Coll. Antropol. **37** (2013) 4: 1089–1094
Original scientific paper

Influence of Health Education Regarding Correct Diet on Anthropometric Indexes in Children

Vesna Bilić-Kirin[1,2], Jelena Burazin[1], Vesna Buljan[1], Valerija Miličić[2] and Rudika Gmajnić[2]

[1] Department of School Medicine, Institute of Public Health for the Osijek-Baranja County, Osijek, Croatia
[2] University »Josip Juraj Strossmayer«, School of Medicine, Osijek, Croatia

A B S T R A C T

Obesity is one of the leading public health issues in the world whose significance lies, not only in its prevalence, but also in its consequences i.e. diseases that gradually develop in obese people. The aim of the study was to determine obesity prevalence among school children and the influence of health education on its prevalence. Study included pupils of 19 first grades in 8 primary schools of Osijek-Baranja County, Croatia. Body weight and height, waist and hip circumference were measured. Parameters for assessing obesity: body mass index (BMI, according to Croatian referral values), waist circumference (WC), waist and hip circumference ratio (WHR) and waist circumference and height ratio (WHtR) were measured. In order to determine whether the health education of pupils and their parents influences children's anthropometric indexes, health education regarding correct diet, obesity and its consequences and the need for life style changes in terms of daily physical activity was conducted in four primary schools. Pupils of other four primary schools were measured as a control group. Prevalence of overweight children according to BMI before education was 8.9% (6.5% of overweight and 2.4% of obese children). In intervention group of children, according to BMI, there was no decrease in proportion of obese after the health education was conducted and prevalence was 2% before and after the education. On the second measurement, pupils in control group showed increase in proportion of obese from 2.9% to 3.5%. According to weight circumference and height ratio before education there were 10.2% of obese children. After six months, there was an increase in proportion of obese to 11.3%. According to this index there was an increase in proportion of obese in all groups of pupils regardless of gender and conducted education. This study shows that in school-based obesity programs it is necessary to apply more intense interventions with another type of methodology; program should be conducted continuously during longer period, otherwise this condition will continue to rise.

Key words: *school children, overweight, obesity, health education, anthropometric index*

Introduction

Obesity is one of the leading public health issues in the world, whose significance lies, not only in its prevalence, but also in its consequences i.e. diseases that gradually develop in obese people. During 20th century increase of life standard and life style changes caused obesity pandemics[1]. Obesity in children is associated with large number of cardiovascular disorders, fat metabolism disorders and glucose intolerance in adult age. Obesity is associated with higher incidence of certain malign diseases (colon, breast, prostate), orthopedic anomalies, sleep apnea. Beside mentioned organic disorders, obese children more often have psychological problems during growing-up, low self-esteem and emotional instability[2]. Research showed that childhood overweight or obesity was predictive of type 2 diabetes, hypertension, dyslipidemia, and high-risk carotid intima–media thickness in adulthood. The data also showed that persons who had normal BMI in childhood but who became obese as adults had adverse risk-factor profiles, whereas those who were overweight or obese as children but who became non-obese as adults had a cardiovascular-risk profile that was similar to that of persons who were never obese[3].

According to WHO, there are around 43 million of overweight or obese pre-school children in the world. In European region, where in average around 24% of children aged 6 to 9 years are overweight or obese, situation is extremely serious[4,5]. Comparisons between USA, Great Britain and France showed that there between 9.7% and 16.1% of obese, and between 21.7% and 34.2% over-

Received for publication May 9, 2010

weight children. Girls are more obese than boys[2,6]. Authors of study warn about difficulties in comparing data of different international studies. Namely, comparison of overweight and obese children is much more difficult than of adults due to lack of adjusted international criteria for children. According to data from Croatian health-statistical annual for 2010 on nutritional status of school children aged 7 to 14 years measured by anthropometric index weight for height, there were 13.97% of boys and 12.3% of girls with values above 90th percentile. Comparing that to same data from school year 2005/2006 there has been an increase in overweight children[7].

Today's children often have incorrect attitude towards food, they eat small amounts of fruits and vegetables, milk and milk products, and ingest large amounts of fast-food, sweets, snacks and gassed juices. On the other hand, they are less physically active, exposed to sedentary lifestyle in front of TV and computer. This leads to obesity or food disorder. Jureša et all reported that obese and overweight children in Croatia come from families with higher levels of education[8]. Parents have major role in creating or preventing incorrect dietary habits. Child that is obese in early age will have more difficulties in losing weight than individual that got obese later in life. Risk of obese children for becoming obese adults is two time higher than risk of non-obese children. Furthermore, one third of obese pre-school children become obese adults and one half of obese school children become obese adults. Clearly, correlation between obesity in childhood and adulthood is increasing with growing-up. Idea that obesity is predetermined in infanthood with the number of fatty cells is no longer sustainable since obese infant often does not become obese child. However, obesity at age of 13 years is a good indicator of obesity in adult age, and period from age 7 to 12 is the most suitable for prevention programs[2,9]. One of program measures is health education. Health education is a health care measure that, by developing healthy and changing harmful behaviour, and by teaching and informing about health procedures, helps to improve health, prevent, treat and alleviate consequences of a disease[10]. More successful are interventions that include parents. Despite efforts undertaken by international organizations and national governments for promotion of awareness of a problem concerning body weight and obesity in childhood in most European countries there has been an increase in number of obese children.

Different anthropometric indexes are used for assessment of obesity and distribution of fat tissue: body mass index (BMI), waist circumference (WC), waist and hip circumference ratio (WHR), waist circumference and height ratio (WHtR). Value of different anthropometric indexes (AI) as predictors of increased cardiovascular risks is a matter of scientific discussion. BMI depends on gender and age, thus absolute BMI in children and adolescents is not good indicator for classification of overweight and obese. Therefore, better indicator for children is relative BMI or use of percentiles. European expert group for obesity in children suggested a way to calculate obesity: children with BMI between 90th and 97th percentile are overweight and those above 97th percentile are obese. According to American studies overweight are children with BMI above 85th percentile and obese those above 95th percentile[2]. For visceral obesity, which is better indicator of cardiovascular risk, waist circumference is better indicator than traditional obesity indicator BMI, and in childhood and adolescence waist circumference and height ratio has showed to be even better obesity indicator[11].

Subject and Methods

Study included pupils of 19 first grades in 8 primary schools of Osijek-Baranja County, Croatia. Body weight and height, waist and hip circumference were measured. Body height (cm) was measured using altimeter, waist circumference and hip circumference (cm) were measured using measuring tape and body weight (kg) was measured using medicinal weight scale. All measurements were done with the same measuring instruments. Parameters and diagnostic criteria for obesity assessment were: BMI (according to Croatian referral values for children)[12] children with BMI between 90th and 97th percentile are overweight and those above 97th percentile are obese, WHR (used criteria are for adults since we could not find ones for children: =0.9 for boys and =0.8 for girls) and WHtR (values =0.5 are considered obesity). In order to determine whether the health education of pupils and their parents influences children's anthropometric indexes, health education regarding correct diet and obesity was conducted in four primary schools (intervention group). Health education regarding correct diet and obesity was done by a school doctor in schools. Lectures for pupils were carried out during classes in duration of 45 minutes. Lectures for parents were carried out after school at parents' meetings in duration of 60 minutes. Lecture along with Power point presentation for pupils and parents educated on healthy diet, basic food components, physical activity, most common dietary mistakes, obesity and its consequences. Pupils of other four primary schools were measured as a control group. Both groups comprised of two urban schools, one suburban and one village school. Measurements were repeated after 6 months.

Results

Total of 372 children (191 boys and 181 girls) were measured. Twenty of them were excluded from the study since they were not measured on both occasions. Out of 372, 200 (53.8%) children and their parents were included in health education. After 6 months, increase in body weight was on average 10.2%. In intervention group average increase in body weight was 10.8% and was even in both genders. In control group, increase in body weight was lower in girls (8.9%) than in boys (10.1%) and the difference was not significant at $p<0.05$, but was significant at $p<=0.064$ (CI 93.6%).

Increase in body height was on average 4.3 cm (3.4%) in all groups. Waist circumference increased on average

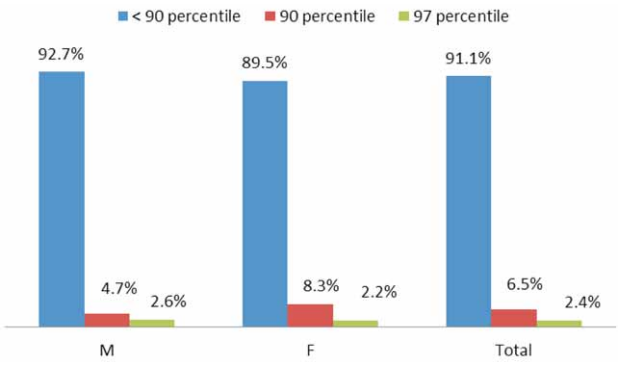

Fig. 1. *Distribution of children according to BMI at the first measurement. M – male, F – female.*

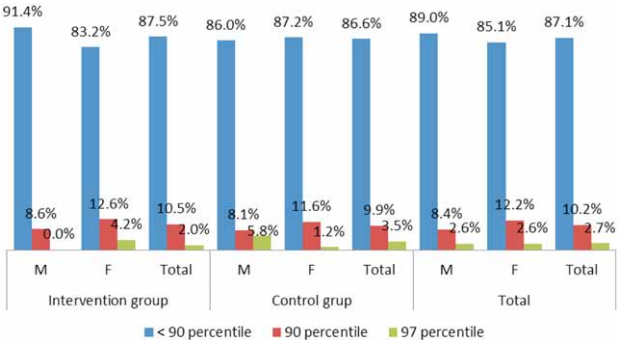

Fig. 2. *Distribution of children according to BMI at the second measurement. M – male, F – female.*

2.8%. Hip circumference increased on average 7.7% (8.4% in boys and 7.1% in girls). At the first measurement there were 6.5% (24/372) of overweight children with BMI between 90th and 97th percentile and 2.4% (9/372) of obese children with BMI above 97th percentile (2.6% of boys and 2.2% of girls). In intervention group there were 7% of overweight children and 2% of obese children. In control group there were 5.8% of overweight children and 2.9% of obese children (Figure1). At the second measurement, in the intervention group, there were 7% of overweight children (3.8% of boys and 10.5% of girls) and 2% of obese children (1% of boys and 3.2% of girls). In control group there were 5.8% of overweight children (5.8% of boys and 5.8% of girls) and 2.9% of obese children (4.7% of boys and 1.2% of girls). After the second measurement, increase in BMI was determined; there were 10.2% of overweight and 2.7% of obese children (2.6% in boys and 2.8% in girls). In intervention group there were 10.5% of overweight children (8.6% of boys and 12.6% of girls) and 2% of obese children (0% in boys and 4.2% in girls). In control group there were 9.9% of overweight children (8.1% of boys and 11.6% of girls) and 3.5% of obese children (5.8% of boys and 1.2% of girls) (Figure 2).

According to waist circumference and height ratio, at the first measurement there were 10.2% of obese children. In intervention group before health education there were 10.5% of obese children (7.6% of boys and 13.7% of girls), and after education there were 12% of obese children (8.6% of boys and 15.8% of girls). In control group at the first measurement there were 9.9% of obese children (10.5% of boys and 9.3% of girls). After 6 months there were 10.5% of obese children (12.8% of boys and 8.1% of girls) (Table 1).

Discussion

Obesity with its consequences in developed countries in the third millennium shows tendency to become one of the leading public health issues. Number of people that are overweight is still increasing and in 1998 WHO declared global epidemic[2].

Due to that, public health efforts are directed to prevention programs. Unfortunately, obesity is hard to

TABLE 1
ANTHROPOMETRIC INDEXES BEFORE AND AFTER HEALTH EDUCATION IN INTERVENTION AND CONTROL GROUP (N=372)

Subjects	AI	% of obese at the first measurement			% of obese at the second measurement		
		M	F	M+F	M	F	M+F
Intervention group	BMI	1.0	3.2	2.0	0.0	4.2	2.0
	WHR	76.2	97.9	86.5	32.4	92.6	61.0
	WHtR	7.6	13.7	10.5	8.6	15.8	12.0
Control group	BMI	4.7	1.2	2.9	5.8	1.2	3.5
	WHR	55.8	90.7	73.3	22.1	83.7	52.9
	WHtR	10.5	9.3	9.9	12.8	8.1	10.5
Total	BMI	2.6	2.2	2.4	2.6	2.8	2.7
	WHR	67.0	94.5	80.4	27.7	88.4	57.3
	WHtR	8.9	11.6	10.2	10.5	12.2	11.3

AI – anthropometric indexes, M – male, F – female, BMI – body mass index, WHR – waist and hip circumference ratio, WHtR – waist circumference and height ratio

prevent since it is a multifactorial problem dependant on genetics, social factors, life style, especially dietary habits, physical activity and educational elements.

In many countries that recognized the problem, programs are directed to therapeutic rather than preventive approach. Such concept is particularly encouraged by pharmaceutical industry, while prevention programs are not recognized since they demand long term investments with uncertain results.

Schools are in a unique position to address the issue of childhood obesity. Children and adolescents spend approximately six hours a day in school on weekdays. Almost all young people are enrolled in primary schools. Promotion of healthy eating and physical activity habits have traditionally been components of the curriculum, and research has documented that school programs can promote healthy eating and physical activity[13]. In addition, associations have been found between physical activity, proper nutrition, and academic performance. Changes in family dynamics in which both parents work and organization of child's daily routine have significantly influenced the phenomenon called sedentary life style. It is difficult to determine whether physical inactivity is the cause or the result of obesity in children and adults, but in any case it is its significant mark. Results of primary obesity prevention are possible to observe only in the long term, which is its basic limitation with regard to problem of sustaining motivation of all participants[14].

In our study health education, regarding correct diet, obesity and its consequences, need for change of life style with the accent on daily physical activity, included children together with their parents. Prevalence of overweight children according to BMI in first grades of primary schools of Osijek-Baranja County, Croatia was 8.9% before education. These results are similar to literature data for European countries (from 5.1% to 25.4%)[4,15,16]. In intervention group proportion of obese children was not decreased after health education, and it was 2% before and after education. Pupils from control group showed increase in obese children from 2.9% to 3.5%. Health education influenced firstly boys with consequent decrease in obesity in intervention group (from 1.0% to 0%), while proportion of obese increased in control group (from 4.7% to 5.8%). In intervention group girls showed increase in obesity after education (from 3.2% to 4.2%), while in control group there were no changes (1.2% in both measurements). χ^2-test showed no statistical significance (at $p<0.05$), therefore we cannot make conclusions regarding influence of health education regarding gender, since the sample of obese children is too small.

The waist circumference to height ratio (WHtR) is a further indicator for body shape. International reference values, however, do not exist. An advantage in using WHtR seems to be that it is not age dependent at certain levels and it may therefore be possible to use a single cut-off value for all children[17].

According to this index proportion of obese before education was 10.2%, which shows good correlation with BMI, which was 8.9%. After education there was an increase in proportion of obese to 11.3%. Regardless of gender and education, in both groups of children there was an increase in proportion of obese according to this index.

Obesity expressed as BMI shows increase in many countries, but few studies investigated trends in prevalence of visceral obesity. In certain studies fast increase in visceral obesity compared to obesity expressed through BMI was observed. In 2003prevalence of visceral obesity in adult population of Croatia was 43.5%[18]. For assessment of visceral obesity anthropometric indexes that describe relationship between waist and hip circumferences are used. In our study obesity was determined by criteria used for adults, since literature data do not offer criteria for children. This way, proportion of obese was 80.4%, which significantly differs from other two anthropometric indexes used and from subjective assessment of obesity by clinical examination. Therefore, criteria for this parameter need to be defined for children. Furthermore, this index showed another paradox i.e. statistically significant decrease in obesity in children regardless gender or health education. This decrease was so dramatic that makes this index questionable for assessment of obesity in children in general, even if childhood criteria should be made. In any case, there is a need to understand the relationship between BMI, WC and WHC, with growth and health risk in order to establish consistent criteria that will define cut-off value for obesity.

This study shows that in school-based obesity programs it is necessary to apply more intense interventions with another type of methodology; program should be conducted continuously during long-term period, otherwise this condition will continue to rise.

Literature data indicate uneven success of educational programs. Kain et all determined total increase in body weight in children aged 4 to 7 years despite conducted education of teachers and higher number of hours of physical education in public schools[19].

Certain studies showed that intervention programs had a positive effect in prevention and decreasing obesity in children. This effect seems to be higher in older children, involving interventions with physical activity and nutritional education combined, with parent's participation and with one-year duration. School or after-school interventions had a similar effect[19,20].

Study in which children were in a procedure of behavioural treatment was conducted in Sweden. After 3 years, children who started this kind of treatment before age of 10 years had more significant reduction of BMI than children in which treatment was started later in life. Adolescents aged 14 to 16 years that were very obese did not decrease BMI after period of treatment. The most obese children showed signs of obesity as early as age of 7 years[21].

Certain authors tried to determine value of new technologies application in obesity prevention. Smith tried to review the effect of telemedicine, text message or telephone support on patient outcomes and care processes in

pediatric obesity management. Health information technology (IT) interventions have improved access to obesity treatment and rates of screening. However, the impact on weight loss and other health outcomes remains understudied and inconsistent. More interactive and time-intensive interventions may enhance health IT's clinical effectiveness in chronic disease management[22].

Conclusion

In conclusion we can say that obesity is complex and insufficiently known disease. In treatment of childhood obesity, it is particularly important to apply multidisciplinary approach directed to reduction of energy intake, education, change of life style and attitude toward food and physical activity. Since influence of family surrounding is one of the most important in accepting attitudes and behaviours associated with life style, therapeutic interventions should firstly be directed toward whole family. Government is prepared to make action plans, suggestions, laws, but at the same time it does not conduct them effectively and sufficiently enough. Therefore, broad approach with long term national program is needed in creating prevention program for obesity. This program should be made and conducted as soon as possible, because waiting only enlarges the problem.

REFERENCES

1. JELČIĆ J, KORŠIĆ M, Liječ vjesn, 131 (2009) 279. — 2. GRGURIĆ J, Zdrav život, Obiteljski časopis o zdravlju, 33 (2006), accessed 01.03.2013. Available from: URL: http://www.zdrav-zivot.com.hr/index.php?cat=debljina_u_djece. — 3. JUONALA M, MAGNUSSEN CG, BERENSON GS, VENN A, BURNS TL, SABIN MA, SRINIVASAN SR, DANIELS SR, DAVIS PH, CHEN W, SUN C, CHEUNG M, VIIKARI JS, DWEYER T, RAITAKARI OT, N Engl J Med., 365 (2011) 1876. DOI: 10.1056/NEJMoa1010112. — 4. Carroquino MJ, Prevalence of overweight and obesity in children and adolescents, WHO, accessed 01.03.2013. Available from: URL: http://www.euro.who.int/__data/assets/pdf_file/0005/96980/2.3.-Prevalence-of-overweight-and-obesity-EDITED_layouted_V3.pdf. — 5. KAIĆ-RAK A, THE NEED TO REGULATE FOOD MARKETING OF FOODS FOR CHILDREN. In: Proceedings (IV. Croatian Congress of School and University Medicine, Split, 2012). — 6. OSELLI S, VENTRELLA AR, BRASILI P, Coll Antropol, 36 (2012) 63. — 7. CROATIAN HEALTH SERVICE YEARBOOK 2010, accessed 01.03.2013. Available from: URL: http://www.hzjz.hr/publikacije/hzs_ljetopis/Ljetopis_Yearbook_HR_2010.pdf. — 8. JUREŠA V, MUSIL V, KUJUNDŽIĆ-TILJAK M, Coll Antropol, 36 (2012) 47. — 9. VIDEMSEK M, STIHEC J, KARPLJUK D, STARMAN A, Coll Antropol, 32 (2008) 813. — 10. PAVLEKOVIĆ G, KUZMAN M, JUREŠA V, Promicanje zdravlja u školi (School of Public Health »Andrija Štampar«, University of Zagreb, School of Medicine, Zagreb,2001). — 11. BRAMBILLA P, BEDOGNI G, HEO M, PIETROBELLI A, Int J Obes, 32 (2013). DOI: 10.1038/ijo.2013.32. — 12. JUREŠA V, MUSIL V, KUJUNDŽIĆ-TILJAK M, Croatian reference values for weight, height, body mass index for boys and girls 6.5 to 18.5 years of age, accessed 01.03.2013. Available from: URL: http://www.mef.hr/druga.php?grupa=020332050100. — 13. PROBART C, MCDONNELL E, WEIRICH JE, BIRKENSHAW P, FEKETE V, Coll Antropol, 31 (2007) 29. — 14. BRALIĆ I, Pediatr Croat, 56 (2012) 335. — 15. JANSSEN I, KATZMARZYK PT, BOYCE WF, VEREECKEN C, MULVIHILL C, ROBERTS C, CURRIE C, PICKETT W, Obesrev, 6 (2005) 123. — 16. WIJNHOVEN TM, VAN RAAIJ JM, SPINELLI A, RITO AI, HOVENGEN R, KUNESOVA M, STARC G, RUTTER H, SJÖBERG A, PETRAUSKIENE A, O'DWYER U, PETROVA S, FARRUGIA SANT'ANGELO V, WAUTERS M, YNGVE A, RUBANA IM, BREDA J, Pediatr Obes, 8 (2013) 79. DOI: 10.1111/j.2047-6310.2012.00090. — 17. AEBERLI I, GUT-KNABENHANS I, KUSCHE-AMMANN RS, MOLINARI L, ZIMMERMANN MB, Swiss Med Wkly, 1 (2011) 13227. DOI: 10.4414/smw.2011.13227. — 18. FISTER K, KOLCIĆ I, MILANOVIĆ SM, KERN J, Coll Antropol, 33 (2009) 25. — 19. KAIN J, LEYTON B, CONCHA F, WEISSTAUB G, LOBOS L, BUSTOS N, VIO F, Arch Latinoam Nutr, 62 (2012) 60. — 20. VASQUES C, MAGALHÃES P, CORTINHAS A, MOTA P, LEITÃO J, LOPES VP, J PhysAct Health, 30 (2013). – 21. DANIELSSON P, KOWALSKI J, EKBLOM Ö, MARCUS C, Arch PediatrAdolesc Med, 116 (2012) 1103. DOI:b10.1001/2013.jamapediatrics.319. – 22. SMITH AJ, SKOW A, BODURTHA J, KINRA S, Pediatrics, 131 (2013) 894. DOI: 10.1542/peds.2012-2011.

V. Bilić-Kirin

Institute of Public Health for the Osijek-Baranya County, Department of School Medicine, Franje Krežme 1, 31000 Osijek, Croatia
e-mail: vesna.bilic.kirin@gmail.com

UTJECAJ ZDRAVSTVENOG ODGOJA O PRAVILNOJ PREHRANI NA ANTROPOMETRIJSKE INDEKSE KOD DJECE

SAŽETAK

Debljina je jedan od vodećih javnozdravstvenih problema današnjeg svijeta čije značenje ne proizlazi samo iz njene učestalosti već i iz niza bolesti pridruženih pretilosti koje se postupno razvijaju. Cilj studije je bio utvrditi prevalencija debljine u školske djece i utjecaj zdravstvenog odgoja na njenu pojavnost. Studija je uključila učenike 19 prvih razreda u 8 osnovnih škola u Osječko-baranjskoj županiji. Mjerena je tjelesna težina, tjelesna visina, obim struka i obim bokova. Izračunati su parametri za procjenu pretilosti: BMI (prema hrvatskim referentnim vrijednostima indeksa tjelesne mase), opseg struka (WC), omjer opsega struka i bokova (WHR) i omjer opseg struka i visina (WtHR). U cilju utvrđivanja utječe li zdravstveni odgoj učenika i roditelja na antropometrijske indekse u četiri osnovne škole proveden je zdravstveni odgoj o pravilnoj prehrani i pretilosti i njezinim posljedicama, potrebi promjene životnih navika s naglaskom na svakodnevnu tjelesnu aktivnost. Učenici ostalih četiriju osnovnih škola mjereni su kao kontrolna skupina. Prevalencija

djece s prekomjernom tjelesnom težinom prema BMI prije edukacije iznosila je 8,9% (s prekomjernom tjelesnom težinom 6,5%, pretilih je 2,4%). U promatranoj skupini učenika prema BMI nije došlo do smanjenja udjela pretilih nakon provedenog zdravstvenog odgoja te je vrijednost prije i nakon edukacije iznosila 2,0%. Učenici kontrolne skupine na drugom su mjerenju pokazali povećanje udjela pretilih s 2,.9% na 3,5%. Prema indeksu omjer opsega struka i visine udio pretilih prije edukacije ukupno je iznosio 10,2%. Nakon šest mjeseci došlo je do povećanja udjela pretilih na 11,3%. Prema ovom indeksu došlo je do povećanja udjela pretilih u svim skupinama učenika neovisno o spolu i provedenoj edukaciji. Ova studija ukazuje na nedovoljnu efikasnost do sada primijenjenih preventivnih programa i potrebu kontinuiranog provođenja istih kroz duže razdoblje uz modifikaciju metodologija u pristupu problemu.