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Functional Health Literacy Among First-Year University Students in Hungary: The Role of Socio-Demographic Factors

Cintia Horváth[1*], Barbara Abonyi[2], Tamás Csányi[3]

1-Eötvös Loránd University. **(Corresponding Author)** horvath.cintia@tok.elte.hu
2- Eszterházy Károly Catholic University.
3- Hungarian University of Sports Science.

Background and Objective: Health literacy has increasingly been recognised as a key social determinant of health, closely linked to educational pathways and family background. Young adults entering higher education represent a particularly sensitive population, as they are required to make independent health-related decisions while previously accumulated social and educational resources continue to shape their competencies. This study aimed to examine the associations between functional health literacy and socio-demographic background characteristics among first-year university students in Hungary.

Material and Methods: A cross-sectional survey was conducted between September and October 2025 using a convenience sample of 314 first-year full-time university students. Functional health literacy was assessed using the Hungarian version of the NVS. Socio-demographic inequalities were operationalised using gender, faculty affiliation, place of residence, secondary school type, sport-related programme, participation in a physical education-specialised track, and parental educational attainment. Data were analysed using non-parametric group comparisons, chi-square tests, and multiple linear regression.

Results: Approximately two-thirds of students demonstrated adequate health literacy, while one-quarter had limited and 6.4% inadequate health literacy. Place of residence was significantly associated with health literacy in both score- and category-based analyses, while physical education specialisation was associated with health literacy category distribution. The multivariable model was significant ($F(23, 290)=2.042$, $p=.004$; $R^2=.139$; adjusted $R^2=.071$), with significant coefficients for specific categories of place of residence and secondary school type.

Conclusion: The findings suggest that functional health literacy among students entering higher education is relatively homogeneous, although some differences were observed in relation to socio-demographic background characteristics. Given the limited explanatory power of the multivariable model, these associations should be interpreted cautiously. The findings nevertheless highlight the potential relevance of considering students' social and educational backgrounds when developing health literacy initiatives in higher education.

Keywords: Health Literacy; Students; Educational Status; Socioeconomic Factors; Cross-Sectional Studies

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Introduction

Over the past decade, health literacy has become a central concept in educational and public health research, given its close association with health behaviours, health education and health outcomes. Nutbeam and Lloyd conceptualise health literacy explicitly as a social determinant of health, linking individual resources, the social environment, and the structural characteristics of healthcare systems. From this perspective, health literacy is not merely a cognitive skill but rather the product of a dynamic interaction between individuals and their environments, shaping health-related decision-making and access to services (1,2). Consequently, social patterning and inequalities in health literacy may emerge early in the life course and persist across subsequent stages, including higher education (3,4,5).

Highlighting the role of formal education, Paakkari and Okan argue that health literacy should be framed in the language of educational systems, conceptualising it as a transversal competence that can be embedded within formal schooling and understood as part of lifelong learning (6). This perspective is particularly relevant for young adults in higher education, who increasingly make autonomous health-related decisions while the development of skills required to interpret health information and navigate healthcare systems continues to be shaped by prior educational experiences and family background (7,8).

Research on child and adolescent health literacy has been strongly influenced by the work of Bröder and colleagues. Their systematic review demonstrated that health literacy in younger populations differs conceptually and substantively from adult-oriented models, extending beyond functional skills to encompass family, school and peer contexts (9). Subsequent work proposed a target-group-centred approach that emphasises participation, autonomy, and empowerment, situating health-related competencies within educational, familial and community systems (10,11,12). In line with this framework, Paakkari et al., drawing on data from the international Health Behaviour in School-aged Children (HBSC) study, showed that European adolescents' health literacy varies substantially across countries and social groups and is closely associated with health behaviours and subjective well-being. These disparities are particularly relevant for higher education, as the university years represent a transitional phase between adolescence and young adulthood, during which previously acquired skills and resources are activated within new informational and institutional environments (13).

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A growing body of research has examined health literacy among university students across different countries and educational programmes, consistently indicating that student populations are heterogeneous. Studies have identified variation in health literacy across student subgroups (14), associations with university-based health education (15), and limited or marginal health literacy among some future health professionals, particularly those from disadvantaged socio-economic backgrounds (16,17). Research in general university populations has similarly linked health literacy to demographic characteristics (18), parental education and urban–rural background (19), and broader social disadvantage (20), with territorial and social inequalities also documented in Hungary (21). Importantly, deficits have also been identified among students enrolled in health-related programmes, particularly in navigating healthcare systems and critically appraising health information (22,23). A meta-analysis further confirmed associations between student health literacy and socio-economic status, parental education, and place of residence (24).

Taken together, this literature indicates that socio-demographic background is an important consideration in student health literacy research. Students from lower socio-economic backgrounds and rural areas have been reported to be at greater risk of limited health literacy (25), while associations with parental education and material conditions have also been observed in other national contexts (26). Among European adolescents, socio-economic factors have additionally been shown to partly mediate the relationship between health literacy and health behaviours (13). These findings are consistent with mechanistic frameworks proposing that social background may influence health outcomes through health literacy via pathways involving access to information, navigation of institutions, and self-management capacities (4).

Despite the growing international literature on health literacy among university students, evidence from Central and Eastern Europe remains comparatively limited, and little is known about functional health literacy specifically among students entering higher education in Hungary. In particular, the extent to which socio-demographic, familial, and prior educational characteristics are associated with functional health literacy in this transitional population remains insufficiently understood.

Given this research gap, there is a clear rationale for the targeted assessment of functional health literacy using rapid, standardised instruments that capture core competencies required for interpreting everyday health information, such as reading comprehension, numeracy, and information appraisal (27,28). At the same time, the limitations of such tools must be acknowledged, particularly when applied to younger and highly educated populations (29). International findings suggest that residential context, family resources – especially parental education – and educational trajectories are of particular relevance. In Hungary, these factors are especially salient due to the country's settlement structure, regional disparities, and stratified educational pathways, which may generate unequal

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opportunities for accessing health information and developing health-related skills among students entering higher education (30).

Accordingly, the present study aimed to (1) describe levels of functional health literacy among first-year university students in Hungary; (2) examine differences in functional health literacy according to individual, familial, and educational background characteristics; and (3) assess the extent to which these characteristics are associated with variation in functional health literacy scores when considered simultaneously.

Materials and Methods

Study design and participants

The study employed a cross-sectional quantitative design using an online self-administered questionnaire. A convenience sample of first-year, full-time university students was recruited through voluntary participation in an online survey conducted between September and October 2025. Inclusion criteria were enrolment as a first-year, full-time university student and provision of electronic informed consent. Questionnaires submitted by students who did not meet the inclusion criteria or that contained incomplete responses were excluded during the data-cleaning process. Following data cleaning and the exclusion of incomplete questionnaires, the final analytical sample comprised 314 students. Participants were aged between 18 and 24 years (mean age=19.30 years; SD=1.31). The sample was restricted to first-year students in order to capture social and educational disparities persisting at entry into higher education.

Participation was voluntary and anonymous. Prior to completing the questionnaire, all participants received written information about the aims of the study, data management procedures, and the conditions of participation, and provided informed consent electronically.

The exclusive focus on functional health literacy was a deliberate methodological choice. Functional health literacy captures core skills required for understanding and applying everyday health-related information, which are directly relevant to health education and policy-oriented interventions. In addition, the widespread international use of the Newest Vital Sign facilitates comparability with previous studies conducted in young adult and student populations. While this approach does not encompass interactive or critical dimensions of health literacy, it provides a focused and policy-relevant assessment of foundational competencies.

Measures

The first section of the questionnaire assessed socio-demographic background characteristics, including gender, age, faculty affiliation, enrolment in a sport-related programme, type of place of residence, type of secondary school attended, participation in a

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physical education-specialised secondary school track, and parents' highest level of educational attainment. These variables were selected based on previous international evidence identifying them as relevant determinants of health literacy.

Health literacy was assessed using the Hungarian version of the Newest Vital Sign (NVS), a widely used screening instrument for estimating functional health literacy (27). The Hungarian validation of the instrument was conducted by Mátyás, Vincze and Bíró, who confirmed its reliability and factor structure, reporting acceptable internal consistency (Cronbach's α=0.72) (41). The NVS consists of six items based on an interpretation of a nutrition label, assessing a combination of reading comprehension, numeracy, and health information appraisal skills. Total scores range from 0 to 6, with higher scores indicating higher levels of functional health literacy. In accordance with international recommendations, respondents were categorised as having inadequate (0–1 points), limited (2–3 points), or adequate health literacy (4–6 points).

Data analysis

Prior to statistical analysis, the dataset was screened for completeness and consistency. Records with incomplete questionnaire responses were excluded during the data-cleaning process; consequently, no missing data were present in the final analytical dataset. All statistical analyses were performed using IBM SPSS Statistics. Descriptive statistics were used to characterise the socio-demographic composition of the sample and the distribution of health literacy scores. The normality of the NVS total score was assessed using the Shapiro–Wilk test, which indicated a significant deviation from normality ($p<.001$). Accordingly, non-parametric statistical procedures were applied in univariate group comparisons.

Differences between two-category groups (gender, enrolment in a sport-related programme, participation in a physical education–specialised track) were examined using Mann–Whitney U tests, while Kruskal–Wallis tests were applied for comparisons across variables with more than two categories (faculty, type of residence, type of secondary school, and parental education). When overall group differences were statistically significant, Dunn's post hoc tests with Bonferroni correction were performed.

Associations between health literacy categories (inadequate, limited, adequate) and socio-demographic variables were analysed using chi-square tests, and Cramer's *V* was calculated to estimate effect sizes. To examine the simultaneous associations of socio-demographic characteristics with functional health literacy, a multiple linear regression model was fitted with the NVS total score as the dependent variable. The following variables were entered simultaneously using the Enter method: gender, faculty affiliation, enrolment in a sport-related programme, type of residence, type of secondary school, participation in a physical education-specialised track, paternal educational attainment, and maternal educational attainment. All predictors were treated as categorical factors. For predictors with more than

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two categories, JASP represented the factor levels using indicator (dummy) variables relative to a reference category. Thus, although eight conceptual predictors were included in the model, the categorical factor structure resulted in 23 regression degrees of freedom. No observations were excluded from the regression because of missing data; therefore, the analysis was based on the complete analytical sample of 314 participants.

Multiple linear regression was selected because the NVS total score provides a quantitative measure of functional health literacy and allows differences across the full score range to be examined. Model diagnostics included assessment of residuals, influential observations, and multicollinearity. No influential cases were identified, and the observed variance inflation factors did not indicate problematic multicollinearity. Residual diagnostics were also inspected to evaluate the adequacy of the fitted model.

Although the health literacy categories could have been analysed using multinomial logistic regression, the score-based approach was intentionally prioritised. The use of the continuous NVS total score allowed for greater sensitivity to subtle variations in functional health literacy that may be obscured by categorical classification. Moreover, the primary aim of the multivariable analysis was to examine the additive and independent contributions of socio-demographic factors across the health literacy continuum rather than to model category membership probabilities.

The study protocol was reviewed and approved by the appropriate institutional review board. All procedures involving human participants were conducted in accordance with the ethical standards of the institutional and/or national research committee and with the principles of the Declaration of Helsinki (1975), as revised in 2008.

Results

Sample characteristics

A total of 314 first-year, full-time university students participated in the study (N=314). Participants were aged between 18 and 24 years (mean=19.30, SD=1.31). The sample comprised 69.4% women (N=218). With regard to faculty affiliation, 28.0% of students were enrolled in Education, 24.8% in Natural Sciences, 18.8% in Arts, 15.0% in Economics, while 6.7% studied in Humanities and an equal proportion (N=21) in Information Technology. Overall, 25.8% of respondents were enrolled in sport-related degree programmes, whereas 74.2% studied in non-sport-related programmes. In terms of place of residence, 52.8% of participants lived in other towns, 31.8% in villages or small settlement, 8.0% in county seat, and 7.3% in the capital city. Regarding secondary educational background, 66.2% of students had completed general upper secondary education, 20.1% had attended vocational grammar schools, 10.5% reported other types of secondary schooling, and 3.2% had graduated from vocational or trade schools. Within the sample, 12.1% of participants had previously attended a physical education–specialised secondary school track **(Table 1).**

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Table 1. Distribution of students' place of residence across academic faculties

		Hum.[1]	Eco.[2]	Info. Tech.[3]	Arts	Education	Nat. Sc.[4]	Total
Capital city	N	0	0	2	10	4	7	23
	%[5]	0.0	0.0	8.7	43.4	17.3	30.4	100.0
	%[6]	0.0	0.0	9.5	16.9	4.5	8.9	7.3
county seat	N	0	3	3	0	7	12	25
	%	0.0	12.0	12.0	0.0	28.0	48.0	100.0
	%	0.0	6.3	14.2	0.0	7.9	15.3	7.9
village or small settlement	N	9	20	9	11	32	19	100
	%	9.0	20.0	9.0	11.0	32.0	19.0	100.0
	%	42.8	42.5	42.8	18.6	36.3	24.3	31.8
other town	N	12	24	7	38	45	40	166
	%	7.2	14.4	4.2	22.8	27.1	24.1	100.0
	%	57.1	51.0	33.3	64.4	51.1	51.2	52.8
Total	N	21	47	21	59	88	78	314
	%	6.6	14.9	6.6	18.7	28.0	24.8	100.0
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0

A significant association was found between students' place of residence and faculty affiliation ($\chi^2(15)=38.41$, $p<.001$), indicating a non-random distribution of academic fields across settlement types. Examination of standardised residuals showed that students from the capital city were overrepresented in the Arts faculty and underrepresented in Humanities and Economics, whereas students from county seats were overrepresented in Natural Sciences. Students from villages or small settlements were underrepresented in Education, while those from other towns showed a slight overrepresentation in this faculty.

Regarding parental education, the most common educational attainment among fathers was vocational qualification (37.6%), followed by upper secondary (27.1%) and tertiary education (26.8%). Among mothers, tertiary education was the most frequent (47.1%), followed by upper secondary (31.8%) and vocational qualification (17.8%). The proportions reporting only primary education, incomplete primary education, or missing responses were low in both groups.

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[1] Humanities
[2] Economics
[3] Information Technology
[4] Natural Sciences
[5] within row
[6] within column

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Health literacy was assessed using both categorical classifications and total NVS scores. Overall, 68.2% of first-year university students demonstrated adequate health literacy, 25.5% had limited health literacy, and 6.4% were classified as having inadequate health literacy. Across academic fields, the proportion of students with adequate health literacy exceeded 59% in all faculties, ranging from 59.3% in Arts to 71.6% in Education **(Table 2).**

Table 2. Distribution of health literacy categories by field of study (NVS)

	Inadequate N (%)	Limited N (%)	Adequate N (%)	Total N
Humanities	2 (9.5)	4 (19.0)	15 (71.4)	21
Economics	4 (8.5)	12 (25.5)	31 (66.0)	47
Information Technology	1 (4.8)	5 (23.8)	15 (71.4)	21
Arts	0 (0.0)	24 (40.7)	35 (59.3)	59
Education	6 (6.8)	19 (21.6)	63 (71.6)	88
Natural Sciences	7 (9.0)	16 (20.5)	55 (70.5)	78

Although some variation was observed across academic fields, the majority of students in all faculties demonstrated adequate health literacy, and the differences were not statistically significant ($\chi^2(10)=13.35$, $p=.205$, Cramer's $V=0.146$). Likewise, the distribution of health literacy categories did not differ significantly between students enrolled in sport-related and non-sport-related programmes ($\chi^2(2)=2.563$, $p=.278$, Cramer's $V=0.090$) **(Table 3).**

Table 3. Distribution of health literacy categories by sports-related study status (NVS)

Category	Inadequate N (%)	Limited N (%)	Adequate N (%)	Total N
Sports-related	8 (9.9)	18 (22.2)	55 (67.9)	81
Non-sports-related	12 (5.2)	62 (26.6)	159 (68.2)	233

Similarly, the distribution of health literacy categories did not differ significantly between male and female students, with adequate health literacy observed in 67.7% of men and 68.3% of women **(Table 4).**

Table 4. Distribution of health literacy categories by gender (NVS)

	Inadequate N (%)	Limited N (%)	Adequate N (%)	Total N
Male	7 (7.3)	24 (25.0)	65 (67.7)	96
Female	13 (6.0)	56 (25.7)	149 (68.3)	218

No significant gender differences were observed in the distribution of health literacy categories ($\chi^2(2)=0.201$, $p=.904$, Cramer's $V=0.025$). Similarly, the proportion of students with

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adequate health literacy was nearly identical among those who had and had not attended a physical education-specialised secondary school track **(Table 5).**

Table 5. Health literacy categories by secondary-school physical education track

	Inadequate N (%)	Limited N (%)	Adequate N (%)	Total N
Physical education track	6 (15.8)	6 (15.8)	26 (68.4)	38
Non-PE track	14 (5.1)	74 (26.8)	188 (68.1)	276

Although participation in a physical education-specialised secondary school track was not associated with a meaningful difference in the prevalence of adequate health literacy, the overall distribution of health literacy categories differed significantly between the groups ($\chi^2(2)=7.616$, p=.022, Cramer's V=0.156).

Health literacy categories differed according to place of residence. Students from villages or small municipalities showed the highest proportion of adequate health literacy, whereas those living in the capital city had the lowest proportion **(Table 6).**

Table 6. Distribution of health literacy categories by type of place of residence (NVS)

Category	Inadequate N (%)	Limited N (%)	Adequate N (%)	Total N
Capital city	3 (13.0)	11 (47.8)	9 (39.1)	23
County seat	4 (16.0)	4 (16.0)	17 (68.0)	25
Village	1 (1.0)	22 (22.0)	77 (77.0)	100
Other town	12 (7.2)	43 (25.9)	111 (66.9)	166

A statistically significant association was observed between type of place of residence and health literacy categories ($\chi^2(6)=19.88$, p=.003, Cramer's V=0.178).

Health literacy categories also varied according to secondary school type. Students who had completed general upper secondary education showed a higher proportion of adequate health literacy than those with a vocational grammar school background. Although all students who had graduated from vocational or trade schools were classified as having adequate health literacy, this subgroup comprised only 10 participants **(Table 7).**

Table 7. Distribution of health literacy categories by type of secondary school completed (NVS)

	Inadequate N (%)	Limited N (%)	Adequate N (%)	Total N
Other	4 (12.1)	8 (24.2)	21 (63.6)	33
Grammar school	14 (6.7)	49 (23.6)	145 (69.7)	208
Vocational grammar school	2 (3.2)	23 (36.5)	38 (60.3)	63

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Vocational school	0 (0.0)	0 (0.0)	10 (100.0)	10

Based on chi-square tests, the distribution of health literacy categories did not differ significantly by type of secondary school, although the association approached statistical significance ($\chi^2(6)=11.51$, p=.074, Cramer's V=0.135). Neither fathers' ($\chi^2(10)=6.428$, p=.778, Cramer's V=0.101) nor mothers' educational attainment ($\chi^2(8)=12.39$, p=.135, Cramer's V=0.140) was significantly associated with health literacy categories.

Non-parametric analyses likewise showed no significant differences in NVS total scores across faculties, sport-related programme enrolment, gender, or participation in a physical education-specialised secondary school track (all p>.05).

In contrast, NVS total scores differed significantly according to place of residence (Kruskal–Wallis: H(3)=12.50, p=.006, rank ε^2=.040, 95% CI (.014, .105)). Dunn's post hoc comparisons with Bonferroni correction showed that students living in villages or small municipalities had significantly higher NVS scores than those living in the capital city (z=−3.264, pBonf=.007, r_rb=.437). No other pairwise comparisons remained statistically significant after Bonferroni correction (all pBonf ≥ .103). Significant differences were also observed according to type of secondary school (Kruskal–Wallis: H(3)=13.61, p=.003, rank ε^2=.043, 95% CI (.017, .088)). Dunn's post hoc comparisons with Bonferroni correction indicated that students who had attended vocational school/vocational training school had significantly higher NVS scores than those in the "other" secondary-school category (z=−3.105, pBonf=.011, r_rb=.633) and those who had attended Vocational grammar schoolsecondary school (z=−3.056, pBonf=.013, r_rb=.595). No other pairwise comparisons remained statistically significant after Bonferroni correction (all pBonf≥.117).

Although fathers' educational attainment was not associated with NVS scores (H(5)=5.329, p=.377), the association with mothers' educational attainment approached statistical significance (H(4)=9.065, p=.059) **(Table 8).**

Table 8. Associations between sociodemographic characteristics and health literacy[1]

Background variable	Score-based analysis (NVS total score)	Category-based analysis (NVS categories)
Field of study	Not significant (H(5)=1.455, p=.918)	Not significant ($\chi^2(10)=13.35$, p=.205)
Programme type (sport-related)	Not significant (U=9400, p=.958)	Not significant ($\chi^2(2)=2.563$, p=.278)

[1] Score-based analyses (Mann–Whitney U, Kruskal–Wallis tests) examined differences in the distribution of NVS total scores, whereas category-based analyses (χ^2 tests) compared the distribution of health literacy levels.

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Gender	Not significant (U=11056, p=.414)	Not significant ($\chi^2(2)=0.201$, p=.904)
Place of residence	Significant (H(3)=12.50, p=.006)	Significant ($\chi^2(6)=19.88$, p=.003)
Type of secondary school	Significant (H(3)=13.61, p=.003)	Trend-level association ($\chi^2(6)=11.51$, p=.074)
PE-specialised secondary school	Not significant (U=4670, p=.263)	Significant ($\chi^2(2)=7.616$, p=.022)
Father's educational attainment	Not significant (H(5)=5.329, p=.377)	Not significant ($\chi^2(10)=6.428$, p=.778)
Mother's educational attainment	Trend-level association (H(4)=9.065, p=.059)	Not significant ($\chi^2(8)=12.39$, p=.135)

The multiple linear regression model examining the simultaneous associations of socio-demographic background variables with NVS total scores was statistically significant, F(23, 290)=2.042, p=.004, accounting for 13.9% of the variance in NVS scores (R^2=.139; adjusted R^2=.071). Compared with students residing in the capital city, students residing in a county seat (b=1.020, SE=0.502, t=2.033, p=.043), in a village/rural settlement (b=1.293, SE=0.409, t=3.162, p=.002), and in other town (b=0.879, SE=0.380, t=2.313, p=.021) had significantly higher NVS total scores. Regarding type of secondary school, students who had attended vocational school/vocational training school had significantly higher NVS scores than those in the reference category ("other" secondary school type) (b=1.513, SE=0.642, t=2.357, p=.019). No statistically significant regression coefficients were observed for gender, faculty affiliation, enrolment in a sport-related programme, participation in a physical education-specialised track, or paternal or maternal educational attainment (all p > .05). Despite reaching statistical significance, the model showed modest explanatory power, particularly after adjustment for the number of parameters included.

Discussion

The present study aimed to examine how functional health literacy among Hungarian young adult university students is associated with selected socio-demographic background characteristics. Overall, the findings suggest that health literacy within the student population is relatively homogeneous, while some differences can nevertheless be identified along a limited number of social and educational dimensions.

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In the sample examined, approximately two-thirds of students demonstrated adequate functional health literacy, whereas around one-third were classified within the inadequate or limited categories. This distribution is consistent with findings from international studies conducted among university populations, which indicate that a substantial proportion of young adults in higher education continue to exhibit lower levels of health literacy (8,24). When applying the Newest Vital Sign, it is well documented that younger and more highly educated groups tend to perform relatively well, while the instrument remains sensitive to deficits in core functional skills (27,28).

Socio-demographic factors not associated with health literacy

Several socio-demographic characteristics – including gender, academic field, enrolment in sport-related programmes, and fathers' educational attainment – showed no statistically significant associations with functional health literacy in either the score-based or category-based univariate analyses. No statistically significant regression coefficients were observed for these characteristics in the multivariable model. This is consistent with previous research suggesting that functional health literacy does not consistently differentiate across gender or educational fields (5,31,32). Taken together, these findings indicate that functional health literacy among students entering higher education cannot be explained solely by basic demographic or educational characteristics.

Associations with place of residence and educational context

Place of residence showed the most consistent association with functional health literacy across the different analytical approaches. In the univariate score-based analysis, students living in villages or small municipalities had significantly higher NVS scores than those residing in the capital city, while the category-based analysis also showed a significant association between place of residence and health literacy classification. In the multivariable model, significant regression coefficients were observed for several residential categories relative to the capital city as the reference category, with students residing in county seats, villages or small settlements, and other towns showing higher NVS scores. These findings are consistent with international and national research identifying territorial inequalities as relevant to health literacy (33,34,35).

The comparatively lower health literacy observed among students residing in the capital should nevertheless be interpreted cautiously and should not be attributed to urbanicity alone. The observed differences may reflect broader variation in prior educational experiences, access to health information, institutional environments, and other contextual resources associated with students' transition to higher education. Further research is needed to clarify the mechanisms underlying these residential differences.

Prior educational context also showed associations with functional health literacy, although the pattern was not uniform across analytical approaches. NVS total scores differed significantly according to type of secondary school, with post hoc comparisons indicating higher scores among students from vocational school/vocational training backgrounds than among selected comparison groups. In the multivariable model, a significant regression coefficient was also observed for the vocational school/vocational training category relative

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to the reference category ("other" secondary school type). However, secondary school type was not significantly associated with the distribution of health literacy categories. These findings suggest that prior educational pathways may be associated with differences in functional health literacy performance, although the small size of some secondary-school subgroups and the inconsistency across analytical approaches warrant cautious interpretation.

Participation in a physical education–specialised secondary school track showed a different pattern. It was associated with the distribution of health literacy categories, but no corresponding difference was observed in NVS total scores, and physical education specialisation was not significant in the multivariable model. Thus, the findings suggest a possible association between previous physical education specialisation and health literacy classification but do not support a consistent independent association with overall NVS performance. Further research is needed to determine whether and how specific aspects of sport-oriented educational environments may contribute to health-related competencies (36,37).

Multivariable findings and explanatory power

The multivariable analysis provided a more nuanced picture of these associations. The overall regression model was statistically significant and accounted for 13.9% of the variance in NVS scores, although the adjusted proportion of explained variance was more modest (adjusted R^2=.071). The significant regression coefficients for specific categories of place of residence and type of secondary school were consistent with the broader pattern suggesting relevance of residential and prior educational context, whereas gender, faculty affiliation, enrolment in a sport-related programme, participation in a physical education–specialised track, and paternal and maternal educational attainment showed no statistically significant regression coefficients.

Despite the statistical significance of the overall model, its relatively modest explanatory power indicates that the socio-demographic characteristics examined capture only a limited proportion of individual variation in NVS performance. Other factors not assessed in the present study, including health-related experiences, family health communication, access to and use of health information, and broader educational or psychosocial characteristics, may also contribute to functional health literacy (4,40). The findings should therefore be interpreted as evidence of associations with selected background characteristics rather than as indicating that these characteristics comprehensively explain individual differences in functional health literacy.

Practical implications and Limitations

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The findings of the present study have several practical implications for health literacy development in higher education. The observed differences according to residential and educational background suggest that functional health literacy should not be considered solely at the individual level. Rather, higher education institutions may benefit from recognising that students enter university with heterogeneous social, educational, and informational experiences and from considering this diversity alongside individual knowledge and skill development when designing health literacy initiatives.

Place of residence showed the most consistent association with functional health literacy, suggesting that students from different residential backgrounds may enter higher education with different prior informational, educational, and institutional experiences. Although the mechanisms underlying these differences cannot be determined from the present study, the findings support the value of considering residential heterogeneity when developing health literacy initiatives. The first academic year may provide a particularly relevant opportunity to assess and support students' health literacy needs, including their ability to interpret health information, navigate healthcare systems, and critically engage with digital health resources.

Prior educational background may also warrant consideration. Differences in NVS performance according to secondary-school type suggest that students may enter higher education with heterogeneous opportunities and experiences relevant to the development of functional health literacy. However, because these associations were not consistent across all analytical approaches and some secondary-school subgroups were small, the findings should not be interpreted as evidence that particular educational pathways directly result in higher or lower health literacy. Rather, they highlight the potential value of assessing health literacy needs at entry to higher education rather than assuming comparable functional health literacy across students with different educational backgrounds.

The association between participation in a physical education–specialised secondary school track and the distribution of health literacy categories also warrants further investigation. This finding was not accompanied by a significant difference in NVS total scores, and physical education specialisation was not significant in the multivariable model. The present findings therefore do not provide sufficient evidence for an independent association between sport-oriented educational environments and higher functional health literacy. Future research could examine more directly whether specific components of physical education and sport-oriented educational environments contribute to the development of health-related competencies.

Several limitations should be considered when interpreting the findings. The cross-sectional design precludes causal inference, and the directionality of the observed associations cannot be established. The sample was limited to first-year students from a single higher education institution and was recruited using convenience sampling, restricting both the generalisability and representativeness of the findings. The results should therefore not be interpreted as representative of all first-year university students in Hungary. In addition, some socio-demographic categories, particularly certain secondary-school subgroups, contained relatively few participants, which may have reduced the stability and precision of subgroup

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comparisons and regression estimates. Findings involving these categories should therefore be interpreted cautiously. Finally, the Newest Vital Sign primarily assesses functional health literacy and does not provide a comprehensive assessment of interactive and critical dimensions of health literacy, which may be particularly relevant in contemporary digital health information environments. Future research should therefore extend these findings using larger and more diverse samples, longitudinal designs, and multidimensional measures of health literacy.

Conclusion

Overall, functional health literacy among first-year university students in the present sample was relatively homogeneous, although differences were observed according to residential and educational background. Place of residence showed the most consistent association across analytical approaches, whereas associations with prior educational context varied depending on how functional health literacy and background characteristics were analysed.

This study contributes to the health literacy literature in several ways. Empirically, it provides one of the first comprehensive examinations of functional health literacy among first-year university students in Hungary using the Newest Vital Sign, thereby extending the predominantly adult- and patient-focused evidence base to an important educational transition period. Theoretically, the findings are consistent with conceptualisations of health literacy as socially embedded, suggesting that residential and educational contexts may remain relevant to functional health literacy even among young adults who have entered higher education. Methodologically, the combination of score-based and category-based analytical approaches illustrates how different operationalisations of health literacy may reveal complementary patterns of variation. Together, the findings support the value of considering structural and educational contexts alongside individual health literacy skills when studying and supporting university student populations.

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Availability of Data and Materials: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of interest: The authors declare that they have no competing interests.

Consent for publication: Not applicable.

Ethics Approval and Consent to Participate: The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, including voluntary participation, informed consent, and the protection of participants' privacy and confidentiality. The study was conducted with the approval of the competent Research Ethics Committee of Eszterházy Károly Catholic University. Prior to data collection, all participants received detailed information about the aim, methodology, and data management procedures of the research. Participation was voluntary and anonymous. Before completing the questionnaire, students provided written informed consent, which clearly stated that their participation was voluntary, could be withdrawn at any time without justification, and that their

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responses would be treated confidentially and used solely for research purposes. All data were processed in accordance with applicable data protection regulations. The dataset was handled confidentially and fully anonymized prior to analysis.

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