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RESEARCH ARTICLE

The Association between Various Lifestyle Patterns and the Body Mass Index in Adolescents

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Objective: The study aims to analyze obesogenic behavioral patterns of adolescents living in Mureș County, Romania, as well as to establish a relationship between these behaviors and their Body Mass Index (BMI), in an attempt to provide effective prevention strategies for obesity. **Material and Methods**: 153 students between 9th to 12th grade, aged between 14 and 19 years old, from the Vocational and Art Highschool of Târgu Mureș were included in the study. All the candidates filled out an evaluation questionnaire of lifestyle and risky behaviors. The analyzed data were sex, age, residence, BMI and risky eating behavior defined as the consumption of carbohydrates (bread, potatoes, sweets), sodas, junk food, alcohol (wine, distilled beverages, beer), beer separately, level of physical activity (school and extra-school sports activities), sedentary behaviors (≥2 hours/day in front of a screen: personal computer-PC and television-TV), and spending ≥2 hours/day separately on the PC and on the TV. **Results**: A statistically significant association was observed between BMI and consumption of fast-food, tobacco, beer, sedentary behavior and spending ≥2 hours/day in front of the PC. Moreover, there was a statistically significant difference between the BMI values of adolescents presenting all studied risk behaviors compared to those who did not. **Conclusions**: Obesity among adolescents from Mureș County is influenced by lifestyle choices like fast-food, tobacco, beer, sedentary behavior and spending ≥2 hours/day in front of the PC.

Keywords: BMI, adolescents, risk behavior

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Introduction

The global prevalence of obesity almost tripled from 1975 to 2016 [1], as obesity has become a global epidemic even for the young ones: children and teenagers (from 4% in 1976 to 18% în 2016) [2,3]. According to World Health Organization (WHO), in 2016 over 340 million children and teenagers (5 to 19 years) were overweight or obese [1]. Although initially obesity was considered a disease that affected developed countries, after the transformations that occured between 1980-1990, a sudden increase was also manifested in Eastern European countries [4].

Obesity occurs as a nutritional imbalance when energy intake exceeds caloric expenditure. The multifactorial etiology of this disease is dependent on a series of behavioral patterns that are prone to predispose an individual to become obese. Notable examples of obesogenic behaviors include:

Alcohol consumption: according to the WHO [5], 15 years old adolescent drinks 6.3 liters of pure alcohol/year or 13.5 grams of pure alcohol/day.

Fast food intake: the fast-paced lifestyle that characterizes the current society impacts every aspect of human life, including dietary habits. Fast food diet, rich in fat, salt and meat products has slowly replaced the traditional cuisine. Adolescents are often eating fast food, although these aliments fail in providing the daily necessities of vitamins and minerals.

Sweets and Sugar-Sweetened Beverage Consumption (SSBC): children and teenagers with high consumption of sweets and SSBC have an increased risk for developing metabolic syndrome, abdominal obesity, and arterial hypertension [6]. Moreover, SSBC intake has been associated with high triglyceride level, a high waist circumference, as well as high blood pressure [7]. Subsequently, WHO states that a diet high in sugary products has no proven benefits and, as a consequence, reduced free sugars intake is recommended [8].

Smoking: the WHO European region leads in the number of both adult and teenager's smokers (28% and 12%). Although the global sex distribution of smokers showed that 12% of them are male and 11% are female, in Romania 37.4% of the male population smokes, as well as 16.7% of the female population [9]. Smoking is responsible for 7.2 million deaths/year, killing more individuals than acquired immunodeficiency syndrome, malaria, and tuberculosis combined [10].

Physical activity: data from Romania showed that in 2018 only 23% of children and teenagers aged ≤13 years old had a satisfactory level of physical activity, 29% of each were boys and 17% of each were girls. On the other hand,

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30% of teenagers and adults aged ≥ 15 years old reported a proper level of physical activity [11].

Sedentariness (activities like watching TV and spending time in front of a computer): The American Pediatrics Association recommends less than 2 hours/day of entertainment screen time for children and adolescents [12]. Children are exposed to 25000 TV advertisements/ year, approximately 20% of each promoting food and drinks products [13].

A high BMI in childhood and adolescence is associated with a high obesity risk during adulthood, as well as with an increased risk of premature death [14,15]. Also, it has been proven that obesity during childhood and adolescence impacts adult life in various ways, by increasing the cardiometabolic risk (the patients are more prone to develop Diabetes Mellitus, Hypertension, ischemic heart disease or even Stroke) and also by favoring the onset of pathologies like bronchial asthma or polycystic ovary syndrome [16].

Moreover, obesity during youth is associated with various musculoskeletal disorders, psychological conditions and different malignancies (endometrial, breast, ovarian, prostate, liver, biliary bladder, kidney and colon cancer) [1].

The development of a project to evaluate the dimension of risk behaviors in adolescents represents the opening of a sphere of major problems, both in society and in the medical world, namely efficient prevention. Good management is represented by the knowledge of the dimensions of the phenomenon and of the bio-psycho-social particularities, which is why we consider that updating risk behaviors in adolescents is very important. Preventing obesity should remain a priority because the continuous transformation of living conditions predisposes to new risk factors, that the study aims to evaluate the local obesogenic behavioral pattern and to evaluated the relationship between BMI and risk behaviors in adolescents living in Mureş County. Our findings will expand the database and will support future obesity prevention programs knowing the current state of adolescent behavior.

Material and Methods

A cross-sectional study was performed in Mures County, in June 2019, to evaluate the relationship between BMI and the behavioral patterns of adolescents that can lead to obesity. The study was approved by the Ethics Committee of the College of Physicians in Romania and it follows the Helsinki Declaration principles.

153 students from the High School of the Arts, Târgu Mureș, aged between 14 and 19, were asked to anonymously answer a 20 questions questionnaire to identify obesogenic risk behaviors. Each questionnaire was completed in 50 minutes, under similar conditions. Informed consent was presented and granted. The school principal and all participants in the study agreed to the processing and presentation of the data.

Tracked parameters:

- Demographics: gender, age, background
- BMI (kg/m2)
- Dietary habits: Sweets and SSBC consumption, fast-food, bread and potatoes intake
- Alcohol (*wine,* distilled beverages *or beer*) and tabacco consumption
- Physical activity level: school and extra-school sports activities
- Sedentary behaviors: ≥2 hours/day time spent in the front of a screen (television and personal computer), and separately, just in front of a television (TV) and just in front of a personal computer (PC).

The data analysis included descriptive statistics elements (frequency, percentage, confidence interval 95%, mean, median, standard deviation) and inferential statistics. The D'Agostino & Pearson test was applied to determine data normal distribution. For comparison of medians, the Mann-Whitney test, non-parametric test, and Spearman test for correlation determination were applied. The level of significance was set for 0.05. The statistical analysis was performed using the GraphPad Prism 7 utility, the Trial version.

Results

The analyzed group included 11.11% (17, with BMI≤18.4) underweight students, 79.08% (121, BMI=18.5-24.9) students with normal BMI, 8.5% (13, BMI >25.0-29.9) overweight and 1.31% (2, BMI≥30) obese students. The description of the study group in terms of risk behaviors is presented in Table I.

Table II represent the mean ± SD (median) of BMI in adolescents with risk behavior and without it, and p shows if there whether or not a statistically significant difference between the median values of BMI in those with and without consumption.

We found statistical significant positive correlations ($p<0.05$) between the BMI and the excessive hours spent in front of the PC ($r = 0.3494$, CI 95%: 0.1973-0.4850), as well as total time spend in front of the PC and the TV ($r = 0.3023$, CI 95%: 0.1462-0.4437).

Discussions

The results of the current study show that most of the young people in the targeted group have a normal weight, but also a large proportion of the students express obesogenic behaviors. There is a proven correlation between the studied behavioral patterns and the value of BMI.

According to Donna Spruijt-Metz, three major behaviors are influencing obesity: food intake, physical activity and sleep [17]. The findings of the study are consistent with other studies on obesity among young people from a cultural and socioeconomic background that resembles countries like Romania, countries where a rapid transition in dietary habits have been observed, mainly due to

Table I. The description of the studied group in terms of risk behaviors

Parameter studied		Frequency	Percentage	Confidence interval (95%)
Gender	Female	97	63.40%	55.24%-71.03%
	Male	56	36.60%	28.97%-44.76%
Living area	Rural	36	23.53%	17.06%-31.06%
	Urban	117	76.47%	68.94%-82.94%
Daily sweet beverages consumption		74	48.37%	40.22%-56.58%
Sweets intake	Moderate (2-3 days/week)	17	11.11%	6.61%-17.19%
	High (daily)	90	58.82%	50.59%-66.71%
Daily bread and potatoes consumption		127	83.01%	76.10%-88.59%
Fast-food consumption	Moderate (1 days/week - 2 days/month)	66	43.14%	35.17%-51.38%
	High (≥2-3 day/week)	34	22.22%	15.91%-29.64%
Physical activity level	Moderate (≥1 day/week school or extra-school sports activities)	32	20.92%	14.77%-28.22%
	Sustained (≥1 day/week school and ≥1 day/week extra-school sports activities)	115	75.16%	67.54%-81.79%
Smoking habits	Moderate (2-10 cigarettes/day)	60	39.22%	31.43%-47.43%
	Sustained (>10 cigarettes/day)	8	5.23%	2.28%-10.04%
Alcohol intake (≥1 day/week of wine, distilled beverages or beer)		115	75.16%	67.54%-81.79%
Only beer consumption (≥1 day/week)		64	41.83%	33.92%-50.07%
Sedentariness (≥2 hours/day total time spent in the front of a screen)		119	77.78%	70.36-84.09%
PC≥2 hours/day		98	64.05%	55.91%-71.64%
TV ≥2 hours/day		43	28.10%	21.14%-35.93%

Table II. Influence of risk behavior vs risk-free behavior on BMI

Parameter studied	Yes - mean±SD (median)	No - mean±SD (median)	p
Sweets intake	21.43±2.72 (21.20)	21.70±2.99 (21.35)	0.4652
Bread and potatoes consumption	21.54±2.79 (21.20)	21.38±2.86 (21.35)	0.8383
Daily sweet beverages consumption	21.92±2.74 (21.40)	21.13±2.81 (21.00)	0.0855
Fast-food consumption	21.81±2.62 (21.35)	20.95±3.05 (20.10)	0.0382
Physical activity	21.54±2.79 (21.35)	20.88±3.01 (20.55)	0.5888
Smoker	22.05±2.84 (21.60)	21.08±2.70 (20.90)	0.0289
Alcohol intake	21.65±2.95 (21.40)	21.08±2.26 (20.95)	0.3048
Beer consumption	22.51±3.03 (21.95)	20.79±2.38 (20.83)	0.0004
Sedentariness	21.73±2.66 (21.30)	20.74±3.14 (20.15)	0.0367
PC ≥2 hours/day	22.06±2.62 (21.45)	20.53±2.86 (20.20)	0.0008
TV ≥2 hours/day	21.51±3.02 (21.00)	21.51±2.71 (21.30)	0.8407
Risk behavior	22.53±3.20 (22.10)	21.25±2.63 (21.10)	0.0338

urbanization. For example, although most of the Iranian cuisine is made up of bread and rice, bread consumption among Iranian adolescents is 58.4%, lower than that in our study [18].

Another study among adolescents living in Târgu Mureş indicates that 55.30% of teenagers are consuming sweetened drinks [19], a percentage close to the group in our study (48.37%).

In the United States, on the other hand, the trend towards tobacco consumption among adolescents is declining. A study performed for 18 years over students living in Arkansas, USA, shows a decrease in tobacco consumption from 74.4% in 1995 to 52.1% in 2013 [20], possibly due to successfully conducted prevention programs. Moreover, there is a proven association between alcohol intake and tobacco consumption, people who consume alcohol are more likely to smoke [21]. In their study, Akbartabartoori et al found that cigarette smoking negatively affects BMI just in adults over 24 years especially in men, but not in younger people. In women, smoking is associated to central adiposity, in contrast to men witch is not, but a reduction in muscle mass could suggest a lower hip circumference [22]. Interesting, Chiolero et al found that nicotine has two effects: increasing energy expenditure and reducing appetite in the short term, and in contrast, in long term, heavy smokers associate a higher BMI than light smokers or nonsmokers, because of an accumulation of many risky behaviors besides smoking like low physical activity and poor diet that lead to weight gain. Also, smoking is associated with increases insulin resistance and central fat accumulation [23].

In the 2015 ESPAD project, it is reported that almost all Europeans aged 15-16 years old consumed alcohol at least once in their lives (35-96%). The highest consumption rates occur in the Czech Republic, Albania, and Hungary, while the smallest ones are in Iceland, Macedonia, and Norway [24].

According to the results of the current study, there is no statistically significant difference between adolescents who consume alcohol and BMI value, but when the beer consumption was analyzed separately, a relationship between beer consumption and BMI was noticed. Beer has a higher level of carbohydrate as compared to other alcoholic beverages.

There are studies that demonstrate that excessive time spent on the Internet has negative effects on adolescents such as affecting communication and face-to-face interaction with family and friends [25], physical activity [26],

proper eating habits [27], sleeping [28], completing academic tasks [29], also the time spent online is directly proportional to the Internet dependency [30]. According to Griffiths, there are six symptoms presents in pathological Internet users (PIU): salience (more online activities), mood modification (using the Internet as a method of reducing stress), tolerance (need to be more online), withdrawal (increasing the level of depression and irritability in the offline world), conflicts and relapse (failed to disconnect) [31].

Tony Durkee et al classified Internet users into three groups of Internet users: adaptive, maladaptive, and PIU. Results showed a higher prevalence among pathological users compared to the others at risk-behaviors such as poor sleeping habits, tobacco use, physical inactivity and also multiple risk-behaviors was associated with the PIU group (89.9%) [32].

According to a study conducted in Brazil on 6529 teenagers, there is an association between various behaviors like spending time in front of a PC, low levels of physical activity and consumptions of fruits/vegetables and high alcohol intake. Boys living in urban areas are more predisposed to expressing obesogenic behaviors. 21.2% of the total number of participants presented at least one risky behavior, while 37.3% presented two, 28.5% had three, and 8.0% had all the risky behavior mentioned above [33].

Also, the current study states a linkage between BMI and time spend on in front of the PC (≥ 2 hours/day), although there is no direct correlation between BMI and the time spent in front of the TV, probably because entertainment preferences of teenagers have changed over the past years. These results are partially following Roya Kelishadi's study on Iranian teens, where BMI was linked directly to time spent in front of PC/TV (≥ 2) [20].

The study presents a series of limitations. Firstly, there is a relatively small number of participants in the study, all of them being students in the same high school, therefore the data could not be extrapolated and be representative for a region. Because the material and methods of the study were based on a questionnaire, there was also noted a bias of subjectivity and accuracy from the participants.

Another limitation consists in the design of the study. Taking into consideration that the design is cross-sectional, it only offers one snapshot of the current risky behaviors among teenagers, and therefore it cannot predict, follow up and evaluate the consequences in the long term. In the future, the study will extend to a larger population and the study design will be converted so that the data could be representative.

Constant re-evaluation of data regarding the teenager's lifestyle is a useful tool in a modern society where health and quality of life are fundamental for a long prosper life. The emergence of new risk factors for obesity, as well as the continuous transformation of living conditions among people everywhere, explains the need for adequate prevention campaigns against obesity. It is necesary to elaborate more efficient community intervention in schools, to insure the informations about the risks of obesity and ways to reduce it.

Conclusions

There is an association between BMI and the teenagers' predisposition for fast food, cigarettes, beer consumption, sedentary behavior and spending ≥2 hours/day in front of a PC. There is a statistically significant difference between the BMI of adolescents presenting all risk behaviors studied compared with those who do not have them.

Authors'contribution

Irina-Bianca Kosovski, M.D. (Conceptualization; Data curation; Investigation; Resources; Writing – original draft)
Dana-Valentina Ghiga, Lecturer, PhD, M.D. (Methodology; Supervision; Validation; Writing – review & editing)
Monica Tarcea, Professor, PhD, M.D. (Supervision; Validation; Writing – review & editing)
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Ana Ioana Savin, M.D. (Data curation; Writing – review & editing)
Anca Bacârea, Associate Professor, PhD, M.D. (Conceptualization; Project administration; Supervision; Validation; Visualization; Writing – review & editing)

Conflict of interest

None to declare.

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