

# The association of healthy lifestyle behaviors with mental health indicators among adolescents of different family affluence

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## Research article

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# Abstract

**Background** Healthy lifestyles may contribute to better mental health, which is particularly important in adolescence, an age at which half of all mental health problems first occur. This association may be even more relevant in adolescents of low family affluence, who show more mental health problems, as well as more unhealthy lifestyles. This study investigated the healthy lifestyle behaviors, namely sufficient sleep and physical activity, daily breakfast intake, low levels of alcohol use or smoking, in relation to mental health and mental health problems (feelings of depression, anxiety, stress and self-esteem) among adolescents from different family affluence. Furthermore, the moderating role of family affluence was examined in those relations.

**Methods** Adolescents aged 12-18y were recruited via a random sample of schools. A total of 1037 adolescents participated (M age=15.2, 49.8% female). Multiple linear regression analyses assessed the association between healthy lifestyles and mental health outcomes and the moderating role of family affluence.

**Results** All healthy lifestyle behaviors were associated with at least one mental health outcome. Adolescents from low-medium family affluence had lower levels of physical activity, less often took breakfast, and reported lower self-esteem than adolescents from high family affluence. The results only showed a moderating effect of family affluence for smoking in relation to stress: at low levels of smoking, high family affluence youngsters experienced more stress symptoms than low-medium family affluence youth. At high levels of smoking, low-medium family affluence youth, however, experienced more stress symptoms than high family affluence youth.

**Conclusion** These findings support the value of integrating healthy lifestyle behaviors in interventions for mental health promotion, for both youth of low-medium and high family affluence.

## Background

Youth mental health is defined by the World Health Organization as a state of well-being allowing youngsters to learn and acquire education, have a positive sense of identity, manage their thoughts and emotions, have a fulfilling social life and full participation in society (1). Mental health thus exceeds the absence of mental disorders or disabilities (1). Instead, it is a dynamic ability to find a balance between all aspects of life (2). Poor mental health is a severe public health concern, particularly in adolescents. Half of all mental health problems start by the age of 14, making adolescence a crucial period for mental health promotion (3). Worldwide, it is estimated that 10–20% of adolescents experience mental health problems (4). Evidence-based treatments for mental health problems, such as psychotherapy and pharmacotherapy, form a cornerstone of care available for those suffering from mental health problems. Such treatments, however, also face challenges: only small effects of treatment were found for a large group of patients (5, 6), young people are often reluctant to seek professional help (7), treatment comes at a high price for individuals and health care systems, and such treatments may have a range of

undesirable side-effects (8). In this context, prevention of mental health problems is of utmost importance.

Mental health is influenced by many factors, including everyday behaviors that can be altered by individuals (9, 10). Mental health programs support adolescents in managing their mental health by improving everyday health behaviors, are empowering, destigmatizing, and can have a large impact at population level at low cost (5). Several modifiable risk and protective factors have been identified in adolescents: sufficient sleep and physical activity and a healthy diet were associated with better mental health outcomes, such as lower depression, anxiety, stress (5, 10-15) and higher self-esteem (13, 14, 16-19); whereas high alcohol consumption and smoking were associated with less beneficial mental health outcomes, such as higher psychological distress, depression, anxiety, stress (5, 20-22), and lower self-esteem (23, 24). Increasing healthy behaviors (sufficient sleep and physical activity, and a healthy diet) and reducing these unhealthy behaviors (alcohol consumption and smoking) can increase adolescents' resilience and mental well-being.

In most countries, adolescent health outcomes are associated with socioeconomic status (SES) (25-29). Adolescents of low SES thus form a particular group of interest for promoting mental health via healthy lifestyles. Both mental health and healthy lifestyles in adolescents of low SES are found to be lower than among adolescents of high SES. A systematic review (30), which included studies that measured SES in various ways (i.e., through parental occupation, income or education), showed that socioeconomically disadvantaged children and adolescents are two to three times more likely to develop mental health problems (30-32) than their peers from socioeconomically advantaged families. In addition, adolescents from low SES reported lower levels of sleep, physical activity and healthy diet, and higher levels of smoking than teens from high SES (26, 33-42). Research on how adolescents' alcohol consumption differed as a function of SES was inconsistent (39, 41, 43, 44). It can be expected that unhealthy lifestyles have an even stronger association with mental health in adolescents of lower SES than of higher SES, since both healthy lifestyles and mental health are found to be poorer in this population. To our knowledge, only two studies so far have addressed the associations between healthy lifestyle behaviors and mental health in adolescents of low SES. These studies showed positive associations, but focused on only one health behavior (i.e., physical activity or sleep) in relation to psychological distress (35, 45). The present study combines different health behaviors and includes positive well-being in defining mental health. Moreover, SES is measured using the Family Affluence Scale, as this can be easily answered by adolescents themselves. In this article, 'family affluence', which is an indicator of SES, will be further used to refer to SES. The aim of the current study is to investigate: 1) associations between healthy lifestyles, namely sufficient sleep duration and physical activity, daily breakfast intake, low levels of alcohol use or smoking, and mental health (research question RQ1); 2) the level of healthy lifestyle behaviors and mental health among adolescents from different family affluence (RQ2); and 3) the moderating role of family affluence in the relation between healthy lifestyles and mental health (RQ3). It is hypothesized that higher levels of healthy lifestyles are associated with better mental health (H1); that adolescents from lower family affluence report lower levels of healthy lifestyles and poorer mental health than adolescents of higher family affluence (H2); and we expect to find that family affluence plays a

moderating role in the relation between the investigated healthy lifestyle behaviors and mental health outcomes (H3). Our results may indicate which lifestyle behaviors are associated with adolescent mental health, and may encourage health professionals in designing programs to lower the risk for mental health problems among adolescents. In addition, these results can shed a light on health promotion strategies particularly effective in lower family affluent groups in youth.

## Methods

### *Participants and data-collection*

We selected a random sample of schools (n=26) from a government database of secondary schools in Flanders, a region in Belgium consisting of around 6 million inhabitants. Eight schools (31%) agreed to collaborate in the study. The main reason for not participating was no time to set-up the survey at the school within the desired time frame. The study took place between November 2014 and May 2015. Within each school, classes were randomly selected. We aimed to collect data among all grades 7-12 (aged 12-18), which was not always practically feasible. Data collection took place at school, during one class hour. The anonymous paper-and-pencil survey was administered by the researchers, who explained at the start of the survey that students were under no obligation to participate and could withdraw at any time. Students were assured that their responses would be confidential and that no information would be shared with teachers, parents, or fellow students. Five students declined to participate, none of the parents declined consent. The study received approval from the Ethics Committee of the Ghent University Hospital (2012/307, B670201214183). Adolescents provided written informed consent, parents provided passive informed consent.

### *Measures*

#### *General socio-demographic information*

Items were derived from the HBSC 2009/10 questionnaire, a cross-national survey supported by the World Health Organization (46). Socio-demographic variables included gender, age, type of education, country of birth, family living situation, self-reported weight and height (used to calculate Body Mass Index, BMI).

#### Family affluence

This part of the HBSC questionnaire also comprised the validated adolescent self-report 'Family Affluence Scale' (FAS), to identify family material wealth and socio-economic status (SES) of children and adolescents (47). The FAS is used as an indicator of SES. It has widely been used to explore and explain socioeconomic inequalities in a wide range of health indicators in the HBSC study over the last 20 years (48). FAS is validated against other measures of SES and macro-economic indicators at country level (47, 48). The FAS was developed to overcome the problem of inaccurate perceptions and missing data among children and adolescents of their family's finances, especially among lower socio-economic groups which could thus lead to an underestimation of socioeconomic inequalities (28, 48). It was

proposed as a less intrusive, more comprehensible approach to identify the family's socioeconomic status (49) than inquiring about parents' educational, occupation or income levels (47, 50). It is indicated that in contrast to for example parental occupation, the proportion of missing data on FAS items is low (48). The FAS consists of four items: number of cars, own bedroom, computers owned and number of holidays per year (47, 49). A composite FAS score (ranging from 0-9) is calculated for each adolescent based on his or her responses to these four items. The following, international, cut-off points were used: score of 0, 1, 2 classified as low affluence; score of 3, 4, 5 as medium affluence; and a score of 6, 7, 8, 9 classified as high affluence (47).

### *Healthy lifestyles*

Items to assess healthy lifestyles, except for sleep duration, were also taken from the HBSC survey. Several health-related lifestyle behaviors among adolescents are interrelated. Based on Principal Component Analyses on these data reported elsewhere (11), healthy lifestyles were grouped into two factors: 'energy-balance related behaviors', consisting of physical activity and a healthy diet, and 'addictive behaviors and sleep duration', consisting of alcohol consumption, smoking and perceived sleep duration. These factors will be used to discuss the results, individual behaviors are however retained in the analyses.

### *Energy-balance related behaviors*

*Physical activity* was measured by the number of days they achieved  $\geq 60$  minutes of moderate to vigorous physical activity, was defined in the questionnaire as: "bodily movements that make your heart beat faster and make you feel out of breath at some moments". A *healthy diet* was measured by assessing the number of days per week adolescents had have breakfast. Eating a regular, healthy breakfast has been found to contribute to the daily recommended intake of essential nutrients (51, 52). Moreover, daily breakfast consumption can serve as an indicator to identify adolescents at risk for unhealthy lifestyle behaviors. For example, daily breakfast intake has proven to be associated with both daily fruit and vegetable consumption and an inverse relationship was found with daily soft drink consumption (42).

### *Addictive behaviors and perceived sleep duration*

*Alcohol use* was assessed by summing the frequency of six different types of alcohol consumption: beer, wine, spirits/liquor, alcopops and any other drink that contains alcohol (0-never; 4-daily. Range of summed score 0-24). An index combined several questions on *tobacco use frequency* (range 0: 'never tried smoked' to 4: 'smoking  $\geq 11$  cigarettes per day, considered as daily high dose smoker (=median among daily smokers)). To calculate *sleep duration* (number of hours slept per night), adolescents were asked to report at what time they usually go to bed and get up.

### *Mental health*

Mental health was measured through feelings of depression, anxiety and stress and self-esteem. *Feelings of depression, anxiety and stress* were measured with the Depression Anxiety Stress Scales (DASS-21) which has good psychometric properties to measure adolescent mental health outcomes (53, 54). It consists of seven items per subscale (54). Total scores per subscale were used as dependent variables, with high reliability for each of the subscales ( $\alpha_{\text{depression}}=0.90$ ;  $\alpha_{\text{anxiety}}=0.84$ ;  $\alpha_{\text{stress}}=0.87$ ). Focusing on *self-esteem* is considered a core element of mental health promotion and a fruitful basis for a broad-spectrum approach (55). Positive global self-esteem was measured by a single item from the Rosenberg Self-Esteem Scale (RES), namely 'I take a positive attitude toward myself'. Global self-esteem can be measured by a single item (56) and this specific item is a main contributor to global positive self-esteem (57, 58).

### *Analysis*

Multiple linear regression analyses assessed the association between healthy lifestyles and mental health outcomes (RQ1); and the moderating role of family affluence in the relation between healthy lifestyles and mental health outcomes (RQ3). Analyses were controlled for individual background factors that significantly influenced mental health outcomes (namely, BMI, gender and age). Analyses were conducted stepwise, by first examining the influence of family affluence and background variables, next the healthy lifestyle variables, and lastly the interaction effects between healthy lifestyle variables and family affluence. Collinearity diagnostics were conducted examining Variance Inflation Factor (VIF) ( $\leq 10$ ) and tolerance ( $\geq 0.1$ ). Cross-tabulations were checked for empty combinations of cells or low expected frequencies (59). Continuous independent variables were mean centered. Moderator variables were created by multiplication of interaction variables. Graphical presentations of moderator analyses were made using PROCESS 2.16.3 for SPSS, and based on parsimonious model results. Post-hoc analyses of significant interaction effects were performed using the Johnson-Neyman method. All analyses were conducted in SPSS 25.0.

## **Results**

The initial sample consisted of 1062 adolescents, from which 25 were removed due to incomplete or unsatisfying answers (no variation on relevant diverging questions or nonsense answers to open-ended questions), resulting in an analyzed sample of 1037 adolescents (49.8% female; M age=15.17y  $\pm$  1.86; M BMI=19.56  $\pm$  3.70) (Table 1). For 20 adolescents, no FAS score could be calculated due to missing information. The majority of the adolescents had a high family affluence (82.4%) and were born in Belgium (94.0%). Around two third lived with both parents (64.1%), one third had another family situation (e.g. living with one parent or in co-parenthood, living with other family members). VIF showed no multicollinearity among independent variables.

Results on sample characteristics can be found in Table 1. On average the sample performed  $\geq 60$  min. of moderate to vigorous physical activity on 3,3 days a week; they took breakfast on 5,38 days a week; and slept 7.87 hours per night. Moreover, the sample had a relatively low frequency of alcohol consumption (sum score 3.36/24) and 12,5% were current smokers. Adolescents of high family affluence were physically active on significantly more days, took breakfast on more days and had higher self-esteem than adolescents of lower family affluence. There were no significant differences in alcohol consumption or smoking, sleep duration, or other mental health outcomes between adolescents of low-medium and high family affluence (RQ2).

**Table 1.** Sample characteristics and differences between (in)dependent variables

	Full sample (n=1037)	Low-med family affluence (n=179)	High family affluence (n=838)	Significance of difference
<b>Physical activity</b>				
$\geq 60$ min. physical activity (number of days/week)	M=3.33 $\pm$ 2.09	M=2.83 $\pm$ 2.07	M=3.40 $\pm$ 2.08	F(1, 990)=11.04**
<b>Healthy diet</b>				
Breakfast (number of days/week)	M=5.38 $\pm$ 2.19	M=4.88 $\pm$ 2.38	M=5.50 $\pm$ 2.13	F(1, 999)=11.54**
<b>Alcohol consumption</b>				
Frequency of alcohol consumption (0-24)	M=3.36 $\pm$ 3.85	M=2.82 $\pm$ 3.60	M=3.45 $\pm$ 3.86	F(1, 994)=3.84°
<b>Smoking</b>				
Current smokers (daily + non-daily)	12.5%	14.6%	11.9%	$\chi^2=0.95$
high dose daily smokers	4.5%	7.0%	4.0%	$\chi^2=3.05^°$
<b>Perceived sleep duration</b>				
Average hours of sleep/night	M=7.87 $\pm$ 1.42	M=7.95 $\pm$ 1.55	M=7.85 $\pm$ 1.39	F(1, 984)=0.69
<b>Mental health outcomes</b>				
Symptoms of depression	M=6.21 $\pm$ 8.53	M=6.80 $\pm$ 9.34	M=6.09 $\pm$ 8.34	F(1, 999)=1.02
Anxiety	M=5.48 $\pm$ 7.11	M=5.60 $\pm$ 7.23	M=5.45 $\pm$ 7.10	F(1, 1000)=0.06
Stress	M=7.99 $\pm$ 8.12	M=8.30 $\pm$ 8.33	M=7.92 $\pm$ 8.10	F(1, 1002)=0.33
Self-esteem	M=3.71 $\pm$ 1.09	M=3.52 $\pm$ 1.15	M=3.76 $\pm$ 1.06	F(1, 973)=7.57**

° p<0.1, \* p<.05, \*\* p<.01, \*\*\* p<.001

BMI was not a significant predictor for any mental health outcome and therefore not included in further regression analyses.

Table 2 (full table in appendix) shows the main effects of addictive behaviors and sleep on mental health outcomes, as well as the results of the moderating role of family affluence in the relation between these behaviors and mental health outcomes (RQ1 and 3). A lower sleep duration was significantly associated with lower mental health on all studied indicators. More smoking had a main effect on higher levels of depression, anxiety and stress, whereas higher alcohol consumption was only significantly associated with more feelings of stress. There was only one moderating effect of family affluence in these relations with mental health outcomes, namely in the relation between smoking and stress (Fig. 1). For both youth of low-medium and high affluent families, smoking increased as stress increased. Among youth of low-medium family affluence, however, this increase was sharper ( $\beta=2.78$ ,  $SE=0.52$ ,  $p<.001$ ) than among youth of high family affluence ( $\beta=1.12$ ,  $SE=0.29$ ,  $p<.001$ ). Family affluence was also a significant main predictor of lower self-esteem.

**Table 2.** Regression analysis on the moderating role of family affluence in the relation between addictive behaviors and sleep, and mental health outcomes

	Dependent variable: mental health outcomes			
	Depression	Anxiety	Stress	Self-esteem
<b>Parsimonious model results (Interaction effects)</b>	F(3, 951)=25.85, $p<.001$ , adj. $R^2=0.08$	F(3, 952)=28.02, $p<.001$ , adj. $R^2=0.08$	F(6, 935)=17.60, $p<.001$ , adj. $R^2=0.10$	F(3, 938)=21.26, $p<.001$ , adj. $R^2=0.06$
	$\beta$ (B, SE)			
Gender	-0.17 (-2.87; 0.54)***	-0.18 (-2.53; 0.45)***	-0.18 (-3.02; 0.51)***	0.19 (0.41; 0.07)***
Family Affluence	/	/	-0.03 (-0.61; 0.67)	0.10 (0.29; 0.09)**
Smoking	0.14 (1.15; 0.27)***	0.15 (1.07; 0.23)***	0.30 (2.42; 0.54)***	/
Sleep	-0.16 (-0.99; 0.20)***	-0.16 (-0.79; 0.16)***	-0.12 (-0.71; 0.19)***	0.15 (0.12; 0.02)***
Alcohol	/	/	0.09 (0.21; 0.08)**	/
Smoking * Family Affluence	/	/	-0.19 (-1.69; 0.59)**	/

$R^2$ : Nagelkerke  $R^2$  °  $p<.1$ ; \*  $p<0.05$ ; \*\*  $p<.01$ ; \*\*\*  $p<.001$

[Figure 1]

Table 3 (full table in appendix) shows the associations between the energy-balance related behaviors and mental health, as well as the results of the moderating role of family affluence in the relation between energy-balance related behaviors and mental health outcomes (RQ1 and 3). Daily breakfast intake was

associated with higher mental health on all outcomes. Higher levels of physical activity only showed a significant main effect on one of the mental health outcomes, i.c. lower feelings of depression. There was no moderating role of family affluence in the relation between energy-balance related behaviors with any of the mental health outcomes. Family affluence, however, showed a significant association with self-esteem: youth of low-medium family affluence had lower self-esteem than youth of high family affluence.

**Table 3.** Regression analysis on the moderating role of family affluence in the relation between energy-balance related behaviors and mental health outcomes

	Dependent variable:			
	Depression	Anxiety	Stress	Self-esteem
<b>Parsimonious model results (Interaction effects)</b>	F(3, 981)=14.51, p<.001, adj. R <sup>2</sup> =0.04	F(2, 993)=22.46, p<.001, R <sup>2</sup> =0.04	F(3, 933)=15.02, p<.001, R <sup>2</sup> =0.04	F (3, 951)=20.12, p<.001, adj. R <sup>2</sup> =0.06
	$\beta$ (B, SE)			
Gender	-0.13 (-2.71; 0.54)***	-0.15 (-2.12; 0.44)***	-0.16 (-2.65; 0.52)***	0.18 (0.39; 0.07)***
Age	/	/	0.07 (0.29; 0.14)*	/
Family Affluence	/	/	/	0.08 (0.22; 0.09)*
Physical activity	-0.09 (-0.38; 0.13)**	/	/	/
Days of breakfast	-0.11 (-0.42; 0.12)**	-0.15 (-0.49; 0.10)***	-0.13 (-0.47; 0.12)***	0.15 (0.07; 0.02)***

R<sup>2</sup>: Nagelkerke R<sup>2</sup> ° p<.1; \* p<0.05; \*\* p<.01; \*\*\* p<.001

## Discussion

This study investigated healthy lifestyle behaviors and mental health among adolescents, thereby differentiating between adolescents from low to medium and high family affluence, and examining whether family affluence plays a moderating role in the relation between certain healthy lifestyles and mental health outcomes. Findings indicated that healthy lifestyle behaviors were indeed associated with better mental health outcomes, and that certain but not all healthy lifestyle behaviors and mental health outcomes were lower among adolescents of low to medium family affluence than those of high family affluence. We, however, did not find that family affluence moderated the association between healthy lifestyles and mental health outcomes, except for smoking in relation to stress. This indicated that

healthy lifestyles are equally important in mental health among adolescents, regardless of their family affluence.

The results show that all healthy lifestyle behaviors were associated with at least one mental health outcome. Lower sleep duration and daily breakfast intake were significantly associated with lower mental health on all studied indicators. Higher levels of physical activity only showed a significant association with one of the mental health outcomes, i.e. lower feelings of depression. Higher alcohol consumption was only significantly associated with more feelings of stress. More smoking showed an association with higher levels of feelings of depression, anxiety, and stress, but not with self-esteem. This pattern of results was, however, not completely in line with our idea that all forms of healthy lifestyles would be associated with all of the mental health outcomes (lower feelings of depression, anxiety and stress and higher self-esteem). Only sufficient sleep and daily breakfast intake were related to all mental health outcomes included in this study. It may be that depending on the mental health outcome, other healthy lifestyle behaviors are important. In this sense, combining different healthy lifestyle behaviors in a mental health promotion intervention may be beneficial, as various mental health outcomes are important for a positive mental well-being of adolescents.

The results only partially support the hypothesis that adolescents from lower family affluence would engage in lower levels of healthy lifestyles and experience poorer mental health outcomes than adolescents from higher family affluence. Consistent with previous studies (31, 32, 34, 39), the present study shows that adolescents from lower and medium family affluence had lower levels of physical activity, less often took breakfast, and reported lower self-esteem than adolescents from high family affluence. No significant differences between youngsters of low-medium and high family affluence were found for sleep duration, for alcohol consumption or smoking, and for feelings of depression, anxiety and stress. Regarding sleep and smoking, previous studies reported that adolescents from lower family affluence had poorer sleep duration (33, 35) and higher levels of cigarette smoking (38–41) than adolescents from high family affluence. Our findings regarding sleep duration and cigarette smoking were therefore not consistent with previous studies. In the area of alcohol consumption, studies that compared adolescents of low family affluence with adolescents of high family affluence (39, 43, 44) already reported inconsistent results.

Some of the differences between our findings and the literature may be due to different ways of measuring SES. Prior work already indicated that relationships between healthy lifestyles and SES may be inconsistent across SES indicators (26, 30, 41). In our study, an adolescent self-report measure, namely FAS, was used to identify SES of adolescents (47). This in comparison with previous studies that measure (parental) SES through income, education or occupation (33, 35, 40, 41, 43, 44). FAS measures only one aspect of SES, which is much more related to income, material wealth and spending patterns (26, 60). Physical activity and daily breakfast intake might be influenced more by financial resources (i.e., possibility of registering in a sports club or purchasing healthy food) than sleep, alcohol or smoking. Those behaviors may be more strongly associated with education and occupational status than with income or material wealth. Parental occupation reflects to some degree parents' educational status.

Educational strategies, values, norms and model behavior of parents may be more likely to positively influence sleep, alcohol or smoking (26, 60). Moreover, FAS associations are strong for health outcomes that are related to family culture and behavior (such as physical activity and healthy diet), but less so for some behaviors where peer norms are a potentially powerful influence (like alcohol use and smoking). Those addictive behaviors (alcohol use and smoking) might be less strongly influenced by parental socioeconomic status, such as what is measured by the FAS, but might have a stronger association with peer-related factors (26). In general, it is important that further research explores to what extent the different aspects of SES influence adolescent healthy lifestyle behavior as this could give important insights for preventive strategies (26).

Although this study shows that healthy lifestyles are clearly significant predictors of mental health, and there are some differences in healthy lifestyles according to family affluence, we did not find any significant differences in mental health problems (feelings of depression, anxiety and stress) between adolescents from low-medium family affluence and adolescents from high family affluence. Prior work indicates that low family affluence tends to be more strongly related with externalizing problems (e.g., attention deficit hyperactivity disorder, conduct disorder, antisocial behavior) than with internalizing problems (such as depression, anxiety and stress that were included here) among children and adolescents (30). Moreover, the results show that only 4–10% of variation in mental health is explained by the included lifestyle behaviors. This means that there are many other factors that contribute to mental health that were not included in this study and may be interesting to include in future research. Possibly there were other protective mechanisms in mental health problems for adolescents from low-medium family affluence which do not allow us to see any difference in mental health problems between those two family affluent groups. For example, social support from friends and spending time with friends during leisure time are the strongest protective factors against symptoms of depression and anxiety in adolescents (61). As high perceived social support offsets poor mental health in adolescents, this is most protective in areas of low socioeconomic disadvantage (62). That we did not find any difference in mental health problems among adolescents from low-medium and high affluence, might be due to sufficient social support among adolescents of low-medium affluence counteracting for the difference in mental health problems. To conclude, overall mental health can be lower in adolescents from low-medium family affluence (they reported lower levels of self-esteem), but, due to other protective mechanisms, this does not necessarily mean that those adolescents will have (symptoms of) a mental disorder.

This study furthermore shows no moderating effect of family affluence, except for smoking in relation to stress. At low levels of smoking, high family affluence adolescents experienced more stress symptoms than low-medium family affluence youth. At high levels of smoking, low-medium family affluence youth, however, experienced more stress symptoms than high family affluence youth. A possible explanation might be that smoking may be a coping mechanism to deal with this stress (63–65), and that this coping mechanism is used more by youth of low-medium family affluence than by youth of high family affluence. This hypothesis needs to be validated in future research. Only in interventions that would specifically focus on smoking in relation to stress, we may observe a greater impact among adolescents

with a low-medium affluence. For other healthy lifestyle behaviors, the same relationships exist between lifestyle behaviors and mental health outcomes, independently of family affluence. This would mean that, apart from smoking, mental health interventions can focus similarly on the healthy lifestyle behaviors, regardless of family affluence. This does not mean that interventions should not be tailored to low-medium family affluence, as they, to some extent, still report lower levels of healthy lifestyle behaviors and poorer mental health outcomes. Future research needs to explore in what way mental health or healthy lifestyle promotion can be tailored to adolescents of low family affluence.

## **Conclusion**

Attention should continue to be paid to (mental) health inequalities between adolescents of low-medium family affluence and high family affluence. Poor mental health among adolescents of low-medium family affluence might be reduced by improving health-related behavior. Our study concluded that all included healthy lifestyle behaviors are associated with at least one of the mental health outcomes. Adolescents can tackle these behaviors in their daily lives to reduce their risk of mental health problems and build their resilience, and should therefore be integrated in interventions for mental health promotion. This was to our knowledge the first study to assess whether family affluence plays a moderating role in the association between these aforementioned different healthy lifestyle behaviors and mental health outcomes. No moderating effect of family affluence was found, except for smoking in relation to stress.

## **Limitations and strengths**

This study had some limitations. A first limitation is the cross-sectional nature of the data. Hence, the causal direction of these relationships cannot be determined. Second, there is a wide variety of SES-measures across studies in literature. The inconsistent use of these SES-measures complicates comparisons, explanations and interpretations. Third, the majority of our sample was highly affluent, consistent with the high affluence of the country. This may limit the generalizability of our findings to other countries with a lower national level of affluence. Fourth, the explained variance of the healthy lifestyles in relation to mental health outcomes was quite small. Even though various healthy lifestyle behaviors were analyzed there are, of course, other important (lifestyle) factors that were not included in this study. Mental health promotion programs may therefore consider to also include other components besides healthy lifestyles. Furthermore, interpreting adolescents' alcohol use and smoking obtained from self-reports can be difficult as these may be influenced by social desirability. Nevertheless, we expect a low social desirability bias given the survey's anonymity. Despite the widespread use of the four items in FAS, they may not be bias-free, especially in cross-national contexts. The FAS-items should continue to be updated to reflect material affluence of the family across countries. The study also had several strengths. First of all, mental health was defined using a broad concept of both positive well-being and mental health problems, in line with the WHO conceptualization of mental health. Family affluence was measured using a validated scale that provides reliable information based on adolescents' self-reports (47). The FAS has the advantage that it can be easily answered by youth. Furthermore, the FAS makes international comparisons possible, as this scale is used in all the HBSC-studies across different

countries. It is indicated that the FAS may be more ecologically valid than parental income data since it is based on the family context of consumption (47, 50). Our study added to the scarce research on healthy lifestyles to improve youth mental health and how this differed by youth's family affluence. Our study showed that healthy lifestyles differ between youth of low-medium and high family affluence and that these healthy lifestyles may contribute to a better mental health for all.

## Abbreviations

- SES
- socioeconomic status
- FAS
- family affluence scale

## Declarations

### *Ethics approval and consent to participate*

The study received approval from the Ethics Committee of the Ghent University Hospital (2012/307, B670201214183). Adolescents provided written informed consent, parents provided passive informed consent. Parents were informed about the study through the school and received a telephone number and e-mail address from the researchers, where they could let them know if they did not want their children to participate. If they did not contact the researchers, they agreed to participation. The institutional review board approved the use of passive parental consent.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### *Competing interests*

Ann DeSmet, co-author of this manuscript, is a member of the editorial board (Associate Editor) of BMC Public Health.

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### *Authors' contributions*

LM designed the research question, literature review, and was the main author in writing the manuscript. AS designed the study, collected the data, analyzed and interpreted data. GC, GC and CP contributed in refining research questions and interpretation of findings. All authors read and approved the final manuscript.

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## Full Tables

**Table 2.** Regression analysis on the moderating role of family affluence in the relation between addictive behaviors and sleep, and mental health outcomes

	Dependent variable: mental health outcomes			
	Depression	Anxiety	Stress	Self-esteem
<b>Full model results (direct effects, only family affluence)</b>	$F(1, 999)=1.02$ , $p=0.312$ , adj. $R^2=0.00$	$F(1, 1000)=0.06$ , $p=0.803$ , adj. $R^2=-0.00$	$F(1, 1002)=0.326$ , $p=0.568$ , adj. $R^2=-0.00$	$F(1, 973)=7.57$ , $p=0.006$ , adj. $R^2=0.01$
Family affluence (ref. low/medium)	-0.03 (-0.71; 0.71)	-0.08 (-0.15; 0.59)	-0.02 (-0.38; 0.67)	0.09 (0.25; 0.09)**
<b>Full model results (direct effects, all background variables)</b>	$F(4, 775)=7.56$ , $p<.001$ , adj. $R^2=0.03$	$F(4,775)=6.83$ , $p<.001$ ; adj. $R^2=0.03$	$F(4, 776)=8.98$ , $p<.001$ , $R^2=0.04$	$F(4, 753)=10.49$ , $p<.001$ , $R^2=0.05$
	<b><math>\beta</math> (B, SE)</b>			
Age	0.09 (0.40; 0.17)*	0.06 (0.24; 0.14) <sup>°</sup>	0.08 (0.35; 0.16)*	0.00 (0.00; 0.02)
Gender (ref. girls)	-0.17 (-2.98; 0.61)***	-0.17 (-2.40; 0.50)***	-0.19 (-3.11; 0.57)***	0.21 (0.45; 0.08)***
Family affluence (ref. low/medium)	-0.05 (-1.10; 0.82)	-0.03 (-0.61; 0.66)	-0.04 (-0.78; 0.76)	0.09 (0.26; 0.10)**
BMI	0.02 (0.05; 0.09)	0.03 (0.05; 0.07)	0.03 (0.06; 0.08)	-0.04 (-0.01; 0.01)
<b>Full model results (direct effects)</b>	$F(6, 875)=13.82$ , $p<.001$ , adj. $R^2=0.08$	$F(6, 876)=15.92$ , $p<.001$ , adj. $R^2=0.09$	$F(6, 876)=16.64$ , $p<.001$ , $R^2=0.10$	$F(6, 854)=10.86$ ; $p<.001$ , adj. $R^2=0.06$
Age	-0.05 (-0.23; 0.19)	-0.09 (-0.34; 0.15)*	-0.08 (-0.34; 0.17)*	0.07 (0.04; 0.02) <sup>°</sup>
Gender	-0.17 (-2.90; 0.57)***	-0.18 (-2.55; 0.46)***	-0.19 (-3.14; 0.53)***	0.20 (0.43; 0.07)***
Family Affluence	-0.04 (-0.89; 0.74)	-0.03 (-0.63; 0.60)	-0.04 (-0.82; 0.69)	0.10 (0.28; 0.09)**
Alcohol consumption	0.05 (0.12; 0.09)	0.07 (0.13; 0.08) <sup>°</sup>	0.13 (0.27; 0.09)**	-0.06 (-0.02; 0.01)
Smoking	0.14 (1.20; 0.31)***	0.17 (1.17; 0.25)***	0.16 (1.26; 0.29)***	-0.05 (-0.05; 0.04)
Perceived sleep duration	-0.18 (-1.05; 0.21)***	-0.17 (-0.84; 0.17)***	-0.14 (-0.77; 0.19)***	0.15 (0.11; 0.03)***
<b>Full model results (Interaction effects)</b>	$F(9,872)=9.64$ , $p<.001$ , adj. $R^2=0.08$	$F(9, 873)=11.15$ , $p<.001$ , adj. $R^2=0.09$	$F(9, 873)=12.02$ , $p<.001$ , adj. $R^2=0.10$	$F(9, 851)=7.74$ , $p<.001$ , adj. $R^2=0.07$

	$\beta$ (B, SE)			
Age	-0.05 (-0.24; 0.19)	-0.09 (-0.35; 0.15)*	-0.08 (-0.34; 0.17)*	0.07 (0.04; 0.24) <sup>°</sup>
Gender (ref. girls)	-0.17 (-2.87; 0.57)***	-0.18 (-2.52; 0.46)***	-0.19 (-3.09; 0.53)***	0.20 (0.43; 0.07)***
Family Affluence (ref. low/medium)	-0.05 (-1.10; 0.76)	-0.04 (-0.72; 0.62)	-0.03 (-0.72; 0.70)	0.10 (0.27; 0.10)**
Alcohol consumption	0.17 (0.40; 0.24) <sup>°</sup>	0.20 (0.38; 0.19)*	0.17 (0.37; 0.22) <sup>°</sup>	-0.13 (-0.04; 0.03)
Smoking	0.17 (1.40; 0.72) <sup>°</sup>	0.21 (0.58; 1.41)*	0.30 (2.39; 0.67)***	-0.10 (-0.10; 0.09)
Perceived sleep duration	-0.18 (-1.09; 0.44)*	-0.16 (-0.78; 0.36)*	-0.10 (-0.57; 0.41)	0.04 (0.03; 0.06)
Alcohol * FAS	-0.13 (-0.32; 0.25)	-0.14 (-0.29; 0.20)	-0.06 (-0.13; 0.23)	0.08 (0.03; 0.03)
Smoking * FAS	-0.04 (-0.35; 0.80)	-0.05 (-0.38; 0.65)	-0.17 (-1.48; 0.74)*	0.06 (0.07; 0.10)
Sleep * FAS	0.00 (0.01; 0.50)	-0.02 (-0.12; 0.40)	-0.04 (-0.27; 0.46)	0.13 (0.11; 0.06) <sup>°</sup>
<b>Parsimonious model results (Interaction effects)</b>	F(3, 951)=25.85, p<.001, adj. R <sup>2</sup> =0.08	F(3, 952)=28.02, p<.001, adj. R <sup>2</sup> =0.08	F(6, 935)=17.60, p<.001, adj. R <sup>2</sup> =0.10	F(3, 938)=21.26, p<.001, adj. R <sup>2</sup> =0.06
	$\beta$ (B, SE)			
Gender	-0.17 (-2.87; 0.54)***	-0.18 (-2.53; 0.45)***	-0.18 (-3.02; 0.51)***	0.19 (0.41; 0.07)***
Family Affluence	/	/	-0.03 (-0.61; 0.67)	0.10 (0.29; 0.09)**
Smoking	0.14 (1.15; 0.27)***	0.15 (1.07; 0.23)***	0.30 (2.42; 0.54)***	/
Sleep	-0.16 (-0.99; 0.20)***	-0.16 (-0.79; 0.16)***	-0.12 (-0.71; 0.19)***	0.15 (0.12; 0.02)***
Alcohol	/	/	0.09 (0.21; 0.08)**	/
Smoking * Family Affluence	/	/	-0.19 (-1.69; 0.59)**	/

R<sup>2</sup>: Nagelkerke R<sup>2</sup> <sup>°</sup> p<.1; \* p<0.05; \*\* p<.01; \*\*\* p<.001

**Table 3.** Regression analysis on the moderating role of family affluence in the relation between energy-balance related behaviors and mental health outcomes

	Dependent variable:			
	Depression	Anxiety	Stress	Self-esteem
<b>Full model results (direct effects)</b>	F(5, 905)=9.47, p<.001, adj. R <sup>2</sup> =0.04	F(5, 906)=9.41, p<.001, adj. R <sup>2</sup> =0.04	F(5, 906)=9.49, p<.001, adj. R <sup>2</sup> =0.05	F(5, 885)=11.80, p<.001, adj. R <sup>2</sup> =0.06
	<b>β (B, SE)</b>			
Age	0.07 (0.31; 0.16)*	0.05 (0.19; 0.13)	0.08 (0.35; 0.15)*	0.01 (0.00; 0.02)
Gender	-0.13 (-2.23; 0.57)***	-0.15 (-2.08; 0.47)***	-0.16 (-2.63; 0.54)***	0.18 (0.39; 0.07)***
Family Affluence	-0.02 (-0.41; 0.74)	-0.01 (-0.16; 0.60)	-0.02 (-0.40; 0.70)	0.07 (0.20; 0.09)*
Days of breakfast	-0.10 (-0.38; 0.13)**	-0.15 (-0.47; 0.11)***	-0.14 (-0.51; 0.12)***	0.14 (0.07; 0.02)***
Physical activity days	-0.10 (-0.43; 0.14)**	-0.03 (-0.12; 0.11)	0.01 (0.03; 0.13)	0.04 (0.02; 0.02)
<b>Full model results (interaction effects)</b>	F(7, 903)=6.84, p<.001, adj. R <sup>2</sup> =0.04	F(7, 904)=6.84, p<.001, adj. R <sup>2</sup> =0.04	F(7, 904)=7.21, p<.001, adj. R <sup>2</sup> =0.05	F(7, 883)=8.70, p<.001, adj. R <sup>2</sup> =0.06
	<b>β (B, SE)</b>			
Age	0.07 (0.31; 0.16)*	0.05 (0.19; 0.13)	0.08 (0.35; 0.15)*	0.01 (0.00; 0.02)
Gender (ref. girls)	-0.13 (-2.25; 0.57)***	-0.15 (-2.08; 0.47)***	-0.16 (-2.61; 0.54)***	0.18 (0.39; 0.07)***
Family Affluence	-0.02 (-0.51; 0.75)	-0.01 (-0.09; 0.62)	-0.01 (-0.24; 0.71)	0.07 (0.20; 0.10)*
Days of breakfast	-0.05 (-0.20; 0.29)	-0.12 (-0.38; 0.24)	-0.10 (-0.36; 0.27)	0.06 (0.03; 0.04)
Physical activity days	-0.10 (-0.39; 0.33)	-0.10 (-0.35; 0.27)	-0.12 (-0.46; 0.31)	0.11 (0.06; 0.04)
Days of breakfast * FAS	-0.05 (-0.23; 0.32)	-0.03 (-0.10; 0.26)	-0.04 (-0.17; 0.30)	0.09 (0.05; 0.04)
Physical activity days * FAS	-0.01 (-0.05; 0.36)	0.08 (0.28; 0.30)	0.14 (0.58; 0.34) <sup>o</sup>	-0.08 (-0.09; 0.05)
<b>Parsimonious model results (Interaction effects)</b>	F(3, 981)=14.51, p<.001, adj. R <sup>2</sup> =0.04	F(2, 993)=22.46, p<.001, R <sup>2</sup> =0.04	F(3, 933)=15.02, p<.001, R <sup>2</sup> =0.04	F(3, 951)=20.12, p<.001, adj. R <sup>2</sup> =0.06
	<b>β (B, SE)</b>			

Gender	-0.13 (-2.71; 0.54)***	-0.15 (-2.12; 0.44)***	-0.16 (-2.65; 0.52)***	0.18 (0.39; 0.07)***
Age	/	/	0.07 (0.29; 0.14)*	/
Family Affluence	/	/	/	0.08 (0.22; 0.09)*
Physical activity	-0.09 (-0.38; 0.13)**	/	/	/
Days of breakfast	-0.11 (-0.42; 0.12)**	-0.15 (-0.49; 0.10)***	-0.13 (-0.47; 0.12)***	0.15 (0.07; 0.02)***

R<sup>2</sup>: Nagelkerke R<sup>2</sup> ° p<.1; \* p<0.05; \*\* p<.01; \*\*\* p<.001

## Figures

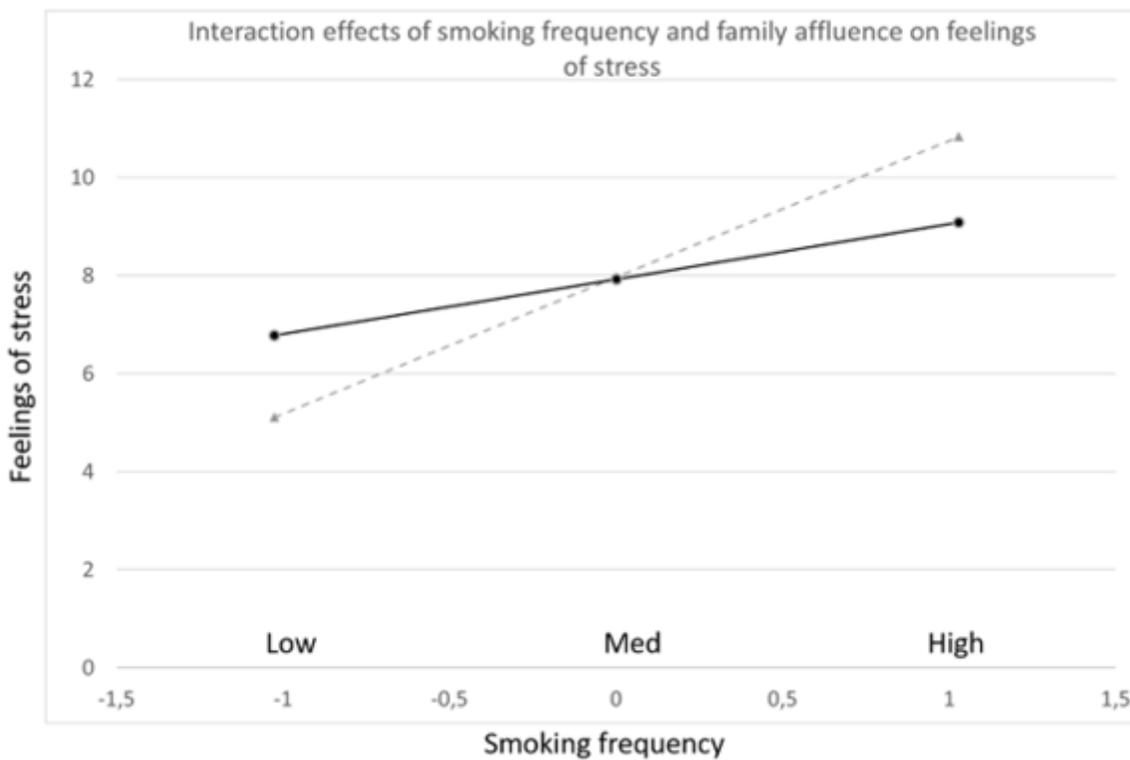


Figure 1

Interaction effects of smoking and family affluence on the experience of stress