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LIFESTYLE FACTORS

# Lifestyle Factors Associated With Overweight/Obesity Status in Croatian Adolescents: A Population-Based Study

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## Abstract

*Much is known about the influence of potential lifestyle factors on adolescents' nutritional status, but in Croatia there are not many studies of this topic. Past studies have shown many variables associated with being overweight/obese. Thus, this study investigated the associations between the overweight/obesity status and lifestyle factors of Croatian adolescents. In this cross-sectional study, participants were 1,950 urban secondary-school students (884 male, 1,066 female) aged 17 to 18 years old. The dependent variable was body mass index derived from self-reported height and weight. The outcome was binarized, where participants with value < 25.0 lb/in were collapsed into normal weight, while those ≥ 25.1 lb/in into the overweight/obesity weight category. Independent variables were gender, type of school, physical activity, sedentary behavior, self-rated health, self-perceived socioeconomic status, and psychological distress. The associations between the dependent and independent variables were analyzed through multiple logistic regression analysis. In the univariate model, being overweight/obese was significantly associated with a male gender (OR 0.31; 95%*

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*CI 0.23 to 0.42), attending a vocational school (OR 1.87; 95% CI 1.42 to 2.48), not meeting the recommendations for moderate-to-vigorous physical activity (OR 0.44; 95% CI 0.22 to 0.88), more time spent in sedentary behavior (OR 1.53; 95% CI 1.07 to 2.19), poor self-rated health (OR 0.35; 95% CI 0.20 to 0.56), and lower socioeconomic status (OR 0.63; 95% CI 0.48 to 0.84). In the multivariate model, the same associations occured between the dependent and independent variable. In both models, psychological distress was not associated with being overweight/obese. In conclusion, the findings suggest that lifestyle factors are independently associated with body mass index.*

Obesity has become one of the major public health concerns in the world, especially in children and adolescents (Lobstein, Baur, & Uauy, 2004; Y. Wang & Lobstein, 2006). In 2005, the prevalence of overweight and obesity in children was 10.6% in high-income countries, yet around 5% in low-income countries (Y. Wang & Lobstein, 2006). Past studies have shown that being overweight/obese is associated with many variables, such as demographic or lifestyle factors (Lobstein et al., 2004; Spear et al., 2007). Those obesity-associated lifestyle factors are often related to many health-related habits and activities (Al-Hazzaa, Abahussain, Al-Sobayel, Qahwaji, & Musaiger, 2012). More specifically, several previous studies have shown, that being overweight/obese in childhood is often associated with lower levels of physical activity (Al-Hazzaa et al., 2012; Bhuiyan et al., 2013; Dupuy et al., 2011; Petribú et al., 2011), more time spent in sedentary behaviors (Bhuiyan, Zaman, & Ahmed, 2013; Lazarou & Soteriades, 2009; Petribú, Tassitano, Nascimento, Santos, & Cabral, 2011; K. Silva, Nahas, Hoefelmann, Lopes, & Oliveira, 2008), poorer self-rated health status (Fonseca & Gaspar de Matos, 2005), unhealthy diet (Al-Hazzaa et al., 2012; Janssen et al., 2005), low socioeconomic status (Kachi, Otsuka, & Kawada, 2015; You & Choo, 2016), higher levels of psychological distress (Kubzansky, Gilthorpe, & Goodman, 2011), and attending vocational schools (Sedej, Lusa, Battelino, & Kotnik, 2016).

In Croatia, data collected from 2001/2002 showed that the prevalence of overweight/obesity in adolescent males aged 13 to 15 years was roughly 14% and adolescent females almost 17% (Zaborskis, Petronyte, Sumskas, Kuzman, & Iannotti, 2008). Moreover, according to the data from the Health Behaviour in School-Aged

Children (HBSC) study, the prevalence of overweight in 2009/2010 in Croatian 15-year-old females and males was 23% and 10%, respectively, and for adult women was 24.5% and for men was 24.1% (Currie et al., 2009). Since overweight and obesity in childhood have negative conotations on morbidity and mortality in adulthood (Reilly & Kelly, 2011) and it is hard to reverse (De Onis & Lobstein, 2010), it is important to notice that adulthood prevalence of obesity in Croatia, following the recent trends, might be 35% for men and 42% for women by the year 2020, yet those numbers will increase by the year 2030 (37% for men and 48% for women; World Health Organization, 2013).

Since the prevalence of overweight and obesity in Croatian children is rising (Currie et al., 2009), and yet there are still a lack of studies investigating which potential lifestyle factors may influence such conditions, it is important to investigate which lifestyle factors could have positive and negative consequences on childhood overweight and obesity status. Thus, this study investigated the associations between overweight/obesity status and lifestyle factors in 17- and 18-year-old Croatian adolescents.

## Method

### Participants

In this cross-sectional study, participants were 2,100 urban secondary school students from the city of Zagreb. A random sampling approach was used in the selection of schools. At the end, 15 schools (8 public high schools and 7 vocational schools) agreed to take part in the study. Before the study began, both participants and their parents/guardians gave informed written consent to participate in the study. Of these, 100 participants did not want to participate in the study and 50 of them did not fulfill the whole questionnaires during the study protocol. At the end, 1,950 participants (884 male, 1,066 female) were enrolled in the study. All the procedures in the study were done in accordance to the Declaration of Helsinki. Also, the Ethics Committee of the Faculty of Kinesiology approved the study and its protocol.

## Dependent Variable

To assess weight status of the participants, we asked for their current height and weight. Body mass index was calculated based on the internationally accepted formula Weight (lb) / [Height (in)]$^2$ × 703. Participants were categorized into the groups: underweight (x < 18.0), normal weight (18.1–25.0), overweight (x ≥ 25.1–30.0), and obesity group (x > 30.1). For the purpose of this study, we binarized the outcome, where values < 25.0 were collapsed into "normal" category status, while values ≥ 25.1 were collapsed into "overweight/obesity" category status.

## Lifestyle Factors

To assess physical activity in the last 7 days, the International Physical Activity Questionnaire-short form was used (Craig et al., 2003). The purpose of this questionnaire is to evaluate different levels of physical activity in the last 7 days, based on the frequency of the days, minutes, and type of physical activity. The results are expressed as metabolic equivalents (MET-values). According to the World Health Organization (2004), the recommendations for participating in physical activity for children aged ≤ 17 are based on doing ≥ 60 min/day of moderate-to-vigorous physical activity (≥ 420 min/week). In that way, we binarized the outcome, where participants who reported doing moderate-to-vigorous physical activity < 60 min/day were collapsed into one category, while those ≥ 60 min/day of moderate-to-vigorous physical activity in the other category.

Sedentary behavior was assessed via a one-item question from the International Physical Activity Questionnaire: "How much time did you spend sitting on a week day during the last 7 days?". Responses were expressed as minutes. According to Tremblay et al. (2011), 120 min/day or less of recreational screen activities such as television watching, video game playing, and using the computer is positively associated with additional health benefits. We binarized the outcome, where participants who reported their sitting time ≤ 120 min /day were collapsed into one category, while those with responses > 120 min/day into the other category (Tremblay et al., 2011).

Next, type of school was assessed via a one-item question: "What type of school do you currently attend?" In Croatia, like in most European countries, there are, in general, two type of schools: (1) public high schools and (2) vocational schools (Sedej et al., 2016). We entered this factor into the model, since a few recent studies have shown that students from vocational schools were less physically active and were more likely to have higher body mass index compared to their public high schools peers (Sedej et al., 2016).

A few studies have shown that self-rated health represents a good mortality predictor, especially in adolescents (Johnson & Richter, 2002; Koivusilta, Arja, & Andres, 2003). The findings suggest that adolescents who smoke or drink report poorer health during adolescence than those who do not. Adolescents who are frequent or heavy alcohol and tobacco users report poorer subjective overall health. Self-rated health was assessed via a one-item question: "In general, how would you perceive your health?" Responses were arranged across the 5-point Likert-type scale: (1) *very poor*, (2) *poor*, (3) *fair*, (4) *very good*, and (5) *excellent*. We also binarized the outcome, where responses *very poor* and *poor* collapsed into poor health, while *fair*, *good*, and *excellent* collapsed into good health (Eriksson, Undén, & Elofsson, 2001).

As a potential factor, we entered self-perceived socioeconomic status. We asked for both parents' occupational status at the time the study was conducted. Socioeconomic status was first categorised in high (professionals and managers—people who own their bussiness or firm or they are in higher positions in the company), middle (white collar—people who usually perform job duties in an office setting, typical examples are accountants, bankers, attorneys, and real-estate agents), and low (blue collar—people who perform labor jobs and work with their hands, typical examples re cleaning, maintenance, and assembly line workers). We binarized the outcome, where responses in the range 2–4 were collapsed into middle/high and responses in the range 5–6 were collapsed into low socioeconomic status (Z. Wang, Byrne, Kenardy, & Hills, 2005).

Also as another potential factor, we assessed the state of the mental health of the participants, using Kessler K6 questionnaire with six items: (1) "During the past month, how often did you feel nervous?" (2) "During the past month, how often did you feel hopeless?"

(3) "During the last month, how often did you feel restless or fidgety?" (4) "During the last month, how often did you feel so depressed that nothing could cheer you up?" (5) "During the last month, how often did you feel that everything was an effort?" and (6) "During the last month, how often did you feel worthless?" Each question had five possible responses ranging from 0–4. We summed up the values (0–24) for each participant, with a lower score indicating a lower level of psychological distress (Kessler et al., 2003). At the end, we binarized the outcome, where participants with scores < 13 were collapsed into the low psychological distress category, while those with scores 13+ into the high psychological distress category (Kessler et al., 2003).

### Data Analysis

Categorical variables are expressed as frequencies and percentages. We used Spearman's coefficient to determine relations between the dependent and independent variables. The associations between the dependent and independent variables were analyzed via logistic regression analysis. First, we entered separate lifestyle factors into Model 1 (univariate model) to determine independent associations between each of the factors with being overweight/obese. In the second model (Model 2), we entered each lifestyle factor simultaneously. Results are expressed as odds ratios (*OR*) with 95% confidence intervals (95% CI). Significance was set up at $p \leq 0.05$, and all tests performed in the study were two-sided.

## Results

Table 1 presents basic characteristics of the study participants. In public high schools, a higher percentage (72.6%) of students were in the normal weight category compared to their vocational school (27.4%) peers. In general, more than 90% of the study participants did not meet the recommendations for participating in moderate-to-vigorous physical activity, yet a higher percentage of participants with normal weight status reported to meet the recommendations (8.3% vs. 3.9%) according to those categorized as overweight or obese. As expected, a higher percentage (82.8%) of overweight/obese students than normal weight participants (75.8%) reported sitting > 120 min/day. A higher percentage of the participants in the normal weight group than in the overweight/obese group (97.0% vs. 91.8%)

reported having good self-rated health. Poorer socioeconomic status was reported by the overweight/obese participants (38.5% vs. 28.4%), yet no significant differences occured between two groups in psychological distress (14.2% vs. 16.5%).

**Table 1**
*Basic Descriptive Characteristics of the Study Participants*

| | **Total (*N* = 1,950)** | **Normal status (*N* = 1,718)** | **Overweight/ obese status (*N* = 232)** |
|---|---|---|---|
| **Study variable** | ***N* (%)** | ***N* (%)** | ***N* (%)** |
| Gender | | | |
| Male | 884 (45.3) | 722 (42.0) | 162 (69.8) |
| Female | 1066 (54.7) | 996 (58.0) | 70 (30.2) |
| Type of school | | | |
| Public high school | 1383 (70.9) | 1247 (72.6) | 136 (58.6) |
| Vocational school | 567 (29.1) | 471 (27.4) | 96 (41.4) |
| Physical activity | | | |
| < 60 min/day | 1798 (92.2) | 1575 (91.7) | 223 (96.1) |
| ≥ 60 min/day | 152 (7.8) | 143 (8.3) | 9 (3.9) |
| Sedentary behaviour | | | |
| ≤ 120 min/day | 455 (23.3) | 415 (24.2) | 40 (17.2) |
| > 120 min/day | 1495 (76.7) | 1303 (75.8) | 192 (82.8) |
| Self-rated health | | | |
| Poor | 71 (3.6) | 52 (3.0) | 19 (8.2) |
| Good | 1879 (96.4) | 1666 (97.0) | 213 (91.8) |
| Socioeconomic status | | | |
| Low | 577 (29.6) | 488 (28.4) | 89 (38.5) |
| Middle/high | 1372 (70.4) | 1230 (71.6) | 142 (61.5) |
| Psychological distress | | | |
| Low | 1633 (83.7) | 1434 (83.5) | 199 (85.8) |
| High | 317 (16.3) | 284 (16.5) | 33 (14.2) |

Table 2 presents relations between body mass index and lifestyle factors. As expected, not meeting the recommendations for participating in ≥ 60 min of moderate-to-vigorous physical activity, having poor self-rated health, and sitting > 120 min/day were all related

with being overweight/obese. Also, low socioeconomic status was associated with overweight/obesity status in adolescents.

**Table 2**
*Spearman's Rank of Correlation Between Body Mass Index and Lifestyle Factors*

| | Body mass index | |
|---|---|---|
| **Study variable** | ***r* (95% CI)** | ***p*** |
| Gender (male = 1; female = 2) | -0.18 (-0.22 to -0.14) | < 0.001* |
| Type of school (public high school = 1; vocational school = 2) | 0.10 (0.05 to 0.15) | < 0.001* |
| Physical activity (< 60 min/day = 1; ≥ 60 min/day = 2) | -0.05 (-0.07 to -0.02) | 0.018* |
| Sedentary behaviour (≤ 120 min/day = 1; > 120 min/day = 2) | 0.05 (0.01 to 0.09) | 0.021* |
| Self-rated health (poor = 1; good = 2) | -0.09 (-0.14 to -0.03) | < 0.001* |
| Socioeconomic status (high = 1; low = 2) | 0.07 (0.02 to 0.12) | 0.002* |
| Psychological distress (low = 1; high = 2) | 0.02 (-0.02 to 0.06) | 0.386 |

*$p \leq 0.05$.

Table 3 presents the associations between overweight/obesity status and lifestyle factors. In the univariate model (Model 1), male students, students from vocational schools, students who did not meet the recommendations for participating in moderate-to-vigorous physical activity, students who spent > 120 min/day sitting, and students who reported poor self-rated health and low socioeconomic status were more likely to be overweight/obese. In the multivariate model (Model 2), the same associations occured between the overweight/obesity status and lifestyle factors. Finally, psychological distress was not associated with being overweight/obese in either models ($p > 0.05$).

**Table 3**
*Odds Ratios for Overweight/Obesity Status*

| | Model 1[a] | | Model 2[b] | |
|---|---|---|---|---|
| **Study variable** | ***OR* (95% CI)** | ***p*** | ***OR* (95% CI)** | ***p*** |
| Gender | | | | |
| Male | | | | |
| Female | 0.31 (0.23 to 0.42) | < 0.001* | 0.30 (0.22 to 0.41) | < 0.001* |
| Type of school | | | | |
| Public high school | | | | |
| Vocational school | 1.87 (1.41 to 2.48) | < 0.001* | 1.42 (1.04 to 1.94) | 0.025* |
| Physical activity | | | | |
| < 60 min/day | | | | |
| ≥ 60 min/day | 0.44 (0.22 to 0.88) | 0.021* | 0.37 (0.18 to 0.75) | 0.006* |
| Sedentary behaviour | | | | |
| ≤ 120 min/day | | | | |
| > 120 min/day | 1.53 (1.07 to 2.19) | 0.020* | 1.75 (1.21 to 2.54) | 0.003* |
| Self-rated health | | | | |
| Poor | | | | |
| Good | 0.35 (0.20 to 0.60) | < 0.001* | 0.26 (0.14 to 0.46) | < 0.001* |
| Socioeconomic status | | | | |
| Low | | | | |
| Middle/high | 0.63 (0.48 to 0.84) | 0.002* | 0.70 (0.51 to 0.95) | 0.023* |
| Psychological distress | | | | |
| Low | | | | |
| High | 1.19 (0.81 to 1.76) | 0.372 | 1.00 (0.65 to 1.53) | 0.998 |

[a]Univariate model examines the associations between overweight/obese status and lifestyle factors entered separately into the model 1 (7 models); [b]Multivariate model examines the associations between overweight/obese status and lifestyle factors entered simultaneously into Model 2 (1 model).

*$p \leq 0.05$.

## Discussion

This study investigated the associations between the overweight/obesity status and potential lifestyle factors in 17- and 18-year-old Croatian urban adolescents.

Results from our study showed that female students were less likely than male students to be overweight/obese, which is similar to results in other studies (Al-Hazzaa et al., 2012; Connecticut Department of Public Health, 2010; K. Silva et al., 2008). Male students, according to gender variable, were strongly associated with overweight/obesity status (Connecticut Department of Public Health, 2010). This could be explained by several reasons. First, female students, in general, reported more frequently that they were on a diet or doing something else to lose weight because they wanted to achieve the ideal image of the female body imposed through the media. Women want to look like people from public life.They also reported that they should lower their weight, even if they were making no efforts to do so (Zaborskis et al., 2008). On the other hand, male students often reported that they wish to put extra weight (Zaborskis et al., 2008). Second, we used results from self-reported height and weight and body mass index calculated from these values. Previous findings have shown that female adolescents often tend to underestimate their weight more than male adolescents do, and overweight individuals often underestimate weight more than nonoverweight individuals do (Sherry, Jefferds, & Grummer-Strawn, 2007). In one Croatian study, overweight female students underestimated their weight and overestimated their height, which led to great variability between the objective and subjective measures (Ambrosi-Randić & Bulian, 2007). Third, female students are more often concerned about their body weight and image than male students are. To confirm that statement, Morrison, Kalin, and Morrison (2004) showed that women perceive their bodies differently than men. Specifically, the ideal women's body figure is slim, while for men the ideal body figure is muscular (McCabe & Ricciardelli, 2005).

Next, our results showed that students from vocational schools were more likely to be overweight/obese than those from public high schools. A study on Slovenian adolescents showed a significantly lower prevalence of overweight and obesity status in adolescents attending public high schools compared to their vocational school

peers (Sedej et al., 2016). Several possible factors might explain such conditions. First, several studies have shown that children in vocational schools are less physically active, spend more time watching TV, spend more time sitting in front of the computer, and have higher body mass index than children attending grammar schools (Alricsson, Domalewski, Romild, & Asplund, 2008; Horst, Oenema, Velde, & Brug, 2009). Second, children attending vocational schools are often shown to have poorer academic achievement, which is in direct association with overweight and obesity status (Do & Finkelstein, 2011). Moreover, adolescents from vocational schools tend to have lower socioeconomic status, which often leads to poor dietary habits (food rich with sugar, fatty acids, fast food) and, occasionally, to overweight and obese status (Do & Finkelstein, 2011).

Being overweight/obese was associated with lower levels of physical activity in our study (i.e., not meeting the recommendations proposed by the World Health Organization, 2004). Previous studies have shown similar findings, where insufficiently active secondary school students were more likely to be overweight/obese (Al-Hazzaa et al., 2012; Bhuiyan et al., 2013; Dupuy et al., 2011; Petribú et al., 2011). In one study, results showed that physical activity, particulary vigorous-intensity physical activity, played the important role of preventing childhood overweight and obesity status (Al-Hazzaa et al., 2012; Patrick et al., 2004). Another study showed that participating in home-based physical activity ≥ 30 min significantly decreased the chance of being overweight/obese (Bhuiyan et al., 2013). Moreover, one review showed that vigorous-intensity physical activity decreased adiposity and increased aerobic capacities in 5- to 18-year-old adolescents (Parikh & Stratton, 2011). The most common reasons why children and adolescents drop out from participating in physical activity are a lack of neighborhood safety, organization of physical activity, victimization (Humbert et al., 2006), and psychosocial barriers (Curtis, 2008). Based on these findings, it is necesary to design and implement public health programs for increased promotion of physical activity, especially in urban adolescents, who are at higher risk for being overweight/obese than their rural peers, which has been reported in some studies (Ghosh, 2011; Petribú et al., 2011).

More time spent in sedentary behavior was significantly and positively associated with overweight/obesity status in Croatian adolescents. Previous findings have shown the same associations, where more time spent in sedentary behavior increased the chance for overweight/obesity status in adolescents (Bhuiyan et al., 2013; Lazarou & Soteriades, 2009; Petribú et al., 2011; K. Silva et al., 2008). Bhuiyan et al. (2013) reported that overweight children spent > 4 hr/day in sedentary activities compared to normal weight children. In one other study, television watching and sedentary activities played the most important factors associated with obesity (Lazarou & Soteriades, 2009). Several potential mechanisms could explain the associations between sedendary behavior and overweight/obesity status, which include the reduction of resting energy expenditure, increased energy intake, and replacing physical activity with television watching (Jordan & Robinson, 2008). Also, it has been shown that sedentary adolescents consume less fresh fruits and vegetables, and a more "Westernized"-type diet, such as sweets, chocolates, and food rich with saturated fatty acids (del Mar Bibiloni, Martínez, Llull, Pons, & Tur, 2012), which might lead to higher body mass index.

Good self-rated health was inversely associated with overweight/obesity status in our study, which is similar to some studies conducted with adolescents (Fonseca & Gaspar de Matos, 2005; Vingilis, Wade, & Adlaf, 1998). Specifically, in the study conducted by Fonseca and Gaspar de Matos (2005), results showed that overweight/obese adolescents were less likely to make new friendship, yet more likely to report poor self-rated health, negative attitude appearance, and a wish to change something about their bodies. The authors concluded that preventive programs helping to promote better body satisfaction, sociability, and diet are needed, especially for overweight and obese adolescents, since they remain overweight/obese in adulthood (Fonseca & Gaspar de Matos, 2005).

Consistent with the results of other studies (Kachi et al., 2015; You & Choo, 2016), our results showed that lower socioeconomic status was positively associated with being overweight/obese in Croatian adolescents. These findings could be explained by several potential mechanisms. First, it has been shown that low socioeconomic status (i.e., that children and adolescents from low-income families were more vulnerable to having a poor diet and to becoming

obese; Costarelli & Manios, 2009). In relation with that, one study showed that low-income families could not afford high-quality products (fruits, vegetables, fish, cereals, olive oil), which cost much more than "Westernized"-type products, often rich with saturated-fatty acids, calories, and sugar (Lopez et al., 2009). Also, socioeconomic status has also been associated with information availability, which some authors think may determine physical activity patterns (G. Silva, Balaban, & Motta, 2005).

Our study had several limitations. First, due to the cross-sectional design, we could not exclude the possibility of reverse causality between the dependent and independent variables. Second, we used subjective measures to assess body mass index and lifestyle factors. Studies have shown that, for example, physical activity reported through previously validated questionnaires (Craig et al., 2003) often lead to overestimation (Gillison, Standage, & Skevington, 2006). Also, we used self-reported height and weight and body mass index calculated from these values as the dependent variable. As highlighted before, subjective measures often lead to potential bias and high variability compared to objectively assessed methods (Ambrosi-Randić & Bulian, 2007; Sherry et al., 2007). Future longitudinal studies need to be performed that track and confirm the direction of association between the nutritional status and potential lifestyle behaviors, especially in developing countries.

## Conclusions

In conclusion, our study showed that being overweight/obese was significantly associated with being a male student, attending a vocational school, not meeting the recommendations for moderate-to-vigorous physical activity proposed by the World Health Organization, more time spent in sedentary behaviors, poor self-rated health, and low socioeconomic status. According to our results, special policies and strategies need to be implemented, particulary within the school system (more hours of physical education per week, organized leisure-time physical activities, diet plan, and programming), to decrease the prevalence of overweight/obese children and adolescents and to promote healthy lifestyle habits for better physical and mental health.

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