

# BMJ Open Cross-sectional study of BMI, weight concern, body size perception, dieting and mental distress in adolescents: The HUNT Study

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## ABSTRACT

**Objective** We examined the associations between body mass index (BMI), weight concern, body size perception, dieting and mental distress in a population-based study of 7350 adolescents.

**Design** Cross-sectional.

**Settings** Data from a Norwegian population-based cohort, The Young-HUNT3 (2006–2008) from the county of Nord-Trøndelag, Norway.

**Participants** A total of 7350 adolescents (13–19 years) who had both self-reported questionnaire data and anthropometric measures.

**Primary outcome measures** Odds for mental distress given sex, BMI, weight concern, body size perception and dieting. Analyses were performed in binomial logistic regression models.

**Results** Compared with being overweight/obese, having weight concern, irrespective of BMI, was associated with higher OR for mental distress (MD) among boys and girls. Body size overestimation was associated with an increase in the OR for MD, in participants who were overweight/obese, had weight concern or dieted. This effect was more pronounced in boys.

**Conclusions** Weight concern and body-size estimation are strongly associated with mental health in adolescent boys and girls. Routine assessment of adolescents' attitudes towards their weight and body size is advised.

## INTRODUCTION

Long-term negative effects of paediatric obesity on the physical and mental well-being are widely known. Preventing obesity has however, proved difficult.<sup>1–3</sup> To lose weight, many adolescents resort to dieting; whose effectivity and long-term health consequences are debated.<sup>4–7</sup> In order to strive to achieve (or maintain) normal weight, it is necessary for individuals, to have awareness of their own body.

Previous studies in adolescent populations, have collectively pointed at inter-related and multifaceted relationships between body awareness, body mass index (BMI) and dieting.<sup>4–7</sup> High BMI and having concerns about one's weight or body size have been

## Strengths and limitations of this study

- Our findings were based on a study of a large, population-representative data set of male and female adolescents.
- Stratification of our study population into smaller groups based on their body size perception and weight concern allowed for inferences being made on the interaction terms between the two, which had clear methodological advantage in making inferences as to which component seemed to contribute more to the outcome variable.
- The relationship of weight concern, body-size estimation and mental distress has been discussed within the framework of the cognitive dissonance theory.
- A limitation of this study was the cross-sectional design that is not suitable for studying causality between exposure and outcome variables.

associated with poorer mental health among adolescents, but what contributes to this association is not fully understood.<sup>6</sup>

Body awareness is a human construct, formed by comparisons made between individuals' perception of their own body (body-image) to that of others (body-ideal).<sup>8</sup> The definition of body-ideals may vary depending on the context within which it is applied. In medical terms, there is a preference for normal BMI (defined by the WHO as between 18.5 and 24.9). Societal body-ideals, which seems to be culturally dependent, is what advance individuals towards goals such as being liked or being successful.<sup>9</sup> In a societal context, emphasis is often put on body shape/size.<sup>9</sup> Weight perception and body-ideals may vary in different racial or ethnical groups.<sup>10</sup> For instance, in western societies, there is a preference for overly thin bodies in girls<sup>11</sup> and masculine and lean bodies in boys.<sup>12–15</sup> Individuals may also compare their weight

(or BMI) to what they consider most prevalent (hence normal) by looking at their peers.<sup>14</sup>

In the past few decades, there has been a significant increase in the obesity rate and mean population BMI among both adults and adolescents.<sup>16</sup> This is contrary to the current societal preference for overly thin body-ideals many adolescents find unattainable.<sup>9</sup> In today's western societies, the perceived distance between BMI in overweight/obese individuals and societal or medical body-ideals has increased compared with previous situations. In contrast, due to the increase in mean population BMI, the perceived distance between BMI in overweight/obese individuals and the population norm has decreased. It is known that holding contradictory elements of cognition causes psychological discomfort (cognitive dissonance theory).<sup>17,18</sup>

Psychological theories have provided a scientific framework for studying body-image.<sup>17</sup> For instance, in the field of eating behaviour, cognitive dissonance theory (CDT) has been applied to study body acceptance in female adolescents and adults.<sup>19</sup> CDT suggests that humans have an inert drive to create and maintain harmony between their attitudes and behaviour, because disharmony (or cognitive dissonance) causes psychological discomfort. Accordingly, incongruity between the body-ideals themselves, as well as incongruity between individuals' body-image and their body-ideals, could create psychological discomfort, which may then be reduced by making changes in cognition or behaviour (such as dieting).

In the current study, we have explored associations between body-image, dieting and mental distress in 7350 Norwegian adolescents who had taken part in The Young-HUNT3 Survey (2006–2008). Body-ideals were defined as, 1—being of normal weight BMI (medical preference), and 2—being closer to societal thinner/leaner body-ideals. Taking advantage of data available on a range of health-related issues, we divided our participants into groups based on their BMI, body-image and dieting behaviour. Body-image consisted of two elements: individuals' perception of their weight (weight concern) and body size (body size underestimation and overestimation). Odds for mental distress were then estimated across these groups. By cross-comparing the odds we made inferences as to which body-ideals seem to be playing a greater part in increasing psychological discomfort among adolescents.

We hypothesised that adolescents with excess weight, experience higher psychological discomfort due to an increase in the discrepancy between their weight perception and societal preference for thinness and medical preference for lower BMI. We hypothesised that body size overestimation is associated with higher psychological discomfort because overestimation puts adolescents in a less favourable position compared with the societal body-ideal. Due to greater societal preference for thinness in girls, we expected this association to be stronger in the female group. We hypothesised that body size underestimation in adolescents is associated with lower

psychological discomfort because the underestimation puts the adolescents in a more favourable position compared with the societal body-ideal. Within the context of CDT, behavioural changes such as dieting are expected to reduce psychological discomfort caused by cognitive dissonance between body-image and body-ideals. We therefore hypothesised that dieting is associated with lower odds for mental distress (MD), in both girls and boys.

To our best knowledge, this is the first time CDT is used as a theoretical framework to infer the relative significance of societal definitions of body-ideals for body-awareness at adolescence.

## METHODS

### Participants

Data from The Young-HUNT3 Survey (YH3) (2006–2008) was used in the present study. YH3 is the third wave of the adolescent arm of the Trøndelag Health Study (The HUNT Study).

The Young-HUNT surveys were carried out at the Nord-Trøndelag Region County's schools, and comprises three cross-sectional surveys: Young-HUNT1, YH1 (1995–1997), Young-HUNT3, YH3 (2006–2008) and Young-HUNT4, YH4 (2016–2019). A survey of a limited number of Young-HUNT1 participants was done in a smaller cohort, Young-HUNT2, YH2 (2000–2001).

After completion of YH3 and in total, data on 17 820 adolescent research participants (13–19 years old, response rate 78%–90%) were collected.<sup>20 21</sup> Cohort profiles of The HUNT Study are previously described elsewhere.<sup>20 21</sup>

YH3 data included self-administered questionnaires, structured interviews, collection of biological samples and clinical measurements, carried out by trained personnel. For anthropometric measurements of height, weight, hip and waist circumference, standard procedures were followed.<sup>21</sup> In the present study, questionnaire data and anthropometric measurements have been used.

In total, 8202 individuals in junior and senior high schools participated in YH3 (78% response rate).<sup>21</sup> Of those, 7718 individuals had both answered the YH3 questionnaire and had anthropometric measurements data available. Due to missing data on body size perception, dieting or MD, 386 participants were excluded from our study. The total study population was 7350 (3806 boys and 3544 girls).

## MEASUREMENTS

### Mental distress

The five-item Hopkins Symptom Checklist (SCL-5)<sup>22</sup> was used to evaluate participants' level of MD. SCL-5, a valid and reliable measure of MD<sup>22 23</sup> consists of the following question items: 'Feeling blue',—'Feeling fearful',—'Feeling hopeless about the future',—'Worrying too much about things' and—'Experiencing nervousness

or shakiness inside'. Participants recorded their answer on a 4-point Likert scale from one ('not bothered') to four ('very much bothered').

Only participants (N=7329) who had answered four or more questions were included. The mean scores for each question were summed up to a total score that was then divided by the number of questions answered. Based on a previously defined cut-off point,<sup>22</sup> participants with 'high' MD ( $\geq 2$ ) were identified and compared with those with 'low' ( $< 2$ ) levels of MD. In this paper, adolescents with high MD are referred to as those with MD.

### Anthropometric measures

Participants' weight was measured to the nearest half kilo and height to the nearest cm.<sup>21</sup> BMI was calculated as weight (kg)/height<sup>2</sup> (m<sup>2</sup>). The adolescent BMI-based weight categories were defined using the age-specified and sex-specified International Obesity Task Force cut-off values,<sup>24 25</sup> participants were grouped into four categories; obese, overweight, normal weight or underweight. In the analyses, overweight and obese in addition to underweight and normal weight were collapsed into groups.

### Weight concern and dieting

The Young HUNT research participants were asked a series of questions about their «Meals and eating habits», including a question item on dieting.<sup>26</sup> The dieting item consists of the following question: 'Are you trying to lose weight?', with the answer options: 'No, I am comfortable with my weight' (1), 'No, but I need to lose weight' (2) or 'Yes' (3). The two latter options both indicated weight concern, but only the latter point to actively changing eating behaviours to reduce weight.

By pairing this information with participants' actual BMI-based weight category, we stratified participants into the following five groups (also see figures 1 and 2) that bore information on participants' BMI-based weight

category, weight concern or dieting behaviour (or the lack of).

1. Unnecessary weight concern (UC): Normal or underweight adolescents with UC, but without dieting behaviour (answer option 2).
2. Unnecessary weight concern with dieting (UD): Normal or underweight adolescents with weight concern and dieting behaviour (answer option 3).
3. Healthy weight concern with dieting (HD): Overweight/obese adolescents with weight concern and dieting behaviour (answer option 3).
4. Lack of weight concern (LC): Overweight/obese adolescents who were neither concerned about their weight, nor dieted (answer option 1).
5. Reference: Normal or underweight adolescents with no weight concern or dieting behaviour (answer option 1).

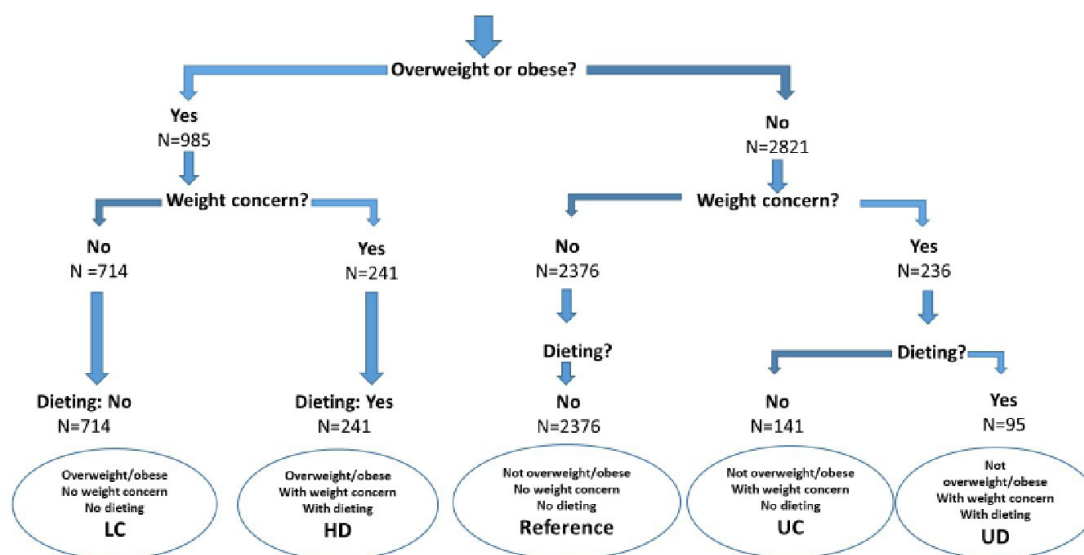
### Body size perception

Study participants were asked about how they perceived their body size as follows: 'Do you consider yourself to be: 'very fat', 'quite fat', 'about the same as others', 'quite thin' or 'very thin'?

By combining individuals' body size perception (BSP) with their BMI-based weight category, we defined three BSP groups: BSP overestimation (normal weight underweight who consider themselves 'very fat', 'quite fat'), BSP underestimation (overweight/obese who consider themselves 'about the same as others', 'quite thin' or 'very thin') and accurate BSP estimation (for instance, overweight obese who thought they were quite fat or very fat).

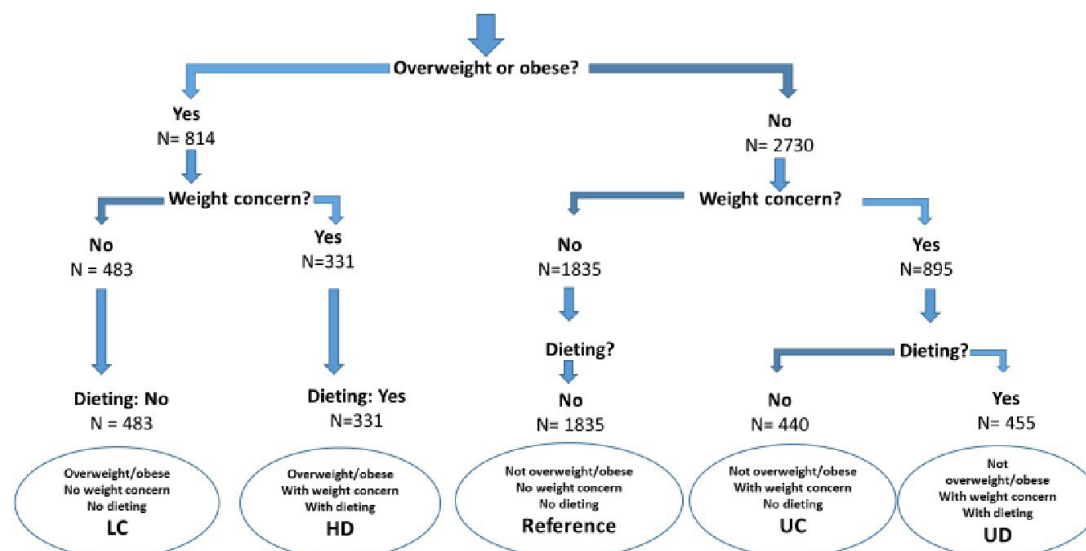
### Statistical analysis

A three-way log-linear analysis was performed to determine which model components (individuals' BMI-based weight category, weight concern, BSP, dieting and sex) were necessary to retain in order to best account for the



**Figure 1** Study population men N=3806. HD, healthy dieting; LC, lack of weight concern; UC, unnecessary weight concern; UD, unnecessary dieting.





**Figure 2** Study population women N=3544. HD, healthy dieting; LC, lack of weight concern; UC, unnecessary weight concern; UD, unnecessary dieting.

data. The log-linear analysis suggested a hierarchical unsaturated model for the associations between sex, weight concern/dieting and body size perception. An unsaturated model was chosen using SPSS Statistics' hierarchical log-linear model selection procedure with a backwards elimination stepwise procedure. This produced a model that included all main effects and two two-way associations of weight concern/dieting and BSP. The log-linear analysis did not recommend including interaction terms between sex and other factors. The model had a likelihood ratio of  $\chi^2(14) < 0.001 p=1$ .

Binomial logistic regression was employed to study the associations between BMI, weight concern/dieting, BSP and MD among adolescents. Analyses were performed in groups stratified according to weight concern, BSP (BSP overestimation and underestimation) and dieting. After stratification on BSP overestimation and underestimation, groups with BSP underestimation had very few participants; hence excluded from the final analyses. All association analyses were adjusted for age. All association analyses were performed against the group with least cognitive dissonance, that is, adolescents with normal weight, no weight concern, with accurate BSP and not dieting.

Results are reported as OR for MD, with 95% CIs. Overall missingness (<5%) was considered as missing at random. A complete case analyses were performed. IBM SPSS Statistics V.26 was used for the analyses.

### Application of CDT

According to CDT, discrepancies between adolescents' body-image and their body-ideals should be associated with increased MD. Emergence of divergent sets of body-ideals would inevitably lead to discrepancy between how adolescents view their weight and body size in different

context within which body-ideals are defined. Accordingly, individuals' sum of cognitive dissonance (CD) due to discrepancy between body-image and body-ideals (see figures 1 and 2), can be considered as the sum of:

1. CD due to weight concern as a mismatch between person's actual BMI and medical body-ideal (normal weight BMI).
2. CD due to discrepancy between person's body size estimation and their societal body-ideal.

For instance, in a normal weight person who thinks she/he is overweight, CD may be, in part, due to as discrepancy between what the person thinks they weigh and their ideal weight. This ideal weight, however, is defined based on medical and societal expectations. On the other hand, ideal weight may be, in part, relative to the population mean BMI that has been changing upwards in the past few decades. Similarly, changes in CD are expected due to discrepancies between individuals' perception of their body size and an increasingly thin societal body-ideal.

By comparing the odds for MD across groups defined according to their BMI-based weight category, weight concern, BSP (BSP underestimation and overestimation) and dieting, authors made inferences as to which of these possible discrepancies seem to have higher impact on the total CD.

All study procedures were in accordance with the Helsinki Declaration, as of 1975, and revised in 2000.

Participants signed written consents before they were enrolled in The Young-HUNT Study. In Norway, legal age for providing informed consent is 16 years. Written consents were obtained from participants aged 16 years or older and from their parents or legal guardians if participants were younger than 16 years.

### Patient and public involvement

No patient involved.

**Table 1** Population characteristics

		Boys		Girls	
		N	%	N	%
BMI-based weight categories	Obese	244	6.4	179	4.7
	Overweight	741	19.5	668	17.6
	Normal weight	122	3.2	179	4.7
	Underweight	2699	70.9	2765	72.9
Are you trying to lose weight?	No, I am happy with my weight	2998	79.8	2206	58.3
	No, but I need to lose weight	423	11.3	760	20.1
	Yes	338	9	819	21.6
Weight concern/dieting	Unnecessary concern but not dieting in normal weight/underweight (UC)	146	4	440	12.4
	Unnecessary concern and dieting in normal weight/underweight (UD)	95	2.6	455	12.8
	Weight concern and dieting in overweight/obese (HD)	241	6.7	331	9.3
	Lack of concern, no dieting in overweight/obese (LC)	714	19.8	483	13.6
	Lack of concern, no dieting in normal weight/underweight (reference)	2413	66.9	1835	51.8
Body size perception	Very fat	58	1.6	122	3.2
	Quite fat	676	18.1	1008	26.6
	Like others	721	19.3	534	14.1
	Quite thin	66	1.8	41	1.1
	Very thin	2212	59.3	2080	55.0
Body size perception	BSP underestimation	687	19.8	455	13.0
	BSP overestimation	585	16.8	783	22.3
	BSP accurate	2204	63.4	2272	64.7
Mental distress (SCL-5)	Low mental distress (score <2)	3251	89.8	2715	73.0
	High mental distress (score ≥2)	361	10.2	1002	27.0

BMI-based weight categories are age and sex adjusted in accordance with Cole *et al.*<sup>23,24</sup>  
 BMI, body mass index; BSP, body size perception; HD, healthy dieting; LC, lack of weight concern; MD, mental distress; SCL-5, five-item Hopkins Symptom Checklist; UC, unnecessary weight concern; UD, unnecessary dieting.

## RESULTS

### Population characteristics

Study participant's characteristics of main variables are summarised in [table 1](#). In total, 7350 adolescents (3806 boys and 3544 girls) were included in the current study (mean age: 15.82 years old).

Most boys (70.9%) and girls (72.9%) were of normal weight BMI. The prevalence of overweight/obesity was slightly higher among boys than girls (25.9% vs 22.3%). Being underweight was slightly more prevalent in girls than boys (4.7% vs 3.2%).

More girls than boys showed UC (overestimation of weight in UC and UD groups, 6.6% in boys vs 25.2% in girls). More boys showed LC/dieting despite being overweight/obese (underestimation of weight in LC group, 19.8% of boys vs 13.6% of girls).

More boys misperceive their body size as thinner (BSP underestimation in 19.8% of boys vs 13% of girls), and more girls misperceived their body size as fatter (BSP overestimation in 16.8% of boys vs 22.3% of girls). In boys, BSP overestimation was more prevalent than weight overestimation (UC and UD groups) ([table 1](#)).

The majority of boys and girls were happy with their weight, hence not dieting. Compared with their female counterparts, fewer overweight/obese boys had weight concern or tried to lose weight by dieting (weight

underestimation seen in LC group: 19.8% of boys vs 13.6% of girls). Compared with boys, and irrespective of BMI-based weight category, more girls resorted to dieting in order to lose weight, as expressed by the prevalence of dieting in HD group (9.3% of girls vs 6.7% of boys) and UD group (12.8% of girls vs 2.6% of boys). The higher prevalence of dieting in girls paralleled their higher tendency of BSP overestimation ([table 1](#)).

MD was prevalent in both genders, more so in girls than boys (27% vs 10.2%, [table 1](#)). The relative risk for MD in girls compared with boys was 2.66, 95% CI 2.38 to 2.96, p value<0.0001 (data not shown).

### Association between participants' BMI, weight concern/dieting, BSP and MD

Confirming findings from the initial log-linear analysis, the discrepant number of participants in each BMI-based weight category compared with the size of groups with presumed correlated weight concern or BSP ([table 1](#)) showed that weight concern and BSP do not entirely measure the same thing.

In both boys and girls, being overweight/obese was associated with increased odds for MD, independent of the presence of weight concern or dieting ([tables 2 and 3](#); OR for MD in HD and LC groups). Likewise, comparable size effects were observed in the in normal weight/

**Table 2** Associations between weight concern, dieting and mental distress in boys and girls

	Boys			Girls		
	OR	95% CI		OR	95% CI	
		Lower	Upper		Lower	Upper
Unnecessary weight concern, no dieting in normal weight/ underweight (UC)	2.133	1.333	3.412	2.595	2.064	3.264
Unnecessary weight concern and dieting in normal weight/ underweight (UD)	2.122	1.198	3.759	3.846	3.085	4.795
Weight concern and dieting in overweight/obese (HD)	2.759	1.941	3.921	3.358	2.618	4.308
Lack of weight concern, not dieting in overweight/obese (LC)	1.397	1.059	1.844	1.566	1.235	1.986

Reference group: Non-overweight/obese participants with no weight concern or dieting.

HD, healthy dieting group; LC, lack of weight concern group; UC, unnecessary weight concern group; UD, unnecessary dieting group.

**Table 3** Associations between weight concern, dieting and mental distress in boys and girls, in the group with BSP overestimation

	Boys			Girls		
	OR	95% CI		OR	95% CI	
		Lower	Upper		Lower	Upper
Unnecessary weight concern, no dieting in normal weight/ underweight (UC)	16.692	13.287	20.969	13.552	10.184	18.034
Unnecessary weight concern and dieting in normal weight/ underweight (UD)	15.374	12.205	19.366	12.827	9.662	17.029
Weight concern and dieting in overweight/obese (HD)	6.809	5.275	8.788	6.073	4.345	8.490
Lack of weight concern, not dieting in overweight/obese (LC)	20.670	16.886	25.148	11.869	8.895	15.839

Reference group: Non-overweight/obese participants with no weight concern or dieting, with BSP accurate.

BSP, body size perception; HD, healthy dieting group; LC, lack of weight concern group; UC, unnecessary weight concern group; UD, unnecessary dieting group.

underweight groups with UC and UD (in tables 2 and 3; higher odds for MD in UC and UD groups).

In both boys and girls, analyses based on BSP overestimation had even larger effects on the associations between all the various weight concern/dieting groups and MD. (table 3).

Interestingly, overweight/obese adolescents with weight concern and dieting had much lower odds for MD (HD group, OR: 6.8, 95% CI 5.3 to 8.8 and 6.1, 95% CI 4.3 to 8.5, boys and girls, respectively) compared with overweight/obese with LC and dieting (LC group, OR: 20.6, 95% CI 16.9 to 25.15 and 11.9, 95% CI 8.9 to 15.8, boys and girls, respectively) (see table 3). Similar association effects were observed in the associations between weight concern /dieting and MD in the normal weight/underweight groups (see results in the UC and UD groups compared with the reference group).

On the other hand, overweight/obese participants with weight concern and dieting (HD group, OR for MD: 6.81) had much lower OR for MD compared with overweight/obese participants with no weight concern or dieting (LC group, OR for MD: 20.61). Interestingly, our analyses revealed similar effects (table 2) or even higher odds (table 3) for MD among boys compared with girls.

## DISCUSSION

### Principal findings

We found strong supporting evidence that being overweight/obese, having weight concern or body size overestimation are all associated with higher odds for MD. We also found supporting evidence that being overweight/obese, body size overestimation, having weight concern and reporting dieting were associated with relatively lower odds for MD in boys and girls. Contrary to our hypothesis that predicted higher risk of MD among girls due to more focus on thinness, we found that boys with BSP overestimation consistently showed greater increases risk than girls. These results were significant in our population, but the low number of participants in each group makes our results less generalisable.

### Comparison with previous studies

Concern about being overweight in overweight individuals has been shown previously to be associated with poor mental health more strongly than the excess weight by itself.<sup>27 28</sup> Both BSP and obesity levels have changed among adolescents over the past decades, although in a multinational study of longitudinal trends in the associations between body size misperception and dieting in adolescents, overweight did not change the dieting trends.<sup>29</sup> Our findings supported this observation in both the overweight/obese and normal weight/underweight groups, providing more evidence as to the relative importance of cognitive aspects of overweight/obesity, that seem to be by themselves, and independent of individual's BMI, associate with MD among adolescents.

While weight and height (BMI) are routinely measures and tracked throughout childhood and adolescence, no routine enquiries are made about adolescents' attitude towards their own weight or body size.<sup>30</sup> This may lead to failure in early identification of vulnerable adolescents who harbour unnecessary concern about their own weight or body size. Likewise, UD may itself lead to adverse physical complications, and should be prevented.

In agreement with a previous report,<sup>31</sup> we found BSP overestimation to be common in our study population. Since body size misperception does not seem to occur due to cognitive or perceptual failures,<sup>32</sup> we propose that inaccuracy in BSP occur due to body-ideals.

As children transit to adolescence, their exposure to body-ideals increases in tandem with the increase in dieting behaviour.<sup>9</sup> In the past few decades, divergent definitions of body-ideals have been emerging.<sup>15 33</sup> While the obesity epidemic has shifted public perception towards normalisation of excess weight, the negative health consequences of obesity remain unchanged.<sup>34</sup> On the other hand, desirability of thinness has risen. According to the CDT, divergent body-ideals may increase psychological discomfort, even among normal weight adolescents and can potentially cause MD, as shown in our study population.

Body size overestimation is associated with poorer mental health which can lead to UD that may, in turn, further jeopardise adolescents' physical well-being.<sup>35–42</sup> Due to this relationship, authors suggest that children and adolescents are asked about their attitudes towards their own body in routine follow-up examinations by paediatricians, community nurses or other health workers.

Compared with their female counterparts, adolescent boys who overestimated their body size quite consistently showed higher odds for MD. In line with previous findings,<sup>6</sup> we found higher male vulnerability to MD across all weight concern/dieting groups. Since weight concern/dieting groups were defined based on BMI, the higher male vulnerability cannot be solely related to individuals' BMI. This higher male vulnerability could not be attributed to male societal body-ideals either, because male body-ideals are less focused on being overtly thin, and more on being muscular.<sup>43–45</sup>

Being overweight/obese puts adolescents in a less favourable social position compared with their peers, and is in itself associated with poorer mental health among adolescents.<sup>46</sup> The observed higher vulnerability to MD among adolescent boys who overestimate their body size, could be a simple reflection of a higher number of overweight/obese boys, that is, an issue of statistical strength. However, the increase in odds for MD was observed across all BMI groups in our population. On the other hand, the general increase in the population mean BMI has also normalised being obese among obese adolescents, which may in effect, lead to less stigma around being overweight/obese, since it becomes easier for the overweight to fit in with their peers.<sup>34 47</sup>



Like in previous studies,<sup>48</sup> the overweight/obese female study participants in our study tended to overestimate their weight and body size.

Dieting was far more prevalent among girls compared with boys in our population, and previous studies have also shown that more overweight girls, compared with boys, correctly identify themselves as 'too heavy'.<sup>34</sup> Furthermore, dieting was shown to be negatively associated with MD in our population.<sup>49</sup> Considering this, we conclude that higher vulnerability to MD among men who overestimate their body size, may be due to lack of a behavioural change such as dieting.

### Strengths and limitations of this study

Our study was performed in a large population-based homogenous population of male and female adolescents, which made our results more generalisable.

Studies combining components of body-image and body dissatisfaction has shown clear methodological advantages in previous association studies between body-image and body dissatisfaction among female adults.<sup>50</sup> We believe that grouping our study population into smaller but more units has been useful in making inferences as to which exposure variable seemed to contribute the greatest to MD.

The population stratification came however at the cost of having much smaller number of participants in some groups. Although results remained consistent and statistically significant across all groups in both genders. The smaller participant numbers in some groups came with the disadvantage of introducing bias in a regression model, and hence made it less possible to make conclusive remarks.

It should also be noted that because of the cross-sectional design of our study, we were unable to make any conclusions on causality between exposures and outcome.

Application of the CDT framework to our findings has offered some theoretical explanation for why societal body-ideals seem to be of greater importance in body-image formation in adolescents. Similarly, CDT has offered some theoretical explanation for higher vulnerability for MD among boys who overestimate their body size.

Our results suggest that inconsistencies in the existing literature on adolescent obesity and its psychological comorbidities, may stem from biased methodological approaches that give greater importance to adolescents' BMI rather than their weight concern or BSP.<sup>28</sup>

### CONCLUSION

Our study points at a few important factors that were consistently associated with MD among our participants. Being overweight, having weight concern even if unnecessary increases the odds for MD among boys and girls. Body size overestimation seems to have a greater impact on MD related to weight concern and dieting among adolescents. Unexpectedly, we found that male adolescents who

overestimate their body size are at a particularly high risk for having MD compared with their female counterparts.

Since societal body-ideals seem to play a greater part in formation of body-image, interventions aimed at reducing the psychological burden of a negative body-image should also focus on changing the societal body-ideals to a set of attainable body-ideals that are population representative. Such changes in societal body-ideals may help adolescents to form a more accurate body-image, which may prevent UC or UD.

A more holistic exploratory approach towards adolescents' body-image and body-ideals, make for a more comprehensive assessment of developmental growth, and may help identify vulnerable adolescents, whom do not necessarily meet the clinical thresholds of current diagnostic categories but nevertheless show higher odds for MD. A change of focus from normalisation of BMI to normalisation of different body size/shapes may improve mental well-being among adolescents with body-image dissatisfaction. Replication of our findings in clinical populations of adolescents with body-image dissatisfaction, may pave the way for improvement in the novel treatment techniques for disorders of feeding and eating, with more attention paid to sex differences in the descriptive phenomenology of weight and body perception.

Dieting seems to associate with better mental well-being in overweight and obese adolescents in our study, which may be a potential area for interventions aimed at promoting health and well-being. Since behavioural changes such as dieting often make fast and short-lived reduction in CD, it is imperative to encourage adolescents to reduce weight by offering them motivational support over longer follow-up periods, where end target is not solely a certain BMI, but overall health of individuals.

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**Patient consent for publication** Not applicable.

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**Data availability statement** Data are available upon reasonable request. Data used in the current study are stored in the HUNT databank. In accordance with Norwegian Data Inspectorate, these data cannot be made publicly available. Data used from The HUNT Study in research projects will be made available upon written request to the HUNT Data Access Committee (hunt@medicine.ntnu.no). The HUNT data access information (available here: <http://www.ntnu.edu/hunt/data>) gives a detailed description of the policy regarding data availability.

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