

Short Thesis for the Degree of Doctor of Philosophy (PhD)

Methodology and evaluation of school health promotion

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1. Introduction

1.1. The development of health promotion

The World Health Organization (WHO) was established in 1948 as the United Nations agency to coordinate health affairs. Its initial focus was on communicable diseases, nutrition, and sanitation. However, the leading causes of mortality from the mid-20th century shifted to non-communicable diseases in a process called epidemiological transition the characteristics and trends of which were first described by the American epidemiologist Abdel Omran. At the same time, medical care systems with their growing arsenal of diagnostic and therapeutic opportunities became available to masses in developed welfare states, and the steady increase of government-financed healthcare spending raised questions about the efficiency and long-term financial viability of medical care.

By synthesizing new research findings on the direct and indirect causes of diseases including non-communicable diseases, the Canadian government issued a document known as the Lalonde Report in 1974 that introduced the so-called health field concept. This specified health as a result of not only the health care system (one field) but human biology, environmental and lifestyle factors as other fields in which the causes of diseases and death are located thus pointing to the role of factors other than patient care. This document was a major contribution to the rethinking of the purpose and functions of traditional public health that took place during the development of the so-called *new public health* movement from the 1970s onwards. As evidence of this shift in global public thinking, the WHO published the Alma-Ata Declaration in 1978, the first global document to declare that health should be achieved by all and to achieve this, a reorientation of health services towards primary health care was suggested. "Health For All" was set out as an overarching goal in the identically titled 1979 strategy of the European Region of the WHO (HFA 2000) which reaffirmed the principles of the Declaration of Alma-Ata and outlined the activities needed to achieve this strategic aim, such as expanding primary care, multisectoral targeting of health determinants, and community planning and implementation based on public participation.

A prominent step in the "new public health" movement was the emergence of the health promotion movement launched at the first international conference on health promotion in Ottawa in 1986. Its final document, the Ottawa Charter laid down the definition and major activities of health promotion, in addition to the basic conditions of health. Some consider health promotion to be part of new public health, others do not, for example, the WHO defines health promotion as the process of enabling people to increase their control over and improve their health. According to the latter interpretation, health promotion therefore excludes the tasks and legally based activities of classical (top-down) public health.

The Hungarian translation of the term "new public health" has also been a source of professional controversy. In his 1982 textbook, Pál Kertai defined public health (*közegészségügy*) as the fourth major branch of universal medicine – alongside theoretical, clinical, and social medicine – dealing with communities rather than individuals and aiming at prevention rather than curation. However, an interdisciplinary professional organisation established in 1991 in Hungary named the National Association for the Science of Public

Health defined its fundamental aim as “the development of the sciences of public health (*népegészségügy*)”. The Medical School of the University of Debrecen was at the forefront in Hungary for the institutionalisation of new public health (*népegészségügy*). It established a School of Public Health in 1997, and almost a decade later the one and only Faculty of Public Health in 2005 (by then within the successor University of Debrecen) under the leadership of Professor Róza Ádány. A Master of Science course in Public Health was launched at the Faculty in 2004 with specialisation in health promotion.

Chapter III of the Health Act of 1997 also used the new term (*népegészségügy*) which was defined as an organised social activity aimed at improving the health status of the population through disease prevention. Despite some debates, it has been settled that the practice of “new public health” has become known in Hungary by its new designation (*népegészségügy*) and its theory as public health science (*népegészségtan*). Developments in the last two decades at the institutional level have also pointed towards the separation of entities carrying out legally based (public health authority) and community-based, participative (health promotion) activities.

1.2. Outcomes of global health conferences

The development of health promotion theory and practice has been greatly aided by further health promotion conferences. The second international conference on health promotion in Adelaide in 1988 highlighted public policy for health promotion, which provided the legislative background for the other four main activities. The third global conference on health promotion (Sundsvall) focused on the health-promoting environment, encompassing not only the natural and built environment but also the social, economic, spiritual and political environment, and the need for initiatives in all sectors to create health-promoting environments, with implementation being a joint responsibility of communities, NGOs, governments and international organisations. The opportunities for health promotion in the 21st century were outlined in the Jakarta Declaration of 1997, which concluded the fourth international conference on health promotion. New elements have been added to the prerequisites for health (e.g. social security and respect for human rights) and new issues have been given greater prominence (e.g. mental health). The fifth international conference in Mexico City in 2000 focused on eliminating health inequalities, and the final document advocated the preparation of national health promotion plans and the establishment of national or international networks to promote health promotion. The sixth international conference on health promotion, held in Bangkok in 2005, examined the impact of globalisation on health promotion activities and highlighted new factors that negatively affect health: increasing inequality, urbanisation, global environmental change and urbanisation, while also pointing to the health-promoting impact of globalisation through global exchanges of information and communication technologies. The seventh international conference on health promotion took place in Nairobi in 2009, and the final document of the conference states that the widespread goals of health promotion have not yet been achieved, despite the evidence of the effectiveness of health promotion and previous international declarations. Gaps were identified in three areas: policy choices that take into account the social determinants of health, moving health systems towards health promotion, and translating

existing evidence into practice. The 8th conference held in Helsinki in 2013 focused on “Health in All Policies (HiAP)”. An important prior development was the publication of a report commissioned by the World Health Organization from the Commission on Social Determinants of Health titled “Closing the gap in a generation”. The report introduced a complex model for health that included its social determinants and recommended actions to achieve health equity through actions targeting these determinants. The conference recommended the implementation of CSDH recommendations by intersectoral policy making. The 9th conference was held in Sanghai in 2016 and focused on opportunities and potentials by which health promotion could contribute to the achievement of the Sustainable Development Goals issued in 2015 by the United Nations. The 10th conference was organized in 2021 online and focused on the contributions health promotion could make to well-being, equity and sustainable development.

1.3. National data from the Health Behaviour in School-age Children (HBSC) survey

One of the important principles of health promotion mentioned in the Ottawa Charter is the setting-based approach of which schools represent a particularly important setting. Schools are not only institutions for transferring knowledge and increasing educational level but also support the physical and mental development of the most malleable age groups; provide built and social environments for pupils; facilitate peer and adult relationships; and provide opportunities to reduce social inequalities. All these functions of the schools are fundamentally defined by policy decisions so considering all these factors, schools are one of the most important settings for health promotion.

With regard to the health of adolescents as an important age group, an initiative was launched in 1982, led by Finland, the United Kingdom and Norway, to develop a uniform measurement tool (questionnaire) to assess the health and lifestyle of school-age youth so that data collected in each country could be compared. This initiative gave rise to the international research network named Health Behaviour in School-aged Children (HBSC), supported by the World Health Organization, which has been conducting a survey every four years since 1983 on representative samples of school-age children in the member states of the network, using a standardized methodology. Hungary joined the network in 1986 and has participated in all surveys since then. The 2009 survey was organized by the research team of the National Institute of Child Health (during the data collection that preceded the health promotion program discussed in this thesis). The lifestyle, health habits and subjective health status was investigated in a representative sample of more than 8000 Hungarian children in 5th, 7th, 9th and 11th grades in public schools. The survey also examined individual, social and environmental factors that may influence the health-related characteristics listed above. Compared to the 2006 survey, the time spent using computers as a physically passive leisure-time activity increased by 2009 irrespective of gender and age. The proportion of children who tried smoking, alcohol and drugs at a very young age also increased, and illegal drug use became more common. The mental health of adolescents improved slightly compared to 2006, but the proportion of students who took at least 60 minutes of moderate-intensity

physical activity per day did not change (17% of boys compared to 11% of girls). This was the proportion of children who were physically active in line with the WHO Physical Activity Recommendations for 5-17-year olds published in 2010. The prevalence of overweight (12.5% of the total sample) and obese pupils (2.6% of the total sample), calculated from self-reported anthropometric data, did not change significantly.

This chapter shows that although the concept of health promotion has been well defined over the past three decades and its methodology has been well developed, no significant improvement was achieved in the health status of Hungarian school-age children, one of the most important target groups, and their level of physical activity was significantly below international recommendations while the proportion of overweight and obese children remained high.

In light of these data, we became interested in a health promotion project that was entirely initiated and developed by the teaching staff of a Hungarian public school as a community, and which was developed without governmental protocol or incentive, based on the international concept of whole school health promotion, implementing all four pillars. Our research team contacted the school and offered to evaluate this program to provide lessons for the design of future programs.

2. Literature review

2.1. Unfolding the concept of school health promotion

School health promotion is an important domain of the implementation of health promotion, targeting school students. The importance of schools is based on their manifold impact: they engage children daily in an age when new knowledge is most easily absorbed; schools provide a social environment for children to learn and establish contact with other children and adults; and because of the longer life expectancy of youth compared to older people, school interventions have longer-lasting results. Students take home their newly learned knowledge and skills thereby influencing their parents' lifestyles. Schools are found in all countries, nationally regulated, operate in a similar way and have considerable freedom to run their own extracurricular programmes of their own design if adequate financial support is obtained. School health promotion helps children to become healthier by developing skills and habits that accompany them throughout their lives, and also contributes to becoming more effective learners. Improving the health of teachers and other school staff increases job satisfaction and reduces absenteeism.

The European Network of Health Promoting Schools (ENHPS) was established in 1991 with the support of the European Commission, the European Regional Office of the WHO, and the Council of Europe to combine education and health promotion to help schools change in ways that enhance the physical, mental and social well-being of students, as well as their learning. Schools as places and school students as target groups have thus been a major focus of conceptual development in health promotion since the 1980s. This led to the formulation of integrated principles for school health promotion in 1995 which launched as the Global School Health Initiative. School health promotion is based on a holistic model of health aiming to improve the biological, psychological and social factors that influence health,

targeting not only students but also teachers, school staff, and parents, helping to develop healthier lifestyles. The Global Initiative proposed the design of contextually appropriate actions that respond to local needs and conditions, building significantly on the ENHPS experience which at the time had already been implemented.

2.2. International and national organisations working on school health promotion

2.2.1. Schools for Health in Europe (SHE) and Focusing Resources on Effective School Health (FRESH)

The ENHPS network has grown from 7 to 43 countries, and has published a number of brochures and position papers to help plan school health promotion projects during its existence until 2007. The ENHPS network became a non-profit foundation in 2017 and continues to operate as Schools for Health in Europe (SHE). Instead of focusing on projects in schools, SHE provides policy and structural support to member institutions, including national and regional coordinators. SHE takes a 'whole school' approach to school health promotion, as defined by the WHO, which means that schools continuously strengthen their capacity as healthy environments for living, working and learning.

This approach is based on five core values: equity, sustainability, inclusion, empowerment and democracy, and consists of six core components: healthy school policy, physical environment of the school, social environment of the school, individual health-related skills and competences, community linkages, and health services. The background paper for the SHE 2nd summary publication highlights the following features:

1. integrated and long-term programmes to improve nutrition, physical activity and mental health are the most effective;
2. more intensive and longer programmes are more effective;
3. thematic programmes to prevent the use of various drugs (tobacco, alcohol, and drugs) are the least effective.

Evaluation is useful not only to guide planning and improve future projects, but also helps accountability to the funder.

Focusing Resources on Effective School Health (FRESH) is a collaboration of four major international organisations (WHO, World Bank, United Nations Children's Fund, UNESCO) launched in 2000 to help these organisations, and particularly developing countries, work together to design and implement cost-effective activities to help schools provide healthier environments for children.

2.2.2. Development and organisations of school health promotion in Hungary

The Hungarian school health promotion movement was launched by the Hungarian Association of the Network for Healthier Schools in 1992. The Association, supported by a World Bank loan within the framework of the Health Services and Management Programme between 1994 and 2000, developed curricula reflecting a modern approach, and teacher training for accreditation. These curricula have been taught in the context of the subject

"Healthy Living" since 1995, first in 10 primary schools. On the basis of impact assessment and process evaluation, it was recommended that the subject be introduced in all schools, particularly in those where the only opportunity to increase students' self-confidence and self-esteem was in the classroom. This movement contributed significantly to the spread of the concept of school health promotion in Hungary.

The Ministry of Education in its Decree No.28 of 2000 stipulated the inclusion of healthy life education and health protection in the curriculum, while the Public Education Act amended in 2003 (Act 69/2003 on Public Education, §48(3)) stipulated the inclusion of a health and environmental education programme in the school curriculum. The effectiveness of the implemented complex school programmes was demonstrated by national research reports. The need for legislative changes was supported by a research report published in 2004 ("Guide to the preparation of health education and health promotion programmes in schools"), which found that in the majority of schools in the country, health education programmes focused at the prevention of legal and illegal substance use relying on random external implementers, and in fact, focusing not so much on reducing the prevalence of substance use but rather on obtaining available funding, not giving true priority to these programmes.

Integrated school health promotion programmes in Hungary remained sporadic, and the national measures to support them had only been partially implemented. At the national level, daily physical education (Act No 190/2011 on Public Education, §48(3)) and the provision of school canteens (Ministry of Education Decree No. 32/2005) had been regulated by law. The SROP 6.1.2/A/09/1 tender provided framework and financial support for the implementation of integrated health promotion programmes at local (municipal) level, for which the Árpád Tóth High School (ÁTHS) in Debrecen successfully applied in 2009. Supported by this tender, a health promotion programme was implemented in the high school from February 2011 until September 2011. The monitoring and evaluation of this programme was undertaken by the non-governmental organization "National Association of Public Health Training and Research Centres", mainly relying on the resources of one of its members, the Faculty of Public Health of the University of Debrecen. The evaluation concept was developed by the experts of the Association in consultation with the school leadership, taking into account financial and human resource constraints. For this reason, the evaluation was limited to the student body, and only quantitative methods were used. Hungary had earlier joined the European Network of Health Promoting Schools, and a national policy for the introduction of a holistic health promotion (HHP) plan in schools had already been developed in 2003. The programme of the ÁTHS planned to implement elements of the HHP even though this was not required at that time (the HHP was introduced for all institutions of public education in Hungary only in 2012 by Decree 20/2012 of the Ministry of Human Resources in § 128-131 (3)). Due to several technical obstacles, the duration of the implemented programme was much shorter than planned.

2.3.Evaluation of school health promotion projects

The evaluation of school health promotion programmes can provide important information for the design, quality and effectiveness of future programmes, and can also provide information on the school setting and on health and education interventions although published evaluations show considerable heterogeneity. This is due to the fact that school health promotion programmes can almost never be evaluated in the form of randomised controlled trials, the gold standard of experimental studies, but only as a quasi-experimental design in which the unit of analysis, sampling, appropriate statistical methods and efforts to separate secular trends from programme effects must be carefully defined with respect to limitations. Careful consideration is required to construct the theoretical foundation of the evaluation, and to control or at least consider factors and determinants that limit the inference of causality. The evaluation should involve all stakeholders wherever possible; both qualitative and quantitative methods should be used; and realistic exploration should uncover the possible processes through which the programme would have an impact as well as processes by which the evaluation would reveal the relationships behind changes.

Sufficient practical experience had been accumulated by the mid-2000s to summarise the experiences of the various programmes implemented in the framework of the school health promotion concept as summarised in a report published by the European Regional Office of the WHO in 2006. Based on these experiences, comprehensive and integrated programmes for mental health, healthy eating and physical activity that involve the whole school were found to be the most effective; the more intensive and longer the duration, the greater was the impact. Thematic programmes on prevention of substance use (smoking, alcohol and drug use) were found to be the least effective. One of the current main challenges for health promotion interventions, according to international and national experience, has remained their evaluation, which is particularly true for school health promotion programmes.

Based on the above summarized literature it can be concluded that only a fraction of the large number of internationally and domestically implemented school health promotion programmes have been followed up and evaluated in the longer term. In addition, although adolescents' self-esteem and life satisfaction are topics of great research interest, the relationship of these variables with the psychosocial environment and physical inactivity has been addressed in few publications of the school health promotion literature.

2.4. Description of the school health promotion programme in Árpád Tóth High School

The Árpád Tóth High School submitted an application entitled “Implementation of a comprehensive school health promotion plan in Árpád Tóth High School” to the Ministry of Health for funding in the Public Health Programme of the New Hungary Development Plan, funded by the Social Renewal Operational Programme (SROP). The programme was planned to run from 1 October 2010 to 30 September 2011 but due to administrative delays, implementation was carried out between April and September of 2011. The programme was followed up until the autumn semester of the 2013/2014 school year.

The school health promotion programme had four main components:

1. the implementation of healthy nutrition in order to improve the quality of school meals;
2. to promote daily physical activity for all students through joint physical activity programmes (11 programmes between April and September 2011);
3. adopting teaching methods (teacher training) that improve students' health
 - a. person-centred pedagogical methods (4 lead teachers follow a supervision course (30 hours); 33+7 teachers follow a case-based course (5x6 hours))
 - b. use of arts (course for 2 teachers)
 - c. short course in gymnastics for 5 teachers
 - d. long course in gymnastics for 1 PE teacher
 - e. renewal of dance pedagogy training for 1 dance and drama teacher
 - f. development of interpersonal skills for 16 teachers
 - g. relaxation training for 7 teachers
4. health education, with particular attention to topics of particular interest to students.

These thematic projects directly or indirectly targeted not only the students but also parents, teachers and all school staff. The implementation of the health promotion programme was facilitated by the preparedness of the teaching staff, and by the harmonious cooperation with the school health service, parents and NGOs associated with the school throughout the programme.

The focus of this thesis was to evaluate the health promotion programme described above, and to explore links that have not been or have been poorly explored in previous research.

2.5.Objectives

Objective 1: To compare the health status and health behaviour of the participating students (target group) with characteristics of the same age group at the national level before the start of the school health promotion programme (baseline survey).

Research question 1.a. for this objective aimed to characterise the health status of the target group. Research question 1.b. asked whether the students participating in the health promotion programme differed from the national average of their peers in terms of health status and health behaviour.

Objective 2: Short-term evaluation of the health promotion programme

Research question 2 investigated whether students' health behaviour, health status and attitudes towards school as a psychosocial environment differed before and after the health promotion programme, based on the first round of follow-up (F1).

Objective 3: Long-term evaluation of the health promotion programme

Research question 3.a asked whether three years after the end of the programme, at round 3 of the follow-up or final survey (F3), there were any changes in students of grade 12 who were directly involved in the health promotion programme compared to their pre-programme status.

Research question 3.b sought to answer the extent to which any observed changes could be attributed to a secular trend. To do this, we compared data from younger students who were not yet in the school during the intervention but participated in the final survey (Follow-up3 or F3) with data of students who received the intervention and were still in the school in grade 12 at F3.

Objective 4: Analysis of the association of life satisfaction with physical inactivity

The fourth research question aimed at the relationship between physical inactivity, subjective health, and life satisfaction; and which of the demographic factors are associated with life satisfaction in the sample pooled from all surveys.

Objective 5: Analysis of the relationship between life satisfaction and the psychosocial environment of the school

The fifth research question examined the relationship between life satisfaction as an indicator of mental health and variables of the school psychosocial environment in the sample pooled from all surveys.

3. Materials and Methods

3.1. Description of interventions for students

Two of the four main elements of the programme described in Chapter 2.4 were directly targeted at the school's students:

1. to promote daily physical activity for all students through joint physical activity programmes (11 programmes between April and September 2011), and
2. health education with a special focus on topics of particular interest to students.

To complete the anonymous online questionnaires, parents of the students submitted their written consent to the high school which then organised the completion of the questionnaire. Number of the ethical permission of the study: DE OEC RKEB/IKEB 3475-2011.

3.2. Target group

To evaluate the impact of the health promotion programme, four repeated cross-sectional studies were conducted in the implementing school, Árpád Tóth High School in Debrecen. First, the baseline survey took place in April 2011, before the start of the programme. The next three surveys were conducted after the programme had ended (July 2011). Of these, the first evaluation survey (follow-up 1) took place 6 months later, in October 2011; the second (follow-up 2) in September 2012; and the third (follow-up 3) in September 2013. The same 35 questions were used for each survey to ensure that the survey data were complete. The survey response rate, given as the ratio of the number of students completing the questionnaire to the total number of students in the school, was above 60% in all cases. The

distribution of students completing the questionnaire by grade was similar to the proportions observed in the full sample, with a slight female predominance at all data collection times. The baseline condition was evaluated and compared with the national age-grade average using the database of the baseline survey. The remaining analyses were carried out on the cleaned database as described in chapter 3.4.

3.3.Data collection schedule

An internet-based questionnaire was used to collect the data. The network server was set up by a computer scientist at the Department of Preventive Medicine, Faculty of Public Health, University of Debrecen. The server was a standard Linux server with PHP and MySQL support. The webpage contained a short description informing the students about the purpose and design of the study, followed by the 35 questions on a single page. In each survey, all students in each grade of the school were invited to participate. Prior to the surveys, the students' guardians signed a consent form to allow their child to participate in the study. Students who submitted a signed parental consent form accessed the questionnaire at pre-scheduled times in the school's computer room. Data obtained from the survey cannot be used to identify students and were only evaluated in an aggregated way. The questionnaires were completed voluntarily and anonymously by students who had parental consent. Participants were asked to provide the questionnaire with an identifier of their choice, up to 10 characters, but their internet protocol (IP) address was not included in the database. Preliminary tests showed that the questionnaire could be completed in no more than 20 minutes. The questionnaires were completed under the supervision of Master students of the Faculty of Public Health of the University of Debrecen and teachers of the Árpád Tóth High School. The number of students in the given school year was provided by the school management for the researchers.

In Chapter 4.1 of the Results, for research question 1.a, we characterised all the students (grades 9-13) in the baseline survey. To answer research question 1.b, we compared the scores of the 9th and 11th grade students in the baseline survey with the national age-grade average.

In Chapter 4.2 of the Results, a short-term evaluation of the programme was carried out (research question 2) by comparing the data of students in 9th grade, 10th grade and 11th grade at the baseline survey with those of 10th grade, 11th grade and 12th students at follow-up 1 survey.

In Chapter 4.3 of the Results, we focused on the long-term evaluation of the programme (research questions 3.a and 3.b.). To answer research question 3.a, we analysed data from students who were still directly involved in the programme, being 9th grader at baseline survey and 12th grader at the time of the third follow-up survey. Research question 3.b was designed to explore the changes caused by secular trends. To do this, we compared 12th graders in the third follow-up with 9th, 10th and 11th graders in the same school year.

By combining the data from the four surveys into a database, we sought to answer research question 4 (life satisfaction in relation to physical activity) and research question 5 (life satisfaction in relation to mental health and psychosocial factors at school).

3.3.1. Scope of collected data

The questions were selected from the Hungarian version of the Health Behaviour Survey of School-Aged Children (HBSC). Demographic data included gender, year of birth and school class. The socio-economic status of families was characterised by a direct question on the subjective well-being of the family and by a composite indicator that we trained. The latter we trained from the permanent place of residence (1:county town...4: tanan) , the highest education level of the parents (1:graduated from university or college...5: graduated less than 8 grades), the number of computers in the household (1: none...4: more than two; we had to reverse the direction of this variable). The indicator was thus placed on a scale of 4 to 18 points, with a higher score indicating a lower social status.

The general and mental health of the students was assessed by perceived health (one item of self-rated health), self-esteem (10 items of the Rosenberg self-esteem (SE) scale), and life satisfaction (LS measured by the Cantril ladder). Loneliness was characterized by a dichotomized composite indicator derived from one direct and another indirect four-grade scale.

As to health behaviour, we asked students about their physical activity, diet, consumption of psychoactive drugs, and leisure habits. Three questions were used to assess physical activity (PA): 1) frequency and 2) duration of physical activity outside school, and 3) frequency of participation in physical education classes at school. From these, a composite indicator of physical activity was constructed and classified into three categories: inactive, moderately active, and active. To assess dietary habits, students reported about various food items, and consumption of breakfast and lunch on school days. To explore substance use, we asked respondents about their current smoking habits, their level of drunkenness and their lifetime prevalence of use of various drugs. Recreational television and computer use was assessed using a binary variable.

Students were also asked about school and its psychosocial determinants with 14 items. Their attitude towards school was also assessed on a four-point Likert scale and an eleven-point scale. Students were asked to rate their opinion of the difficulty of the tasks they received at school (on a scale of 5 to 25) and of their classmates and teachers (both rated on a scale of 4 to 20). After compiling the questionnaire, a code dictionary was prepared including a detailed description of each item in the questionnaire along with the names, descriptions and possible values of the variables.

3.4.Data Analysis

Upon completion of the questionnaire, data were automatically uploaded to an online database from which the data were downloaded in a Microsoft Excel file. Duplicates were checked and removed from the database, and records that did not contain data were filtered out. Data were checked to ensure that only the values given in the code dictionary were included in the cells.

3.5.Statistical methods

After data cleaning, data analysis was performed using MS 365 Excel and STATA 16.1. For the analysis of the baseline survey of the intervention group and its comparison with the mean of the national age group, and for the short- and long-term analysis of the program, a two-sample t-test was used to compare the data for continuous variables, and a chi-square test for categorical variables. The level of significance was set at 0.05. A correlation analysis was performed using Spearman's rank correlation between the variable of subjective family wealth and the composite indicator of socioeconomic status (Spearman's $\rho=0.361$, $p<0.001$), based on which the variable describing the subjective family wealth was used in further analyses. This was followed by an analysis of the association of life satisfaction with school variables, gender and physical activity habits. To check the normality of life satisfaction, normality tests based on skewness and kurtosis were used. Life satisfaction was heteroskedastic in relation to gender ($p=0.022$), physical activity ($p=0.008$), subjective family wealth ($p<0.001$), grade ($p<0.001$) and subjective health ($p<0.001$). Correlation between variables was analysed using Pearson's correlation for continuous variables, and Spearman's rank correlation for categorical variables. To describe life satisfaction using categorical variables, we used the one-factor analysis of variance (ANOVA) and its nonparametric version, the Kruskal-Wallis test. Spearman's rank correlation was also used to find out whether the 14 school variables are related to life satisfaction. All 14 items were significantly correlated with life satisfaction ($p<0.001$), but for some variables pairwise correlation did not yield significant results, warranting further analysis. Factor analysis of the 14 variables revealed 2 factors, one was students' perceptions of their teachers (Cronbach's $\alpha=0.801$) and the other was their classmates (Cronbach's $\alpha=0.824$). The uniqueness of the other 5 variables was high (>0.45), with two additional factors (difficulty of school tasks (Cronbach $\alpha=0.784$) and general attitude towards school (Cronbach $\alpha=0.731$). Differences between scales were eliminated by using standardised coefficients after regression. The variance of life satisfaction was heteroskedastic in relation to class, school variables and self-evaluation. After model selection, robust heteroskedastic linear (HL) regression with Huber/White (sandwich) variance estimation was used to explain the variance of life satisfaction in relation to the above variables. Ordinary Least Squares (OLS) was used to model the relationship between life satisfaction and physical activity variables. Regression coefficients were plotted using Jann's method.

4. Results

4.1. Characteristics of the target group before the programme according to the baseline survey

Characteristics of students in grades 9-13 attending the ÁTHS in Debrecen at the time of the baseline survey

The average age of the 947 responding students was 17.14 years \pm 1.24 (min:15; max: 20 years), 59% of them girls. A significantly higher proportion of male students resided in a city (80% vs. 74%, $p=0.004$). Fathers of male students were more highly educated (graduated from high school or higher: 72% vs. 62%, $p=0.009$), while there was no significant difference

between the sexes in the educational attainment of mothers (graduated from high school or higher: 54% vs. 47%, $p=0.247$) . A significantly higher proportion of boys compared to girls lived in well-off families (33% vs. 23%, $p<0,01$). There was no significant difference between genders in the number of computers in the home ($p=0.167$).

A higher proportion of boys in the study (87% vs. 78%, $p<0.001$) rated their health as excellent or good compared to girls. The mean value for life satisfaction was 7.83 ± 1.5 points with no significant gender difference ($p=0,920$). Girls were more likely to feel lonely or very lonely (7% vs. 5%, $p<0.01$). Social position in the class was perceived as having a leadership role by 29% of boys compared to 18% of girls ($p<0.001$).

In terms of their feelings towards their school, 87% of male students liked their school much or very much, while a significantly higher proportion, 94% of girls felt this way ($p<0.001$). No significant difference between the boys and girls were seen in students' attitudes towards their teachers (boys: 9.77 ± 2.96 vs. girls: 9.55 ± 2.52 , $p=0.228$), in attitudes towards their classmates (boys: 8.74 ± 2.50 vs. girls: 8.67 ± 2.41 , $p=0.628$) and in general attitude towards their schools (boys: 6.53 ± 2.88 vs. girls: 6.71 ± 2.27 , $p=0.246$). Scaling the difficulty of school tasks, boys gave a significantly lower mean score compared to girls (13.13 ± 3.17 points vs 13.59 ± 2.96 points, $p=0.023$).

In terms of time spent in front of the television, gender difference was slightly significant (less than 1 hour daily, boys: 67% vs. girls: 66%, $p=0.038$), while boys spent significantly more time in front of the monitor than girls (less than 1 hour daily, boys: 44% vs. girls: 56%, $p<0.001$).

96% of boys and 93% of girls participated in at least 3 physical education classes per week ($p<0.05$), significantly greater proportion of boys liked to participate in physical education classes than girls (70% vs. 58%, $p<0.001$). The proportion of girls who participated in less than one hour of intensive physical activity per week out of the school was almost twice as high as boys (54% vs. 30%, $p<0,001$). 54% of boys and 41% of girls exercised between two and four hours per week for more than four hours per week ($p<0.001$). All these data reflect higher levels of physical activity among boys.

On a weekday, 55% of boys and 49% of girls ate breakfast every morning ($p=0.016$), and three quarter of boys and 59% of girls ate lunch every day ($p<0.001$). There was no significant difference between boys and girls in terms of trying smoking (never tried: 44% vs. 45%, $p=0.719$) and present state of smoking (non-smoker: 80% vs. 82%, $p=0.209$). We asked similar questions about alcohol consumption. 46% of girls and 34% of boys had never consumed so much alcohol so as to get drunk ($p<0.001$). For all drugs, the vast majority of students (>97%) had never tried legal and illegal drugs, and no significant gender difference was found between boys and girls.

Comparison of the characteristics of 9th and 11th grade students attending ÁTHS in Debrecen with nationally representative data from the same grade

There was a higher proportion of girls in the ÁTHS survey ($p < 0.05$); a higher proportion of ÁTHS students lived in a city than in the national sample ($p < 0.001$). Among parents of both genders of high school students, there is a significantly higher proportion of those with tertiary education compared to parents of HBSC students among whom there is a significantly higher proportion with secondary or primary education ($p < 0.001$). The proportion of computers in the household also differs between the two groups, indirectly showing that students in the ÁTHS live in families with better socio-economic status than students surveyed in the HBSC. In terms of subjective health, we found significant differences in both genders in favour of ÁTHS students compared to that of the national peer sample. 91% of boys and 81% of girls attending ÁTHS considered their health to be excellent or good compared to 77% of boys and 66% of girls in the national sample ($p < 0.001$ for both genders). A similarly large difference was found for loneliness with students in the ÁTHS significantly less lonely ($p < 0.001$).

Large difference was also found for life satisfaction, with a 1.1 point higher mean score among students in the ÁTHS (ÁTHS: 7.97 ± 1.36 ; HBSC: 6.82 ± 1.80 , $p < 0.001$). Self-esteem of the students on a scale ranging from 10 to 40 was significantly higher among boys in the ÁTHS compared to the national average of the same age (ÁTHS: 30.52 ± 5.25 ; HBSC: 29.45 ± 4.96 ; $p < 0.001$). No such difference was found for girls (ÁTHS: 28.71 ± 5.18 ; HBSC: 28.24 ± 5.13 ; $p = 0.1534$). For both genders, liking school was significantly higher among the students of ÁTHS. The proportion of boys (93% vs. 72%; $p < 0.001$) and girls (96% vs. 79%; $p < 0.001$) who reported liking their school was higher in the ÁTHS than in the national sample. Relationship with teachers was assessed on a scale of 4 to 20 points, while relationship with classmates was assessed on a scale of 3 to 15 points. Interestingly, satisfaction with teachers was significantly, by almost three points higher among students in the HBSC sample compared to those in the ÁTHS (ÁTHS: 10.06 ± 2.58 ; HBSC: 12.99 ± 3.36 ; $p < 0.001$). A similar result was found for satisfaction with classmates (ÁTHS: 9.13 ± 2.28 ; HBSC: 11.09 ± 2.51 ; $p < 0.001$).

Significant gender differences were found for all questions related to physical activity. Girls in the ÁTHS exercise significantly more than girls in the HBSC: 56% of girls in the ÁTHS exercise more than once a week, compared to 46% in the national sample ($p < 0.001$). No significant difference was found for boys ($p = 0.13$) but with an opposing trend. 69.4% of boys in the ÁTHS compared to 72.6% of boys in the HBSC exercise outside of physical education (PE) class at least once a week. When looking at the amount of time spent with physical activity per week, differences were found in both sexes. 45% of boys in the ÁTHS compared to only 34% of boys in the national sample exercise more than 3 hours per week ($p < 0.001$). This compares to 26% of girls in the ÁTHS versus only 15% of girls in the HBSC ($p < 0.001$). These results suggest that girls in this high school were more physically active outside of PE lessons than their counterparts in the national peer sample. Though boys at this high school are less frequently active but the overall duration of physical activity per week is longer compared to boys in the national sample. Most students of the school perform at least half of the physical activity recommended by the WHO.

The number of students who ate breakfast every school day was significantly higher in this high school than in the national sample (ÁTHS: 55.6%; HBSC: 43.7% $p<0.001$). Half of the high school students in 9th grade and 11th grade had ever smoked cigarettes, cigars or pipes, compared to 70% in the national sample ($p<0.001$). 85% of students in ÁTHS do not currently smoke but 6% of students smoke daily and 9% occasionally, while in the age-grade sample 62% of students do not smoke, 25% smoke daily and 13% occasionally ($p<0.001$). 43% of boys and 52% of girls in secondary school had never consumed so much alcohol so as to get drunk, while the proportion of boys and girls who had been drunk more than 10 times was 13% and 8%, respectively ($p=0.034$). The rates were also more favourable for girls in the national peer sample: 27% of boys and 37% of girls had never consumed alcohol to the point of becoming drunk, while the proportion of those who had been drunk more than 10 times was 28% for boys and 13% for girls. The proportion of binge drinkers was significantly lower among the high school students compared to the national peer sample for both sexes ($p<0.001$).

4.2.Short-term evaluation of interventions

The total number of students in the school was 1141 before the intervention. The questionnaire was completed by 947 students of whom 746 students in 9th, 10th or 11th grades participated in the baseline survey (average age 16.7 ± 0.92 years; 59.6% female). The 12th grade was excluded from the analysis to ensure comparability, as these students were no longer in the school at the time of the first follow-up (F1 in October 2011). The autumn evaluation was carried out among students in 10th, 11th and 12th grades of whom 630 students provided questionnaires eligible for analysis. Girls made up the majority of students in all grades (63.96%). There were no significant changes in leisure time and school physical activity compared to the baseline survey data. Analysing the composite indicator of physical activity – created as described in Methods – revealed that some students gave inconsistent answers. Therefore, only 261 students in the baseline survey and 249 students in the first follow-up (F1) could be allocated into one of the 3 categories of the variable. The proportion of boys doing intensive physical activity did not change ($d=-8.91\%$, $p=0.201$), while significantly decreased among girls ($d=-12.25\%$, $p=0.01$). A binary variable constructed as described in Methods was used to characterise the consumption of rarely recommended foods. There was a significant increase in the proportion of both boys (10.24%, $p=0.01$) and girls (6.06%, $p=0.04$) who never bought such rarely recommended food items in the school canteen. There was also an improving trend in breakfast and lunch consumption on school days at follow-up 1. The proportion of boys who ate breakfast increased by 5.29% and the proportion of girls who ate breakfast every school day increased by 2.68%. The proportion of students who ate lunch every school day increased for both sexes (3.98% for boys and 5.63% for girls, the latter showing a marginally significant improvement, $p=0.069$). The proportion of non-smokers decreased for both sexes by the time of the 1st follow-up (boys: -1.09%, girls: -1.92%), the proportion of daily smokers increased by 2.65% for boys and 1.48% for girls. The proportion who had never been drunk in their lives decreased (boys -5.42%, girls -4.10%), and the proportion who had been drunk more than 10 times increased (boys 10.89%, girls 0.58%). The prevalence of neither smoking nor binge drinking showed significant

change. Use of six types of drugs was assessed using a composite variable as described in Methods. Both boys (-4.66%) and girls (-2.45%) showed a non-significantly decreasing trend of never having used any of the six drugs. 1.80% fewer boys and 2.11% fewer girls spent 3 hours or more watching television per day at follow-up 1 compared to baseline, a non-significant improvement for both sexes. Time spent with computers also decreased for both sexes, more so for girls, with a 5.77% decrease in the proportion of girls using computers for more than 3 hours a day. The change in time spent on computers was not significant for either sex.

In terms of perceived health, there was an upward trend in the proportion of boys who rated their health as excellent (35.33% vs. 40.35%, $p=0.239$) and a significant improvement in the same proportion for girls (21.85% vs. 28.43%, $p=0.043$). Significant decrease occurred in the proportion of those who did not feel lonely in both genders (boys: $p<0.001$; girls: $p=0.056$). Life satisfaction and self-esteem did not change significantly between the surveys. Attitudes towards school were assessed using two variables. On an 11-point scale, students' attitudes showed a worsening trend ($d=-0.21$, $p=0.087$) after the intervention compared to that before. There was a significant, 3% decrease in the proportion of those who liked or very much liked school ($p<0.001$). There was no significant change in feelings towards teachers after the intervention compared to before (baseline: 13.76 ± 2.6 ; follow-up1: 13.49 ± 2.6 , $p=0.056$). Attitudes towards classmates marginally significantly worsened (baseline: 11.91 ± 2.27 ; follow-up1: 11.34 ± 2.45 , $p=0.056$). Students' perceived their school tasks to be significantly more difficult (baseline: 15.55 ± 29.6 ; follow-up1: 14.87 ± 2.9 , $p<0.001$) after the intervention compared to that before.

4.3. Long-term evaluation of interventions

The total number of students in the high school in April 2011 was 1141 of whom 947 students completed the questionnaire during the baseline survey. Of those, 265 students were in 9th grade at this time (61.5% female). These students were in 12th grade during the third round of follow-up, of whom 175 students submitted questionnaires eligible for evaluation (70.3% female). In order to carry out the long-term evaluation, 9th grade students at the baseline survey were compared to 12th grade students in the third follow-up (F3) (that is, students of the same study year were compared at baseline and three years later). In order to detect secular trends, 12th graders at follow-up 3 were compared with students in 9th-11th grades in the same survey (F3). Demographic characteristics of the students who participated in both the baseline survey and the third follow-up did not change significantly notwithstanding their age. At the time of the third follow-up, a significantly lower proportion of parents of 12th graders had at least a high school diploma but a significantly higher proportion lived in urban areas than parents of the 9th-11th graders in the same survey. There were no significant differences between groups in the subjective wealth of families. Attitudes towards school were measured by two variables. On an 11-point scale, both boys ($d=-1.18$ points; $p=0.001$) and girls ($d=-0.98$ points; $p=0.002$) had significantly worse attitudes towards school in 12th grade compared to 9th grade. Opinions of 12th grade students did not differ from those of 9th-11th graders in the final survey (F3). Attitudes towards school assessed on a four-

point scale significantly worsened for both sexes, with an 11% decrease in the proportion of boys and a 13.7% decrease in the proportion of girls who liked school much or very much ($p < 0.001$ for both sexes). The opinion of boys in 12th grade at the final survey (F3) was significantly better than that of boys in 9th-11th grades in the same survey. There was no significant change in feelings about teachers by the time of the final survey (F3) (boys baseline survey: 14.7 ± 2.8 points; F3: 14.7 ± 2.8 points, $p = 0.425$; girls baseline survey: 14.4 ± 2.3 points; F3: 13.5 ± 2.8 points; $p = 0.745$). At the time of the final survey, 12th graders' attitudes towards school did not differ from those in 9th-11th grades. Attitudes towards classmates significantly worsened by the time of the third follow-up, however, 9th-11th graders' opinions of their classmates were significantly better than 12th graders' opinions of their classmates at F3. The opposite trend can be observed in the perception of the difficulty of school tasks. Students in the baseline survey perceived school tasks as significantly easier compared to the time of the third follow-up (boys: $p = 0.028$, girls: $p < 0.001$). At the third follow-up, 9th-11th graders perceived their school tasks as significantly more difficult than 12th graders.

Comparing data of the baseline and third follow-up surveys, boys showed a significant deterioration in all three indicators of physical activity, while girls, although they exercised significantly less often in their leisure time, spent significantly longer time exercising per week at the time of the third follow-up survey than at the baseline survey. All three indicators of physical activity in both sexes were significantly more favourable at the time of the third follow-up for 9th-11th graders than for 12th graders. At baseline, 69% of boys and 48% of girls were classified as vigorous exercisers, while at F3, only 45% of boys and 20% of girls were allocated in the same category ($p < 0.001$ for both sexes). However, at follow-up 3, students in 9th-11th grades showed significantly higher rates of vigorous physical activity than their peers in 12th grade ($p < 0.001$ for both genders).

Consumption of rarely recommended food items decreased significantly for both genders by F3. The proportion of boys in 12th grade eating foods recommended for infrequent consumption was significantly lower than that of their peers in 9th-11th grades, while girls had foods recommended for infrequent consumption significantly more often than their peers in 9th-11th grades. The proportion of eating breakfast on all school days decreased from the baseline survey to Follow-up 3 (boys 57% vs 52%; girls 60% vs 54%, both sexes $p < 0.001$). At F3, boys in 9th-11th grades ate breakfast significantly more often (58%, $p < 0.001$) and girls significantly less frequently (47%, $p < 0.001$) compared to their peers in 12th grade. In terms of lunch on school days, at follow-up 3, a lower proportion of 12th grade boys and girls ate lunch every school day compared to at baseline, but at F3, an even lower proportion of 9th-11th graders ate lunch every day compared to 12th graders. Among both boys and girls, the proportion who had never used drugs before the programme was 96% which did not significantly change by Follow-up 3 (boys 88%, $p = 0.058$; girls 94%, $p = 0.212$). At F3, the proportion of abstainers from drugs among 9th-11th graders (boys 93%, $p = 0.144$; girls 96%, $p = 0.195$) was similar to their 12th grade peers. Prior to the programme, 53% of boys and 62% of girls had never been drunk; this decreased to 16% and 32%, respectively by F3 (both sexes:

$p < 0.001$). At Follow-up3, the proportion of abstainers from alcohol was significantly higher among 9th-11th graders than 12th graders (both sexes: $p < 0.001$). 90% of boys and 91% of girls were non-smokers at the baseline survey which decreased to 73% and 80%, respectively by F3 ($p = 0.001$ for both sexes). At Follow-up3, a significantly higher proportion of 9th-11th graders were non-smokers than their 12th grader counterparts. At the time of the baseline survey, only 1.02% of boys considered themselves to be lonely, compared to none of the girls. There was no significant change in loneliness in either gender at Follow-up3 (boys: $p = 0.434$; girls: $p = 0.419$). No significant difference was found comparing 12th grades with 9th-11th graders at F3 (boys: $p = 0.367$; girls: $p = 0.418$). There was no change in life satisfaction before and after the programme (boys: baseline: 8.1 ± 1.3 points; F3: 7.8 ± 1.7 , $p = 0.254$; girls: baseline: 8.04 ± 1.5 points; F3: 7.9 ± 1.6 points; $p = 0.319$), as well as self-esteem (boys baseline: 30.7 ± 4.9 points; F3: 30.8 ± 6.05 points; $p = 0.907$; girls: baseline: 28.43 ± 4.7 points; F3: 29 ± 5.5 points; $p = 0.361$). Considering both variables, the results of 12th graders in the third follow-up did not differ significantly from those of 9th-11th graders. Before the programme, 95.1% of boys and 84.1% of girls thought their health was excellent or good; this decreased by 12.4% for boys and 4.4% for girls by F3 ($p < 0.001$ for both sexes). At the time of the third follow-up, 9th-11th graders perceived their own health significantly more favourably than those of 12th graders at the same time ($p < 0.001$ for both sexes).

4.4. Physical activity in relation to life satisfaction

Creation of a pooled database

Life satisfaction was not related to the date of the surveys (baseline: 7.83 ± 1.50 ; first follow-up: 7.98 ± 1.57 ; second follow-up: 7.95 ± 1.60 ; third follow-up: 7.90 ± 1.53 ; $p_{\text{trend}} = 0.157$). Therefore, all four surveys were pooled to create a large sample ($N = 3450$). Response rates were 77.67% for the baseline survey, 70.41% for the first, 60.41% for the second, and 64.36% for the third survey, calculated from the total number of registered students in each survey year. This pooled database was used subsequently to investigate the association of life satisfaction with other variables and modelling. As described in Methods (chapter 3.5), life satisfaction could be considered as a normally distributed continuous variable.

Characteristics of students in the pooled database

There was no difference in gender distribution ($p = 0.607$), permanent residence ($p = 0.682$), and perceived family wealth ($p = 0.276$) by survey year, so these variables are described for the pooled sample. Girls comprised the majority in all grades in all survey years. In all survey years, more girls than boys completed the questionnaire with proportions ranging from 54.05% to 70.29%. 77.6% of the students were city dwellers, 22.4% lived in villages or farms with no significant gender difference in permanent residence ($p = 0.071$). 29.7% of the students lived in families perceived to be well or very well off, 63.5% perceived their families as average, whereas 6.8% of them lived in families not so well or not at all well off. This was not different ($p = 0.199$) from those in 9th and 11th grades in the national HBSC sample of 2014.

Satisfaction with life showed no significant change over time (boys: $p=0.30$; girls: $p=0.31$). However a decreasing trend was observed from Grade 9 to Grade 12 for boys (grade 9: 8.09 ± 1.5 ; grade 10: 7.98 ± 1.52 ; grade 11: 8.09 ± 1.5 ; grade 11: 7.98 ± 1.52 ; grade 11: 8.09 ± 1.5). Grade 11: 7.88 ± 1.57 ; Grade 12: 7.64 ± 1.73 ; $p<0.001$) and girls (Grade 9: 8.12 ± 1.45 ; Grade 10: 7.91 ± 1.50 ; Grade 11: 7.86 ± 1.53 ; Grade 12: 7.85 ± 1.55 ; $p=0.018$) without significant difference between genders in any grade. There were no significant differences by survey year in the distribution of physical activity (survey2: $p=0.959$, survey3: $p=0.553$, survey4: $p=0.390$ compared to survey1). However, this was not true for grade so physical activity was analysed by grade and gender. Physical activity was assessed by 3 separate items which were used to allocate students into one of 3 categories (vigorous, moderate, inactive) of a composite variable created as described in Methods. Consequently, only those students could be allocated in the composite variable who gave consistent answers to all 3 questions (38% of those who answered all 3 single-item questions on PA). The proportion of those who were vigorously active per week showed significant gender difference with male advantage in all grades ($p<0.001$ for all grades), and decreased from Grade 9 to Grade 12 by 15.31% among boys, and by 30.43% among girls. Even more dramatic is the rise in the proportion of inactive students by 37.2% among boys and by 67% among girls ($p<0.001$ for both).

Correlation of variables

Life satisfaction, gender, type of permanent residence, perceived family wealth, physical activity, body mass index, self-esteem and survey years were tested by Spearman correlation. Body mass index not being correlated with life satisfaction was omitted but gender was kept in further analysis. Date of survey was not significantly correlated with life satisfaction but in further investigation by hierarchical regression, date of survey was defined as random effect, and gender, type of residence, perceived family wealth, grade, composite PA and self-rated health as fixed effects. The hierarchical model was not significantly different from one-level ordinary linear regression (OLS) ($p=1.000$).

Model selection

To identify the best model, ordinal linear regression with and without robust variance, and heteroskedastic linear regression were performed. The rationale for model selection was to compare the appropriateness of the composite variable of physical activity with the 3 single items of physical activity. In each model, life satisfaction was the output (dependent) variable, and independent covariates were identical (gender, type of permanent residence, subjective family wealth, school grade, subjective health). The first 3 models (Models 1-3) included the composite variable of physical activity using different regression techniques as described above. Based on the smallest Akaike information criterion (AIC) and the largest explained proportion of variance, linear regression with robust variance estimation (Model 2) proved to be the most appropriate. The same regression model was carried out replacing the composite indicator with each of the 3 single items of PA (Models 4-6). All of these produced lower explanatory power and much larger AIC, supporting the choice of the composite indicator as an appropriate estimator of PA. Subsequently, the best model (Model 2) was used to describe

determinants of life satisfaction (LS). Independent variables were arranged by order of decreasing effect on LS according to the standardized beta coefficients: good self-reported health (as opposed to bad) increased life satisfaction by 0.30 standard deviation; having very well or well-off family (as opposed to not well-off) increased LS by 0.16 standard deviation; and being inactive decreased LS by 0.1 standard deviation (as opposed to being vigorously active). Moderate activity and other independent variables (city as permanent residence compared to village, girls compared to boys, and grades 10, 11 or 12 compared to grade 9) had no significant effect on life satisfaction.

4.5. Impact of self-esteem and school psychosocial factors on life satisfaction

We used the same pooled database for this analysis that was described in the previous chapter (chapter 4.4) (N=3450). Life satisfaction could be considered as a normally distributed continuous variable. In a bivariate analysis, satisfaction with life by school grade (study year) was described using a nonparametric Kruskal-Wallis test. We observed a significant decrease of 0.33 points in the pooled data from grade 9 to grade 12 in the bivariate analysis (grade 9: 8.10 ± 1.47 ; grade 10: 7.94 ± 1.50 ; grade 11: 7.86 ± 1.55 ; grade 12: 7.77 ± 1.6), $p < 0.001$). A negative linear fit was found between life satisfaction and grade. There were no differences in gender distribution ($p = 0.607$), type of permanent residence ($p = 0.682$) and perceived family wealth ($p = 0.276$) between survey years in the bivariate analysis. These variables were described for the full sample in the previous chapter (Chapter 4.4).

Model selection

In order to select independent variables for modelling, Spearman correlation was used to check correlation between life satisfaction and demographic, individual and school-related psychosocial variables. Gender showed no correlation with life satisfaction ($p = 0.707$) but showed significant correlation with self-esteem ($p < 0.001$) so it was kept in further models along with other variables significantly associated with life satisfaction. Demographic binary variables such as gender, place of residence and perceived family wealth; individual psychosocial variables such as self-esteem, perceived loneliness, and self-rated academic achievement; and variables of the school psychosocial environment such as perception of teachers and classmates, difficulty of schoolwork, and general attitude to the school, as well as grade as a proxy of age were included in all models. To find the best model for predicting life satisfaction, model selection was performed taking into account the heteroskedasticity of life satisfaction by self-esteem ($p < 0.001$). Each of the five models included all independent variables, and differed by method of regression, estimation of variance (standard error), self-esteem in a supposed linear or nonlinear association with LS, and interactions. The best model to estimate life satisfaction based on the smallest Akaike information criterion was Model 5 described below.

Independent variables of life satisfaction

Model 5 applied heteroskedastic regression, robust estimation of variance, supposed nonlinear correlation between LS and self-esteem, and included interactions. Self-esteem significantly interacted with some school-related psychosocial covariates such as perception of classmates ($p < 0.001$), difficulty of schoolwork ($p < 0.001$), and gender ($p < 0.001$). Perception of teachers ($p = 0.150$) and general attitude to school ($p = 0.407$) were not significantly correlated with self-esteem so only their main effects on LS were analysed. Family wealth perceived as well-off compared to not well-off proved to be major determinant of life satisfaction since perceived well-off family status was associated with 0.35 points increase in life satisfaction ($p < 0.001$). Self-esteem was another important determinant of life satisfaction: one point increase in self-esteem was associated with 0.23 points increase in life satisfaction ($p < 0.001$). Being considered a good student was associated with 0.17 points increase in LS compared to being a not good student ($p = 0.003$). Favourable perception about classmates ($b = 0.11$; $p = 0.047$), favourable general attitude to school ($b = 0.09$; $p < 0.001$), and favourable perception of teachers ($b = 0.03$; $p = 0.016$) had smaller but significant positive effects on LS. In opposition, perceiving schoolwork to be more difficult decreased life satisfaction ($b = -0.17$; $p = 0.004$), and being lonely sometimes or often was associated with a large, 0.58 points decrease in life satisfaction compared to those who were never lonely ($p < 0.001$). Being girl (compared to being boy) ($p = 0.847$), living in a city (compared to a village) ($p = 0.062$), or grade ($p = 0.153$ or greater for all four years) had no significant association with LS. In terms of interactions, difficulty of schoolwork on LS was significantly modified by self-esteem so that the negative effect on LS of one point increase in perceived difficulty of schoolwork was largest at the lowest level of self-esteem (at score 10: $b = -0.125$, $p = 0.001$) compared to higher scores (at score 20: $b = -0.084$, $p < 0.001$; at score 30: $b = -0.042$, $p < 0.001$) whereas the difficulty of schoolwork had no impact on life satisfaction at the highest level of self-esteem ($b = -0.001$, $p = 0.951$).

Association of the perception of classmates with LS was also modified by self-esteem. Among those with the lowest score of self-esteem (score of 10), 1 point increase in the positive perception of classmates predicted a significant, 0.083 point increase ($p = 0.035$) in life satisfaction but this effect decreased with increasing self-esteem: at the self-esteem score of 20, 1 point increase in the perception of classmates predicted 0.052 point increase in LS ($p = 0.017$) which tapered off (at score 30: $b = 0.02$, $p = 0.045$) and disappeared at the highest level of self-esteem (at score 40: $b = -0.010$, $p = 0.608$). In other words, the positive effect of favourable perception of classmates on life satisfaction was strongest among those with low self-esteem but tapered off as self-esteem increased.

Self-esteem also modified the effect of gender on life satisfaction though the overall effect of gender on LS was not significant in the regression model. Gender had no effect on LS at the lowest scores of self-esteem (at score 10: $b = 0.033$, $p = 0.877$, at score 20: $b = 0.128$, $p = 0.280$) but became significant determinant at higher levels of self-esteem (at score 30: $b = 0.223$, $b < 0.001$; at score 40: $b = 0.318$, $p = 0.003$) so that girls had higher life satisfaction compared to boys when their self-esteem was equal.

5. Discussion

Our study presents a series of repeated health surveys that enabled the evaluation of a comprehensive school health promotion programme implemented by a high school in Debrecen, also providing an opportunity to identify variables that predict changes in life satisfaction.

Comparing the results of the baseline survey with that of the national age group, students in Árpád Tóth High School (ÁTHS) live in families with better socio-economic status than students in HBSC. The subjective health, loneliness, life satisfaction and health behaviour and school-related attitudes of students in ÁTHS are more favourable compared to the characteristics of national peers. The self-esteem of boys attending Árpád Tóth High School was significantly more favourable than that of boys in the HBSC, with no significant difference for girls. On the other hand, attitudes towards teachers and classmates were significantly better among students in the national sample compared to students in our high school. This only partially supports our first hypothesis that students participating in the health promotion programme have significantly better health status, more favourable health behaviour, and better attitudes towards school compared to that of the national age group.

To analyse the short-term impact of the programme, quantitative evaluation was used to compare the health status and health behaviour of students before (baseline survey) and 4 months after the intervention (Follow-up 1 or F1). The proportion of students in excellent health increased; there were significant improvements in eating habits, such as never purchasing snacks for consumption at school. However, the proportion of inactive students increased compared to the baseline survey. This partially supports our second hypothesis that students participating in the health promotion programme have significantly better health status, more favourable health behaviours and better school-related attitudes after the programme than before.

Long-term evaluation was carried out to reveal the impact of the programme 3 years after by comparing appropriately matched groups. Students who participated in the programme as 9th graders were followed through until the third follow-up (F3) when they were already in 12th grade. There was a significant reduction in the consumption of rarely recommended foods among 12th grade students; they rated their schoolwork as easier than at the baseline survey, when they were in 9th grade. Attitudes towards school significantly worsened for both sexes on two of the indicators tested, a possible secular trend that the programme could not influence. The proportion of physically inactive students significantly increased from 9th grade to 12th grade. There was a significant decrease in the time and amount of physical activity in leisure time and at school, a decrease in the proportion of pupils who ate breakfast and lunch on school days, a decrease in the proportion who never drank alcohol, and a significant increase in the proportion who smoked. Attitudes towards classmates also deteriorated for both sexes. However, the negative trends observed in physical activity and psychoactive substance use can be considered as secular and could not be reversed by the programme. There was a significant decrease in the proportion of boys who rated their health as excellent or good, and both girls and boys had more negative perception of their classmates. There were no significant changes in students' drug use, opinions of teachers, loneliness, life satisfaction and self-esteem. Perceived health among girls did not change

significantly. Our third hypothesis, that significant changes described in the short-term are still detectable at the end of the follow-up, was also only partially supported.

As described in the Methods, records of the four cross-sectional surveys were pooled into one database thereby making the data suitable for examining the demographic, behavioural, and psychosocial determinants of life satisfaction.

Perceived health and subjective family well-being were shown to be strongly significant positive, and physical inactivity as significant negative factor of life satisfaction, without gender differences. Demographic variables such as type of permanent residence, gender, and school grade had no impact on LS. This answered the 4th research question. Life satisfaction was strongly positively associated with self-esteem and the following variables of the school psychosocial environment: being a good student, and having a positive attitude towards school. In addition to the significant main effect, self-esteem moderates the effect of difficulty with schoolwork and attitudes towards classmates on life satisfaction, more strongly at lower levels of self-esteem, and tapering off at the highest level of self-esteem. Gender had no effect on life satisfaction at the lowest level of self-esteem but became significantly positive at higher levels implying that girls were more satisfied with life than boys when their self-esteem was equal.

One of the advantages of our study was that all four cross-sectional studies were conducted using the same methods that was identical to that of the Hungarian HBSC study. This allowed comparisons between study years, and with the national representative sample of the peer groups as well. All students were invited to fill the questionnaire at each data collection time, and a high response rate was achieved thus reducing the selection bias potentially inherent in sample selection.

The intervention programme organised in the school addressed all the main dimensions of school health promotion, including health education, ensuring daily physical education for students in the school, introducing them to person-centred pedagogical methods, and familiarising teachers with different conflict management methods. The programme was supported by the teaching staff and the school administration.

One limitation of the health promotion programme was the six-month delay in the planned start due to reasons beyond the control of the school management which reduced the implementation period from one year to six months, and the fact that the daily physical education could only be optional. This likely reduced the impact of the programme but changes in the school curriculum and the person-centred pedagogical methods implemented through teacher training were expected to have a long-term impact on students. Only students with parental consent were allowed to participate in the evaluation. Students whose parents declined to participate or did not fill out the parental consent form or were absent from school on survey days may have differed from other students in terms of life satisfaction but given the satisfactory participation rate (60-78%) and the repeated data collections, valid estimates could be made for this population. Not applying qualitative methods, and omitting teachers and parents from the evaluation due to constraints in finances, human resources and time were immutable shortcomings of the study.

Due to the setting, a further limitation of the study is that extension of the results to other educational institutions is limited. When comparing the baseline survey data with the national

mean of peers, students attending the TÁG had significantly more favourable socio-demographic characteristics than their counterparts in the nationally representative (HBSC) survey. It must be taken into account that TÁG is a good school as evidenced by its 19th place in the public school ranking of 2012. Therefore, the question arises to what extent can these students and their attitudes be considered “average”; for example, it may be supposed that students from 'good' schools with high prestige have higher expectations of their school than students from less good schools. The Hungarian HBSC report of 2010 provides further evidence to support this hypothesis. In that report, comparison of 9th and 11th graders by different types of schools showed that students in secondary schools offering A-levels were less satisfied with their teachers than students in schools offering no A-levels. Conversely, attitudes towards classmates were significantly less favourable among students attending vocational schools and apprenticeship training compared to their counterparts attending vocational secondary schools or upper secondary schools.

A further limiting factor is that repeated cross-sectional studies do not allow causal links to be identified. When examining explanatory factors for life satisfaction, the pooling of records taken at different points in time produced a relatively large sample which, with the best selected model, compensated for potential estimation problems related to life satisfaction, such as the conditionally normal outcome variable and unequal error variance in the OLS model. Nevertheless, standard errors still may have distorted the results. Another limiting factor was the use of the composite variable of physical activity which resulted in loss of information as this variable could be generated only for one-third of the total sample. However, the inclusion of students only with consistent responses probably increased the reliability of the results.

5.1. Secular trends in adolescents' health behaviour and health status in international and national contexts

A time-series analysis of HBSC surveys from 2001 to 2014 presented by the World Health Organization's European Regional Office presents a time-series analysis of health behaviour. The frequency of daily fruit consumption shows a decreasing trend with age and girls consume more fruit than boys. Sugar-containing soft drinks are consumed more by boys and older students. The prevalence of smoking at least once per week has been increasing, and in some countries is male-dominated. No clear secular trends in the prevalence of binge drinking was found but in half of the participating countries, boys were more likely to binge drink than girls. The amount of physical activity decreases with age, and there has been a trend for boys to be more active. This is supported by the following studies. A large, pooled analysis of data from nearly 300 studies found that the majority of adolescents worldwide do not get the recommended frequency and intensity of physical activity, and although the frequency of physical inactivity declined significantly for boys, there is no change for girls. HBSC data from 32 countries found that overall levels of physical activity were low and declined with age among school-age children over the past two decades. Physical activity in the US National Health and Nutrition Examination Survey also declined from childhood to adolescence (6-19 years) in both sexes.

Reviewing data from the Hungarian HBSC surveys between 2001 and 2018, the

following trends in adolescents' health behaviour can be observed (without information on trends by increasing age). The proportion of daily fruit consumption increased until 2014 survey, then showed a significant decrease. There was a marked increase in the consumption of sugary drinks up to 2014, mainly among boys, but this changed to an improving trend by 2018. The proportion of pupils who had breakfast every school day significantly fell by 6% by 2018 compared to 2014. Daily consumption rates of sweets during the same period also decreased by 6% but the proportion of overweight students still showed an increase of 5-6%, averaging around 23% in 2018 (fluctuating around 15-18% between 2000 and 2014). The proportion of adolescent girls who exercise at least one hour a day at least with moderate intensity steadily increased, albeit with some blips, until 2018, but among boys there was an improvement only until 2014 after which there was a downward trend. The proportion of daily smokers increased until 2010, then decreased significantly by 2014 and has since stagnated. The proportion of those who had been drunk at least twice in their lifetime shows a similar pattern, increasing until 2010 and decreasing thereafter. Overall, less than one-fifth of 5th-11th graders are at the recommended level of physical activity for their age. Rates of substance use were similar to those seen previously: one in eight adolescents smoked at least once a week, 40% had consumed alcohol in the month before the survey, and 25% of secondary school students had tried some drugs in their lifetime. More than a third of students in 5th-11th grades had been drunk in their lifetime, but this is a decreasing trend compared to previous surveys. Health perceptions among Hungarian teenagers have worsened over the past four years, with 25% of them saying their health is not good. Both sexes but especially girls show a high proportion of regular experience of various physical and mental symptoms (fatigue, irritability, moodiness, nervousness), and a third of students report various mood problems and depressive feelings.

5.2. The current state of holistic school health promotion in the country

The strategy "Healthy Hungary 2014-2020" set out the main public health objectives and actions in line with the Constitution among which one of the most important interventions is the holistic institutional/school health promotion (hereinafter abbreviated as HIHP). HIHP is the umbrella term for institutional actions to promote and maintain health promotion, health-conscious behaviour, effective disease prevention and health literacy.

The widespread dissemination of whole-school health promotion and the implementation of programmes designed on the basis of this concept is an important way to improve physical and mental health in the national school system. International and national evidence suggests that it is preferable to integrate interventions into the public education system rather than to implement them on an ad-hoc project basis. There is a number of relevant governmental legislation toward this goal such as the regulation of the supply of school canteens (Decree of the Minister of Education No. 32/2005), the Act on the protection of non-smokers (Act XLII of 1999 on the protection of non-smokers and on certain rules of consumption and distribution of tobacco products), the 2011 Act CXC on National Public Education, which also provides for – among others – daily physical education; the Ministry of Human Resources Decree 20/2012 on the operation of educational institutions and the naming of public educational institutions, which describes the activities of comprehensive school health promotion; as well

as the National Curriculum renewed in 2012; and the 2014 Ministry of Human Resources Decree on public catering. These legal acts are complemented by the supporting role of school health care in Act CLIV of 1997 on health care, § 42.1, and by the Act CXXIII of 2015 on primary health care, Decree 26/1997 (IX.3) Ministry of National Wellbeing on school health care, and Decree 51/1997 (XII.18) Ministry of National Wellbeing on health services for the prevention and early detection of diseases and on the certification of screening tests covered by health insurance.

According to the national and international literature, holistic school health promotion can improve learning outcomes; reduce school drop-outs and improve school performance through promoting social inclusion and equal opportunities. However, it can also contribute to the primary prevention of chronic non-communicable diseases through the primary prevention of smoking, alcohol, drug use and other addictions, and through improving resilience, stress management and problem solving. Mental health development can be achieved through improved self-awareness and self-esteem, the development of a mature, autonomous personality, and improved social relationships with peers, parents and teachers. Considering all these, the effective implementation of comprehensive school health promotion is a national goal from the viewpoint of public health, national education and the entire society.

The State Secretariat for Education has been continuously working for the expansion of HIHP. The renewal of the national curriculum for public education and of the pedagogical methods in several large public education projects also significantly contribute to the implementation of HIHP. A National Coordinator was appointed by the State Secretariat for Health in 2018 thereby rejoining the country to the WHO „Schools for Health in Europe” (SHE) network. Various actors in public health and the relevant sectors of the Ministry of Human Resources have been working on the further development of intersectoral support for HIHP. The Office of Education created an online questionnaire to facilitate the follow-up of HIHP which will hopefully help the evaluation of all implemented projects.

5.3. Recommendations for increasing the effectiveness of school health promotion and further research

Based on the lessons learned from the above programme and taking into account international recommendations, the following recommendations are made to improve the effectiveness of school health promotion.

1. When designing school health promotion projects, relevant national legislation, HIHP recommendations, lessons learned from implemented national programs and good practices should all be taken into account.
2. It is recommended that interventions should have a minimum duration of 1 year to maximise impact.
3. Project planning and implementation should be carried out in several schools or networks of schools in order to separate the impact of the programme from secular trends and school-specific factors during evaluation.

4. Conditions for daily and compulsory physical activity should be provided, combined with regular and systematic monitoring of the physical status of students.
5. In addition to population-level follow-up, follow-up of individual students should be carried out; therefore it is proposed that data collected through different methods (questionnaire or physical fitness assessment) should be coded in a way that precludes personal identification during data analysis but changes in the condition of individual students be possible to follow during their school career.
6. The evaluation of projects and programmes should cover all elements of the intervention and all target groups, including not only the health status, behaviour and school performance of students but also the health status and educational performance of teachers.
7. The evaluation should apply quantitative and qualitative methods as well; and in order to detect long-term impact, monitoring should be carried out for several years after the end of the programme.
8. When planning school health promoting programmes and projects, evaluation should also be planned and budgeted for as part of the HIHP plan.

6. New Results

1. In the short-term evaluation of the programme, we found an increase in the proportion of students with excellent self-rated health and a significant improvement in eating habits, but also an increase in the proportion of inactive students compared to before the programme.
2. The programme has been shown to reduce the consumption of rarely recommended foods over the long term. The negative change in attitudes towards school and classmates, the increase in physical inactivity and the increase in the frequency of substance consumption can be considered as a secular trend which this programme could not counteract.
3. Perceived health, self-esteem, and subjective family well-being were shown to be highly significant positive determinants of life satisfaction for both boys and girls in our study.
4. Physical inactivity, difficulties with schoolwork, and loneliness are significant negative determinants of life satisfaction among boys and girls alike in our sample of high school students.
5. Self-esteem is not only a direct determinant of life satisfaction but also a moderator of the effect of difficulties of schoolwork and attitudes towards classmates on LS. The moderating effect is most pronounced at lower levels of self-esteem and disappears at its highest levels.
6. Gender had no effect on life satisfaction at the lowest level of self-esteem, but became significant determinant at higher levels of self-esteem, such that girls were more satisfied with their lives than boys when having the same high level of self-esteem.

7. Summary

The concept of health promoting schools approved by the World Health Organization in 1996 called for integrated school health promotion programs. Such a program was implemented in a high school in Debrecen in 2011. In order to evaluate the program, four cross-sectional questionnaire surveys were carried out inviting all students of the school: one before the intervention (baseline survey), and three more at the beginning of the subsequent 3 academic years (follow-up surveys). The survey included items and scales taken from the Hungarian questionnaire of the Health Behaviour in School-aged Children on demographic data, general and mental health, health behaviour, as well as the psychosocial environment of the school including the students' feelings about the school, their teachers, and classmates.

Using the collected data before and after the programme, we investigated the characteristics of the students compared to the national features of the same age group; we carried out the short- and long-term evaluation of the programme; and after pooling the data of all four surveys (N=3450), we identified the independent variables of life satisfaction. Statistical analysis was carried out with STATA 16.0. Two-sample t-test was used for continuous variables, and chi-square test for categorical variables. Various types of linear regression were tested to identify the best model for predicting life satisfaction, such as ordinary and heteroskedastic linear regression, ordinary and robust variance estimation, linear and nonlinear association between certain covariates, and testing interactions.

The short-term evaluation showed improved subjective health and better nutritional habits after the intervention but an increased proportion of physically inactive students. The long-term evaluation was based on a survey carried out in the 3rd year after the intervention; this revealed that a lower proportion of the students consumed rarely recommended food items and reported their schoolwork to be less difficult compared to the baseline. Life satisfaction had a significant positive correlation with subjective health, subjective family wealth, and self-esteem, while negative correlation was seen with physical inactivity, difficulty of schoolwork and loneliness. Self-esteem was also a modifier for the effect of certain variables of the psychosocial school environment on life satisfaction.

The integrated school health promotion program aimed at addressing all major dimensions of school health including health education on nutrition, provision of daily physical education in the school for students, personal development, and conflict management among teachers. In addition, the program was supported by the school leadership. The limitations of the evaluation, such as the single-school implementation, the quantitative evaluation limited to students does not allow the extrapolation of the results to all high school students in Hungary, and separating the effect of the program from secular trends is restricted. However, the long follow-up and the large sample size of the pooled records allowed a reasonably reliable estimation of life satisfaction.

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10. Publications in support of the thesis



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List of publications related to the dissertation

1. **Lábiscsák-Erdélyi, Z.**, Somhegyi, A., Veres-Balajti, I., Kósa, K.: Bad for Girls and Boys: gender Does Not Modify the Negative Effect of Physical Inactivity on Life Satisfaction in Adolescents. *Front. Public Health*. 10, 1-8, 2022.
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2. **Lábiscsák-Erdélyi, Z.**, Veres-Balajti, I., Somhegyi, A., Kósa, K.: Self-Esteem Is Independent Factor and Moderator of School-Related Psychosocial Determinants of Life Satisfaction in Adolescents. *Int. J. Environ. Res. Public Health*. 19 (9), 1-14, 2022.
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List of other publications

3. **Lábiscsák-Erdélyi, Z.**, Daragó, L., Somhegyi, A., Kósa, K.: Egy debreceni középiskola tanulói egészségmagatartásának összehasonlítása az országos korosztályos jellemzőkkel. *Népegészségügy*. 94 (1), 33-43, 2016.

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