.54	0.001	0.16
8. When I am sick, it is my fault (I)	4.0 (4.0)	4.0 (4.0)	3.15	0.004	0.15
9. How quickly I recover largely depends on luck (C).	3.0 (5.0)	4.0 (4.0)	0.90	0.370	0.04
10. Doctors decide about my health (P)	4.0 (5.0)	3.0 (4.0)	3.23	0.004	0.15
11. My good health is largely the result of happy coincidence (luck) (C)	4.0 (5.0)	4.0 (5.0)	-1.04	0.303	0.05
12. My health mainly depends on what I myself do (I)	4.0 (5.0)	5.0 (3.0)	-4.33	<0.001	0.20
13. If I take care of myself, I can avoid illness (I)	4.0 (4.0)	4.0 (4.0)	2.07	0.047	0.10
14. When I recover, it is usually thanks to other people (e.g., doctors, nurses, family, friends) who provide me with good care (P)	5.0 (4.0)	4.0 (5.0)	5.82	<0.001	0.27
15. No matter what I do, I will probably get sick anyway (C)	5.0 (4.0)	4.0 (4.0)	2.08	0.047	0.10
16. If I am destined to remain healthy, I will remain healthy (C)	3.0 (5.0)	3.0 (4.0)	1.56	0.144	0.07
17. If I take appropriate actions, I will remain healthy (I)	5.0 (3.0)	4.0 (4.0)	3.16	0.004	0.15
18. For my health, I can only do what the doctor advises me (P)	5.0 (4.0)	4.0 (4.0)	2.73	0.001	0.13

Note: Effect sizes (r) are reported as absolute values; the direction of differences is indicated by the Z statistic

Inventory (HBI) overall score, and total self-reported physical activity (IPAQ) across the two cohorts. All evaluated relationships are detailed in Table 3. In 2016, total self-reported physical activity was not significantly associated with overall HBI or any MHLC dimensions (all  $p > 0.05$ ). At the same time, a weak but statistically significant positive correlation was observed exclusively between the Powerful Others locus of control and the overall HBI score ( $\rho = 0.18$ ;  $p = 0.005$ ), while the remaining associations, including Internal HLC, were not statistically significant. In contrast, the 2026 cohort demonstrated an emergent, moderate positive correlation between the Internal locus of control and health-promoting behaviours ( $\rho = 0.32$ ,  $p < 0.001$ ). Furthermore, the positive association between the Powerful Others dimension and the overall HBI score remained statistically significant in the 2026 cohort and even strengthened ( $\rho = 0.29$ ,  $p < 0.001$ ). This pattern reveals a substantively interesting shift over the decade: whereas in 2016 health-promoting behaviours were associated primarily with a reliance on external factors and professionals (Powerful Others), by 2026, individuals exhibited a dual pattern, associating health behaviours with both personal agency (Internal HLC) and external guidance. Notably, across both the 2016 and 2026 cohorts, no statistically significant correlations were found between any of the MHLC dimensions and total self-reported physical activity (all  $p > 0.05$ ). Similarly, the overall HBI score was not significantly associated with total self-reported physical activity in either timeframe.

**Table 3.** Spearman's rank correlation coefficients ( $\rho$ ) between MHLC dimensions, overall HBI score, and total physical activity (IPAQ) for 2016 and 2026 cohorts

Correlated Variables	2016 Cohort (N=230)	2026 Cohort (N=243)
MHLC Internal (I) vs. Overall HBI Score	$\rho = 0.05$ ; $p = 0.421$	$\rho = 0.32$ ; $p < 0.001$
MHLC Powerful Others (P) vs. Overall HBI Score	$\rho = 0.18$ ; $p = 0.005$	$\rho = 0.29$ ; $p < 0.001$
MHLC Chance (C) vs. Overall HBI Score	$\rho = -0.06$ ; $p = 0.359$	$\rho = 0.09$ ; $p = 0.171$
MHLC Internal (I) vs. Total PA (IPAQ)	$\rho = 0.02$ ; $p = 0.752$	$\rho = -0.07$ ; $p = 0.301$
MHLC Powerful Others (P) vs. Total PA (IPAQ)	$\rho = 0.02$ ; $p = 0.801$	$\rho = -0.07$ ; $p = 0.310$
MHLC Chance (C) vs. Total PA (IPAQ)	$\rho = -0.03$ ; $p = 0.598$	$\rho = -0.08$ ; $p = 0.233$
Overall HBI Score vs. Total PA (IPAQ)	$\rho = 0.08$ ; $p = 0.241$	$\rho = 0.08$ ; $p = 0.193$

Note: The section emphasizes strengthened associations between Internal HLC and HBI in 2026, and the emerging association with Powerful Others

In the 2016 cohort, self-reported physical activity indicators were strongly intercorrelated (e.g., vigorous activity with total self-reported physical activity:  $\rho = 0.94$ ;  $p < 0.001$ ). Similarly, the HBI subscales showed strong correlations with the overall HBI score ( $\rho$  ranging from 0.64–0.79, all  $p < 0.001$ ). However, total self-reported physical activity demonstrated no significant association with the overall HBI ( $\rho = 0.08$ ;  $p = 0.241$ ) or with any MHLC dimensions. Regarding health locus of control, a weak positive association was observed exclusively between the Powerful Others dimension and

the overall HBI score ( $\rho = 0.18$ ;  $p = 0.005$ ). No significant correlations were found between the Internal or Chance dimensions and health-promoting behaviors.

In the 2026 cohort, the Internal locus of control emerged as a significant factor, demonstrating a moderate positive correlation with the overall HBI score ( $\rho = 0.32$ ;  $p < 0.001$ ), as well as with specific subscales, such as Proper Dietary Habits ( $\rho = 0.28$ ;  $p < 0.001$ ) and Preventive Behaviors ( $\rho = 0.27$ ;  $p < 0.001$ ). Furthermore, the Powerful Others dimension remained a relevant factor, showing an increased positive correlation with the overall HBI ( $\rho = 0.29$ ;  $p < 0.001$ ). This finding suggests that the 2026 cohort integrates both a heightened sense of personal responsibility and continued trust in external authorities when shaping their health behaviours. Consistent with the earlier cohort, self-reported physical activity remained independent of both the HBI and MHLIC dimensions (all  $\rho \leq 0.09$ ). Within the physical activity domains in 2026, the correlation between vigorous and moderate activity was  $\rho = 0.32$ ;  $p < 0.001$ .

## DISCUSSION

The current study investigated differences in self-reported physical activity, health behaviours, and health locus of control among female nursing students between two cohorts (2016 vs. 2026). While preliminary descriptive findings from the 2016 cohort were previously presented at academic forums, this represents the authors' first comprehensive publication. By providing a detailed comparison with the 2026 cohort, incorporating nuanced item-level analyses of the MHLIC and robust multiple-testing corrections, the study addresses a significant gap in the literature. A central aim was to assess the differences in the relationships between health locus of control, health-promoting behaviours (HBI), and self-reported physical activity (PA). The obtained results reveal significant differences in several health-related parameters and their interconnections, offering valuable insights into the attitudes and practices of future healthcare professionals.

**Cohort differences in self-reported physical activity and health-promoting behaviours.** The obtained results indicate significantly lower total self-reported physical activity in the 2026 cohort compared to 2016, primarily reflecting lower levels of vigorous and moderate exertion. This finding aligns with broader societal observations of increasingly sedentary lifestyles. The significantly higher daily sedentary time and the greater proportion of students classified within the low IPAQ category in 2026 further highlight this difference [22]. This pattern mirrors global observations among university students, often associated with escalating academic pressures and prolonged screen time [1, 23]. While some studies have reported a stabilization or slight differences in specific activity types within certain demographics [2, 7], the lower activity levels observed in our specific nursing cohort make it an important area for targeted intervention.

Alongside this lower self-reported physical activity, the overall HBI score was also significantly lower in the 2026 cohort, particularly within the domains of 'Preventive behaviours', 'Positive mental attitude', and 'Proper dietary habits'. These findings point to a generally lower adoption of health-promoting practices, which may be relevant for the long-term well-being of this professional group. As nursing

professionals are expected to serve as role models and health educators, these observed differences warrant educational attention. Similar lower scores in dietary quality and stress management have been documented among university students globally [6], frequently associated with the lifestyle transitions inherent in higher education.

**Reconfiguration of health locus of control and its relationship with health behaviours.** An important finding of the current study is the significant decrease in the aggregated 'Powerful Others' dimension of the MHLIC in the 2026 cohort, alongside the statistical stability of the 'Internal' and 'Chance' dimensions. The MHLIC scales, originally developed by Wallston et al. [15, 16], provide a framework for understanding the perception of the individual of control over their health. The observed lower reliance on external authorities (such as healthcare professionals) suggests a notable difference in the perspectives of contemporary nursing students. This aligns with modern trends emphasizing individual autonomy and proactive self-care [19, 24]. It may reflect both broader societal changes and an evolving critical mindset aligned with modern nursing curricula, which increasingly encourage students to navigate health information independently rather than deferring solely to traditional medical hierarchies.

Although the aggregated 'Internal' dimension did not differ significantly, the item-level analysis in the current study revealed notable differences in specific beliefs. The 2026 cohort expressed a significantly stronger belief in personal agency regarding general health decisions and recovery (e.g., items 1, 6, and 12). However, this was simultaneously counterbalanced by a lower level of self-blame for illness (item 8) and a reduced conviction that personal actions can absolutely guarantee health (items 13 and 17). This nuanced pattern suggests that while modern nursing students strongly value their autonomy, they possess a more realistic, scientifically grounded understanding of disease etiology, acknowledging that illness can occur despite meticulous self-care, thereby avoiding unwarranted self-blame.

The difference in the 'Powerful Others' dimension was consistent across multiple specific statements (e.g., items 7, 10, 14, and 18). Students in 2026 expressed lower reliance on doctors and medical care for their health outcomes. Importantly, this does not necessarily imply a rejection of medical expertise; rather, it indicates a maturation of the student-professional identity. It reflects a transition from paternalistic models of care toward a collaborative approach, where the individual identifies as an active participant in their health journey rather than a passive recipient.

Similarly, while the overall 'Chance' index remained stable, agreement with specific fatalistic statements (items 4 and 15) was significantly lower in 2026. This indicates that while a general acceptance of chance persists, specific health outcomes are increasingly perceived as less random. This is likely associated with enhanced health literacy and a better understanding of modifiable risk factors, aligning with research showing that targeted health education empowers individuals to perceive greater control over previously considered 'random' health events [10, 20].

**Evolving interconnections between locus of control, health behaviours, and physical activity.** Correlation analysis in the current study revealed notable differences

in the relationships between the studied variables across the two cohorts. In 2016, self-reported physical activity was a largely compartmentalized domain, showing no significant association with overall HBI or MHLC dimensions. Importantly, in contrast to initial assumptions, no significant association was observed between the Internal locus of control and HBI; instead, a weak but statistically significant relationship was found exclusively for the Powerful Others dimension. This indicates that in the earlier cohort, health-promoting behaviors were linked primarily to reliance on external authorities rather than personal agency.

By 2026, this pattern changed substantially. Health-promoting behaviours were associated with both the Internal and Powerful Others dimensions of health locus of control. The Internal locus of control showed a moderate positive correlation with overall HBI and its subscales (particularly Proper Dietary Habits and Preventive Behaviours), while the association with Powerful Others remained significant. This shift suggests a more integrated model of health regulation, in which individuals combine a sense of personal responsibility with continued trust in professional guidance. This finding is particularly noteworthy in light of the observed decrease in the overall Powerful Others score. It suggests that although contemporary students report lower general reliance on external authorities, those who do maintain such trust are more likely to engage in health-promoting behaviours. Together, these results point toward a transition from a predominantly external orientation in 2016 to a dual, more balanced model of health control in 2026.

Notably, self-reported physical activity consistently remained an independent domain across both cohorts, showing negligible correlations with HBI and MHLC dimensions. This persistent disconnect suggests that physical activity adherence may depend on factors not captured by general health beliefs or locus of control, such as motivational, environmental, or social determinants.

**Implications and future directions.** The concurrent decline in self-reported physical activity and health behaviors, paired with an evolving health locus of control, calls for modernized interventions. The stronger association between locus of control and HBI in the 2026 cohort suggests that programmes fostering an integrated sense of agency, combining internal self-efficacy with a collaborative approach to medical expertise, could be beneficial. However, the persistent independence of self-reported physical activity indicates that generalized health education may not suffice to increase exercise rates. Instead, tailored strategies could benefit from addressing specific motivational drivers [13, 26] and considering potential structural and environmental barriers identified in recent literature [23]. Future approaches may need to consider practical access to exercise facilities and time-management skills rather than solely shifting health beliefs. Future educational frameworks should adapt to these contemporary perceptions to better support the long-term well-being of nursing students.

**Limitations of the study.** Several methodological limitations should be considered when interpreting the findings of this study. First, the repeated cross-sectional design precludes causal inference. While this approach effectively captures broad socio-temporal trends by comparing two independent cohorts, it cannot track individual-level behavioural

trajectories, which would necessitate a true longitudinal cohort design.

Second, the reliance on self-report instruments (IPAQ, HBI, MHLC), introduces inherent risks of subjective bias and social desirability. Participants may intentionally or inadvertently present themselves more favourably, potentially leading to the overestimation of metrics such as self-reported physical activity levels.

Third, the study sample was highly homogeneous, comprising female nursing students. Although this accurately reflects the demographic structure of the nursing profession in Poland, it limits the direct generalizability of the findings to broader academic populations, male nursing students, or youth in other disciplines. Fourth, the analysis did not incorporate detailed socioeconomic indicators (e.g., financial status) or precise measures of occupational workload outside of academic obligations. These unmeasured variables could act as significant confounders influencing lifestyle behaviors. Finally, although robust statistical corrections were applied, the item-level analyses of the MHLC scale remain exploratory in nature. Consequently, these specific findings should be interpreted with caution, bearing in mind the inherent complexities associated with multiple comparisons.

## CONCLUSIONS

1. Higher sedentary time and lower levels of total self-reported physical activity were observed in the 2026 cohort compared to 2016.
2. The structure of health locus of control differed between cohorts, with a decrease in reliance on external medical authorities ('Powerful Others'). While the overall 'Internal' and 'Chance' dimensions remained statistically stable, item-level analyses indicated changes in specific beliefs related to personal agency in health decisions and recovery.
3. Within this professional group, self-reported physical activity appears to function as an autonomous domain, showing no significant associations with health locus of control or overall health-promoting behaviors. This pattern suggests that factors other than general health locus of control beliefs may be associated with physical inactivity.
4. The patterns of associations between health locus of control and health-promoting behaviours shifted over the decade. In 2016, health behaviours were associated exclusively with reliance on external authorities ('Powerful Others'). By 2026, a dual pattern emerged, where health-promoting behaviours were significantly associated with both the 'Internal' dimension (particularly proper dietary habits and preventive actions) and the 'Powerful Others' dimension.
5. These findings highlight the potential importance of targeted educational strategies aimed at supporting health-related behaviors among nursing students. Such approaches may benefit from fostering a balanced sense of personal agency while considering factors associated with physical activity engagement within this population.

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