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Subjective health literacy among Polish adolescents in 2018 vs 2022 – impact of gender, age, and socio-economic factors during COVID-19

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Abstract

Introduction and Objective. The results of the Health Behaviour in School-aged Children (HBSC) surveys conducted in 2018 and 2022 allow for a comparison of selected health-related indicators from before the COVID-19 pandemic and from its final phase. The aim of the study is to assess the level of health literacy (HL) among Polish students aged 13–17 years.

Materials and Method. The surveys were conducted with nationwide samples of students (N2018=5648 and N2022=4994, respectively). Changes in the overall HLSAC-5 index and its five dimensions were examined.

Results. The findings indicate a significant decline in the average HLSAC-5 scores from 15.35±2.40 to 14.84±2.80, alongside an increase in the proportion of students with low HL from 9.85% – 23.67%. Concurrently, the percentage of students rating their health as poor rose from 3.5% to 9.1%. An increasing disparity in HL levels across schools was also observed, with the intraclass correlation coefficient (ICC) escalating from 3.4% to 6.1%. General linear model confirmed a significant influence of gender, age, place of living, family affluence, self-rated health, and eight significant 2-way or 3-way interactions between independent variables. Notably, there were five significant 3-way interactions involving the year of the survey and self-rated health, with the third factor, gender, age, family wealth, presence of a chronic disease, and place of residence, respectively.

Conclusions. The study highlights the dynamic nature of HL and its evolving relationship with various socio-demographic and health factors over time. The changes in students' HL may have been influenced by factors related to living and learning during the COVID-19 pandemic.

Key words

health status, trend, health literacy, socio-economic factors, diversification of schools

INTRODUCTION

Over the past two decades, there has been a growing interest in understanding and enhancing health literacy (HL) across various population groups within the field of public health. There have been numerous discussions about definitions and models of HL tailored to young people, and the context in which health competencies can be useful [1]. These discussions relate to general definitions applicable to the entire population, emphasizing the development of skills to access, understand, and utilize available information to make decisions and take actions that can impact health [2]. One of the most comprehensive definitions in the literature (offered by Perrenoud et al.) states that health literacy 'is defined as people's knowledge, motivation, and competences to access, understand, appraise, and apply health information to make judgments and take decisions in everyday life concerning health care, disease prevention, and health promotion to maintain or improve quality of life during the life course' [3].

Concurrently, tools for measuring HL have been developed and implemented worldwide [4], including several instruments specifically designed for children and adolescents [5]. Initially, the focus was on adult patient populations and their ability to cope with illness; however, attention gradually shifted toward the entire population, including children and adolescents as groups encompassed by comprehensive health education initiatives. The need to involve the educational system in shaping societal health awareness has been emphasized [6]. Schools have been identified as crucial venues for health education, particularly for students with limited opportunities for learning healthy behaviours at home. Consequently, all school-based activities related to health education, promotion, and competency development, are recognized as essential for fostering the health of upcoming generations and reducing health disparities in society [7].

The Health Behaviour in School-aged Children (HBSC) surveys – a major international study conducted every four

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years – have significantly contributed to our understanding of youth HL. At the initiative of several countries within the Health Literacy Writing Group, led by Finnish researchers, a concise and generic tool considering five key areas of HL, the HLSAC-10 (Health Literacy for School Aged Children), was developed after pilot studies in 2016. Next, an abbreviated version, the HLSAC-5, was devised [8]. The HBSC surveys' strengths lie in their capacity for international comparisons, tracking temporal changes, and their comprehensive questionnaire design, which links HL to various factors. These surveys have facilitated numerous studies exploring the determinants of HL and its impact on the health and behaviours of adolescents [9, 10].

However, only recently it has become possible to compare research results from 2018 and 2022. Such a comparison promises to be particularly intriguing, covering as it does the period from before the COVID-19 pandemic, through the pandemic itself (a prolonged time of significant disruptions in school operations in general and in health education in particular), to its concluding phase, when infection numbers subsided and restrictions became less burdensome. The pandemic may also have further exacerbated differences in access to educational access and extracurricular activities, particularly for socio-economically disadvantaged groups [11]. Adolescents surveyed in Poland at the end of the pandemic perceived it as having had a predominantly negative impact on various aspects of life [12]. Conversely, the experiences during this period may have heightened their awareness of health issues and the significance of prevention and their sense of responsibility for their own and others' health [13].

In examining HL among Polish youth before and during the pandemic, we resolved to pay special attention in this study to demographic and social group differences, as well as the influences of family, school, and residential environments on health attitudes. We hypothesized that the impact of the pandemic in terms of heightened appreciation of the value of health, was more pronounced among older adolescents and families with higher social statuses. Exploring how HL evolves in vulnerable youth groups, particularly those with chronic diseases, presents a compelling research topic. While much of the existing literature views health competencies as factors influencing a range of health outcomes [14], in the context of the COVID-19 pandemic it becomes pertinent to also consider the inverse relationship, treating HL itself as an outcome [15].

In particular, we focus on children and adolescents in poorer health condition. Studies indicate that adolescents with chronic diseases were more affected by the consequences of living through the pandemic, manifesting for instance in more pronounced deterioration of mental health [11]. Additionally, this study recognizes the methodological changes in the HBSC surveys across the recent two cycles, potentially impacting the interpretation of the results. Therefore, this article is mainly intended to serve as a discussion on comparing outcomes from two separate rounds of the cross-sectional survey. It aims to contextualize the findings within the scope of these methodological considerations, rather than merely presenting the identified differences without acknowledging these methodological aspects.

OBJECTIVE

The primary aims of the research reported herein, therefore, is to assess the level of HL among Polish school students aged 13–17, surveyed in 2018 and 2022, against the backdrop of selected socio-economic and health-related factors, with particular emphasis on the interaction between factors between factors influencing changes in the level of HL. We also attempted to explain the extent to which methodological variations and minor changes in the HBSC study protocol might affect these findings.

MATERIALS AND METHOD

Participants and procedures. The study included school students who took part in the HBSC surveys in Poland in 2018 and 2022. Three groups of students aged 13, 15, and 17, were taken into consideration, corresponding to the 7th grade of primary school and the 1st and 3rd grades of secondary school (general and technical high schools). The 11-year-old group (5th grade) was excluded due to their non-participation in HL-related questions. Moreover, the oldest group of participants was surveyed in Poland, and therefore fell outside the international protocol. The study analyzed 5,648 records in 2018 and 4,994 in 2022. The two samples differed in terms of gender, age, and place of residence (Tab. 1). The 2022 sample included a higher number of girls and 15-year-olds, with fewer students from large cities and more from smaller towns. However, the average age was similar – 15.44 (SD=1.73) in 2018, and 15.47 (SD=1.45) in 2022, showing no significant difference (p=0.417, Mann-Whitney test).

Schools from all of Poland's 16 provinces (voivodships) were included. In 2018, 100 counties (powiats – into which each voivodship is subdivided) were selected at random, stratified by the local deprivation index [16], from which schools of different types were then selected within these counties. This yielded province samples proportional to the population of each province. The 2022 sample was then drawn from the same counties (but not necessarily the same schools). The sampling plan was established using the current Register of Schools and Educational Institutions (RSPO) from the Ministry of Education and Science website. If a school or parents declined participation, we randomly selected an alternate, similar school within the county or a neighbouring one with a similar deprivation index. The unit of selection was the class, with one class per age level chosen in 2018 and two in 2022. Overall, in the mentioned age groups, the 2018 HL-related surveys covered students from 229 schools, the 2022 surveys from 165 schools.

In the 2017–2018 school year, students completed paper surveys during classroom lessons, whereas four years later, the surveys were conducted online via the web survey system (www.webankieta.pl). In 2022, data were collected between May and June, the final phase of the pandemic.

The procedures for both studies and the questionnaire scope received approval from the local Ethics Committee (2018: Opinion No. 17/2017 with Annex 1, dated 30.03.2017; 2022: Opinion No. 51/2021 dated 24.06.2021).

Questions and indicators. HL questions were integrated into the HBSC survey in 2017–2018 and continued in 2021–2022. In 2016, the HLSAC-10 scale underwent international

validation across four countries (Finland, Poland, Slovakia, and Belgium), involving 1,468 school students [17]. HLSAC-10, a generic subjective assessment tool, includes 10 items, two for each of the five dimensions: theoretical knowledge, practical skills, critical thinking, self-awareness, and citizenship. The HLSAC-5, a condensed version, devised to enhance its broader integration in subsequent HBSC survey rounds, contains one item per dimension [8]. The precise wording of the statements is given below. Both the full and abbreviated HLSAC versions use a 4-point scale, with respondents expressing how true each statement seemed to them ('not at all true', 'not very true', 'somewhat true', 'absolutely true'). The wording of the second response category was slightly altered in both the international and Polish translations (in 2018, it had been 'not completely true'). We chose to use the HLSAC-5, which correlates strongly with the full version (0.921 in 2018, 0.941 in 2022, for ages 13–17), as it facilitates the interpretation of both the overall index and changes in individual questions and their respective dimensions. HLSAC-5 scores range from 5 – 20 points, segmented into three intervals denoting low, average, and high levels of health literacy, with cutoff points at 12/13 and 17/18 points, respectively.

Alongside gender, school class, and place of residence, additional factors considered when analyzing HL trends between 2018–2022 included level of family affluence, self-assessed health, and the presence of chronic diseases. Family affluence was gauged using the third revision of the Family Affluence Scale (FAS III), a robust indicator that is comparable to income or parental education data, which are typically difficult to obtain from children and adolescents [18]. However, it's important to note certain limitations in comparing pre-COVID and COVID-affected periods, particularly the constraints on international travel and the increased computer access due to State-supported remote learning during the pandemic. The FAS III scale ranges from 0 – 13 points, categorizing families into three affluence levels: less affluent, average, and most affluent, with thresholds set at 6–7 and 9–10 points. Between 2018 and 2022, there was a noticeable shift in the family affluence distribution among the students surveyed, with a higher representation of families of average affluence.

For self-assessment of health, students used a 4-point scale ranging from 'excellent' to 'poor', as per the well-established HBSC protocol. Notably, there was a decline in self-rated health during this period, with a doubling in the percentage of students rating their health as below 'good'. Chronic disease prevalence was assessed using a question from the HBSC's Chronic Conditions Short Questionnaire (CCSQ), introduced in the 2005–2006 survey, and validated in multiple countries, including Poland [19]. This question enquired about long-term illnesses, disabilities, or medical conditions diagnosed by a doctor. The proportion of students reporting such conditions remained consistent over the study period.

Methods of analysis. HLSAC-5 responses from the two survey periods were analyzed. Mean item scores were compared using the Mann-Whitney test, with eta squared calculated to measure effect size. Overall mean HLSAC-5 indices from both surveys were similarly compared using the Mann-Whitney test, after confirming non-normal distribution. Chi-square tests assessed differences in HL category participation rates. Data standardization involved weighting for gender and age group differences, assuming that each of the six gender and age-based groups comprised an equal size of 900 students. Additionally, the study investigated the variation in the overall HLSAC-5 index among different schools, utilizing the Intraclass Correlation Coefficient (ICC) to measure the 'school effect'. This coefficient was calculated using a zero-level multilevel model through the mixed model approach, where the school identifier was treated as a random effect to assess the influence of individual schools on the HLSAC-5 index variation.

The multivariate analysis employed the general linear model (GLM) on the aggregated data from both the 2018 and 2022 survey periods, aiming to pinpoint factors that independently affected variations in the HL index. The year of the survey was included as an independent variable. This analysis not only focused on the main effects, but also evaluated the significance of interactions among various demographic, health, and social factors. In particular, the study highlighted significant 2-way and 3-way interactions where the survey year was a contributing factor.

A general linear model identified independent variables affecting HL variation, including the survey year and its interactions with demographic, health, and social factors.

Statistical analyses utilized IBM SPSS Statistics for Windows, Version 28.0 (IBM Corp., 2021).

Table 1. Basic characteristics of two samples

	2018		2022		p
	N	%	N	%	
Total	5,648	100.00	4,994	100.00	
Gender					
Boys	2,669	47.3	2,221	44.5	0.004
Girls	2,979	52.7	2,773	55.5	
Grade					
VII – primary school	2,053	36.3	1,436	28.8	
I – secondary school	1,932	34.2	1,977	39.6	<0.001
III – secondary school	1,663	29.4	1,581	31.7	
Place of residence					
Cities	1,366	24.3	823	16.5	
Towns	2,030	26.1	2,056	41.3	<0.001
Rural areas	2,226	39.6	2,099	42.4	
Family affluence					
Low	1,631	29.4	1,329	27.0	
Average	2,605	46.9	2,556	52.0	<0.001
High	1,314	23.7	1,034	21.0	
Self-rated health					
Very good	990	17.6	712	14.3	
Good	3,578	63.5	2,583	52.0	
Fair	870	15.4	1,220	24.6	<0.001
Poor	197	3.5	451	9.1	
Chronic conditions					
Yes	931	16.5	860	17.3	0.299
No	4,697	83.5	4,111	82.7	

RESULTS

Changes in responses to HLSAC-5 component items between 2018 – 2022. Table 2 displays the distribution the two survey periods, correlating with the dimensions of HL and the respective elements of the complete 10-item scale. Statistically significant differences ($p < 0.001$) were observed in all five items between 2018 – 2022, with a notable increase in 2022 in students selecting the least favourable responses ('not at all true' or 'not very true'). Table 3 presents a comparison of mean item scores between the study periods using the Mann-Whitney test, with the eta-squared statistic calculated to evaluate the consistency of these changes. The mean score for each item decreased significantly over the study period, especially in questions related to theoretical health information, emphasizing health-related knowledge and self-awareness in terms of reflective abilities.

Table 2. Change in response categories in HLSAC-5 items

Theoretical component / Item wording (placement in HLSAC-10)	Survey*	Response categories (%)***			
		Not at all true	Not very true**	Somewhat true	Absolutely true
Theoretical health information – *I have good information about health (item 1)*	2018	1.52	8.24	63.78	26.46
	2022	6.56	16.24	56.04	21.17
Practical knowledge – *When* necessary, *I find health – related information that is easy for me to understand (item 7)*	2018	2.83	12.20	54.67	30.30
	2022	6.93	17.67	52.11	23.30
Critical thinking – *I can compare health-related information from different sources (item 3)*	2018	3.54	17.61	60.22	18.63
	2022	7.74	23.63	52.41	16.22
Self-awareness – *I can give reasons for choices I make regarding my health (item 10)*	2018	2.96	15.13	56.06	25.85
	2022	7.13	23.72	49.48	19.67
Citizenship – *I can judge how my own actions affect the surrounding natural environment (item 6)*	2018	2.33	14.37	55.83	27.46
	2022	6.69	18.65	51.23	23.43

*for all items significant change in the distribution of responses at p<0.001; ** not completely true in 2018; *** weighted samples %

Table 3. Change in means for HLSAC-5 items according to the theoretical components (weighted samples – %)

Theoretical component	Survey	M±SD	Mann-Whitney (Z)	Effect size (eta sq)	p
Theoretical health information	2018	3.15±0.62	-15.001	0.021	<0.001
	2022	2.92±0.79			
Practical knowledge	2018	3.12±0.72	-11.736	0.013	<0.001
	2022	2.92±0.83			
Critical thinking	2018	2.94±0.71	-9.929	0.009	<0.001
	2022	2.77±0.81			
Self-awareness	2018	3.05±0.72	-14.360	0.019	<0.001
	2022	2.82±0.83			
Citizenship	2018	3.08±0.71	-9.399	0.008	<0.001
	2022	2.91±0.83			

Changes in average HLSAC-5 indices from 2018–2022. Table 4 shows an analysis comparing the mean HLSAC-5 indices and their distribution across three levels during the two survey periods. The data, standardized by gender and age, show a statistically significant decrease in the average HLSAC-5 index from 15.35 (SD=2.40) to 14.84 (SD=2.80). There was also a notable increase in students classified in the low HL category, together with a corresponding decline in the average and high HL categories.

Focusing on the average HLSAC-5 index across the whole sample revealed significant disparities among schools in the 2018 and 2022 HBSC studies. In 2018, the mean school-level indices spanned from 13.5 – 17.6, with no students in the low HL category in 27 out of 229 schools (11.7%). The school with the lowest score had 42.9% of its students in the low HL category. In contrast, in 2022, the range of school-level indices widened – 10.2–18.0. In this round, 9 out of 165 schools (5.5%) saw no students categorized as low HL, but in one school, the proportion of students with low HL surged to 66.7%. While the Intraclass Correlation Coefficient (ICC), used to measure the 'school effect', was not particularly high due to the large number of schools. This notably increased from 3.4% in 2018 to 6.1% in 2022, suggesting a growing disparity in HL levels across different schools.

In Table 4, the overall HLSAC-5 index values are analyzed across six youth characteristics over the two study periods. Factors considered include four socio-demographic traits (gender, age, place of residence, family affluence) and two health aspects (self-rated health, presence of chronic conditions). Girls generally achieved higher HL levels than boys. In both study periods, significantly higher rates of low HL levels were noted among boys, with minor gender-related differences in attaining high HL levels. The decrease in the average index and its notable shift in distribution between 2018 – 2022 affected both genders.

Age proved to be a crucial determinant in differentiating HL levels. Across both survey periods, there was a noticeable increase in the average HL index and a decrease in the proportion of students with low HL levels among the different school cohorts. Notably, in 2018, there was a pronounced increase in the percentage of students achieving high HL levels across successive age groups. Marked shifts in HL distribution were observed across three age categories between 2018 – 2022.

The link between students' place of residence and HL was found to be statistically significant in 2018 (p=0.007), but this was not confirmed in 2022 (p=0.407). Place of residence weakly differentiated the percentages of students with low HL levels. The observed difference in 2018 was reflected in an increasing percentage of students with high HL levels in urban areas. Significant changes in the distribution of HL between 2018 – 2022 were seen for all three categories of residential areas.

Family affluence consistently correlated with HL in both survey periods. Students from more affluent backgrounds tended to have lower proportions of low HL, and higher proportions of high HL. This trend was evident across three family affluence categories, with noticeable changes in HL distribution from 2018 – 2022.

Regarding students with chronic conditions, their representation remained similar in both survey samples. While the correlation between chronic health issues and HL was not significant in 2018 (p=0.142), it became noteworthy

by 2022 (p=0.002). In the latter year, students with chronic conditions were more often classified into the extreme HL categories than in the previous survey. Changes in HL distribution over this period were significant among both students with and without chronic conditions.

Finally, the data reinforced a consistent relationship between self-rated health and HL. Students who rated their health as 'good' or 'excellent' generally had more favourable HL levels. In contrast, those who viewed their health as 'fair' or 'poor' were more likely to fall into the low HL category. Significant shifts in HL distribution across all groups defined by self-rated health were observed between the 2018 and 2022 surveys.

Table 4. HLSAC-5 index by selected characteristics of students in two samples

Subgroups	Survey*	M±SD	Health Literacy Level (%)		
			Low	Average	High
Total	**2018**	**15.35±2.40**	**9.85**	**72.28**	**17.87**
	2022	**14.84±2.80**	**23.67**	**62.39**	**13.94**
Gender					
Boys	2018	15.24±2.54	11.81	70.04	18.15
	2022	**14.19±3.26**	**26.04**	**60.07**	**13.89**
Girls	2018	15.45±2.23	7.89	74.52	17.59
	2022	**14.49±2.61**	**21.30**	**64.70**	**14.00**
School Grade					
VII – primary school	2018	15.09±2.48	12.61	71.44	15.94
	2022	**13.69±3.45**	**33.59**	**53.30**	**13.10**
I – secondary school	2018	15.42±2.37	9.11	72.78	18.11
	2022	**14.92±2.68**	**21.71**	**65.74**	**12.55**
III – secondary school	2018	15.53±2.32	7.83	72.56	19.61
	2022	**15.09±2.48**	**12.61**	**71.44**	**15.94**
Place of residence					
City	2018	15.60±2.38	8.84	70.95	20.22
	2022	**14.50±3.10**	**22.61**	**62.54**	**14.85**
Town	2018	15.30±2.44	10.65	70.82	18.53
	2022	14.35±3.05	24.04	61.33	14.62
Rural areas	2018	15.24±2.36	9.71	74.39	15.90
	2022	**14.26±3.08**	**23.66**	**63.32**	**13.01**
Family affluence					
Low	2018	15.02±2.42	12.49	73.08	14.42
	2022	**13.97±3.18**	**28.34**	**59.81**	**11.85**
Average	2018	15.41±2.34	9.11	72.35	18.54
	2022	14.37±2.97	22.40	64.17	13.43
High	2018	15.66±2.41	8.15	70.53	21.33
	2022	**14.77±3.10**	**19.93**	**61.84**	**18.23**
Self-rated health					
Good or very good	2018	15.49±2.35	8.69	72.22	19.09
	2022	14.61±3.10	20.81	62.87	16.32
Fair or poor	2018	14.75±2.49	14.87	72.30	12.83
	2022	**13.78±2.91**	**29.39**	**61.73**	**8.88**
Chronic conditions					
Yes	2018	15.37±2.50	10.84	69.64	19.53
	2022	14.21±3.47	26.65	57.31	16.03
No	2018	15.34±2.37	9.59	72.88	17.53
	2022	**14.49±2.98**	**23.01**	**63.40**	**13.59**

* for all subgroups significant change in 2018–2022 in HL level distribution (chi-sq test) and means (non-parametric Mann-Whitney or Kruskal-Wallis test) at p<0.001

GLM model of factors influencing HLSAC-5 variability and its change between 2018- 2022. Table 5 presents a general linear model with the HLSAC-5 overall index serving as the dependent variable. Among the set of variables analyzed, the presence of chronic conditions was the only factor not found to exhibit a correlation with HL variability in the given age group. After additional factors were adjusted for, a more favourable HL level was evident in 2018 compared to 2022. Cities showed more significant HL improvements than rural areas, with a slight trend also favouring towns (p=0.045). Additionally, gender and age showed a positive correlation, with greater HL levels shown by girls compared to boys, and by the oldest group of 17-year-olds, compared to their 13- and 15-year-old counterparts. Children from lower and average socio-economic status, measured by the FAS scale, displayed lower HL levels compared to their peers from more affluent families. Moreover, a superior self-rated health status was significantly associated with enhanced HL. Collectively, this model accounts for 7.5% of the variability in HLSAC-5.

Table 5. General linear model with main effects for HLSAC-5 total index

Independent variables*	B	SE	T	p	95% CI(B)	
					lower limit	upper limit
Constant	**14.59**	**0.09**	**156.16**	**0.000**	**14.41**	**14.77**
Year of survey						
2018	0.85	0.05	16.07	0.000	0.75	0.96
Chronic conditions						
Yes	0.07	0.07	1.03	0.303	-0.07	0.21
Place of residence						
Cities	0.36	0.07	5.10	0.000	0.22	0.50
Towns	0.12	0.06	2.01	0.045	0.00	0.23
Grade						
VII primary school	-0.90	0.07	-13.69	0.000	-1.03	-0.77
I secondary school	-0.36	0.06	-5.72	0.000	-0.49	-0.24
Gender						
Boy	-0.38	0.05	-7.26	0.000	-0.49	-0.28
Self-rated health						
Good or excellent	0.91	0.06	14.75	0.000	0.79	1.03
Family affluence						
Low	-0.68	0.07	-9.24	0.000	-0.82	-0.54
Average	-0.31	0.07	-4.72	0.000	-0.44	-0.18

* reference categories: survey – 2022; chronic conditions – no; place of living – rural areas; grade – III secondary school; gender – girl; self-rated health – fair or poor

The next model explored 2-way- and 3-way-degree interactions among selected independent variables as predictors of HLSAC-5, with a focus on their interaction with the survey year. This model, inclusive of interactions, accounted for 8.5% of HLSAC-5 variability (Table A1 in the Annex). Overall, seven significant 3-way interactions and one 2-way interaction involving the survey year were identified. Although the primary effect of chronic conditions was statistically non-significant (p=0.228), this factor did interact with the survey year and self-rated health (Fig. 1). In 2018, students with chronic conditions reported higher HL than their healthy counterparts, but this was only observed within the subgroup reporting low self-rated health.

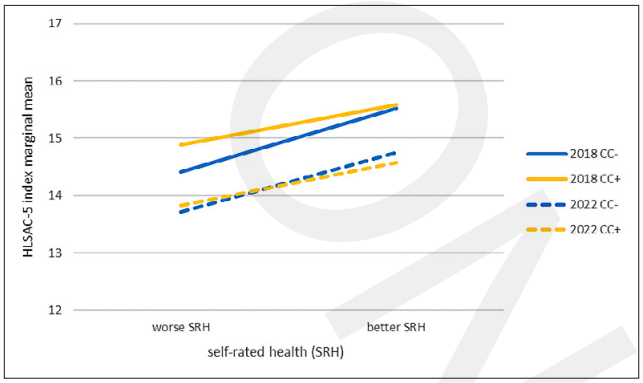

Figure 1. Mean HLSAC-5 by chronic conditions (CC), self-rated health (SRH), and year of survey

Significant interactions were also observed between self-rated health and socio-demographic factors, with the survey year considered as a third variable. Changes in the relationship between average HL and family affluence predominantly affected youths rating their own health below 'good'. However, in 2022, there was a marked decline in HL among the moderately affluent, with improvement only noted among the most affluent group (Fig. 2).

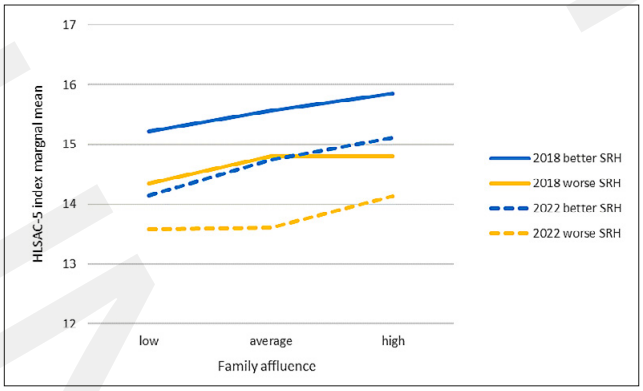

Figure 2. Mean HLSAC-5 by family affluence, self-rated health (SRH), and year of survey

Another interesting finding was a clear decline in HL among students living in rural areas, particularly affecting those with higher self-rated health. For students with poorer self-rated health, the place of residence had a less pronounced effect on the average HLSAC-5 index (Fig. 3)

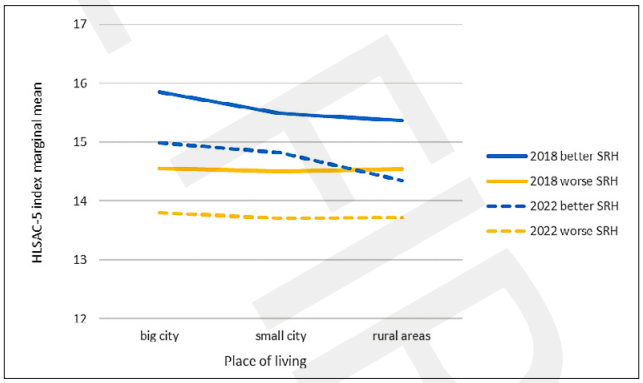

Figure 3. Mean HLSAC-5 by place of residence, self-rated health (SRH), and year of survey

DISCUSSION

Obtained results. The study has presented an analysis of survey results collected in Poland during the school years 2017 – 2018 and 2021 – 2022, involving a total of 10,642 adolescents over two rounds of the Health Behaviour in School-aged Children (HBSC) study. While similar international comparative studies are scarce, Finnish research indicating a decline in health literacy (HL) among youths aged 13 and 15 somewhat parallels our findings [17]. However, while in Poland it was primarily the proportion of Polish students with low HL that increased, in the Finnish trend it was mainly a decrease in high HL levels that was observed.

A significant decline in subjective health literacy was evident, both concerning the overall HLSAC-5 index and its components. In the multifactorial model, the study year emerged as a significant factor influencing the variability of the subjective HLSAC-5 index, in several cases interacting with other predictors of this variability. The unfavurable nature of these trends is most likely attributable both to real changes and to methodological variations between the two cross-sectional studies, necessitating a cautious interpretation in light of potential methodological biases [20].

As emphasized in the Introduction, taking the context of the COVID-19 pandemic into consideration is essential, as the conclusions drawn from comparative analysis can guide post-pandemic efforts to mitigate the long-term adverse effects of the pandemic.

Determinants of HL index and its change. The study confirms higher HL levels in girls versus boys, in older versus younger cohorts, in wealthier versus less affluent families, and among youths with better self-rated health. The influence of residence and chronic disease status on HL proved unstable over time. International comparisons also reveal a complex picture of gender differences in HL for instance, in Paakkari et al.'s study across 10 countries, gender differences favouring girls were significant only in Estonia, Macedonia, and Poland, while in the remaining seven countries gender did not differentiate HL levels [21]. An independent Italian study in Lombardy somewhat echoed these findings [22], while other Polish research using a different research tool (HLS-EU-Q47) among post-primary school students, conversely indicated no gender difference in the overall HL index, but did find differences favouring boys in specific HL dimensions related to accessing and appraising health information [23].

Globally, the literature supports the notion that HL improves with age in school-age youth. Polish data extend the results of the HBSC research network, particularly for 17-year-olds surveyed outside the international protocol. In the current study, the analyses of interactions between factors influencing HLSAC-5 index variability highlight evolving relationships between age, self-rated health, and place of residence, in determining adolescent HL. The current results suggest a connection between HL levels and social factors, including place of residence and family wealth. In the former case, a dependency leaning towards rural areas was only apparent in 2018, as has also been indicated in other studies [24]. Poorer outcomes in rural schools might be expected due to disparities in students' skills, as for instance shown in PISA studies [25]. Subjective HL strongly correlates with overall scientific literacy and several objective indicators related to academic achievement, which are lower in rural

schools [26]. Subsequent studies have nevertheless noted shifts in the relationship between place of residence and self-rated health and between family wealth and self-rated health as predictors of adolescent HL.

In the current analyses, a significantly higher level of HL was confirmed in more affluent families. This is a relationship also seen in other HBSC countries, although the strength of the relationship in Poland is less than in, for example, Austria or the United Kingdom [21]. In a systematic review, Kühn et al. selected 21 articles based on cross-sectional data and analyzed the social determinants of HL among students, indicating not only the importance of family wealth, but also the education and employment status of the parents [27]. Among other determinants directly related to the surveyed students, alongside health and behavioural factors, the financial and housing situations of young people were mentioned. It is worth noting that material issues translate into academic achievements, and besides the material status assessed at the household level, the social background of the school is also not insignificant [28] – an issue we return to below.

Research focusing on HL in youth with chronic diseases typically involves small, specific patient groups, and often concentrates on a uniform set of medical conditions [29]. This approach is instrumental in evaluating the interplay between HL and various health outcomes, such as treatment effectiveness, patient adherence, and a smooth transition from paediatric to adult healthcare systems [30]. In contrast, the HBSC studies broaden this perspective, examining HL within a larger, more diverse population and across a spectrum of non-clinical settings. The findings of the current study indicate that while HL tends to improve alongside better self-perceived health, its correlation with chronic disease status is not consistently observed. Assuming three HL categories in this study, no significant link between HL levels and chronic diseases was noted in 2018; however, a significant association did emerge in 2022. The COVID-19 pandemic seemed to influence this dynamic, with adolescents suffering from chronic health issues less frequently exhibiting average HL levels, and more often presenting with extreme HL values. This suggests that the pandemic may have simultaneously contributed to both positive and negative shifts in health competencies among this demographic.

Methodological aspects of trend analysis. The example of the HLSAC scale illustrates how subtle modifications in response category wording can significantly affect respondents' inclination towards more negative answers. However, it is intriguing that altering a single category led to disproportionate shifts in response distribution across various questions. The most notable decline was observed in students' theoretical knowledge, which is the realm of HL primarily taught in educational settings. Qualitative research during the pandemic revealed that health information disseminated to youths mainly focused on COVID-19 prevention [31]. Another question in which a notable shift was seen, was in the area of health self-awareness. Interpreting these findings would necessitate in-depth analysis, especially to explore the potential factors influencing HL during this period. The diminished self-perception of health knowledge and awareness could at least, in part, stem from widespread misinformation/disinformation in the media and adult discussions during the pandemic [32]. An Australian study has reported a correlation between susceptibility to misinformation and lower health literacy levels [33].

Regarding research methodologies, although previous comparative studies in HBSC countries did not find the survey administration method to significantly impact results, it should be noted that there is a growing trend towards online surveys [34]. Gradually, more member countries of this network are switching over to online survey systems, concluding that online methods do not detract from the reliability of observed trends. The pandemic era saw an enhancement in digital competencies among adolescents, making online surveys a more favoured option.

It is also important to consider how differences in the structure of the adolescent samples, deemed to be nationally representative in both instances, might have affected the results. During the analysis stage, these differences were addressed using a weighting system and multifactorial analysis techniques. While the study largely took place in the same counties (*powiats*), it often involved different localities situated within them, which meant that only a certain subset of schools participated in both rounds. In 2022, the number of schools was reduced in favour of a bigger number of classes from the same school.

A notable finding was the nearly twofold increase in the Intraclass Correlation Coefficient (ICC) during the study periods, highlighting the extent to which the HLSAC-5 index variability depended on school-specific characteristics. Earlier studies employing the ICC noted more significant diversity in Polish schools compared to those in the Czech Republic and Slovakia, both in terms of health literacy (HL) levels and family wealth [35]. This suggests that it may be a distinctive feature of Poland that variations that in social backgrounds at the school level are more pronounced. Considering the influence of regional development and local conditions on shaping students' health competencies is crucial, as other studies have indicated [17]. The study period possibly saw an increased diversification among schools regarding these factors, potentially leading to a decline in the national average HL level. The reduced participation of schools from larger cities in 2022, compared to 2018, replaced by schools from towns with potentially less favourable conditions for developing HL, is noteworthy. Other Polish surveys conducted during the COVID-19 pandemic suggest that the smaller and rural schools faced greater challenges in coping with the pandemic [36]. Geographical disparities in access to quality education are influenced by more than just urban-rural differences, locality relative to larger urban centres, or west-east regional differences. More attention should be directed towards schools with lower student health competencies, with a focus on enhancing the skills of both parents and teachers. Skill gaps in various involved groups and problems in cooperation and communication between these groups may place schools from regions with a higher degree of deprivation at a disadvantage [37].

Limitations and implications for further research. Certain limitations of this study stem from the inherent differences in the assumptions underlying the two cross-sectional studies analyzed, which have been extensively discussed in the article. This was indeed one of our objectives, and we have pointed out and discussed the measures taken during the analysis phase to mitigate them. Similar challenges may be encountered by other research teams working with data

from recurring surveys, such as the HBSC. One implication is that analyses of changes over shorter periods may be more reliable than long-term trends. It should also be noted that the analysis of trends or changes between two rounds of HBSC surveys is always based on cross-sectional data conducted in different groups of students. Such studies well illustrate the external circumstances occurring in a given country and period, but lack the robustness pf longitudinal studies in establishing causal relationships.

It is important to emphasize that the presented study measured only the subjective health literacy (HL) level as defined by the students themselves. Therefore, it is possible that adolescents with more extensive knowledge about health might be more aware of gaps in their health competences, leading them to assess their HL level as being lower compared to children who, objectively, possess less knowledge and competences [38]. The often-quoted paradox named as the Dunning–Kruger cognitive bias, lies in the fact that the more we learn, the more aware we become of the deficit in our own knowledge. Sentences containing this statement are attributed to many famous people, old philosophers, modern writers, and scientists, including Albert Einstein. Consequently, considering that this study, as predicated on subjective evaluations, some adolescents might undervalue their HL in its respective domains.

According to the results of the current study, analysis of HL changes in Poland – while having the advantages of being comprehensive, covering a large sample size from various schools and including additional age groups and a multitude of demographic, social, and health variables – has its limitations. One notable concern is the potential exclusion of certain factors linked to HL in the literature. This oversight may be attributed to the differing scopes of the HBSC questionnaires used in 2018 and 2022, particularly regarding the measurement of school achievements. Future research should therefore not only track changes in general HL indicators, but also consider even more determining factors and focus on local differences observed at the school level – especially in specific youth groups, such as those with chronic diseases. The findings from this study underscore the importance of evaluating the interplay and impact of individual factors, including their interactions. Future trend analyses should expand to encompass shifts in the dynamics and strength of relationships between variables, as is currently being incorporated in HBSC network publications. Stratified analysis, considering multiple factors and local contexts, can offer a more nuanced understanding and guide and evaluate targeted interventions to enhance HL among school-aged youth. Future trend research should evolve to include an examination of shifts in the dynamics and strength of relationships among determinants relevant to the phenomenon under analysis, akin to the approach currently integrated into HBSC network publications.

CONCLUSIONS

The presented comparative analysis of two HBSC cross-sectional studies carried out in Poland among students aged 13–17, has revealed marked differences in health literacy (HL) assessments. This disparity was observed not only in the average HLSAC-5 index scores, but also in their distribution across the low, average, and high HL categories. The changes noted during the study periods could be attributed, in part, to the living and educational conditions prevalent during the COVID-19 pandemic. Significant differences in demographic, social, and self-assessed health characteristics of the groups in both survey rounds, were acknowledged and addressed in the analysis, highlighting their potential impact on HL levels.

These findings reinforce the importance of evaluating trends in health literacy over time, considering a wide array of factors including gender, age, place of residence, family affluence, self-rated health, and the presence of chronic diseases. The study periods also witnessed a deepening of disparities in HL levels among different schools in Poland, underscoring the necessity to tailor health literacy programmes to cater for the specific needs and conditions of each educational environment. Moreover, a more detailed understanding of HL deficits can be achieved by examining the interplay among various influencing factors. Further applied studies would also be helpful.

APPENDIX A

Table A1. General linear model for HLSAC-5 total index with main effects and significant interaction with the year of survey (test of between-subjects effects)

Source	Typ III sum of squares	Df	Mean square	F	p
Corrected model	6899.8	45	153.3	22.2	0.000
Intercept	878017.8	1	878017.8	127474.7	0.000
Main effects					
Year of survey	788.0	1	788.0	114.4	0.000
Chronic conditions	10.0	1	10.0	1.6	0.228
Place of living	79.3	2	39.7	5.8	0.003
Grade	1302.3	2	651.1	94.5	0.000
Gender	396.9	1	396.9	57.6	0.000
Self- rated health	817.8	1	817.8	118.7	0.000
Family affluence	401.1	2	200.6	29.1	0.000
Interactions					
1*4	188.7	2	94.3	13.7	0.000
1*2*5	37.0	2	18.5	2.7	0.058
1*2*6	55.4	2	27.7	4.0	0.018
1*6*7	91.5	6	15.3	2.2	0.039
1*5*6	77.1	2	38.6	5.6	0.004
1*3*4	108.2	8	13.5	1.9	0.047
1*3*6	102.5	4	25.6	3.7	0.005
1*4*6	139.7	4	34.9	5.0	0.000
Error	71068.1	10318	6.9		
Total	2379577.0	10364			
Corrected total	77967.0	10363			
R squared =0.088; Adjusted R squared = 0.085)					

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