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Perceived social support from teachers and classmates does not moderate the inverse association between body mass index and health-related quality of life in adolescents

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Abstract

Purpose The current study investigated the association between body mass index (BMI) and health-related quality of life (HRQoL) among a large and non-clinical sample of adolescents, and tested the possible moderating effect of perceived teacher and classmate support on this association.

Methods French-speaking Belgian adolescents ($n = 11,342$) self-reported height and weight, HRQoL (KIDSCREEN-10), as well as their perception of teacher and classmate relationships. Adjusting for sociodemographics, linear regression analyses with HRQoL as the outcome variable were performed for boys and girls separately. Interactions between BMI and teacher support, and between BMI and classmate support were included to examine the effect of this support on the association between BMI and HRQoL.

Results Obesity was associated with lower HRQoL for boys ($\beta = -2.14$, $p = 0.002$) and for girls ($\beta = -2.96$, $p = 0.001$), while only overweight girls showed a significant impaired HRQoL compared with normal-weight ones ($\beta = -0.94$, $p = 0.01$). In both sexes, lower perceived teacher and classmate support was associated with lower HRQoL. Interactions between BMI and perceived teacher relationships, and between BMI and perceived classmate relationships, were not significant for boys as for girls.

Conclusions Perceived school-related social support constitutes an important dimension of adolescent well-being, suggesting the relevance of considering it for promoting greater HRQoL in overweight and obese youth. Future studies are needed to confirm the absence of moderating effect of this support and explore its effect on other weight-related factors, like body image, weight misperception and bullying, associated with decreased HRQoL in adolescents.

Keywords Health-related quality of life · Body mass index · Perceived classmate support · Perceived teacher support · Adolescent

Abbreviations

BMI	Body mass index
FAS	Family Affluence Scale
HBSC	Health Behaviour in School-aged Children
HRQoL	Health-related quality of life
IOTF	International Obesity Task Force

Childhood overweight and obesity are major public health challenges of the twenty-first century. In Belgium, about 15% of the children (3–9 years) and 18% of the adolescents (10–17 years) were overweight or obese in 2014 [1]. Overweight and obesity developed in childhood are likely to persist in adulthood and are associated with the early development of non-communicable diseases, such as cardiovascular

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diseases, type 2 diabetes and stroke [2]. Beyond such physical health consequences, overweight and obesity also have immediate psychosocial consequences. Several studies have reported a reduced health-related quality of life (HRQoL) in overweight and obese youth [3, 4]. Furthermore, a dose–response relationship, in which HRQoL decreases when body mass index (BMI) increases from normal-weight to overweight and obese categories, has been suggested [5]. HRQoL is a multidimensional concept encompassing physical, psychological, social, behavioural and functional aspects of health. It includes the individual subjective assessment of health and well-being within a specific cultural environment [6, 7]. Previous studies have identified social, physical and emotional functioning as the HRQoL dimensions the most affected in obese children and adolescents [3]. Therefore, while understanding these impairments and underlying mechanisms is essential for prevention and treatment of obesity, it is also needed to better understand which modifiable factors may improve psychosocial well-being of obese youth [8].

Adolescence, usually defined as the period between 10 and 19 years [9], is characterised by social changes with increasing independence from parents and closer relationships with peers. Besides family and friends, adolescents spend much of their time at school; both teachers and classmates may therefore also influence adolescent development [10]. School climate has been recognised as impacting student mental and physical health [11]. More specifically, higher perceived social support from teachers and classmates has been associated with greater psychological well-being, self-esteem, less frequent depressive symptoms and social adjustment among adolescents [12–16]. Overall, perceived social support assesses the perception of how much support from social networks is available if needed [17] and is often operationalised by referring to the quality of a given relationship [16]. Both concepts—perceived social support and relationship quality—are not totally identical but strongly interdependent. On the one hand, the level of social support perceived from a given person is related to the characteristics of the relationship (i.e. mainly positive, mixing both positive and negative feelings, indifferent or mainly negative) [18]. On the other hand, perceiving effective support from a person may in turn enhance relationship satisfaction and reciprocal trust [19]. According to the theoretical model suggesting that social support offers resources (e.g. self-esteem, self-efficacy, problem solving ability) to cope with the negative effects of stress (i.e. personal and persistent events, among which chronic diseases like obesity), social support would be more beneficial to people under greater stress [20]. Building on this "buffer effect" model, perceived school-related social support could therefore influence the inverse association between BMI and HRQoL. Exploring this issue may be particularly relevant

for informing school-based interventions on improving the well-being of overweight and obese students [8].

Previous studies have showed that overweight and obese youth perceive lower levels of teacher and classmate support, relative to other support sources (i.e. parents and friends) [21, 22] and to their non-overweight counterparts [8]. In addition, both cross-sectional [21–23] and longitudinal [8] relationships between higher perceived social support, especially from classmates, and greater HRQoL have been previously underlined in overweight and obese adolescents. However, these results are based on studies focusing on limited samples of overweight or obese adolescents involved in weight-management programmes. These studies did not cover non-treatment-seeking youth, although such adolescents could have different characteristics than treatment-seeking ones (e.g. regarding the perception of social support networks). In addition, they did not include thin and normal-weight adolescents and could therefore not investigate the possible moderating effect of perceived school-related social support on the association between BMI and HRQoL.

Therefore, the purposes of the current study were to investigate the association between BMI and HRQoL among a large and non-clinical sample of adolescents, and to test the moderating effect of perceived social support from teachers and classmates on this association. We hypothesised that (i) overweight and obese adolescents have lower HRQoL than their normal-weight peers; and (ii) this inverse association is weaker among adolescents with high perceived school-related social support than among those with low perceived school-related social support.

Methods

Study population

This study is based on the data collected in a sample of French-speaking Belgian adolescents within the 2014 World Health Organization "Health Behaviour in School-aged Children" (HBSC) survey. The HBSC study is a cross-sectional school-based survey of adolescent health behaviours conducted every 4 years in more than 40 countries and regions, using an international standardised protocol. Self-report questionnaires were completed by the adolescents in the classroom and treated as confidential. A detailed description of the methods and instruments of the HBSC survey can be found elsewhere [24].

In French-speaking Belgium, the survey was approved by the education authority of each school network (private and public). Participants were selected using a two-stage cluster sampling method with the schools as primary sample units and the classes as secondary sample units. Firstly,

the schools were randomly selected from an official list of all schools stratified per province and school network, with an allocation proportional to the school population size of each province and network. Overall, 781 schools were invited, 362 answered (yes/no) and 46.4% of the answering schools agreed to participate. Secondly, classes of primary (fifth and sixth grades) and secondary schools (grade 1–7) were randomly selected in the participating schools. The sample included all students in the selected classes and present on the day of questionnaire completion.

Measures

Health-related quality of life (HRQoL)

HRQoL was measured using the self-report version of the KIDSCREEN-10 tool [7]. This generic instrument includes ten items covering physical (i.e. energy and fitness), psychological, social (i.e. leisure time and relationships with parents and friends) and school aspects, each item being answered on a five-point response scale [7]. The KIDSCREEN-10 has been validated in children and adolescents (8–18 years), based on other generic HRQoL, physical and mental health measures [7]. As in European normative samples where good internal consistency was found for KIDSCREEN-10 (Cronbach's alpha = 0.82) [7], acceptable internal consistency was obtained in the current study (Cronbach's alpha = 0.78). Following the KIDSCREEN manual [25], answers were coded in order that higher values correspond to better well-being, and summed. The sum scores were then transformed into Rasch Person Parameters, which were transformed into values with a mean of 50 and a standard deviation of 10 [25]. When one item of the scale was left unanswered, remaining items were used to estimate the respondent parameter values. Respondents with more than one missing item for the scale were coded as missing for the scale [25].

Body mass index (BMI)

BMI was calculated as the body weight (in kilogrammes) divided by height (in metres) squared. Weight and height were self-reported by the adolescents. Adolescents were classified into four categories: "thin", "normal-weight", "overweight" and "obese", according to the age- and sex-specific cut-offs recommended by the International Obesity Task Force (IOTF) [26]. Self-reported data were considered as valuable for estimating adolescent overweight and obesity in epidemiological studies if measured data are not available due to practical reasons [27, 28].

Perceived teacher and classmate relationships

School-related social support was assessed as the respondent's perception of his relationships with teachers and classmates. Perceived teacher relationships were assessed through a three-item scale including the following statements: "I feel that my teachers accept me as I am", "I feel that my teachers care about me as a person", "I feel a lot of trust in my teachers" [24]. Perceived classmate relationships were measured by means of the three following items: "the students in my class enjoy to be together", "most of the students in my class are kind and helpful", "other students accept me as I am" [29]. For each item of both scales, a five-point Likert scale ranging from "strongly agree" to "strongly disagree" was given. Responses were coded so that higher scores indicated better relationships, and summed. Students having missing data for one or more items were coded as missing for the scale. Using the tertiles of the sum scores in the sample, respondents were classified into three categories reflecting their perception of teacher or classmate relationships: "good", "average" and "poor". Acceptable internal consistency was found for both teacher (Cronbach's alpha = 0.70) and classmate scales (Cronbach's alpha = 0.72) in this study.

Sociodemographic characteristics

In addition to sex, month and year of birth, adolescents were asked to indicate who they were living with in the house where they were living most of the time. Based on this question, adolescents were classified into four types of family structure: "family with two parents", "blended family", "lone-parent family" and "other" (e.g. adolescents living in a foster home). Socioeconomic status was assessed through the revised Family Affluence Scale (FAS), which has been previously validated [30, 31]. This scale includes six items related to the material conditions in the participant household (ownership of a car, own bedroom, number of computers, number of bathrooms, ownership of a dishwasher and abroad holiday frequency during the last year). Students having missing data for one or more items were coded as missing for the scale. Individual responses were scored and summed to provide summary scores ranging from 0 to 13. Individual summary scores were then recoded to create "low" (between 0 and 6), "medium" (between 7 and 9) and "high" (between 10 and 13) affluence groups.
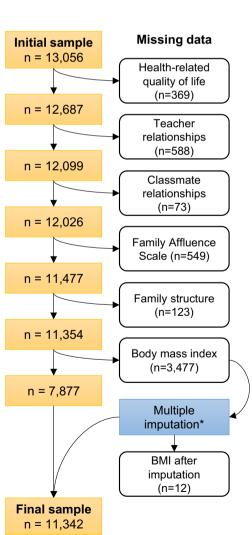
Missing data

After excluding inconsistent questionnaires, those with missing sex or age, and those from students older than 18 years (i.e. the maximal age for which the KIDSCREEN-10 has been validated), data from 13,056 adolescents aged 10–18 years old were available for analysis. Assuming the

data were missing at random, a multiple imputation procedure was conducted to address the high amount of missing BMI in the dataset (32.6% of the 13,056 cases, $n = 4263$). Missing values for BMI in categories were imputed based on 30 iterations of a multinomial logistic regression model including non-missing values of HRQoL, perceived teacher and classmate relationships, sex, age, FAS, family structure, and body image perception as independent variables. Body image perception ("do you think your body is: much too/a bit too thin, about the right size, a bit too/much too fat?") was identified as a relevant auxiliary variable for imputing BMI since it was associated both with the observed values of BMI ($r > 0.4$) and BMI missingness [32, 33]. Furthermore, individuals with missing values for one or more study variables were excluded from the analyses, thereby leading to a final sample of 11,342 adolescents (Fig. 1).

Statistical analyses

Descriptive analyses (means and standard deviations or frequencies) were conducted. Associations between categorical variables (e.g. included/excluded individuals and sex) were estimated using Pearson's chi-squared tests, while associations between continuous and categorical variables (e.g. HRQoL and sex) were estimated using ANOVA and post hoc pairwise comparisons of means. Hierarchical multiple regression analyses were conducted with HRQoL as the outcome variable, BMI in categories, perceived teacher or classmate relationships as independent variables and sex, age, FAS and family structure as confounders. Categorical variables were coded in dummy variables before inclusion in the regression models. Plausible interaction terms (i.e. sex × age and BMI x confounders) were tested and analyses were stratified by sex due to the significant sex × age interaction ($p < 0.001$) (Fig. 2). BMI and confounding factors were entered simultaneously in the first step (Model 1). Perceived teacher (Model 2A) or classmate relationships (Model 2B) were entered in the second step. Finally, the "BMI × teacher support" (Model 3A) or "BMI × classmate support" interaction (Model 3B) was entered in the third step to test the moderating effect of these relationships.
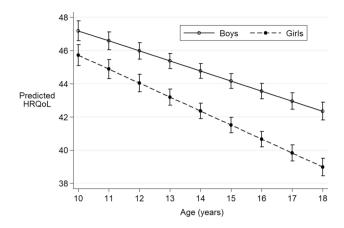
Fig. 1 Flowchart of inclusion in analyses

*Missing BMI values were imputed with a multiple procedure (m=30) based on a multinomial logistic regression using health-related quality of life, teacher and classmate relationships, sex, age, Family Affluence Scale, family structure and body image concerns as independent variables. Individuals with missing values for the body image (n=12) kept missing value for the imputed BMI.

Fig. 2 Predicted health-related quality of life as a function of sex and age

In all models, absence of multicollinearity between explanatory variables was verified using variation influence factors, whereas residual normality and homoscedasticity were verified using graphical methods. The assumption of absence of association between the independent (i.e. BMI) and moderating (i.e. perceived teacher and classmate relationships) variables was verified using Pearson's chi-squared tests [34]. Statistical significance was set at $p < 0.05$. All analyses were conducted using the statistical software STATA version 14.2.

Results

The study sample consisted of 11,342 adolescents with a mean age of 14.6 years (SE 0.02; range 10.1–18.9 years). Table 1 presents the characteristics of the sample, including mean HRQoL scores in the various population subgroups. Compared with adolescents excluded from the analyses due to missing data (Fig. 1), the analysed sample included significantly more girls (52.7% vs. 42.1%), older adolescents (14.6 (SE 0.02) years vs. 14.2 (SE 0.06) years), more adolescents from high FAS (33.9% vs. 29.0%), less adolescents belonging to another type of family structure (1.7% vs. 4.2%) and more adolescents perceiving their relationships with classmates as poor (43.2% vs. 39.1%). HRQoL, BMI in categories and perceived teacher relationships did not differ significantly between included and excluded adolescents. Furthermore, BMI in categories was not significantly associated neither with perceived teacher relationships ($p = 0.41$) nor classmate relationships ($p = 0.30$).

In the linear regression model adjusted for age, FAS and family structure (Model 1), HRQoL was significantly associated with BMI for both boys and girls (Table 2). In both sexes, obesity was significantly associated with reduced HRQoL, whereas the difference between thin and

Table 1 Characteristics of the sample ($n = 11,342$) and mean health-related quality of life (HRQOL) scores

Characteristics	n (%)	HRQOL score		
		Mean	SE	p
Sex				
Males	5361 (47.3)	46.2	0.11	<0.001
Females	5981 (52.7)	43.5	0.10	
Family affluence scale				
High	3843 (33.9)	45.5	0.13	<0.001
Medium	5247 (46.2)	44.7	0.11	
Low	2252 (19.9)	43.8	0.18	
Family structure				
Two parents	7200 (63.5)	45.5	0.10	<0.001
Blended	1625 (14.3)	43.8[a]	0.20	
Lone-parent	2327 (20.5)	43.5[a]	0.16	
Other	190 (1.7)	41.0	0.59	
Body mass index				
Thin	835 (7.4)[b]	45.6	0.32	<0.001
Normal weight	8842 (77.9)	44.9	0.09	
Overweight	1357 (12.0)	44.1	0.25	
Obese	308 (2.7)	42.6	0.59	
Teacher relationships				
Good	3373 (29.7)	48.3	0.15	<0.001
Average	3684 (32.5)	44.8	0.12	
Poor	4285 (37.8)	42.1	0.11	
Classmate relationships				
Good	2501 (22.1)	48.6	0.18	<0.001
Average	3939 (34.7)	45.2	0.12	
Poor	4902 (43.2)	42.5	0.10	

[a]For each characteristic studied, means sharing a letter are not significantly different at the 5% level

[b]Counts and proportions obtained by combining the 30 imputed datasets

normal-weight adolescents was not significant. In girls, overweight was associated with a significant decrease in HRQoL, which was not the case in boys (Table 2). Model 1 explained 4% of the variance in HRQoL in boys and 8% in girls.

When adding the perception of teacher or classmate relationships in the model (Models 2A and 2B), obesity in boys, and both overweight and obesity in girls, remained associated with decreased HRQoL (Table 3). Moreover, reduced HRQoL was observed for adolescents having an average or poor perception of teacher or classmate relationships, in comparison with those indicating good relationships, regardless of sex (Table 3). Compared with Model 1, both Models 2A and 2B explained a significant higher percentage of the variance in HRQoL (Model 2A: $R^2 = 11\%$ in boys and 15% in girls; Model 2B: $R^2 = 11\%$ in boys and 15% in girls). For both sexes, similar results were found when introducing

Table 2 Adjusted coefficients for the linear regression models (Model 1) estimating the association between health-related quality of life and body mass index

	Boys		Girls	
	Coefficient (95% CI)	p	Coefficient (95% CI)	p
Intercept	55.97 (54.59 to 57.35)	<0.001	57.06 (55.77 to 58.34)	<0.001
BMI				
Thin	− 0.38 (− 1.12 to 0.35)	0.31	− 0.64 (− 1.97 to 0.70)	0.35
Normal weight	Ref.		Ref.	
Overweight	− 0.56 (− 1.33 to 0.21)	0.15	− 0.94 (− 1.68 to − 0.19)	0.01
Obese	− 2.14 (− 3.50 to − 0.77)	0.002	− 2.96 (− 4.73 to − 1.18)	0.001
Age (years)	− 0.61 (− 0.70 to − 0.52)	<0.001	− 0.84 (− 0.92 to − 0.75)	<0.001
Family affluence scale				
High	Ref.		Ref.	
Medium	− 0.29 (− 0.76 to 0.18)	0.22	− 0.40 (− 0.85 to 0.06)	0.08
Low	− 0.47 (− 1.09 to 0.14)	0.13	− 0.88 (− 1.45 to − 0.32)	0.002
Family structure				
Two parents	Ref.		Ref.	
Blended	− 1.20 (− 1.81 to − 0.58)	<0.001	− 1.80 (− 2.37 to − 1.23)	<0.001
Lone-parent	− 1.63 (− 2.17 to − 1.09)	<0.001	− 1.56 (− 2.07 to − 1.05)	<0.001
Other	− 2.14 (− 3.96 to − 0.31)	0.02	− 3.90 (− 5.33 to − 2.47)	<0.001

BMI body mass index, *95% CI* 95% confidence interval

Table 3 Adjusted coefficients for the linear regression models estimating the association between health-related quality of life, body mass index and perceived teacher (Model 2A) or classmate (Model 2B) relationships

	Model 2A[a] addition of teacher relationships				Model 2B[a] addition of classmate relationships			
	Boys		Girls		Boys		Girls	
	Coefficient (95% CI)	p	Coefficient (95% CI)	p	Coefficient (95% CI)	p	Coefficient (95% CI)	p
Intercept	56.11 (54.78 to 57.45)	<0.001	56.90 (55.66 to 58.14)	<0.001	58.17 (56.82 to 59.52)	<0.001	58.95 (57.68 to 60.22)	<0.001
BMI								
Thin	− 0.43 (− 1.14 to 0.29)	0.24	− 0.91 (− 2.18 to 0.36)	0.16	− 0.42 (− 1.15 to 0.31)	0.26	− 0.67 (− 1.97 to 0.63)	0.31
Normal weight	Ref		Ref		Ref		Ref	
Overweight	− 0.65 (− 1.40 to 0.09)	0.08	− 0.92 (− 1.65 to − 0.19)	0.01	− 0.36 (− 1.10 to 0.37)	0.33	− 0.80 (− 1.50 to − 0.10)	0.03
Obese	− 2.12 (− 3.50 to − 0.74)	0.003	− 2.80 (− 4.54 to − 1.06)	0.002	− 2.12 (− 3.45 to − 0.78)	0.002	− 3.11 (− 4.79 to − 1.43)	<0.001
Teacher relationships					Classmate relationships			
Good	Ref		Ref		Ref		Ref	
Average	− 2.86 (− 3.37 to − 2.36)	<0.001	− 2.79 (− 3.29 to − 2.29)	<0.001	− 3.06 (− 3.58 to − 2.53)	<0.001	− 2.84 (− 3.38 to − 2.30)	<0.001
Poor	− 5.10 (− 5.60 to − 4.59)	<0.001	− 5.26 (− 5.74 to − 4.77)	<0.001	− 5.36 (− 5.89 to − 4.84)	<0.001	− 5.26 (− 5.77 to − 4.75)	<0.001

BMI body mass index; *95% CI* 95% confidence interval

[a]Models adjusted for age, family affluence scale and family structure

teacher and classmate support simultaneously in the model ($R^2 = 15\%$ in boys and 19% in girls).

In the last models including interaction between BMI and perceived teacher relationships (Model 3A) or between BMI and perceived classmate relationships (Model 3B), these interactions were not significant (Model 3A: $p = 0.97$ in boys and 0.42 in girls; Model 3B: $p = 0.85$ in boys and 0.58 in girls) and did not significantly increase the proportion of the

variance in HRQoL accounted for, compared with Models 2A and 2B, both in boy and girl adolescents (Model 3A: $R^2 = 11\%$ in boys and 15% in girls; Model 3B: $R^2 = 11\%$ in boys and 15% in girls) (Online resources 1 and 2).

Discussion

As hypothesised, our analyses confirm that HRQoL is significantly lower for obese boy and girl adolescents than for their normal-weight peers, after adjustment for age, FAS and family structure. This result is consistent with previous research which has related this impairment to poorer perception of physical appearance, and impaired physical, social and emotional functioning [3–5, 35, 36]. Regardless of BMI, HRQoL is likely to decrease during adolescence due to hormonal, physical and social changes to which adolescents have to cope with [37]. In addition to these changes, obese adolescents are more likely than their normal-weight peers to report poor self-esteem [4, 38] and body dissatisfaction [38–40], to encounter an earlier onset of puberty [41, 42], physical limitations and social difficulties (e.g. stigmatisation and bullying) [43], all factors that may lead to additional HRQoL impairments.

In addition, our study showed that overweight girls have impaired HRQoL compared with normal-weight ones, which was not observed among boys. This sex difference, also underlined in other studies [35, 36, 44], suggests greater HRQoL reductions associated with above normal BMI in girls than in boys. This finding may be compared with the association between obesity and depression which was found to be stronger in girls than in boys [45]. Higher sensitivity and concern of girls for depressive moods [37], body image [46] and self-esteem [37, 47] may contribute to explain such findings since these aspects can also be affected by above normal-weight status as mentioned previously. Moreover early timing of puberty has been associated with depression for girls, whereas this association is more controversial for boys [41].

Furthermore, our results bridge a knowledge gap by showing that thin adolescents do not differ significantly from normal-weight adolescents regarding their HRQoL, for boys as for girls. This finding is noteworthy because little is known in the literature about how under-normal BMI is associated with HRQoL in adolescents. The few existing studies on this topic found similar results in samples of Australian [48] and US adolescents [49]. However, the smaller sample of thin adolescents may have reduced the statistical power to detect differences. In addition, the absence of differences may reflect that most of thin adolescents of the sample (75.1%) were actually classified into "thinness grade 1", corresponding to BMI between 17 and 18.5 at age 18, while few grades 2 and no grade 3 were represented

in our sample, these latter being the most likely to have impaired HRQoL (e.g. due to strong body dissatisfaction and unhealthy weight-control behaviours and dieting) [50].

Regarding our second hypothesis, our results show that perceived teacher and classmate support is associated with HRQoL but does not moderate the inverse association between BMI and HRQoL. These results contradict the "buffer effect" model [20] positing that school-related social support would be more beneficial for overweight or obese adolescents than for their normal-weight counterparts. For instance, Reiter-Purtill et al. have underlined that having reciprocated friendships is associated with less loneliness and higher global self-worth for obese children involved in weight-management programmes, but not for their non-overweight comparison peers [51]. In the current study, however, despite the large overall sample size, the interaction tests between categorical variables may have been subject to insufficient statistical power, particularly in sub-strata involving obese youth. Secondly, we operationalised perceived social support by focusing on relationship quality, even on positive aspects only. However, adolescent relationships may be ambivalent, characterised by a mix of positive and negative feelings [52, 53]. Previous research has shown that such ambivalent relationships may not have the same implications than supportive relationships for health. They may even lead to detrimental outcomes (e.g. higher depression) due to less effective support in case of stress (support interference hypothesis) or to increased interpersonal stress (stress-enhancing hypothesis) [18, 52]. In the current study, measurement tools did not capture possible coexisting levels of negativity, which may therefore have limited our conclusions.

Moreover, our findings seem to support the "main effect" model [20], according to which perceiving positively teacher and classmate relationships would be equally beneficial for adolescent HRQoL regardless of BMI. The main effect of social support on psychosocial adjustment has been identified in previous studies among children with chronic disease like paediatric rheumatic disease [54] or congenital heart disease [55]. Zhang et al. also identified a main effect of social support on psychological stress in the context of bullying victimisation [56]. Concerning overweight and obesity, prior studies have documented cross-sectional or longitudinal associations between higher perceived social support, especially from classmates, and better self-esteem, physical and social functioning and global quality of life within limited samples of treatment-seeking overweight or obese youth [8, 21–23].

While adolescent development is influenced by the relationships with parents and friends, the school context, especially teacher and classmate relationships, also has a substantial influence [57]. Previous research has indicated that perceived school-related social support is strongly associated

with students' life satisfaction and well-being [12–14, 16]. Therefore, given that adolescents spend most of their time at school, we decided in this study to focus on perceived support from teachers and classmates. Besides these *sources* of support, youth can receive different *types* of support which are recognised to enhance the individual functioning: (i) "esteem" support, i.e. actions supporting self-worth; (ii) "emotional" support, i.e. communication meeting emotional or affective needs; (iii) "informational" support, i.e. advice to solve problems; (iv) "instrumental" support, i.e. tangible resources or services and (v) "companionship" support, i.e. social integration [58]. Both scales used to assess perceived teacher and classmate relationships covered mainly esteem (e.g. "other students accept me as I am"), emotional (e.g. "I feel a lot of trust in my teachers") and, to a lesser extent, companionship ("most of the students in my class are kind and helpful") dimensions of support. More specifically, our findings suggest therefore that perceived emotional and esteem support from classmates and teachers are associated with HRQoL but does not moderate the inverse association between BMI and HRQoL. This has to be related to prior research indicating that weight-based victimisation is associated with negative emotional outcomes, social isolation, lower academic performances and poorer health behaviours [43].

To our knowledge, our study is the first attempt to analyse the moderating effect of perceived school-related social support on the inverse association between BMI and HRQoL in a large and population-based sample including thin, normal-weight, overweight and obese adolescents. Other strengths of the current study include the use of the KIDSCREEN-10, a standardised and valid tool providing a global index of HRQoL for both healthy and chronically ill adolescents [7], and the availability of various health status, health behaviour and contextual indicators. However, this study presents several limitations. Firstly, its cross-sectional design prevents any conclusion being drawn regarding causal relationships between BMI, perception of teacher and classmate relationships and HRQoL. Reciprocal associations could exist between BMI and HRQoL, with each exerting impact on each other, like it has been reported between obesity and depression [45]. Similarly, HRQoL and perceived relationships with teachers and classmates could also be associated in a bidirectional way. Further longitudinal studies are therefore needed to explore the directionality of these associations. Secondly, the KIDSCREEN-10 is a generic instrument, which can therefore be less sensitive to changes than disease-specific instruments designed to target situations and symptoms more relevant to a specific disease (e.g. obesity). However, obesity-specific instruments would not be relevant for school-based surveys because not adapted to all BMI categories. The high amount of missing values for the BMI (32.6%) constitutes a third limitation since it may introduce bias and affect generalisability of results. Some studies have shown that missing BMI was associated with sociodemographic and health-related variables [59, 60]; consequently, a multiple imputation procedure was implemented. Fourthly, the use of self-reported weight and height to assess BMI is another possible source of bias: indeed, several studies have shown that people tend to underestimate weight and overestimate height, thereby leading to underestimation of overweight prevalence [27]. Overweight and obese prevalences obtained in our sample were somewhat lower than national estimates based on measured weight and height (i.e. 13.6% of 10–17 years being overweight and 4.6% obese) [1]. Similarly, HRQoL, as well as perceived teacher and classmate relationships, was a construct based on self-reported items and may therefore be subject to social desirability bias. Fifthly, for ease of interpretation, perceived teacher and classmate relationships were both used as categorical variables. Categorising continuous variables may, however, discard information and raise questions about the way the cut-points are selected. Analyses were also conducted with perceived teacher and classmate relationships addressed as continuous variables; they came to the same conclusions regarding the association between BMI and HRQoL (Models 1, 2A and 2B) and the absence of interactions between perceived teacher or classmate relationships, and BMI (Models 3A and 3 B) (data not shown). Finally, although HRQoL, BMI and perceived teacher relationships did not differ between adolescents included in the analyses and those excluded due to missing data, selection bias may have affected our results since being included in the analyses was significantly associated with the sex, age, FAS, family structure and perceived classmate relationships.

Our analyses confirm that, in comparison with normal-weight adolescents, HRQoL is lower for overweight girl and obese boy and girl adolescents. We also identified high perceived school-related social support as strongly associated with greater HRQoL in adolescents irrespective of weight status. These results, in addition to existing literature, may have implications for developing school-based interventions. Specifically, interventions targeting classmate behaviours and teacher–student relationships may help improve HRQoL for overweight and obese adolescents as for thin and normal-weight ones. A positive school climate—including respect for diversity and differences, and support from adults and peers—has been associated with reduction of within-class bullying [61] and greater well-being among students [11]. Through improving youth global functioning, increasing HRQoL could subsequently lead to promote the success of future weight-management strategies for overweight and obese adolescents [8]. Furthermore, our study suggests that perceived teacher and classmate relationships do not moderate the inverse association between BMI and HRQoL. Since it constitutes a first exploratory step, further research

needs to be conducted in other population-based samples to confirm such findings. Using tools able to capture both positive and negative aspects of social relationships (e.g. the social relationships index [62]) would provide new perspectives. Future studies could investigate the moderating effect of perceived school-related social support on other weight-related factors associated with reduced HRQoL like body image, weight-status misperceptions and bullying. This last issue constitutes an important perspective due to pervasive weight stigmatisation which is reflected by victimisation, teasing and bullying for overweight and obese adolescents [43]. Including out-of-school support and using measurement tools covering all support types could also provide new insights into this topic.

Compliance with ethical standards

Conflict of interest The authors declare that they do not have conflict of interest.

Ethical approval The study was approved by the regional education boards of the four different school networks in the Wallonia-Brussels Federation (i.e. Conseil de l'Enseignement des Communes et des Provinces, Direction Générale de l'Enseignement obligatoire de la Fédération Wallonie-Bruxelles, Conseil des Pouvoirs organisateurs de l'Enseignement officiel neutre subventionné, Secrétariat Général de l'Enseignement Catholique).

Informed consent Given the nature of the survey, informed consent was not considered as necessary by the education authority of school networks in the Wallonia-Brussels Federation.

References

1. Lebacq, T. (2015). Enquête de consommation alimentaire 2014–2015, Rapport 1: Anthropométrie (IMC, tour de taille et ratio tour de taille/taille). WIV-ISP. Retrieved February 7, 2018, from, https://fcs.wiv-isp.be/nl/Gedeelde%20%20documenten/FRANS/AM_FR.pdf.
2. World Health Organization (2017). Global strategy on diet, physical activity & health. childhood overweight and obesity. Retrieved January 30, 2017, from, http://www.who.int/dietphysicalactivity/childhood/en/.
3. Tsiros, M. D., Olds, T., Buckley, J. D., Grimshaw, P., Brennan, L., Walkley, J., et al. (2009). Health-related quality of life in obese children and adolescents. *International Journal of Obesity, 33*(4), 387–400.
4. Griffiths, L. J., Parsons, T. J., & Hill, A. J. (2010). Self-esteem and quality of life in obese children and adolescents: A systematic review. *International Journal of Pediatric Obesity, 5*(4), 282–304.
5. Ul-Haq, Z., Mackay, D. F., Fenwick, E., & Pell, J. P. (2013). Meta-analysis of the association between body mass index and health-related quality of life among children and adolescents, assessed using the pediatric quality of life inventory index. *The Journal of Pediatrics, 162*(2), 280–286.
6. World Health Organization (1997). WHOQOL, measuring quality of life. World Health Organization. Retrieved September 2, 2017, from, http://www.who.int/mental_health/media/68.pdf.
7. Ravens-Sieberer, U., Erhart, M., Rajmil, L., Herdman, M., Auquier, P., Bruil, J., et al. (2010). Reliability, construct and criterion validity of the KIDSCREEN-10 score: A short measure for children and adolescents' well-being and health-related quality of life. *Quality of Life Research, 19*(10), 1487–1500.
8. Wu, Y. P., Reiter-Purtill, J., & Zeller, M. H. (2014). The role of social support for promoting quality of life among persistently obese adolescents: Importance of support in schools. *Journal of School Health, 84*(2), 99–105.
9. World Health Organization (1986). *Young people's health—a challenge for society: Report of a WHO Study Group on Young People and "Health for All by the Year 2000"* (Technical Report Series). Switzerland.
10. Eccles, J. S., & Roeser, R. W. (2011). Schools as developmental contexts during adolescence. *Journal of Research on Adolescence, 21*(1), 225–241.
11. Thapa, A., Cohen, J., Guffey, S., & Higgins-D'Alessandro, A. (2013). A review of school climate research. *Review of Educational Research, 83*(3), 357–385.
12. Colarossi, L. G., & Eccles, J. S. (2003). Differential effects of support providers on adolescents' mental health. *Social Work Research, 27*(1), 19–30.
13. Suldo, S. M., Friedrich, A. A., White, T., Farmer, J., Minch, D., & Michalowski, J. (2009). Teacher support and adolescents' subjective well-being: A mixed-methods investigation. *School Psychology Review, 38*(1), 67.
14. Murray-Harvey, R. (2010). Relationship influences on students' academic achievement, psychological health and well-being at school. *Educational and Child Psychology, 27*(1), 104.
15. Rueger, S. Y., Malecki, C. K., & Demaray, M. K. (2008). Gender differences in the relationship between perceived social support and student adjustment during early adolescence. *School Psychology Quarterly, 23*(4), 496.
16. Auerbach, R. P., Bigda-Peyton, J. S., Eberhart, N. K., Webb, C. A., & Ho, M.-H. R. (2011). Conceptualizing the prospective relationship between social support, stress, and depressive symptoms among adolescents. *Journal of Abnormal Child Psychology, 39*(4), 475–487.
17. Chu, P. S., Saucier, D. A., & Hafner, E. (2010). Meta-analysis of the relationships between social support and well-being in children and adolescents. *Journal of Social and Clinical Psychology, 29*(6), 624.
18. Holt-Lunstad, J., Uchino, B. N., Smith, T. W., & Hicks, A. (2007). On the importance of relationship quality: The impact of ambivalence in friendships on cardiovascular functioning. *Annals of behavioral medicine: A publication of the Society of Behavioral Medicine, 33*(3), 278–290.
19. Cutrona, C. E., Russell, D. W., & Gardner, K. A. (2005). The relationship enhancement model of social support. In: T. A.

Revenson, K. Kayser & G. Bodenmann (Eds.), *Couples coping with stress. Emerging perspectives on dyadic coping*. American Psychological Association: Washington, DC, pp. 73–95.

20. Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310.

21. Zeller, M. H., & Modi, A. C. (2006). Predictors of health-related quality of life in obese youth. *Obesity, 14*(1), 122–130.

22. Herzer, M., Zeller, M. H., Rausch, J. R., & Modi, A. C. (2011). Perceived social support and its association with obesity-specific health-related quality of life. *Journal of Developmental & Behavioral Pediatrics, 32*(3), 188.

23. Ingerski, L. M., Janicke, D. M., & Silverstein, J. H. (2007). Brief report: Quality of life in overweight youth—the role of multiple informants and perceived social support. *Journal of Pediatric Psychology, 32*(7), 869–874.

24. Currie, C., Inchley, J., Molcho, M., Lenzi, M., Veselska, Z., & Wild, F. (2014). *HBSC Study protocol: Background, methodology and mandatory items for the 2013/14 survey*. St Andrews.

25. The KIDSCREEN Group Europe. (2016). *The KIDSCREEN Questionnaires. Quality of life questionnaires for children and adolescents. Handbook* (3rd edn.). Lengerich: Pabst Science Publishers.

26. Cole, T. J., & Lobstein, T. (2012). Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatric Obesity, 7*(4), 284–294.

27. Sherry, B., Jefferds, M. E., & Grummer-Strawn, L. M. (2007). Accuracy of adolescent self-report of height and weight in assessing overweight status: A literature review. *Archives of Pediatrics & Adolescent Medicine, 161*(12), 1154–1161.

28. Fonseca, H., Silva, A., Matos, M. G., Esteves, I., Costa, P., Guerra, A., et al. (2010). Validity of BMI based on self-reported weight and height in adolescents. *Acta Paediatrica, 99*(1), 83–88.

29. Torsheim, T., Wold, B., & Samdal, O. (2000). The teacher and classmate support scale factor structure, test-retest reliability and validity in samples of 13-and 15-year-old adolescents. *School Psychology International, 21*(2), 195–212.

30. Torsheim, T., Cavallo, F., Levin, K. A., Schnohr, C., Mazur, J., Niclasen, B., et al. (2016). Psychometric validation of the revised family affluence scale: A latent variable approach. *Child Indicators Research, 9*(3), 771–784.

31. Hartley, J. E. K., Levin, K., & Currie, C. (2016). A new version of the HBSC Family Affluence Scale-FAS III: Scottish qualitative findings from the international FAS development study. *Child Indicators Research, 9*(1), 233–245.

32. Pedersen, A. B., Mikkelsen, E. M., Cronin-Fenton, D., Kristensen, N. R., Pham, T. M., Pedersen, L., et al. (2017). Missing data and multiple imputation in clinical epidemiological research. *Clinical Epidemiology, 9*, 157.

33. Chau, N., Chau, K., Mayet, A., Baumann, M., Legleye, S., & Falissard, B. (2013). Self-reporting and measurement of body mass index in adolescents: Refusals and validity, and the possible role of socioeconomic and health-related factors. *BMC Public Health, 13*(1), 815.

34. Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173.

35. Keating, C. L., Moodie, M. L., & Swinburn, B. A. (2011). The health-related quality of life of overweight and obese adolescents—a study measuring body mass index and adolescent-reported perceptions. *International Journal of Pediatric Obesity, 6*(5-6), 434–441.

36. Ottova, V., Erhart, M., Rajmil, L., Dettenborn-Betz, L., & Ravens-Sieberer, U. (2012). Overweight and its impact on the health-related quality of life in children and adolescents: Results from the European KIDSCREEN survey. *Quality of Life Research, 21*(1), 59–69.

37. Michel, G., Bisegger, C., Fuhr, D. C., & Abel, T. (2009). Age and gender differences in health-related quality of life of children and adolescents in Europe: A multilevel analysis. *Quality of Life Research, 18*(9), 1147–1157.

38. Kolodziejczyk, J. K., Gutzmer, K., Wright, S. M., Arredondo, E. M., Hill, L., Patrick, K., et al. (2015). Influence of specific individual and environmental variables on the relationship between body mass index and health-related quality of life in overweight and obese adolescents. *Quality of Life Research, 24*(1), 251–261.

39. Goldfield, G. S., Moore, C., Henderson, K., Buchholz, A., Obeid, N., & Flament, M. F. (2010). Body dissatisfaction, dietary restraint, depression, and weight status in adolescents. *The Journal of School Health, 80*(4), 186–192.

40. Mond, J., van den Berg, P., Boutelle, K., Hannan, P., & Neumark-Sztainer, D. (2011). Obesity, body dissatisfaction, and emotional well-being in early and late adolescence: Findings from the project EAT study. *Journal of Adolescent Health, 48*(4), 373–378.

41. Walvoord, E. C. (2010). The timing of puberty: Is it changing? Does it matter? *Journal of Adolescent Health, 47*(5), 433–439.

42. Cumming, S. P., Gillison, F. B., & Sherar, L. B. (2011). Biological maturation as a confounding factor in the relation between chronological age and health-related quality of life in adolescent females. *Quality of Life Research, 20*(2), 237–242.

43. Puhl, R. M., & King, K. M. (2013). Weight discrimination and bullying. *Best Practice & Research. Clinical Endocrinology & Metabolism, 27*(2), 117–127.

44. Buttitta, M., Iliescu, C., Rousseau, A., & Guerrien, A. (2014). Quality of life in overweight and obese children and adolescents: A literature review. *Quality of Life Research, 23*(4), 1117–1139.

45. Mannan, M., Mamun, A., Doi, S., & Clavarino, A. (2016). Prospective associations between depression and obesity for adolescent males and females-a systematic review and meta-analysis of longitudinal studies. *PLoS ONE, 11*(6), e0157240.

46. Brennan, M. A., Lalonde, C. E., & Bain, J. L. (2010). Body image perceptions: Do gender differences exist. *Psi Chi Journal of Undergraduate Research, 15*(3), 130–138.

47. Bleidorn, W., Arslan, R. C., Denissen, J. J. A., Rentfrow, P. J., Gebauer, J. E., Potter, J., et al. (2016). Age and gender differences in self-esteem—a cross-cultural window. *Journal of Personality and Social Psychology, 111*(3), 396.

48. Chen, G., Ratcliffe, J., Olds, T., Magarey, A., Jones, M., & Leslie, E. (2014). BMI, health behaviors, and quality of life in children and adolescents: A school-based study. *Pediatrics, 133*(4), e868–e874.

49. Cui, W., Zack, M. M., & Wethington, H. (2014). Health-related quality of life and body mass index among US adolescents. *Quality of Life Research, 23*(7), 2139–2150.

50. Lazzeri, G., Rossi, S., Kelly, C., Vereecken, C., Ahluwalia, N., & Giacchi, M. V. (2014). Trends in thinness prevalence among adolescents in ten European countries and the USA (1998–2006): A cross-sectional survey. *Public Health Nutrition, 17*(10), 2207–2215.

51. Reiter-Purtill, J., Ridel, S., Jordan, R., & Zeller, M. H. (2010). The benefits of reciprocated friendships for treatment-seeking obese youth. *Journal of Pediatric Psychology, 35*(8), 905–914.

52. Uchino, B. N., Holt-Lunstad, J., Uno, D., & Flinders, J. B. (2001). Heterogeneity in the social networks of young and older adults: Prediction of mental health and cardiovascular reactivity during acute stress. *Journal of Behavioral Medicine, 24*(4), 361–382.

53. Fingerman, K. L., Hay, E. L., & Birditt, K. S. (2004). The best of ties, the worst of ties: Close, problematic, and ambivalent social relationships. *Journal of Marriage and the Family, 66*(3), 792–808.

54. von Weiss, R. T., Rapoff, M. A., Varni, J. W., Lindsley, C. B., Olson, N. Y., Madson, K. L., et al. (2002). Daily hassles and social support as predictors of adjustment in children with pediatric rheumatic disease. *Journal of Pediatric Psychology, 27*(2), 155–165.

55. Tak, Y. R., & McCubbin, M. (2002). Family stress, perceived social support and coping following the diagnosis of a child's congenital heart disease. *Journal of Advanced Nursing, 39*(2), 190–198.

56. Zhang, X., Ra, C. K., Zhang, D., Zhang, Y., & MacLeod, K. E. (2016). The impact of school social support and bullying victimization on psychological distress among california adolescents. *Californian Journal of Health Promotion, 14*(2), 56–67.

57. Bokhorst, C. L., Sumter, S. R., & Westenberg, P. M. (2010). Social support from parents, friends, classmates, and teachers in children and adolescents aged 9 to 18 years: Who is perceived as most supportive? *Social Development, 19*(2), 417–426.

58. Caron, J., & Guay, S. (2005). Soutien social et santé mentale: Concept, mesures, recherches récentes et implications pour les cliniciens // Soutien social et santé mentale. *Soutien social au Québec, 30*(2), 15–41.

59. Mikolajczyk, R. T., & Richter, M. (2008). Associations of behavioural, psychosocial and socioeconomic factors with over-and underweight among German adolescents. *International Journal of Public Health, 53*(4), 214–220.

60. Fonseca, H., de Matos, M. G., Guerra, A., & Gomes-Pedro, J. (2009). Emotional, behavioural and social correlates of missing values for BMI. *Archives of Disease in Childhood, 94*(2), 104–109.

61. Gage, N. A., Prykanowski, D. A., & Larson, A. (2014). School climate and bullying victimization: A latent class growth model analysis. *School Psychology Quarterly, 29*(3), 256.

62. Campo, R. A., Uchino, B. N., Holt-Lunstad, J., Vaughn, A., Reblin, M., & Smith, T. W. (2009). The assessment of positivity and negativity in social networks: The reliability and validity of the social relationships index. *Journal of community psychology, 37*(4), 471–486.