Author(s): Whitehead, Ross; Berg, Christina; Cosma, Alina; Gobina, Inese; Keane, Eimear; Neville, Fergus; Ojala, Kristiina; Kelly, Colette

Title: Trends in Adolescent Overweight Perception and Its Association With Psychosomatic Health 2002–2014 : Evidence From 33 Countries

Year: 2017

Version:

Please cite the original version:

Whitehead, R., Berg, C., Cosma, A., Gobina, I., Keane, E., Neville, F., Ojala, K., & Kelly, C. (2017). Trends in Adolescent Overweight Perception and Its Association With Psychosomatic Health 2002–2014 : Evidence From 33 Countries. Journal of Adolescent Health, 60(2), 204-211. https://doi.org/10.1016/j.jadohealth.2016.09.029

Trends in Adolescent Overweight Perception and its Association with Psychosomatic Health 2002-2014: Evidence from 33 Countries

Ross Whitehead Ph.D [a], Christina Berg Ph.D [b], Alina Cosma Ph.D [a], Inese Gobina Ph.D [c], Eimear Keane Ph.D [d], Fergus Neville Ph.D [a], Kristiina Ojala Ph.D [e] and Colette Kelly Ph.D [d].

a School of Medicine, University of St Andrews, Scotland

b Department of Food and Nutrition, and Sport Science, University of Gothenburg, Sweden

c Department of Public Health and Epidemiology, Riga Stradiņš University, Latvia

d Health Sciences, National University of Ireland Galway, Ireland

e Department of Health Sciences, University of Jyväskylä, Finland

Correspondence concerning this article should be addressed to: Ross D. Whitehead, School of Medicine, Medical and Biological Sciences Building, University of St Andrews, St Andrews, Fife, Scotland KY16 9TF. Email: rw394@st-andrews.ac.uk. Telephone: +441334 461739

Acknowledgements

This research was funded by NHS Health Scotland. The opinions expressed in this publication are those of the authors and are not necessarily those of NHS Health Scotland as commissioners of the work or the University Court of the University of St Andrews as undertakers of the work. The authors acknowledge the input of the Eating and Dieting, and Positive Health focus groups within the Health Behaviour in School-aged Children (HBSC) study network. The authors also wish to thank the wider international HBSC research network that developed the study's research protocol in collaboration with the WHO regional office for Europe. Jo Inchley, University of St Andrews is the HBSC International Coordinator and Oddrun Samdal, University of Bergen is the HBSC Data Manager.

List of Abbreviations:

BMI (Body Mass Index)

HBSC (Health Behaviour in School-aged Children)

Abstract

Purpose

Perceiving oneself as overweight is common and strongly associated with adolescents' subjective well-being. The prevalence of overweight perceptions and their impact on well-being may have increased over the past decade due to an increase in the salience of weight-related issues. This study examines trends (2002-2014) in the prevalence of adolescent overweight perceptions and their association with psychosomatic complaints.

Methods

Data from 15-year old adolescents was obtained between 2002 and 2014 in four rounds of the HBSC study in 33 countries in Europe and North America (N=187,511). Design-adjusted logistic regressions were used to quantify changes in overweight perceptions over time. Linear modelling was used to assess change in the association between perceived overweight and self-reported psychosomatic complaint burden, adjusting for overweight status.

Results

Among boys, 10 of 33 countries saw an increase in overweight perceptions between 2002 and 2014, with Russia, Estonia and Latvia showing the most pronounced year-on-year increases. Only England, France, Germany and Norway saw an increase in the positive association between overweight perceptions and psychosomatic complaints among boys. Among girls, most countries (28/33) saw no change in the prevalence of overweight perceptions, with the prevalence over 40% in most nations. However, in 12 countries the association between overweight perceptions and psychosomatic complaints increased among girls, with particularly strong changes seen in Scotland and Norway.

Conclusions

Evidence is presented which suggests that for adolescent girls in 12 Northern and Western European countries, and for boys in four perceiving oneself as overweight may be increasingly deleterious for psychosomatic health

Keywords: body image; body size perception; overweight; adolescents; mental well-being; psychosomatic symptoms; perceived body fatness

Implications and Contribution: We use a unique dataset to examine trends in adolescents' body image and mental well-being in 33 countries. We present evidence suggesting that the influence of body image on adolescent well-being is increasing over time. This may play a role in the observed worsening of mental well-being in adolescent girls.

Trends in Adolescent Overweight Perception and its Association with Psychosomatic Health 2002-2014: Evidence from 33 Countries

Whilst several factors contribute to body image satisfaction, self-perception of body weight plays a particularly important role, especially amongst adolescent girls (1). As normal physical development during adolescence involves rapid and conspicuous somatic changes, including weight gain, it is common for adolescents to monitor changes to their weight during this period (2) and make comparisons against peers (3). This age group also tend to compare their weight against body shapes propagated by media outlets (3), which for decades have portrayed a thin body shape as optimal, especially for females (4), while for males a slim but muscular build dominates the media (5).

Adolescents frequently evaluate themselves as overweight relative to either their perception of normal weight or subjective ideal body size (6). These perceptions are common even among those with a healthy body mass index (BMI), with over one quarter of adolescent girls incorrectly judging themselves as overweight (7). The perception that oneself is overweight, whether accurate or not, is associated with deleterious behaviours and outcomes in adolescence including maladaptive weight-loss strategies (7,8) and weight gain (9). Overweight perceptions are also strongly and consistently associated with reduced subjective well-being among adolescents, especially internalising disorders such as depressive symptoms, anxiety and social withdrawal (7,10).

The subjective well-being of adolescents in many developed nations has worsened over the past two decades, particularly for girls (11). Amongst these findings is evidence that the proportion of adolescents reporting psychosomatic health complaints has increased across

Europe and North America (6,12). These changes have been particularly large for 15-year old girls; in many countries the prevalence experiencing more than one weekly health complaint rose by over 15 percentage points between 2002 and 2014, with a sharp increase between 2010 and 2014. It is imperative to investigate potential determinants of these trends as subjective well-being represents a principal influence on illness and disability during adolescence (13), with impacts on long-term health and prosperity (14,15).

It is necessary to consider the role of body weight perception, due to the aforementioned links with subjective well-being in adolescence. The prevalence of overweight perceptions and the concomitant impact on subjective well-being may have increased in recent years for several reasons. Firstly, the global obesity epidemic has increased the salience of weight-related issues including the role of personal responsibility, body weight scrutiny, stigmatization and pressures to maintain a thin body shape (16,17). Secondly, a dramatic increase in adolescents' consumption of digital visual media (18) has facilitated the proliferation of idealised, yet extreme body shapes amongst this age group. Thirdly, over the past decade many countries in Europe and North America have experienced changes in socio-cultural factors known to influence adolescents' body image, particularly family structure and peer and family support (6,19,20).

International variation in the relationship between body image and subjective well-being is likely given significant cross-national differences in both of these measures (6). There is also international variability in the societal and cultural factors that could affect body weight perception and its impact on subjective well-being (6,16-18). Using a unique dataset collected from 33 countries by the Health Behaviour in School-aged Children (HBSC) study, we examine the hypothesis that the prevalence of overweight perceptions, and their concomitant

impact on psychosomatic complaints has increased amongst adolescents in Europe and North America between 2002 and 2014. Whilst the HBSC study collects data on 11-, 13-, and 15-year olds, 15-year olds are focused on in the present study as this age group has seen the greatest deterioration in psychosomatic health in recent years (6). This group are also at particularly high risk of overweight perceptions (6).

Methods

Data from four rounds of the international HBSC study were used, covering the period 2002-2014. HBSC is a cross-sectional study of adolescent health carried out every four years in line with a standardised research protocol which specifies sampling methods and questionnaire content across 44 participating countries (6). For each survey round, countries collect a nationally representative sample of 15-year olds, with the timing of fieldwork arranged to achieve a mean age 15.5.

Participants were recruited via stratified random cluster sampling, with whole school classes as the sampling unit. Adolescents completed questionnaires in classroom settings, and were able to leave any question blank. Questionnaires were translated from English into respective national languages with back-translation checks. Institutional ethical consent was gained in each participating country, with schools and adolescents each giving informed consent.

Participating countries were eligible for the present analysis if they had collected data on body size perception, psychosomatic complaints, height and weight from 15-year olds in the 2002, 2006, 2010 and 2014 HBSC surveys. A total of 220,805 individual participants were recruited by eligible countries, of which 15.0% (N=33,139) were excluded due to missing responses on one or more of the below items.

138

139 **Overweight Perception**

140 Participants were asked “Do you think your body is: Much too thin, A bit too thin, About the
141 right size, A bit too fat or Much too fat”. The latter two response options were recoded as
142 ‘perceived overweight’. As perceived underweight is also associated with reduced subjective
143 well-being, especially in boys (21), those responding “about the right size” are utilised as the
144 reference category in regression analyses.

145

146 **Psychosomatic Complaints**

147 Psychosomatic health complaints are used here as an indicator of subjective well-being.
148 Participants indicated the frequency with which they had experienced the following eight
149 health complaints over the last six months; “feeling low”, “irritability or bad temper”,
150 “feeling nervous”, “difficulties in getting to sleep”, “feeling dizzy”, “headache”, “stomach
151 ache” and “backache” (0= “Rarely or never”, 1= “About every month”, 2= “About every
152 week”, 3= “More than once a week”, 4= “About every day”). Responses across all eight
153 complaints were summed to generate a single score between 0 and 32, with higher values
154 reflecting a greater psychosomatic complaint burden. This scale has undergone extensive
155 qualitative (22) and quantitative (23) validation and shows good test-retest reliability (22),
156 unidimensionality (24) and external validity (25,26).

157

158 **Body Mass Index**

159 Participants self-reported their height and weight, which were used to calculate BMI (kg/m^2).
160 Those with BMI values less than 12 or greater than 45 were considered outliers and excluded
161 from analyses (0.1%, N=155). BMI was used to categorise participants as either overweight

(including obese) or not overweight according to age- and gender-appropriate International Obesity Taskforce cut-offs (27).

Statistical Analysis

Analyses were stratified by country to allow international comparison. Analyses were also stratified by gender within country. Dataset weights were applied as appropriate to achieve national representativeness of each country at each time point.

Regression analyses were conducted using the SPSS v.22 complex samples toolkit, allowing shared variance within sampling units to be accounted for. Logistic regression was used to quantify changes in the prevalence of overweight perceptions over time (Tables A1 and A2). The linear effect of survey year on psychosomatic complaint burden was evaluated using general linear modelling (Tables A3 and A4). The association between perceived overweight and psychosomatic complaints was estimated at each time point using general linear modelling (Tables 1 and 2). This analysis was adjusted for overweight status, to investigate the association between perceived overweight and psychosomatic complaints independent of actual body size. Lastly, general linear modelling was used to test whether the relationship between perceived overweight and psychosomatic complaints (again adjusting for overweight status) has changed over time by including an interaction term between survey year (zeroed on 2002) and perceived overweight (Figures 1 and 2).

Results

Data were available from 187,511 participants (51.6% girls) from 33 countries over the period 2002-2014, after exclusion of countries without four consecutive waves of data, and individuals with missing responses. The number of respondents per country ranged from 832

to 11,815 (median 5,410; see Table A5). Within this sample, 20.9% (20.6, 21.2) of boys and 41.4% (41.0, 41.8) of girls perceived themselves as overweight (± 95% CI). According to self-reported height and weight, 16.7% (16.4, 16.9) of boys and 9.7% (9.4, 9.9) of girls were classified as overweight or obese. Misperception of overweight status was common, with 10.5% (10.3, 10.7) of boys and 32.9% (32.5, 33.3) of girls classified as normal weight or lower (according to self-reported height and weight) perceiving themselves as overweight.

Trends in Perceived Overweight 2002-2014

Ten countries saw an increase in the prevalence of overweight perceptions among boys, with Russia (*OR*=1.10, $F(1,327)=51.58$, $p<.001$), Estonia (*OR*=1.09, $F(1,252)=52.59$, $p<.001$) and Latvia (*OR*=1.06, $F(1,339)=17.67$, $p<.001$) showing particularly pronounced year-on-year increases (Table A1). Only three countries witnessed a decline among boys, with Macedonia showing the steepest decline (*OR*=0.91, $F(1,251)=33.65$, $p<.001$). No change was seen among boys in 20 of the 33 observed countries. Among girls, the majority of countries (28 of 33) saw no change in the prevalence of overweight perceptions (Table A2). Four countries saw an increase among girls, again with the most pronounced increase in Russia (*OR*=1.11, $F(1,334)=100.48$, $p<.001$). Only Macedonia showed a decline among girls (*OR*=0.92, $F(1,228)=38.00$, $p<.001$).

Trends in Psychosomatic Complaints 2002-2014

In 10 of the 33 countries, a linear increase in boys' psychosomatic complaint burden was seen between 2002 and 2014, with France (*b*=0.14, $F(1,772)=34.89$, $p<.001$), Poland (*b*=0.13, $F(1,230)=20.78$, $p<.001$) and Greenland (*b*=0.13, $F(1,53)=6.19$, $p=.016$) showing the greatest year-on-year increases (Table A3). Five countries saw a reduction in boys, with England (*b*=-0.11, $F(1,123)=14.364$, $p<.001$) and Greece (*b*=-0.11, $F(1,424)=12.92$, $p<.001$) showing the

strongest decline. The remaining 18 countries saw no linear change among boys over this 12-year period. In contrast, for 22 of the countries, a linear increase in girls' psychosomatic complaint burden was seen between 2002 and 2014, with Scotland (b=0.29, F(1,299)=34.29, p<.001), Ireland (b=0.25, F(1,186)=33.92, p<.001), the Netherlands (b=0.21, F(1,409)=49.29, p<.001) and France (b=0.21, F(1,703)=57.49, p<.001) showing the strongest increases (Table A4). Only Ukraine (b=-0.15, F(1,577)=29.28, p<.001) and Greece (b=-0.07, F(1,386)=5.83, p=.016) saw a reduction over this period for girls. No change for girls was seen in nine countries.

Association between Psychosomatic Complaints and Overweight Perception

The coefficients in Tables 1 and 2 represent for boys and girls, respectively, increase in the 32-point psychosomatic symptom score for those that perceive their body is too fat, relative to those that feel their body is 'about right' (adjusting for overweight status). For boys, a positive association was seen in 29 of 33 countries in 2014, such that those perceiving themselves as overweight reported a higher burden of psychosomatic complaints. This association was less widespread across countries prior to 2014; 15 of the 33 countries observed no association at one or more time points. Combining data from years between 2002 and 2014, the strongest associations among boys were seen in Russia (b=3.22, F(1,327)=42.114, p<.001), Sweden (b=2.87, F(1,377)=86.215, p<.001) and Israel (b=2.85, F(1,238)=38.134, p<.001).

The association between overweight perceptions and psychosomatic complaints was more pervasive across time among girls, with significant positive associations for all observed countries, at all time points between 2002 and 2014, except for Switzerland in 2002 (b=0.65, F(1,149)=1.844, p=.177), Greece in 2006 (b=0.96, F(1,84)=3.12, p=.081), and Greenland in

2006 (b=2.05, F(1,26)=3.24, p=.083), 2010 (b=2.27, F(1,20)=3.70, p=.069) and 2014 (b=0.96, F(1,4)=1.35, p=.310). The strongest associations across the period 2002 - 2014 were seen in Ireland (b=4.12, F(1,186)=95.44, p<.001), Scotland (b=3.94, F(1,299)=123.31, p<.001) and Wales (b=3.66, F(1,232)=125.34, p<.001), with particularly strong associations seen in 2014 for Scotland (b=6.15, F(1,65)=34.44, p<.001) and Wales (b=5.65, F(1,61)=43.46, p<.001).

Figures 1 and 2 illustrate the extent to which the association between psychosomatic complaints and overweight perceptions has changed over time for boys and girls, respectively. For boys, there was a significant interaction between survey year and perceived overweight in four countries; England (b=0.17, F(1,123)=7.91, p=.006), France (b=0.16, F(1,772)=7.73, =.006), Norway (b=0.15, F(1,292)=5.75, p=.017) and Germany (b=0.09, F(1,458)=6.57, p=.011). For girls, a significant interaction was seen in 12 of the 33 observed countries (Scotland, Wales, Norway, the Netherlands, Portugal, Germany, Denmark, Canada, Croatia, Switzerland, Spain and France), with strongest effects seen in Scotland (b=0.32, F(1,299)=11.27, p=.001), Wales (b=0.26, F(1,232)=12.53, p<.001) and Norway (b=0.24, F(1,286)=15.11, p<.001). These results indicate that psychosomatic complaint burden increased for adolescents feeling that they are overweight in these countries between 2002 and 2014, relative to those perceiving that their body is ‘about right’. For example, Scottish girls feeling their body is overweight have, relative to those feeling their body is ‘about right’ increased by 0.324 points per annum along the 32-point psychosomatic symptom scale. This reflects an increase equivalent to 12.15% of the entire scale over the period 2002-2014.

As self-reported BMI was used to indicate adolescents’ overweight status it is possible that a self-selection bias was introduced. However, the results presented here were largely similar

when removing the control for overweight status and reinstating those participants (12.1%, N=25,828) that had failed to report height and/or weight. For boys and girls, the observed changes in the relationship between psychosomatic symptoms and overweight perception were substantively identical when controlling for BMI as a continuous, rather than binary variable.

Discussion

This study presents twelve-year trends (2002-2014) in perceived overweight and its association with psychosomatic complaint burden among adolescents in 33 countries in Europe and North America. Among boys there was an increase in the prevalence of perceived overweight in one third of countries, particularly in Russia, Estonia and Latvia, where historically the prevalence of boys' overweight perception has been very low (12). However, for the vast majority of countries, there was little change in the already high prevalence of overweight perceptions among girls. Despite this stability, girls remain more likely than boys to believe they are overweight in all observed countries.

In line with recent research (11) widespread increases were seen in adolescents' psychosomatic complaints between 2002 and 2014, particularly for girls, with increases in psychosomatic complaint burden in two-thirds of the observed countries. Given that in 2002 44% of 15-year old girls in Europe and North America already exhibited more than one weekly psychosomatic complaint (12), the magnitude of change is a cause for concern in a number of countries. This is particularly true in Scotland, Ireland and the Netherlands which each saw girls' complaint burden rise in 2014 to over 130% of their respective levels in 2002. Boys' complaint burden was lower than girls' over this period in the majority of countries, and whilst increases in boys' complaints were seen in some countries, these changes were

less widespread and of a smaller magnitude than those seen for girls. As such, the findings of the present study indicate that the gender gap in psychosomatic complaints has widened since 2002 in many countries.

As overweight perceptions are common and psychosomatic complaints are increasingly burdensome for adolescents, changes in the known association between complaint burden and overweight body perception were examined between 2002 and 2014. For girls in 12 out of 33 countries, and for boys in four, the association between overweight perception and adolescents' health complaints strengthened between 2002 and 2014. In these countries, young people that feel that their body is too fat have experienced a relative deterioration in psychosomatic health compared to those that feel that their body is about the right size. For girls there is an apparent geographical divide in the degree of change in this association. Broadly, countries in Northern and Western Europe (and Canada) have seen a strengthening association between overweight perception and psychosomatic complaints, whereas countries in Southern and Eastern Europe have seen no significant change.

This international variation mirrors differences in the trajectory of population-level BMI. Whereas adult population BMI has increased since the 1980s in Northern and Western European countries, it has until the past decade remained relatively stable in Southern and Eastern Europe (28,29). Whilst Italy and Belgium saw little change in the association between girls' overweight perception and psychosomatic complaint burden, these countries have also seen relatively little change over time in population BMI, particularly for females (29). This apparent association with population-level BMI trajectory may reflect increases in the salience of obesity and weight-based scrutiny which have accompanied national public health efforts designed to combat long-term population weight gain (30). The absence of an

equivalent geographic pattern among boys may indicate that females' psychosomatic health is disproportionately affected by an increase in the public conspicuity of body weight.

International differences in the changing association between adolescents' weight perception and psychosomatic health may also be due to cross-national variation in internet usage. Countries that witnessed a strengthening relationship tended to be those that embraced the internet at an earlier point in history (31) and those that currently have higher levels of internet (32) and social media usage (31,33). Recent evidence indicates that internet exposure and social media use play a particularly strong role in the development of body image concerns (i.e. internalisation of the thin body ideal, body surveillance and the drive for thinness) among girls, with users being more likely than non-users to exhibit body weight concerns (34).

Observed trends in the basic prevalence of self-perceived overweight may provide insight into the comparative judgements that adolescents make when assessing their own body size, typically in reference to media figures or peers (3). In countries where self-perceived overweight was stable between 2002 and 2014, adolescents' perceptions of what constitutes a desirable weight is unlikely to have changed substantially, given the importance of perceived norms in this context (3). The widespread stability of adolescent girls' perceived overweight status may indicate that same-age peers are a particularly important comparison group for girls in most countries, as between 2002 and 2014 the actual weight of adolescent girls' changed relatively little (6,12,35). In contrast, the stability of girls' self-perceived weight is despite adolescents in Europe and North America being increasingly exposed to unrealistic body shapes propagated by online outlets over the past decade (18). This may indicate that figures propagated by media outlets are a less important comparator group in many of the

observed countries. The role of the media is, however, likely to be stronger among populations that have seen increases in the prevalence of perceived overweight (particularly Russia, Estonia and Latvia in the case of boys, and Russia and Ukraine for girls). This is potentially due to low exposure to Westernised body ideals in these countries (36) prior to the recent worldwide proliferation in adolescents' use of digital visual media (18).

Whilst the findings reported here are consistent with a worsening impact of overweight perceptions on girls' psychosomatic health in many countries, it is not possible to make causal inferences given the cross-sectional nature of the HBSC study. A further limitation is that BMI was calculated on the basis of self-reported height and weight, which may result in underestimation. It is possible that the reported association between perceived weight status and psychosomatic complaints would be attenuated when controlling for objective BMI-based overweight status. Additionally, excluding participants that did not self-report BMI potentially introduced a selection bias. However, the results presented here were largely similar when removing the control for BMI-based overweight status and including those that failed to report height and/or weight. Finally, there may exist international differences in the extent to which our measure of perceived body weight, specifically the term "fat" elicited stigma. This may influence the basic prevalence of perceived overweight and its association with psychosomatic symptoms.

Despite these limitations, this study presents a unique cross-national examination of recent trends in adolescents' perception of overweight status, and its association with psychosomatic health. Whilst the prevalence of overweight perceptions remained largely static between 2002 and 2014, the present findings may suggest that such perceptions are increasingly damaging

for adolescents' psychosomatic healthfor females in Northern and Western European countries.

The results of this study should be heeded as a cautionary tale as some countries may yet observe a change in the association between overweight perceptions and psychosomatic health. It is possible that recent increases in adult population BMI (28,29), a surge in internet use (18), and increases in the prevalence of overweight perceptions will have deleterious consequences for mental health in these regions, particularly those in Southern and Eastern Europe.

It is important for further research to consider potential mediators of the relationship between overweight perceptions and psychosomatic complaints, and changes in their role over time. One such mediator may involve maladaptive weight-loss strategies including binge-eating and purging which are likely to be associated with physical pains including headache and stomach ache (37). The present study also highlights that it is critical for future work to consider how to restore objectivity into adolescent body weight perception, and encourage adolescents to recognise positive attributes of their bodies, including strength, fitness and the ability to express oneself through movement. It is also necessary to develop and utilise intervention approaches to incentivise weight loss amongst those that are overweight without damaging self-perception and mental health. For instance a recent physical activity intervention amongst obese adolescents has shown that resistance training can achieve improvements in both body image and mental health (38).

This study indicates that the association between overweight perceptions and psychosomatic complaints increased in many countries between 2002 and 2014, especially for girls in

Northern and Western Europe. As such, the current scrutiny of body size and weight may represent an increasing burden on mental health. This burden may extend to physical health, given links between poor subjective well-being and low engagement in health-promoting behaviours (9,39,40).

References

1. Voelker DK, Reel JJ, Greenleaf C. Weight status and body image perceptions in adolescents: current perspectives. *Adolesc Health Med Ther.* 2015;6:149-158. DOI: 10.2147/AHMT.S68344.
2. Pacanowski CR, Loth KA, Hannan PJ, et al. Self-Weighing throughout adolescence and young adulthood: Implications for well-being. *J Nutr Educ Behav.* 2015;47(6):506-541. DOI: 10.1016/j.jneb.2015.08.008.
3. Jones DC. Social comparison and body image: Attractiveness comparisons to models and peers among adolescent girls and boys. *Sex Roles.* 2001;45(9-10):645-664. DOI: 10.1023/A:1014815725852.
4. Sypeck MF, Gray JJ, Ahrens AH. No longer just a pretty face: Fashion magazines' descriptions of ideal female beauty from 1959 to 1999. *Int J Eat Disorder.* 2004;36(3):342-347. DOI: 10.1002/eat.20039.
5. Jung J. Advertising images of men: Body size and muscularity of men depicted in Men’s Health magazine. *J Global Fashion Market.* 2011;2(4):181-187. DOI: 10.1080/20932685.2011.10593096.
6. Inchley J, Currie D, Young T, et al. Growing up unequal: gender and socioeconomic differences in young people's and well-being. Health Behaviour in School-aged Children (HBSC) study: international report from the 2013/2014 survey. WHO Regional Office for Europe, Copenhagen, Denmark 2016. Available at: http://www.euro.who.int/en/health-topics/Life-stages/child-and-adolescent-health/health-behaviour-in-school-aged-children-hbsc. Accessed June 3, 2016.
7. Isomaa R, Isomaa AL, Marttunen M, et al. Longitudinal concomitants of incorrect weight perception in female and male adolescents. *Body Image.* 2011;8(1):58-63. DOI: 10.1016/j.bodyim.2010.11.005.

8. Winter AL, de Guia NA, Ferrence R, Cohen JE. The relationship between body weight perceptions, weight control behaviours and smoking status among adolescents. *Can J Public Health.* 2002;93(5):362-365. Retrieved from http://www.jstor.org/stable/41993981

9. Liechty JM, Lee MJ. Body size estimation and other psychosocial risk factors for obesity onset among US adolescents: findings from a longitudinal population level study. *Int J Obes.* 2015;39(4):601-607. DOI: 10.1038/ijo.2014.191

10. Ali MM, Fang H, Rizzo JA. Body weight, self-perception and mental health outcomes among adolescents. *J Ment Health Policy.* 2010;13(2):53-63. Retrieved from http://www.icmpe.org/test1/journal/issues/v13i2/v13i2abs02.html

11. Bor W, Dean AJ, Najman J, Hayatbakhsh R. Are child and adolescent mental health problems increasing in the 21st century? A systematic review. *Aust Nz J Psychiat.* 2014;48(7):606-616. DOI: 10.1177/0004867414533834.

12. Currie C, Roberts C, Morgan A, et al. Young people's health in context. Health Behaviour in School-aged Children (HBSC) study: International report from the 2001/2002 survey. WHO Regional Office for Europe, Copenhagen, Denmark 2004. Available at: http://www.who.int/immunization/hpv/target/young_peoples_health_in_context_who_2011_2012.pdf. Accessed June 3, 2016.

13. Adolescents: Health risks and solutions. Factsheet 345. World Health Organization 2014. Available at: http://www.who.int/mediacentre/factsheets/fs345/en/. Accessed June 3, 2016.

14. Hale DR, Bevilacqua L, Viner RM. Adolescent health and adult education and employment: A systematic review. *Pediatrics.* 2015;136(1):128-140. DOI: 10.1542/peds.2014-2105.

15. Hoyt LT, Chase-Lansdale PL, McDade TW, Adam EK. Positive youth, healthy adults: Does positive well-being in adolescence predict better perceived health and fewer risky health behaviors in young adulthood? *J Adolescent Health.* 2012;50(1):66-73. DOI: 10.1016/j.jadohealth.2011.05.002.

16. Bacon L, Aphramor L. Weight science: Evaluating the evidence for a paradigm shift. *Nutr J.* 24 2011;10. DOI: 10.1186/1475-2891-10-9.

17. Brownell KD, Kersh R, Ludwig DS, et al. Personal responsibility and obesity: a constructive approach to a controversial issue. *Health Aff.* 2010;29(3):379-387. DOI: 10.1377/hlthaff.2009.0739.

18. The EPC global media trends book - Series. Volume 2: Global social media trends 2015. World Newsmedia Network. Available at: http://epceurope.eu/wp-content/uploads/2015/09/epc-trends-social-media.pdf. Accessed June 3, 2016.

19. Caccavale LJ, Farhat T, Iannotti RJ. Social engagement in adolescence moderates the association between weight status and body image. *Body Image.* 2012;9(2):221-226. DOI: 10.1016/j.bodyim.2012.01.001.

20. Fenton C, Brooks F, Spencer NH, Morgan A. Sustaining a positive body image in adolescence: an assets-based analysis. *Health Social Care Comm.* 2010;18(2):189-198. DOI: 10.1111/j.1365-2524.2009.00888.x.

21. Kelly CN, Fitzgerald A, Sentenac M, Gakewski J, Molcho M, Nic Gabhainn S. Weight concerns among adolescent boys. *Public Health Nutr.* 2015;19(3):456-462. DOI: 10.1017/S1368980015001615.

22. Haugland S, Wold B. Subjective health complaints in adolescence--reliability and validity of survey methods. *J Adolesc.* 2001;24(5):611-624. DOI: 10.1006/jado.2000.0393.

23. Ravens-Sieberer U, Erhart M, Torsheim T, et al. An international scoring system for self-reported health complaints in adolescents. *Eur J Public Health.* 2008;18(3):294-299. DOI: 10.1093/eurpub/ckn001.

24. Haugland S, Wold B, Stevenson J, et al. Subjective health complaints in adolescence. A cross-national comparison of prevalence and dimensionality. *Eur J Public Health.* 2001;11(1):4-10. DOI: 10.1093/eurpub/11.1.4.

25. Gobina I, Valimaa R, Tynjala J, et al. The medicine use and corresponding subjective health complaints among adolescents, a cross-national survey. *Pharmacoepidemiology Drug Safety.* 2011;20(4):424-431. DOI: 10.1002/pds.2102.

26. Ravens-Sieberer U, Torsheim T, Hetland J, et al. Subjective health, symptom load and quality of life of children and adolescents in Europe. *Int J Public health.* 2009;54 Suppl 2:151-159. DOI: 10.1007/s00038-009-5406-8.

27. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ.* 6 2000;320(7244):1240-1243. DOI: 10.1136/bmj.320.7244.1240.

28. Di Cesare M, Bentham J, Stevens GA, et al. Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19·2 million participants. *Lancet* 2016; (387)**:** 1377-96. DOI: 10.1016/S0140-6736(16)30054-X.

29. Noncommunicable disease country profiles 2011. World Health Organisation 2011. Available at: http://apps.who.int/iris/bitstream/10665/44704/1/9789241502283_eng.pdf. Accessed June 3, 2016.

30. Puhl RM, Heuer CA. Obesity stigma: important considerations for public health. *Am J Public Health.* 2010;100(6):1019-1028. DOI: 10.2105/AJPH.2009.159491.

490 31. Hasebrink U. Children's changing online experiences in a longitudinal perspective.
491 EU Kids online 2014. Available at:
492 http://eprints.lse.ac.uk/60083/1/__lse.ac.uk_storage_LIBRARY_Secondary_libfile_sh
493 ared_repository_Content_EU%20Kids%20Online_EU%20Kids%20Online_Longitudi
494 nal_report.pdf_2014.pdf. Accessed June 3, 2016.
495 32. Internet Stats and Facebook usage in Europe: November 2015 statistics. Internet
496 World Stats 2016. Available at: http://www.internetworldstats.com/stats4.htm.
497 Accessed June 3, 2016.
498 33. Lobe B, Livingstone S, Ólafsson K, Vodeb H. Cross-national comparison of risks and
499 safety on the internet: initial analysis from the EU Kids Online survey of European
500 children. EU Kids Online 2011. Available at:
501 http://www.lse.ac.uk/media@lse/research/EUKidsOnline/EU%20Kids%20II%20(200
502 9-11)/EUKidsOnlineIIReports/D6%20Cross-national.pdf . Accessed June 3, 2016.
503 34. Tiggemann M, Slater A. NetGirls: the Internet, Facebook, and body image concern in
504 adolescent girls. *Int J Eat Disorder.* 2013;46(6):630-633. DOI: 10.1002/eat.22141.
505 35. Rokholm B, Baker JL, Sorensen TI. The levelling off of the obesity epidemic since
506 the year 1999--a review of evidence and perspectives. *Obesity Rev.* 2010;11(12):835-
507 846. DOI: 10.1111/j.1467-789X.2010.00810.x.
508 36. Kalacheva O. A Western body for the Russian woman: shaping gender identity in
509 modern women's magazines. *Anthropol East Europe Rev.* 2002;20(1):75-78.
510 Retrieved from http://www.auburn.edu/~mitrege/FLRU2520/Kalacheva.pdf
511 37. Hadley SJ, Walsh BT. Gastrointestinal disturbances in anorexia nervosa and bulimia
512 nervosa. *Curr Drug Targets CNS Neurol Disord.* 2003;2(1):1-9. DOI:
513 10.2174/1568007033338715.

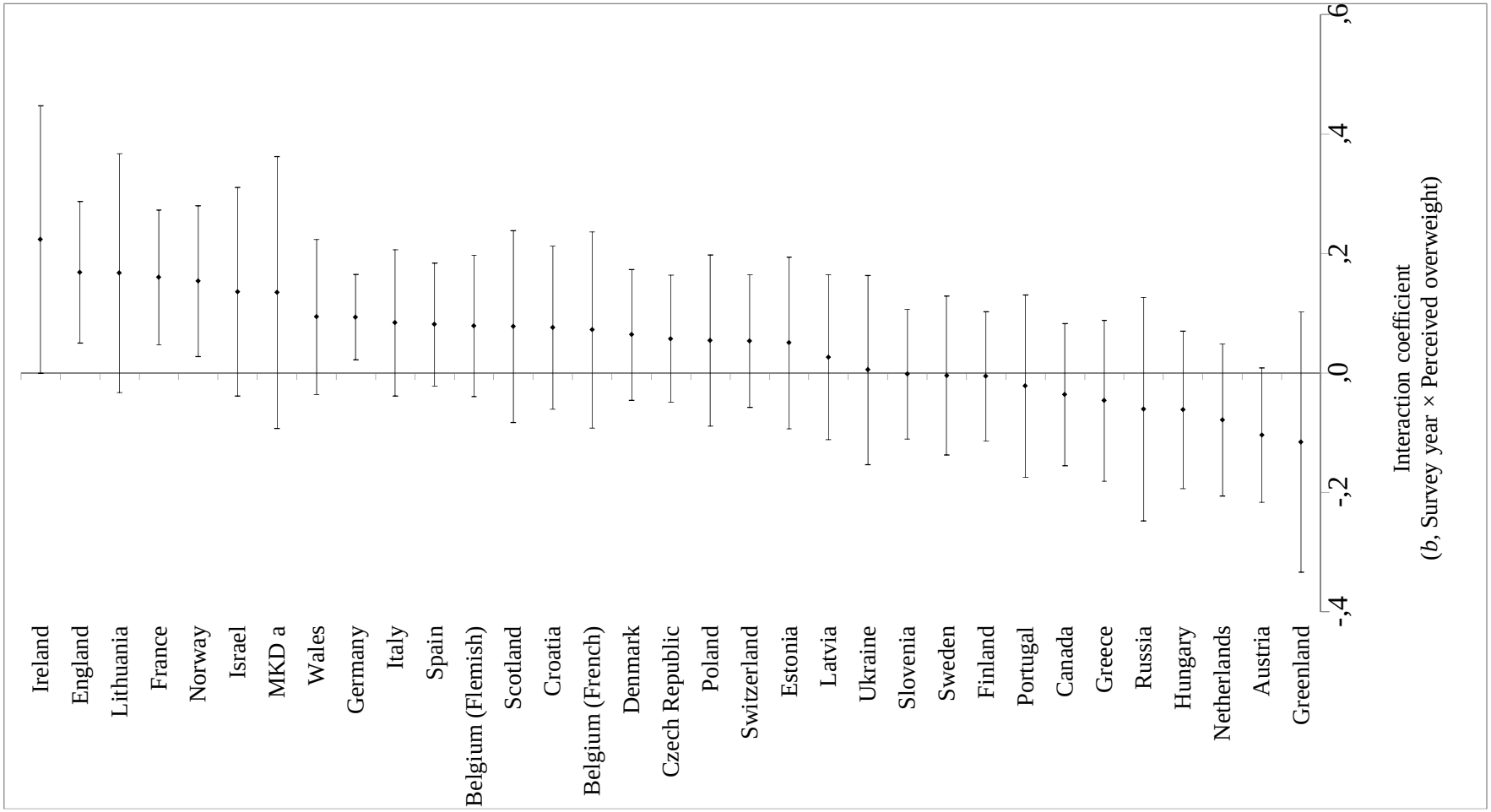
514 38. Goldfield GS, Kenny GP, Alberga AS, et al. Effects of aerobic training, resistance
515 training, or both on psychological health in adolescents with obesity: The HEARTY
516 randomized controlled trial. *J Consult Clin Psychol.* 2015;83(6):1123-1135. DOI:
517 10.1037/ccp0000038.
518 39. Fulkerson JA, Sherwood NE, Perry CL, et al. Depressive symptoms and adolescent
519 eating and health behaviors: a multifaceted view in a population-based sample. *Prev*
520 *Med.* 2004;38(6):865-875. DOI: 10.1016/j.ypmed.2003.12.028.
521 40. O'Neil A, Quirk SE, Housden S, et al. Relationship between diet and mental health in
522 children and adolescents: a systematic review. *Am J Public Health.* 2014;104(10):e31-
523 42. DOI: 10.2105/AJPH.2014.302110.

Figure Captions

Figure 1. Changes over the period 2002-2014 in the association between perceived overweight and psychosomatic complaint burden (ref=’about right’) among 15-year old boys in 33 countries (*b* ± 95% CI). Analyses are adjusted for overweight status based on self-reported height and weight. [a] The former Yugoslav Republic of Macedonia.

Figure 2. Changes over the period 2002-2014 in the association between perceived overweight and psychosomatic complaint burden (ref=’about right’) among 15-year old girls in 33 countries (*b* ± 95% CI). Analyses are adjusted for overweight status based on self-reported height and weight. [a] The former Yugoslav Republic of Macedonia.

Figure 1: Changes in the association between perceived overweight and psychosomatic complaint burden (2002-2014) among 15-year old boys in 33 countries (*b* ± 95% CI).



a The former Yugoslav Republic of Macedonia.

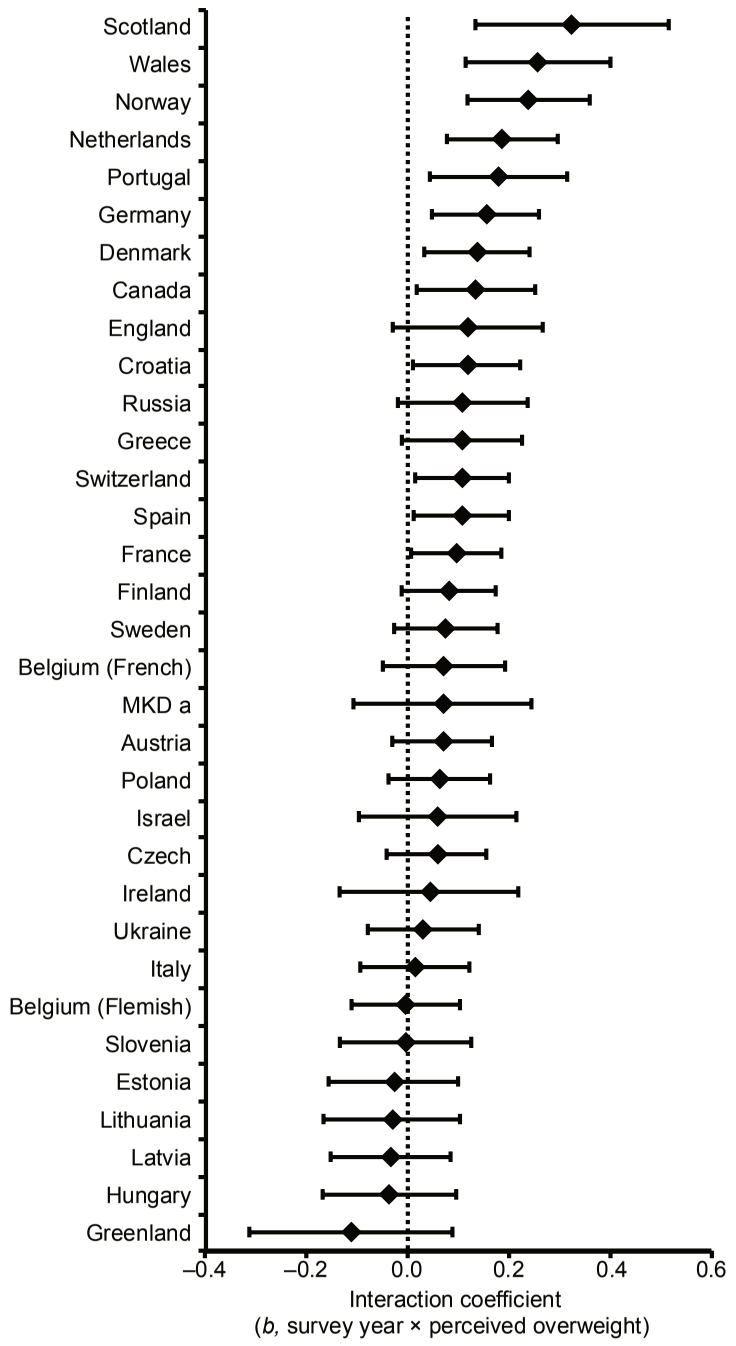

Scotland
Wales
Norway
Netherlands
Portugal
Germany
Denmark
Canada
England
Croatia
Russia
Greece
Switzerland
Spain
France
Finland
Sweden
Belgium (French)
MKD a
Austria
Poland
Israel
Czech
Ireland
Ukraine
Italy
Belgium (Flemish)
Slovenia
Estonia
Lithuania
Latvia
Hungary
Greenland
–0.4
–0.2
0.0
0.2
0.4
0.6
Interaction coefficient
(b, survey year × perceived overweight)

Table SI 1: Unweighted sample size by country, survey year and gender

Country	2002		2006		2010		2014		Total	
	Boys	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
Austria	585	584	658	751	802	857	498	661	2 543	2 853
Belgium (Flemish)	942	958	734	728	614	493	892	624	3 182	2 803
Belgium (French)	392	541	537	509	480	481	632	715	2 041	2 246
Canada	488	602	992	1 081	2 261	2 305	2 057	2 029	5 798	6 017
Croatia	586	793	720	821	1 137	1 176	890	841	3 333	3 631
Czech Republic	785	847	814	808	718	725	792	849	3 109	3 229
Denmark	591	639	659	696	532	603	548	637	2 330	2 575
England	601	716	381	352	297	356	547	410	1 826	1 834
Estonia	587	636	763	753	567	623	577	591	2 494	2 603
Finland	818	851	688	811	955	1 035	897	952	3 358	3 649
France	1 201	1 245	1 075	1 039	745	813	792	792	3 813	3 889
Germany	739	791	1 167	1 169	623	769	942	903	3 471	3 632
Greece	603	650	619	737	779	746	612	664	2 613	2 797
Greenland	72	85	128	136	94	110	94	113	388	444
Hungary	483	791	503	599	717	863	481	501	2 184	2 754
Ireland	216	275	428	330	457	246	251	317	1 352	1 168
Israel	496	655	559	903	585	572	625	759	2 265	2 889
Italy	512	651	630	602	711	709	582	555	2 435	2 517
Latvia	416	587	578	673	611	679	734	909	2 339	2 848
Lithuania	686	777	700	749	691	716	700	615	2 777	2 857
MKD [a]	611	653	874	868	698	621	534	568	2 717	2 710
Netherlands	558	577	593	635	622	648	562	626	2 335	2 486
Norway	720	750	668	599	608	503	390	407	2 386	2 259
Poland	968	1 055	1 051	1 162	656	695	642	716	3 317	3 628
Portugal	339	390	562	720	642	818	611	699	2 154	2 627
Russia	1 075	1 372	1 061	1 301	802	830	575	692	3 513	4 195
Scotland	341	307	567	515	614	613	392	330	1 914	1 765
Slovenia	521	497	727	737	849	847	705	839	2 802	2 920
Spain	677	829	1 261	1 307	857	940	1 452	1 666	4 247	4 742
Sweden	558	566	696	721	916	897	1 127	1 199	3 297	3 383
Switzerland	720	688	667	694	1 032	1 033	994	977	3 413	3 392
Ukraine	678	824	747	916	763	930	700	821	2 888	3 491
Wales	525	505	575	528	583	461	468	399	2 151	1 893
Total	20 090	22 687	23 382	24 950	24 018	24 713	23 295	24 376	90 785	96 726

a The former Yugoslav Republic of Macedonia.