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Bullying and negative appearance feedback among adolescents: is it objective or
misperceived weight that matters?

Abstract

This study investigated (1) whether involvement in bullying as a bully, victim or bully-victim was associated with objectively measured overweight or underweight, or whether it was related to weight misperception (i.e., inaccurate perceptions), and (2) whether appearance-specific feedback mediated the relationship between bullying and weight misperception. In Stage 1, 2782 adolescents aged 11-16 years from British secondary schools were screened for peer bullying and victimisation. In Stage 2, 411 adolescents with weight and height data (objective $n=319$, self-report $n=92$) also self-reported on their weight perception and appearance-specific feedback. Neither bullying nor victimisation were related to objective underweight or overweight. Victims were at increased odds of overweight misperception, while bully-victims were at increased odds of underweight misperception. Additionally, there was an indirect effect of appearance feedback on overweight misperception in bully-victims. Both victims and bully-victims are at increased risk of weight misperception, posing further detrimental effects to their health and wellbeing.

Key words: Bullying; Victimisation; Body Mass Index; Weight misperception; Adolescents.

Background

Overweight and obesity are increasingly prevalent among children and adolescents and have well known adverse consequences on physical and psychological health, as well as educational and social outcomes (Bell et al., 2007; Falkner et al., 2001; Mustillo et al., 2003). These associations may be direct, mediated or moderated by additional factors, and bullying is one of these potential factors. Bullying is the repeated, intentional harm caused by peers that involves a real or perceived power imbalance (Gladden, Vivolo-Kantor, Hamburger, & Lumpkin, 2014). There is convincing evidence that being bullied has extensive adverse effects on physical and psychological health, as well as on social and educational outcomes (Moore, Norman, Suetani, Thomas, Sly, & Scott., 2017; Copeland et al., 2014; Gini & Pozzoli, 2009; Takizawa, Maughan, & Arseneault, 2014; Winsper, Lereya, Zanarini, & Wolke, 2012; Wolke, Copeland, Angold, & Costello, 2013), and has been described as a major public health issue (Feder, 2007).

Cross-sectional and longitudinal research, as well as a recent meta-analysis, suggest that overweight and obese adolescents are at increased risk of being victimised by peers (Kukaswadia, Craig, Janssen, & Pickett, 2011; Mikolajczyk & Richter, 2008; Pearce, Boergers, & Prinstein, 2002; Reulbach et al., 2013; van Geel, Vedder, & Tanilon, 2014), though the relationship tends to vary by sex and bullying type (e.g., physical, verbal) (Griffiths, Wolke, Page, & Horwood, 2006; Kukaswadia et al., 2011; Mikolajczyk & Richter, 2008; Pearce et al., 2002; Wang, Iannotti, & Luk, 2010). However, other cross-sectional and longitudinal studies have found that the association between overweight and victimisation disappears once factors like body dissatisfaction have been accounted for (Farrow & Fox, 2011; Giletta, Scholte, Engels, & Larsen, 2010; Sutter, Nishina, & Adams, 2015).

Some of the inconsistencies in the victimisation and weight literature may be explained by methodological factors. Important covariates that have a clear relationship with overweight, like pubertal stage and parent education (a proxy for socioeconomic status), (Austin, Haines, & Veugelers, 2009; Janssen, Craig, Boyce, & Pickett, 2004; Lenhart, Daly, & Eichen, 2011; Schuster et al., 2014) have often been overlooked. Pubertal stage can influence a variety of social outcomes (Waylen & Wolke, 2004) and as bullying tends to peak during this developmental period (Nansel et al., 2001), pubertal stage may be a particularly important covariate in the victimisation and weight relationship. Another potential issue is the use of self-reported height and weight, the reliability of which is arguable (Gorber, Tremblay, Moher, & Gorber, 2007). Further, when self-reports of height, weight and victimisation are gathered contemporaneously, responses may be biased due to negative affectivity, i.e., a depressive response style (Giletta et al., 2010; Watson & Pennebaker, 1989) or common method variance, i.e., systematic bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). As such, effect sizes may be overstated because of missing covariates or negative affectivity, or underestimated because of reporting bias in height and weight (Cattelino, Bina, Skanjeti, & Calandri, 2015). To further elucidate how bullying and overweight are related, studies that use objectively measured height and weight and include relevant covariates are needed.

Other than methodological factors, a key possibility that could explain inconsistent findings in the peer victimisation and overweight literature is that victimisation might be related to perceived weight rather than objective weight. Several studies have found a perception of overweight or underweight to be associated with increased victimisation (Frisén, Lunde, & Hwang, 2009; Holubcikova, Kolarcik, Geckova, Van Dijk, & Reijneveld, 2015; Reulbach et al., 2013) or that body satisfaction mediates the relationship between overweight and being bullied (Brixval, Rayce, Rasmussen, Holstein, & Due, 2012). A limitation of the extant literature, however, is that the accuracy of weight perceptions has

generally not been assessed, meaning it could indeed be those who are objectively overweight and know it that are more likely to be victimised. Because bullying commonly targets aspects of the victim's appearance (Crozier & Dimmock, 1999), such comments may well be internalised and lead to distorted weight perceptions. Presently, little research has investigated whether peer victimisation is associated with inaccurate weight perceptions.

Weight misperception (i.e., an inaccurate perception) is common in underweight, average weight and overweight children and adolescents, but the emotional and physical consequences differ depending on the direction of the misperception and by sex. For example, while girls are more likely to perceive themselves to be overweight (O'Dea & Caputi, 2001; Talamayan, Springer, Kelder, Gorospe, & Joye, 2006) boys are more likely to perceive themselves to be underweight (O'Dea & Caputi, 2001; Wilson, Viswanathan, Rousson, & Bovet, 2013). Underweight misperception in boys has been associated with depressive symptoms (Byeon, 2015) and lower quality of life (Hayward, Millar, Petersen, Swinburn, & Lewis, 2014), while average weight misperception in underweight boys is associated with decreased depressive symptoms (Byeon, 2015). Average weight misperception in overweight adolescents can exert protective effects against victimisation (Lenhart et al., 2011) and future increases in BMI (Sonneville et al., 2015). Thus, an average weight misperception may be protective against victimisation. Understanding whether victimisation is related to weight misperception and whether the direction of the misperception is maladaptive or protective means future interventions could be better targeted.

If victimisation is related to weight misperception, is the association likely to be direct or mediated by another factor? It is well documented that appearance-teasing is associated with negative perceptions about the body (Lunde, Frisén, & Hwang, 2006; Menzel et al., 2010), but general victimisation, which includes acts like hitting, kicking and social

exclusion, has similarly been associated with poor body image (Lereya, Eryigit-Madzwamuse, Patra, Smith, & Wolke, 2014; Lunde et al., 2006). If victimisation leads to weight misperception via appearance-specific feedback, it may be important to not only consider the frequency of appearance feedback but also the perceived impact (i.e., the level of distress it causes) (Lunde et al., 2006; Thompson, Cattarin, Fowler, & Fisher, 1995). Understanding whether appearance-feedback is the mechanism by which victimisation leads to weight misperception could similarly have important implications for where to direct interventions.

In contrast to the ample, albeit conflicting, research on victimisation and overweight, few studies have explored the association between victimisation and underweight (van Geel, Vedder, & Tanilon, 2014). Boys in particular who are smaller and weaker may be at elevated risk of being victimized by bigger and stronger peers (Olweus, 1978). Some researchers have found underweight boys and girls to be at greater risk of victimisation (Wang et al., 2010), others have found underweight boys to be at lower risk of victimisation (Griffiths et al., 2006), while two more studies have found no association (Mikolajczyk & Richter, 2008; Reulbach et al., 2013). Again, these studies have tended to use contemporaneous self-reports of both height, weight and bullying, which may be liable to bias (Podsakoff et al., 2003; Watson & Pennebaker, 1989). There are thus several gaps in the literature pertaining to the risk of peer victimisation in adolescents who belong to a weight category that deviates from average in any direction.

As well as a focus on overweight in comparison to underweight, the extant literature on bullying and weight (real and perceived) has mainly focussed on victims, but there may be important associations for other bullying roles. Several studies have found that bullies are more likely to be obese or overweight (Griffiths et al., 2006; Janssen et al., 2004; Kukaswadia et al., 2011) and that bullying perpetration is associated with underweight

perception (Holubcikova et al., 2015; Reulbach et al., 2013). However, most studies have not differentiated between pure perpetrators (i.e., bullies) and those who bully but also get victimised (i.e., bully-victims). This is problematic because bullies and bully-victims are quite distinct. When researchers distinguish between bullies, victims and bully-victims, it is often bully-victims that are at the highest risk of poor health and social outcomes (Haynie et al., 2001; Juvonen, Graham, & Schuster, 2003; Wolke et al., 2013). Due to the low prevalence of self-reported bullies (2-5%) (Copeland, Wolke, Angold, & Costello, 2013; Wolke, Woods, Stanford, & Schulz, 2001) large samples need to be screened, meaning research may have been hampered. In contrast, prevalence rates of peer nominated bullies are as high as 13-14% (Boulton & Smith, 1994; Pellegrini et al., 2011). Consequently, a combination of self-reports and peer nominations may more reliably generate a large enough sample of bullies for further investigation (Branson & Cornell, 2009) and enable effects for bullies and bully-victims to be differentiated.

Overall, important knowledge gaps remain regarding the association between two major health concerns afflicting young people, that is, peer victimisation and overweight, as well as a lack of knowledge on the associations for those who are underweight and those who aggress against their peers. To address these gaps, this study investigated, firstly, whether bullying and victimisation were more or less common among objectively overweight or underweight adolescents, or among adolescents who misperceived their weight as average, underweight or overweight, and whether any associations were moderated by sex. Secondly, to gain further knowledge of the mechanisms by which bullying and weight misperception might be related, we examined whether appearance-specific feedback mediated the relationship between bullying involvement and weight misperceptions.

Methods

Design and sample

A power analysis was conducted based on research indicating that 100 participants per group (e.g., bullies, victims, bully-victims, uninvolved) are sufficient to detect moderate differences in body perceptions (Lereya et al., 2014). Bullies have the lowest prevalence rate so were used as the lead group. To obtain 100 bullies, a minimum of 2500 adolescents needed to be screened. However, similar research suggests that attrition in school-based studies occurs at a rate of around 30%, thus an initial sample of 3250 was needed.

A two-stage sampling approach was used (figure 1). In Stage 1, secondary school pupils were screened for bullying involvement using self-report and peer nominations. All those who screened positive for bullying others (i.e., bullies) were invited to take part in Stage 2, alongside a random selection of victims, bully-victims and uninvolved adolescents, who all completed a battery of measurements.

Procedure

The BASE study (The Bullying, Appearance, Social Information Processing and Emotions Study) and all materials were approved by the Departmental Ethics Committee. School recruitment took place between July 2014 and February 2015. Head teachers of secondary schools in the United Kingdom were approached with full details of the study ($k = 160$). Five Head Teachers agreed to participate in the study, and all school pupils (aged 11-16) ($N = 3883$) were invited to participate via written information sheets sent home in sealed envelopes. Parents were asked to return an opt-out form if they did not want their child to participate. Only 144 parents refused their adolescent's participation in the study. Seventy-two percent ($N = 2782$) of pupils gave their active consent and had passive parental consent.

Pupils from each school who completed stage 1 and 2 were entered into a prize draw to win a £50 voucher, with one winner per school.

During Stage 1, pupils were screened for bullying involvement. Self-report and peer nominations were used to identify those who were bullies, victims, bully-victims or uninvolved in bullying. Decision rules to assign screened pupils to the potential bullying roles (Lee, Guy, Dale & Wolke, 2017a) are shown in table 1. As there were a large number of pupils who were victims, bully-victims or uninvolved in bullying, a sub-selection balanced by sex were selected using Microsoft Excel's random number generator. In total 1088 pupils were selected for Stage 2.

In Stage 2, 306 of the selected pupils were absent from school or could not take part due to school organisational difficulties (i.e., one school was unable to allocate the maximum time and computer resources needed for the study). Three parents refused their child's participation (bully $n = 1$, uninvolved $n = 2$), four pupils refused to participate (bully-victim $n = 4$) and five were excluded due to school concerns about vulnerability (victim $n = 1$, bully-victim $n = 3$, uninvolved $n = 1$). In total 770 pupils completed the Stage 2 battery of assessments, but measured height and weight data were missing for 359 pupils because of school time constraints ($n = 277$) or refusals ($n = 82$). As height and weight are not routinely measured in British schools, most pupils did not know their height and weight and therefore did not self-report their measurements (self-reported height $n = 402$; self-reported weight $n = 369$). Thus, the final sample consisted of 411 adolescents (319 with complete objectively measured height and weight and 92 with complete self-reported height and weight). Just over half (51.1%) were female ($M_{age} = 13.6$, $SD=1.4$).

Measures

Electronic questionnaires were completed in a school IT lab or classroom on a PC, laptop or tablet, with at least one investigator present. Bullying and demographic information were obtained at Stage 1 and the remaining measures were assessed at Stage 2, approximately two months later.

Bullying role. Bullying role was assessed at Stage 1 using self-report and peer nominations. *Self-reported bullying* was based on the Bullying and Friendship Interview schedule (Wolke, Woods, Bloomfield, & Karstadt, 2000), a validated measure of bullying behaviour (Griffiths et al., 2006; Schreier et al., 2009). The scale included 13 behavioural descriptions (Wolke, Lee, & Guy, 2017) and assessed three different types of bullying, i.e., direct (e.g., “been hit or beaten up”), relational (e.g., “had lies / nasty things spread about you”) and cyber (e.g. “had embarrassing pictures posted online without permission”). The same items were repeated with slight wording adaptations to assess bullying perpetration. Pupils were asked how frequently any of these behaviours had occurred during the past six months with responses of never, sometimes, quite a lot (several times a month) or a lot (at least once a week). Response of “quite a lot” or “a lot” indicated bullying involvement (Schreier et al., 2009; Wolke et al., 2000).

The *peer nominations* procedure was developed as originally performed by Coie, Dodge, and Coppotelli (1982). Pupils were given a list of names of all the peers in their tutor group and asked to nominate up to three pupils (not themselves) who were victims or perpetrated bullying behaviours (e.g., “Some people are repeatedly hit, shoved around, beaten up, threatened, blackmailed, insulted, called nasty names, played tricks on or stolen from. Which people in your form / tutor group have these things happened to?”). Z-scores were created using the total number of nominations received and the total number of peers in the tutor group. Pupils were identified as involved in bullying if their z-score was one standard

deviation above the tutor group mean on the bullying item (bullies), victimisation item (victims) or on both items (bully-victims). Pupils were identified as uninvolved if they received zero nominations on the bullying and victimisation items. The peer nomination and self-report measures were combined to select the Stage 2 sample, as shown in Table 1.

Individual characteristics. Sex, age, ethnicity and parent education were self-reported at Stage 1. Ethnicity was dummy coded as White British or Other, as there were too few participants in each ethnic category to allow meaningful comparisons (e.g., the next largest ethnic group was Asian at 6.1%). Parent's highest level of education i.e., did not complete school (<11 years), basic schooling (11 years), college (11-13 years) or university (>13 years), was dummy coded into 0=13 years or less (≤ 13) and 1 = more than 13 years (>13) of education. Pubertal development was assessed at stage 2 using the Pubertal development scale (Petersen, Crockett, Richards, & Boxer, 1988). Scale scores were transformed into five pubertal (Tanner) stages (Carskadon & Acebo, 1993). In females, ratings of body hair growth, breast development and menarche were assessed; in males, ratings of body hair growth, voice change and facial hair growth were assessed. This variable was dummy coded (0 = Stage 1-3; 1 = Stage 4-5).

Weight and height. At Stage 2, weight was measured to the nearest 0.1 kg using Tanita BC-1000 portable electronic scale (Tanita Corporation, Tokyo, Japan), whilst wearing lightweight clothes with shoes and jackets removed. Height was measured to the nearest 0.1 cm using a portable stadiometer (Leicester height measure, Child Growth Foundation, UK). BMI was calculated by dividing weight by height squared (kg/m^2) and was subsequently converted into percentile scores using World Health Organisation (WHO) BMI for age and sex cut-offs (Cole, Flegal, Nicholls, & Jackson, 2007). Participants were grouped into three objective weight categories: 0 = average (>15th to <85th WHO age-sex standardised

percentile), 1 = underweight (<15th percentile) and 2 = overweight (>85th percentile).

Complete height and weight measurements were available for 319 adolescents.

All adolescents were asked to self-report weight (in kg or st and lb) and height (in cm or ft and in). BMI was calculated (kg/m^2) and outliers ($\text{BMI} > 40$) were omitted before conducting a linear regression to determine how well self-reported BMI predicted objective BMI. Self-reported height was overestimated and self-reported weight was underestimated, consistent with previous research (Cattelino et al., 2015; Gorber et al., 2007). This meant self-reported BMIs were underestimated. We subsequently corrected for this underestimation by using the UNIFORM function in SPSS 21 (IBM), which computed a random set of values within the range of the confidence intervals of the regression coefficient ($\beta = 3.73$, 95% CI = 0.18 to 7.29) and added these values onto the self-reported BMIs. Corrected self-report BMIs were only used to calculate weight category if objective BMI was unavailable ($n = 92$).

Weight misperception. At Stage 2, adolescents were asked “How would you describe your weight” with responses on a five-point Likert scale from “very underweight” to “very overweight”. Responses were grouped into underweight (“very/ slightly underweight”), average (“about right”) and overweight (“very/ slightly overweight”). Weight misperception was determined by comparing weight perception with objective weight category. Four weight misperception groups were created: 0 = no misperception (i.e., weight perception was accurate), 1 = average weight misperception (i.e., objectively under- or overweight adolescents who perceived themselves to be average), 2 = underweight misperception (i.e., objectively average or overweight adolescents who perceived themselves to be underweight), 3 = overweight misperception (i.e., objectively average or underweight adolescents who perceived themselves to be overweight).

Appearance feedback. A modified version of the short Feedback on Physical Appearance Scale (Tantleff-Dunn, Thompson, & Dunn, 1995) was used. The eight items, answered on 5-point Likert scales (0 = never; 4 = always), assessed verbal and non-verbal negative feedback on appearance (supplementary table 1). The wording on two items was adapted for age-appropriateness (“Someone suggested you go to the gym” was adapted to “Someone suggested you should get some exercise” and “Someone did not offer you any desert” was adapted to “Someone did not offer you any sweets or chocolate”). The item “someone did not offer you sweets or chocolate” had low covariance/correlations compared with all other items and was dropped, leaving seven items to be included in further analysis (Cronbach $\alpha = .81$). The impact of feedback was assessed by asking participants how upset the feedback made them on a 3-point scale (0 = not upset; 2 = very upset). An appearance feedback total score was generated by: 1) summing the responses to the feedback items; 2) summing the impact items; 3) multiplying the feedback score by the impact score.

Statistical Analysis

Using SPSS 21 (IBM), a missing data analysis was conducted by comparing the individual characteristics and bullying role (assessed at Stage 1) of those with and without data at Stage 2. Univariate and bivariate analyses (χ^2 tests, t-tests, ANOVA) examined the association between bullying role and all other variables (all tests were two-sided). The association between bullying role and objective and misperceived weight were examined using multinomial logistic regression models, firstly to examine the unadjusted effects, and secondly, adjusting for covariates (sex, pubertal stage, ethnicity and parent education). We then tested whether any associations were moderated by sex by including interaction terms between sex and bullying role. To account for collinearity and in the name of parsimony, we controlled for biological age (pubertal stage), not chronological age. To check the impact of including the corrected, self-reported BMIs, we conducted a sensitivity analysis by re-

computing the models using only objectively measured weight category. As the coefficients changed minimally, we continued to include adolescents with corrected self-reported weight to preserve statistical power. In all analyses the “uninvolved” bullying role was used as the reference category. Model results are presented as odds ratios (OR) with 95% confidence intervals (95% CI). Finally, to test the mediating effect of the appearance feedback total score on weight misperception, a series of analyses were computed using the *khb* command (Karlson & Holm, 2011) in Stata14. The *khb* command allows mediation to be tested in non-linear models while controlling for covariates. For the mediation analyses, each bullying role was dummy coded and compared to the uninvolved group (e.g., 0 = uninvolved, 1 = victim) and the analyses were run separately for each bullying role. The appearance feedback total score variable was log transformed as it violated assumptions of normality. Mediation results are displayed as standardised regression coefficients, and the total, direct and indirect effects are reported.

Results

Missing and descriptive data

Participants who dropped out of the study between Stage 1 and 2 were older, had lower school attendance and lower socioeconomic status. Of the Stage 2 sample ($n = 700$) girls were more likely to have missing data on self-reported weight (OR = 1.34, 95% CI = 1.00, 1.81, $p = .049$) and adolescents with “Other” (i.e., non-White British) ethnicity were more likely to have missing data on weight perception (OR = 2.09, 95% CI = 1.22, 3.60, $p = .008$). Of the core analytic sample ($n = 411$), all participants had complete data on sex, parent education and weight perception; 4% of participants were missing data on appearance feedback total scores, 14% were missing data on pubertal stage, and 0.3% were missing data

on ethnicity. As a sensitivity analysis, we performed multiple imputation on missing data values and re-ran the models. The estimates from the non-imputed and imputed estimates were almost identical, hence the non-imputed results are reported for parsimony. The bivariate analyses by bullying role (table 2) revealed that bullying role was associated with sex, weight misperception and appearance feedback total score.

Are those with objective underweight or overweight more likely to be involved in bullying?

Most adolescents (60.3%) had an average (>15th to <85th percentile) BMI ($M_{BMI} = 20.57$, $SD = 4.11$). Just under a third of the sample (28.2%) were overweight (>85th to >97th percentile = 18.5%; >97th percentile (obese) = 9.7%) and 11.5% were underweight (<15th percentile). Bullying role did not vary by weight category (table 3, model 1 and 2). That is, objectively underweight and overweight adolescents were not more likely to be bullies, victims or bully-victims. Adolescents at a higher pubertal stage were less likely to be underweight (OR = 0.27, 95% CI = 0.12, 0.60, $p = .001$), while adolescents at a higher pubertal stage were more likely to be overweight (OR = 2.16, 95% CI = 1.23, 3.79, $p = .007$), as were those with non-white British ethnicity (OR = 1.98, 95% CI = 1.05, 3.73, $p = .034$). There was no significant interaction between bullying role and sex on objective weight category.

Are those with misperceived average weight, underweight or overweight more or less likely to be involved in bullying?

Most adolescents (63.7%) accurately perceived their weight. Of the remaining sample, 13.6% had average weight misperception, 11.7% had underweight misperception and 10.9% had overweight misperception. The unadjusted model (table 4 model 1) indicated that victims were at increased odds of overweight misperception and bully-victims were at

increased odds of underweight misperception. Adjustment for covariates (table 4, model 2) increased the strength of the effect in bully-victims. There were no significant associations for bullies. Some estimates are missing in model 2 because too few bullies ($n = 2$) had overweight misperception for estimates to be calculated. There were no significant associations between average weight misperception and bullying involvement (table 4); that is, average weight misperception was not protective against being a victim, bully-victim or bully. There was no significant interaction between bullying role and sex.

Is the relationship between weight misperception and bullying direct or mediated by appearance feedback?

Table 5 shows the total, direct and indirect effects of bullying role on weight misperceptions. There was a total effect of being a victim on overweight misperception and there were total and direct effects of bully-victim status on underweight misperception. That is, overweight misperception in victims and underweight misperception in bully-victims was not mediated by the appearance feedback total score. There was an indirect effect of being a bully-victim on overweight misperception ($\beta = 0.28$, 95% CI = 0.01, 0.56, $p = .045$). That is, bully-victims were more likely to perceive they were overweight if their appearance feedback total scores were high, with appearance feedback explaining 33% of the effect of overweight misperception in bully-victims. There were no mediation effects relating to being a bully or having average weight misperception.

Discussion

This study found, firstly, that bullying perpetration and victimisation were not more or less common amongst objectively defined overweight or underweight adolescents. Secondly, bullying role was related to inaccurate perceptions about weight in those who were victimised; overweight misperception was more common in victims and underweight

misperception was more common in bully-victims. We also found an indirect relationship between being a bully-victim and having an overweight misperception via negative appearance feedback. Bullies did not have weight misperception.

In contrast to some previous research, bullying victimisation and perpetration were not more common among overweight adolescents. This finding is, however, consistent with studies that have assessed objective and perceived weight simultaneously (Brixval et al., 2012; Kaltiala-Heino, Lankinen, Marttunen, Lindberg, & Fröjd, 2016). The lack of association between objective weight and victimisation might be explained by several factors. For instance, the prevalence of overweight in this study was higher than previous studies based in the UK (Griffiths et al., 2006), possibly because we primarily used objective measures of height and weight. A rising trend of overweight in recent decades might suggest that excess adiposity has become normalised. Indeed, the bullying and overweight association may only be present when self-reports are used (Giletta et al., 2010) because contemporaneous self-reports of victimisation, height and weight are potentially biased and may reflect psychological difficulties or self-stigma in adolescents with a high BMI (Giletta et al., 2010; Podsakoff et al., 2003; Watson & Pennebaker, 1989). This study overcame these potential biases by using self-report and peer-nominations of bullying involvement, using objective measures of height and weight, and by assessing bullying and weight at different time periods. A recent, genetically-sensitive longitudinal study similarly found no differences in objective body weight between bullied and non-bullied children during childhood, but found a dose-response relationship between bullying chronicity and risk of becoming overweight in adulthood (Baldwin et al., 2016). Thus, overweight may be an outcome, rather than a cause, of victimisation.

The second key finding was that victimisation was associated with overweight misperception, which supports and extends previous studies that have reported an association

between victimisation and overweight perception (Frisén et al., 2009; Holubcikova et al., 2015; Reulbach et al., 2013). Our results add to previous research by showing that victims appear to be particularly susceptible to inaccurately believing they are overweight, regardless of appearance-specific feedback and impact. It is well-documented that victims have decreased self-esteem, increased internalising difficulties (Stapinski et al., 2014; Vaillancourt, Brittain, McDougall, & Duku, 2013; Wolke, Lee, & Guy) and poor body image (Lee, Guy, Dale, & Wolke, 2017a; Lereya et al., 2014), suggesting that bullying acts that are direct or indirect in nature and not specifically targeted at appearance can be harmful to weight perceptions.

We found that bully-victims were more likely to inaccurately believe they were both underweight and overweight, with overweight misperception being driven by appearance specific feedback total scores. Both bully-victims and victims received a relatively high amount of appearance feedback, but it seems that bully-victims are more likely to internalise frequent negative comments about their weight or appearance. Bully-victims experience the most psychopathology out of the bullying roles, and a distorted body image in terms of weight misperception aligns with research showing that bully-victims are more likely to be preoccupied with weight loss (Lee, Guy, Dale, & Wolke, 2017b) and are at increased risk of disordered eating behaviour (Copeland et al., 2015; Kaltiala-Heino, Rimpelä, Rantanen, & Rimpelä, 2000). The typical trajectory of bully-victims is from victim to bully (Lereya, Copeland, Zammit, & Wolke, 2015), meaning that the experience of victimization may have led these adolescents to feeling smaller and weaker than average, leading to aggression against others to enhance their status and reputation. Bully-victims occupy the lowest position in the social hierarchy (e.g. acceptance, popularity) and are the most defeated despite trying to fight back (Juvonen et al., 2003; Vaillancourt, Hymel, & McDougall, 2003).

In contrast to victims and bully-victims, bullies tended to have accurate weight perceptions, which aligns with research showing that bullies experience few, if any, adverse consequences from harming others (Copeland et al., 2014; Juvonen et al., 2003; Wolke et al., 2013). As there is some evidence that aggressive children have more positively biased self-perceptions (Lynch, Kistner, Stephens, & David-Ferdon, 2016), we might have expected bullies to have weight misperceptions biased towards average, but this was not the case. However, accurate perceptions of weight by bullies and misperceptions by victims and bully-victims is consistent with biases in social information processing, in that victims and bully-victims are more likely to hold attributions of hostile intent or self-blame while bullies are more likely to hold accurate perceptions and attributions (Guy, Lee, & Wolke, 2017). Thus, bullies do not differ in their processing of information from those not involved in bullying, and as shown here, in their perception of weight.

Similarly, average weight misperception did not exert any protective effects against victimisation (i.e., the odds ratio was not significantly below one). As the average weight misperception group consisted of both underweight and overweight adolescents, there are possibly specific and independent benefits of average weight misperception for each weight category (Byeon, 2015; Lenhart et al., 2011; Sonnevile et al., 2015). Power limitations meant we were unable to investigate this in the current study and further research is warranted.

It is well documented that overweight has adverse impacts on physical health (De Onis, Blössner, & Borghi, 2010; Must & Strauss, 1999; Reilly & Dorosty, 1999), but perceptions about the body can similarly affect health on a physiological level. For example, while body appreciation has been positively associated with self-perceived physical health, body dissatisfaction has been associated with variation in inflammatory markers in both average and overweight participants (Černelič-Bizjak & Jenko-Pražnikar, 2014). As body dissatisfaction tends to remain stable over time, particularly in boys (Karazsia, Murnen, &

Tylka, 2016), it is plausible that weight misperception in childhood and adolescence may continue into adulthood to effect physical and psychological health and wellbeing. As victimisation is similarly associated with long-term physical and psychological health consequences (Copeland et al., 2014; Takizawa et al., 2014; Winsper et al., 2012; Wolke et al., 2013), victims and bully-victims with overweight or underweight misperception may be in double jeopardy of adverse health outcomes. Longitudinal studies are needed to examine the potential additive effects of victimisation and body dissatisfaction or distorted body image on future weight and health outcomes. Regarding interventions, our findings clearly indicate that being bullied has comprehensive effects on weight perceptions, regardless of actual weight, and provides further evidence that bullying has wide-reaching effects on a variety of outcomes (Wolke & Lereya, 2015), including becoming obese (Baldwin et al., 2016). As adolescents of all sizes are affected by bullying, interventions should be broadly focussed, rather than specifically targeted at children and adolescents who are over- or underweight.

There are limitations to this study. Firstly, we had some missing data on objective height and weight. Research suggests non-respondents of height and weight differ from respondents in several ways (e.g., younger, bullied more frequently) (Brixval et al., 2012; Mikolajczyk & Richter, 2008). In this study, missing height and weight data was not related to bullying role, weight perception, pubertal stage or parent education. Although state of the art recommendations suggest handling missing data via multiple imputation (van Buuren, 2012), regression techniques have been effectively used to correct self-report BMI (e.g., Giacchi et al., 1998; Gorber et al., 1998; Jain, 2010). We deemed this latter technique to be most appropriate considering our aim of using predominately objective BMI (and rather than imputing these values). Missing data meant we may have been underpowered to detect any sex differences in weight misperception. A previous study found that underweight perception was only found in bully-victims who were boys (Holubcikova et al., 2015), although this

study measured weight perception, rather than misperception. Furthermore, we were unable to disentangle effects between overweight and obese adolescents; it is possible that bullying involvement might only be a risk for those with the highest levels of adiposity (Griffiths et al., 2006; Neumark-Sztainer, Falkner, Story, Perry, & Hannan, 2002). Secondly, we were unable to disentangle whether negative comments were made by peers, parents or others, but previous research indicates that peers are common sources of appearance teasing and can influence unhealthy weight control behaviours (Neumark-Sztainer et al., 2002). Finally, the cross-sectional design prevents any assumptions regarding the direction of causality and the non-representative sample limits generalisability of the findings. A particular strength of this study is the relatively large sample of bullies, which can be difficult to obtain due to low prevalence rates using self-report methods (Copeland et al., 2013; Wolke et al., 2001). The use of peer-nominations allowed us to generate a large enough sample of bullies for further analysis. Peer nominations have been used in multiple studies without adverse effects (e.g., Balda, Punia, Singh, & Singh, 2005; Dawes et al., 2016; Golmaryami & Barry, 2010; Vaillancourt & Hymel, 2006). In our study, participants were only asked to report on their peer's behaviour, thus mitigating any risk of adolescents being subsequently labelled as "victim" or "bully".

In conclusion, inaccurate perceptions about weight appear to be more important than objective weight category with regards to bullying victimisation. Victims and bully-victims are at the greatest risk of weight misperception, either directly because of being bullied or because of negative feedback specifically directed at appearance. In contrast, bullies generally have realistic perceptions about their weight. As bullying affects adolescents for many reasons, interventions should be focused broadly and not specifically targeted at adolescents based on their weight.

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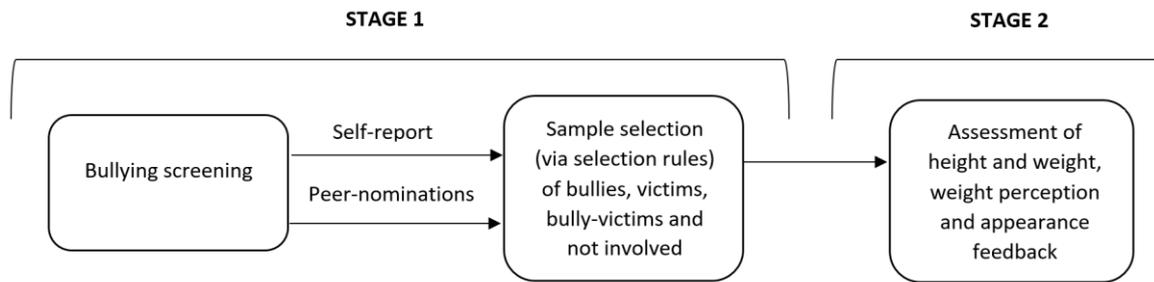


Figure 1 Overview of study design

Table 1 Rules used to select adolescents for Stage 2 assessments and total N selected in each bullying role

Role	Rule
Bully	Self-reported bully OR peer nominated bully (z-score >1) AND not a self-reported or peer nominated victim.
Victim	Self-reported victim (several times a week) AND not a self-reported or peer nominated bully (z-score <1).
Bully-victim	Self-reported bully and victim OR peer nominated bully (z-score >1) and victim (z-score >1) OR any combination self-reported or peer nominated bully and victim.
Uninvolved	Not a self-reported victim or bully AND no peer nominations as a victim or bully.

Table 2 Sample demographics and objective weight category stratified by bullying role. All values are percentages except where indicated.

	Bullying role (<i>n</i> = 411)				<i>p</i>
	Uninvolved	Bully	Victim	Bully-Victim	
N	101	83	75	152	
Sex (%)					
<i>Female</i>	43.6	50.6	72	46.1	.001
<i>Male</i>	56.4	49.4	28	53.9	
Age (mean [SD])	13.42 [1.47]	13.68 [1.43]	13.45 [1.42]	13.66 [1.66]	.408
Ethnicity (%)					
<i>White</i>	87.1	79.3	85.3	86.2	.453
<i>Other</i>	12.9	20.7	14.7	13.8	
Puberty (%)					
<i>Stage 1-3</i>	50	31.9	41	39	.144
<i>Stage 4-5</i>	50	68.1	59	61	
Parent education (%)					
≤13 years	55.4	67.5	62.7	67.8	.246
>13 years	44.6	32.5	37.3	32.2	
Objective weight category (%)					
<i>Average</i>	63.4	59	64	57.2	.223
<i>Underweight</i>	11.9	16.9	12	7.9	
<i>Overweight</i>	24.8	24.1	24	34.9	
Misperceived weight category (%)					.003
<i>No misperception</i>	69.3	72.3	57.3	58.6	
<i>Average misperception</i>	15.8	15.7	10.7	12.5	
<i>Underweight misperception</i>	7.9	9.6	9.3	16.5	
<i>Overweight misperception</i>	6.9	2.4	22.7	12.5	
Appearance feedback total score (mean [SD])	.14 [.27]	.20 [.38]	.71 [.91]	.60 [1.07]	< .001

Table 3 Unadjusted (model 1) and adjusted (model 2) odds ratios with 95% confidence intervals for objective weight category in bullies, victims and bully-victims.

		Bullying role								
		Bully			Victim			Bully-victim		
		OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Model 1 (<i>n</i> = 411)	Underweight	1.52	0.65, 3.59	.335	1.00	0.39, 2.56	.999	0.74	0.31, 1.74	.486
	Overweight	1.04	0.52, 2.10	.902	0.96	0.47, 1.96	.911	1.56	0.88, 2.77	.130
Model 2 (<i>n</i> = 354)	Underweight	1.57	0.59, 4.17	.370	0.72	0.24, 2.19	.560	0.67	0.26, 1.68	.390
	Overweight	0.95	0.43, 2.09	.898	1.11	0.50, 2.51	.793	1.36	0.71, 2.59	.354

Abbreviations: OR, odds ratios; 95% CI, 95% confidence intervals. Significant values are typeface bold. Model 2 sample size reduced because of missing puberty data. The uninvolved bullying role and the average weight group were used as the reference categories. Model 2 was adjusted for sex, ethnicity, pubertal stage and parent education. Of the covariates, those at a higher pubertal stage were less likely to be underweight (OR = 0.27, 95% CI = 0.12, 0.60, *p* = .001), while those at a higher pubertal stage were more likely to be overweight (OR = 2.16, 95% CI = 1.23, 3.79, *p* = .007), as were those with non-white British ethnicity (OR = 1.98, 95% CI = 1.05, 3.73, *p* = .034).

Table 4 Unadjusted (model 1) and adjusted (model 2) odds ratios with 95% confidence intervals for weight misperception in bullies, victims and bully-victims.

		Bullying role								
		Bully			Victim			Bully-victim		
		OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Model 1 (<i>n</i> = 411)	Average weight misperception	0.95	0.42, 2.13	.897	0.81	0.32, 2.06	.664	0.93	0.45, 1.95	.856
	Underweight misperception	1.17	0.41, 3.30	.771	1.42	0.48, 4.21	.522	2.46	1.05, 5.78	.039
	Overweight misperception	0.33	0.67, 1.67	.181	3.95	1.52, 10.31	.005	2.14	0.85, 5.36	.107
Model 2 (<i>n</i> = 354)	Average weight misperception	1.16	0.47, 2.85	.752	0.68	0.22, 2.13	.510	1.15	0.51, 2.57	.738
	Underweight misperception	1.45	0.45, 4.66	.535	1.93	0.59, 6.27	.276	3.05	1.16, 8.00	.023
	Overweight misperception [^]	-	-	-	3.04	1.02, 9.05	.046	2.06	0.76, 5.58	.154

Abbreviations: OR, odds ratios; 95% CI, 95% confidence intervals. Significant values are typeface bold. Model 2 sample size reduced because of missing puberty data. The uninvolved bullying role and the no misperception group were used as the reference categories. Model 2 was adjusted for sex, ethnicity, pubertal stage and parent education. None of the covariates were significant (*ps* >.05).

^ Estimates are missing in the adjusted model for bullies because of quasi-separation of the data: there were low probabilities ($n = 2$) of bullies misperceiving themselves as overweight.

Table 5 Total, direct and indirect effects with 95% confidence intervals of bullying role and appearance-feedback total score on weight misperceptions.

		Total effect (95% CI)	Direct effect (95% CI)	Indirect effect (95% CI)
Bully	Average	0.14	0.2	-0.06
	misperception	(-0.78, 1.07)	(-0.73, 1.13)	(-0.22, 0.10)
	Underweight	0.28	0.31	-0.02
	misperception	(-1.01, 1.58)	(-0.99, 1.60)	(-0.13, 0.08)
	Overweight	-	-	-
	misperception [^]	-	-	-
Victim	Average	-0.72	-0.08	-0.64
	misperception	(-2.13, 0.68)	(-1.32, 1.16)	(-1.60, 0.32)
	Underweight	0.86	0.82	0.04
	misperception	(-0.04, 2.14)	(-0.54, 2.18)	(-0.43, 0.52)
	Overweight	1.20*	0.91	0.29
	misperception	(0.01, 2.39)	(-0.35, 2.18)	(-0.09, 0.66)
Bully- victim	Average	0.15	0.07	0.08
	misperception	(-0.66, 0.96)	(-0.78, 0.92)	(-0.18, 0.33)
	Underweight	1.21*	1.35*	-0.14
	misperception	(0.17, 2.26)	(0.28, 2.42)	(-0.42, 0.15)
	Overweight	0.85	0.57	0.28*
	misperception	(-0.22, 1.93)	(-0.55, 1.69)	(0.01, 0.56)

* $p < .05$

Abbreviations: 95% CI, 95% confidence intervals. Significant values are typeface bold. The uninvolved bullying role and the no misperception group were used as the reference categories.

Sex, ethnicity, pubertal stage and parent education were all controlled for.

^Estimates are missing in the model for bullies because there were too few bullies ($n = 2$) with overweight misperception.