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Abstract

Overweight men often underestimate their weight status. Here we examine whether underestimation occurs when visually judging the weight status of men and whether exposure to heavier body weights may be a cause of visual underestimation of male weight status. Participants systematically underestimated the weight status of overweight and obese men (Study 1) and participants reporting more frequent exposure to heavy male body weights were most likely to underestimate (Study 2). Experimental exposure to different body weights influenced underestimation of weight status (Study 3). Frequent exposure to heavier body weights may cause visual underestimation of the weight status of overweight men.

Introduction

In recent times there has been an increase in the prevalence of obesity in most of the western world (Swinburn et al., 2011). Although the negative economic and health connotations of obesity are widely discussed (Mason, Moroney & Berne, 2013; Tsai, Williamson & Glick, 2010) large proportions of overweight and obese individuals underestimate their own weight status and think they are of a healthier weight than they actually are (Kovalchik, 2008; Kuchler & Variyam, 2003). The likelihood that an overweight or obese person underestimates their weight status is significantly higher among men than in women (Kuchler & Variyam, 2003; Madrigal et al., 2000). A recent meta-analysis also demonstrated that parents underestimate their overweight or obese child's weight (Parry et al., 2008) and it has also been shown that clinicians may be poor at visually recognising obesity in children (Smith, Gately & Rudolf, 2008). Parental underestimation of child weight has been shown to be more pronounced for male children (Jeffery et al., 2005).

Studies show that individuals who underestimate their own weight status may be less motivated to control their body weight (Duncan et al., 2011; Kuchler & Variyam, 2003). Likewise, a tendency to underestimate weight status in others may have public health relevance, as parents (Golan, 2011) and healthcare professionals (Spurrier, Magarey & Wong, 2006) are important agents of change in terms of motivating healthier behaviour in others. Thus, it is important to understand the underlying causes of weight status misperceptions. Although much research has examined weight misperceptions of one's own weight status and amongst parents (Jeffery et al., 2005; Kuchler & Variyam 2003, Parry et al., 2008) such underestimations may be influenced by self-serving biases (Jansen et al., 2006). Moreover, we are not aware of any research that has systematically studied visual weight status misperceptions. Here we examine visual perception of weight status in others.

It is possible that weight status misperceptions have been caused by the increased prevalence of obesity. Burke, Heiland & Nadler (2010) compared national obesity rates and self-perceptions of weight status across a ten year period from 1994 to 2004. Although obesity increased in this time frame, less people identified themselves as being overweight or obese in 2004 than 1994. Overweight and obese children with obese parents or schoolmates have also been shown to be more likely to underestimate their weight status than those with mostly thin social contacts (Ali, Amialchuk & Renna, 2011; Maximova et al., 2008). Similarly, exposing participants to heavier body weights increases the likelihood that participants agree an overweight man's weight looks healthy (Robinson & Kirkham, 2013).

A novel hypothesis based on these findings is that visual perceptions of what constitutes a normal or healthy weight have been recalibrated as a consequence of exposure to heavier body weights. Over time, increasing exposure to obesity may have caused individuals to adjust their visual ‘anchor’ of what constitutes a normal weight (Epley & Gilovich, 2006) which in turn may cause heavier body weights to appear more normal and not be classed as overweight (Johnson, Cooke, Croker, & Wardle, 2008; Robinson & Kirkham, 2014). Thus, a currently untested hypothesis is that recent increases in the prevalence of adiposity may have resulted in people adjusting their visual perceptions of what different weight statuses look like.

The aims of this work were to examine whether people visually underestimate the weight status of men with overweight and obesity and to test whether exposure to heavy body weights may be a mechanism causing visual weight status misperceptions. Given that weight status misperceptions seem to be particularly pronounced amongst men (Kuchler & Variyam, 2003; Madrigal et al., 2000) and a large proportion of men are now overweight (Flegal et al., 2011), we concentrated on visual perceptions of male weight in all studies. Study 1 examined whether a large, self-selected sample of UK participants were able to visually identify healthy weight, overweight and obese men. Study 2 tested whether frequent exposure to heavier body weights is associated with an increased likelihood to visually underestimate weight status. Study 3 built on these findings and examined whether experimentally exposing participants to different body weights impacts on weight status misperceptions. We hypothesised that participants would underestimate the weight status of overweight and obese males and that this tendency to underestimate may be explained by exposure to heavier body weights adjusting visual perception.

STUDY ONE

Method

Participants

A total of 1660 participants registered interest in an online study by accessing a study website. Of these participants, 660 were excluded from final analyses for registering initial interest but then not completing the study (531) or for using a mobile phone to complete the study (129), as participants were advised not to complete the study on a mobile phone in order to keep image sizes constant. Participants were recruited via social media and through online bulletins and announcements made to staff at a large UK university. The advertisements stated participants were being invited to take part in a short study which would examine their ability to accurately recognise and categorise different weight statuses. In order to recruit a large and representative sample, no eligibility criteria were set in terms of age. The final sample of 1000 participants' age ranged from 18 to 75 years (M = 34.95 SD = 12.50). The samples (698 women and 302 men) mean body mass index (BMI) fell inside the overweight range (25.57, SD = 7.96, calculated from self-reported weight/height2). The majority of participants were Caucasian (83%). The study was approved by the authors' institutional ethics board (as were Studies 2 and 3).

Stimuli

The stimuli consisted of 15 photographs of Caucasian men aged 18-30 with varying BMI's [BMI was calculated from measured weight (kg)/height^2 (m)]. There were five healthy weight (M BMI = 21.24, Range 19.38 - 22.40), five overweight (M = 27.23, Range = 25.65 - 28.25) and five obese (M = 31.60, Range = 30.49 - 34.32) men. The age range of photographed men was 18-30 to ensure a similar age range across the three weight statuses. We used full length photos of men with their arms at their sides wearing normal fitting short sleeved t-shirts and full length trousers. The men were dressed in order to mimic the way in which people are exposed to different body weights in everyday life. For each male two photographs were displayed; one stood front on and one side on, both next to a standardised door frame. None of the men photographed had muscular builds (according to body composition) as high muscle mass can confound BMI. In order to control for facial expression, the central section of each subjects face was obscured. We conducted a pilot study with 50 participants who rated the initial stimulus set on a number of scales including age, attractiveness, height, how muscular they appeared and tightness of clothing in order to select healthy weight, overweight and obese photograph sets matched for these variables. See Figure 1 for an example image.

Figure 1. Sample photograph from overweight range (BMI = 27)

Procedure

After providing consent, participants completed demographic information (gender, age, weight and height). They were then told they would view five photographs and be asked to make judgements about each one. Next participants were provided with World Health Organisation (WHO) BMI guidelines for underweight (< 18.5), healthy weight (18.5-24.9) overweight (25.0-29.9) and obese (≥ 30) weight statuses. Each participant was then randomly assigned (using an online pseudorandom number generator) to view five of the fifteen photographs consecutively on individual pages All but one participant saw males from at least two of the three different weight categories. Participants were asked to indicate the weight category they thought each male fell into and were also asked on a five-point Likert type scale (strongly agree to strongly disagree) whether or not they thought each male should 'consider losing weight'. Participants were then given feedback on how accurate they were and debriefed.

Analysis

Accuracy rates were determined for each photograph by calculating how many people correctly identified the weight status of the photographed male. Accuracy rates were then aggregated across the five photographs of each weight status resulting in overall accuracy scores for the healthy weight, overweight and obese photos. We examined overall accuracy in order to determine whether participants were performing at an above chance level using a 2x1 chi square (chance level = 25% accuracy). Chi squares were also used to determine whether accuracy rates differed according to the weight status of the photographed male and whether weight status misperceptions tended to be caused by under- or overestimation.

Results

Accuracy of Weight Status Judgements

Across all photographs participants accurately categorised men as being the correct weight status 42.5% of the time, which is significantly higher than chance [$X^2(1, N = 5000) = 816.67$, $p < .001$]. We then tested whether accuracy was affected by photograph weight status using a 2 X 3 Chi Square (*accuracy:* correct or incorrect and *weight status of photographs*: healthy weight, overweight or obese). Participants were significantly less accurate when the photos were obese (13%) or overweight (38%), as opposed to when they were a healthy weight (76%), [$X^2(2, N = 5000) = 1368.46$, $p < .001$]. See Table 1. Thus, participants miscategorised weight status and this was particularly pronounced when judging the weight status of the overweight and obese. We also tested whether participant characteristics were associated with greater visual categorisation accuracy and found that participant weight status (*accuracy:* correct or incorrect and *weight status of participant*: underweight, healthy weight, overweight or obese) [$X^2(3, N = 4805) = .678$, p = .878] and gender *(accuracy:* correct or incorrect and *gender of participant*: male or female) [$X^2(1, N = 5000) = 1.59$, p = .207] did not significantly affect overall accuracy, indicating that the ability to visually recognise weight status was similar regardless of participant weight or gender. A total of 39 participants failed to provide information about their height or weight and so were excluded from analyses which examined the impact of participant body weight on visual perceptions.

Table 1

Number of accurate and inaccurate weight status categorisations according to the weight status of the male model being judged for Study 1

	N	Accurate Responses (%)	Inaccurate Responses (%)
Healthy Weight	1687	1280 (75.9)	407 (24.1)
Overweight	1646	625 (38.0)	1021 (62.0)
Obese	1667	220 (13.2)	1447 (86.8)

Underestimating weight status

We examined whether trials in which participants failed to correctly identify weight status were more likely to be due to under- or over estimation of weight status. Responses from the obese photos were excluded from this analysis as the highest weight category participants could select was obese. If there was no tendency to under or overestimate weight status, then underestimation and overestimation would occur 50%

of the time for incorrect trials. Participants were more likely to underestimate than overestimate weight status [X^2(1, N = 1428) = 1345.24, $p < .001$]; 98.5% of the time participants were wrong it was due to them underestimating weight status, whilst overestimation only occurred 1.5% of the time. A 2 x 2 Chi Square (*cause of error:* underestimation or overestimation and *weight status of photographs*: healthy weight or overweight) indicated that this systematic tendency to underestimate increased with weight status, [X^2(1, N = 1428) = 28.77, $p < .001$], whereby underestimation was more pronounced for overweight men than healthy weight men. See Table 2.

Table 2

Number of over- and underestimations of weight status according to the weight status of male being judged for Study 1

	N	Overestimate (%)	Underestimate (%)
Healthy Weight	407	17 (4.2)	390 (95.8)
Overweight	1021	4 (0.4)	1017 (99.6)

Conclusions

Participants were poor at visually identifying the weight status of men. This was due to a systematic tendency to underestimate weight status and this increased with the size of the individual being judged, resulting in participants judging overweight and obese men as being of healthier weight statuses than they actually were. Study 2 was designed to test whether this tendency to underestimate weight status may be explained by exposure to heavier body weights. If exposure to heavier body weights is partially responsible for visual underestimation of weight status, then individuals with heavier male peers should be particularly likely to underestimate the weight status of other men.

STUDY TWO

Method

Participants

A total of 100 undergraduate students from a UK university completed a short paper-based questionnaire in exchange for course credit; 10 participants were excluded from analyses as they provided incomplete questionnaire responses. Participant age ranged from 18 to 45 years (M age = 20.19 years, SD = 3.76). The samples' (80 women and 10 men) mean BMI was in the healthy weight range [21.85, SD = 4.15, calculated from self-reported weight (kg)/height2 (m)]. We powered the study to detect a medium-sized correlation between our variables of interest at 80 per cent power (using G*Power software). We recruited slightly above this number to account for any participants providing incomplete data.

Procedure

After providing demographic information participants were shown a photograph of an overweight male (BMI = 26.96) and were asked to indicate on a 10cm Visual Analogue Scale (anchors: far lighter-far heavier) how the male's weight compared to other young men they spent time with (size of peers) and how the males weight compared to other young men in general (size of non-specific others). Both of these measures were self-devised for this study. We measured both frequency of exposure to heavier body weights (size of peers) and perceptions of men in general, so we could control for the latter in analysis. In order to distract from the aims of the study participants also completed some short questionnaire measures about attitudes to overweight and obese individuals. Participants were then given the same BMI information as in Study 1 and were asked to categorise the weight status and estimate the BMI of five overweight and five obese photographed men (see Study 1). The photographs were shown on separate pages. The order in which they were presented was randomly assigned and the same for each participant. We only included overweight and obese men, as it were these weight statuses which participants were most likely to underestimate in Study 1.

Analysis

To construct a sensitive measure of degree of underestimation, BMI estimates were converted into relative error scores by calculating how much participant BMI estimates differed from the actual BMI of the male in each photograph. These were then averaged to provide an average error score for all ten photographs, which reflected a participant's tendency to underestimate or overestimate weight. A negative score indicated underestimation, a positive score indicated overestimation and zero indicated perfect accuracy. Forced entry regression analysis was planned to examine whether size of peers (independent predictor variable) predicted BMI error scores (dependent variable), while accounting for size of non-specific others (other independent variable) in the same model.[1]

Results

Participants were poor at identifying weight status. On average, participants underestimated weight status for 8.46 (SD = 1.84) of the ten photographs, with an average underestimation of -4.98 BMI points (SD = 1.77). There was variability in responses to the size of peers measure (range = 2.60–9.60 on the 10-cm scale, M = 5.28, SD = 1.07) and in the size of nonspecific others measure (range = 2.50–6.90, M = 4.75, SD = .88). The overall regression model was significant F (2, 87) = 4.57, p = .013, R^2 adjusted = .074). Size of peers was significantly related to overall BMI error [t = -2.92, p = .004, β = .303). For each 1 SD increase in size of peers, total error scores increased by -.303 (95% confidence interval (CI) = .161 and .844], indicating that having larger peers is associated with greater underestimation of BMI. Size of non-specific others was not associated with BMI estimation error (*t* = .23, p = .820, β = .024). There was no evidence of multi-collinearity being high in the model (both variance inflation factors <1.5).

We also examined whether participant characteristics were associated with BMI estimation error. Gender [t (88) =.166, p=.869] and participant BMI [r (89)=.022, p=.836] were not associated with overall error, but age was [r (89)=.245, p=.021]. Given that age was associated with BMI estimation error, we examined whether including age in the aforementioned regression model impacted on the relationship between size of peers and BMI estimation error. Controlling for age in the regression model did not affect the significant relationship between size of peers and BMI estimation error (t=3.192, p=.002, β=.320).

Conclusions

Whether a participant had heavier male peers was associated with an increased visual underestimation of weight status of overweight and obese men, although the percentage of explained variance was relatively small (7.4%). We predicted this effect would occur due to a greater visual exposure to heavier body weights. In Study 3, we tested this proposition experimentally.

STUDY THREE

In study 3, participants were exposed to images of either obese or healthy weight men or neutral objects (eg. sofa, clothes) and were then asked to judge the weight status of an overweight man. This paradigm was adopted from Robinson and Kirkham (2013). We hypothesised that if exposure to heavier body weights/obesity is responsible for visual underestimation, then exposing participants to images of leaner healthy weight individuals may reduce underestimation.

Method

Participants

230 US participants (92 women and 138 men) were recruited to take part in an online study via Amazon Mechanical Turk. Mechanical Turk is an online platform where 'workers' complete online tasks for a small cash sum. Participants were told they would be taking part in a 10 minute, mood and perception survey. Sample size was calculated based on detecting a medium sized effect between conditions at 90% power with a $p < .05$. The samples mean BMI fell inside the overweight range [27.7, SD = 6.91, calculated from self-reported weight (kg) /height^2 (m)]. There was variability in terms of participant BMI (range = 16.03-65.91) with participants falling in to underweight

(1.7%), healthy weight (37.4%), overweight (30.4%) and obese (29.5%) categories. Participant age ranged from 18-79 (Mean = 34.52, SD = 11.54).

Procedure

After providing consent, participants were randomly assigned (via the randomisation feature on Qualtrics) to one of three conditions. They either saw ten photographs of obese men (obese exposure, 78 participants), healthy weight men (healthy weight exposure, 77 participants) or neutral objects (control, 75 participants). The same image set was used as in Studies 1 and 2. For the first ten photographs participants were asked to make a non-weight related judgement (e.g. 'This man looks approachable' or 'This teapot looks cheap' for control condition). All participants were then shown an overweight male (BMI = 27) and indicated whether they thought he was underweight, healthy weight, overweight or obese (as in study 1). They were then asked to provide their own age, ethnicity and weight and height information (in their preferred unit of measurements). Participants were then asked what they thought the aims of the study were and debriefed.

Analysis

A 3x2 Chi Square analysis was planned in order to compare whether exposure type (healthy weight, obese, control images) impacted on accurate identification (accurate or inaccurate) of weight status. If a main effect of condition was observed we planned individual Bonferroni corrected 2x2 Chi Squares to examine differences between the exposure conditions.

Results

No participants guessed the true aim of the experiment (that exposure to obese vs healthy weight men would impact on weight status judgements about an overweight male). Conditions were balanced for age, gender and BMI (All $p > .05$). There was a significant effect of exposure condition on weight status categorisation of the overweight male [$X^2(2, N = 230) = 31.44, p < .001$]; 79.5% in the obese exposure condition underestimated his weight status compared to 73.3% in the control and 40.3% in the healthy weight exposure condition (See Table 3). Participants in the healthy weight exposure condition were less likely to underestimate weight than those in the obese exposure condition [$X^2(1, N = 155) = 26.64, p < .001$] and control condition [$X^2(1, N = 152) = 16.92, p < .001$]. The obese exposure and control conditions did not differ [$X^2(1, N = 153) = 1.20, p = .822$]. Participant weight status [X^2 (3, N = 227) = 3.195 p = .362) and gender [X^2 (1, N = 230) = .013, p = .910] had no effect on accuracy.

Table 3

Number of accurate and inaccurate weight status categorisations according to the condition for Study 3

Condition	N	Accurate Responses (%)	Inaccurate Responses (%)
Healthy Weight	77	46 (59.7)	31 (40.3)
Obese	78	15 (19.2)	63 (80.8)
Control	75	20 (26.7)	55 (73.3)

Conclusions

Exposing participants to healthy weight men reduced the likelihood that participants underestimated the weight status of an overweight male, in comparison to when participants were exposed to obese men or neutral objects. Exposure to leaner men may have altered visual perceptions of what a ‘normal’ male body weight looks like (i.e. slimmer) which in turn reduced underestimation of male weight.

GENERAL DISCUSSION

The present studies examined whether individuals are able to visually identify overweight and obesity in men and whether exposure to heavier body weights may explain visual weight status misperceptions. In Study 1, we found that people were poor at accurately recognising the weight status of men. This inaccuracy was characterised by a systematic tendency to underestimate weight status, which resulted in overweight and obese men being perceived as being of healthier weight statuses than they actually were. In Study 2 we found that participants with heavier male friends were more likely to underestimate the weight status of overweight and obese men, suggesting that more frequent exposure to heavier body weights may cause visual underestimation of weight status. This hypothesis was then tested experimentally in Study 3 and we found that exposing participants to images of healthy weight or obese men impacted on their ability to accurately categorise weight status.

The present findings indicate that exposure to obesity may result in visual weight misperceptions, whereby overweight and obese individuals appear as being a healthier weight status than they are. One possible explanation of these findings is that exposure to heavier body weights adjusts or produces an upwards shift to visual perceptions of what a ‘normal’ body weight looks like (Robinson and Kirkham, 2013). Thus, when we are frequently exposed to obesity, overweight and obese individuals may subsequently fall into what we perceive as being the ‘normal’ body weight range and are not perceived as being overweight. The finding that participants in Study 1 systematically underestimated weight status supports this. Study 3 also provides support for this interpretation; underestimation of weight status was reduced by exposing participants to healthy weight men, which may have produced a downward shift to visual perceptions of what a normal male body size looks like.

Although much research has examined personal underestimation of weight status (Kovalchik, 2008; Kuchler & Variyam, 2003), less research has examined perceptions of other peoples' weight status (although see Vartanian et al. (2004)). As weight misperceptions about one's own weight (and one's child) could be motivated by self-serving bias (Jansen et al., 2006), the present work makes a novel contribution by studying *visual* weight status misperception in others. Our findings suggest that a significant proportion of the population may not know what male overweight and obese body weights now look like. The findings of the present work also have similarities to research on personal weight misperceptions. For example, in Study 1 underestimation was particularly likely when judging overweight and obese individuals and personal weight status misperceptions occur most commonly in the overweight and obese (Kovalchik, 2008; Kuchler & Variyam, 2003). Similarly, Studies 2 and 3 suggested a social exposure component to visual weight status underestimations and some epidemiological research has hinted this may be important in explaining personal weight status misperceptions (Ali et al., 2011; Burke et al., 2010; Maximova et al., 2008). Further work directly examining whether distorted visual perception of body weight underlies personal weight status misperceptions would now be of interest.

Turning to the findings of Study 3, participants exposed to obese men did not differ to a control condition in terms of their later weight categorisation accuracy. This may be because participants (from the US) were already used to seeing heavier body weights in everyday life, so further exposure had little effect. However, exposure to healthy weight men did reduce weight status underestimation. This may imply that repeated exposure to information about what different weight statuses look like may reduce underestimation of weight status. Given that the identification of adiposity is critical to intervention (Kuchler & Variyam, 2003; Duncan et al., 2011) these findings could have applied relevance.

Strengths and Future Work

Strengths of the present research were that we used different methods across three studies, with both observational and experimental data supporting our hypotheses. Due to the aims of the present studies we focused on male visual weight status judgments. How these findings relate to female weight status perceptions now warrants investigation, as there may be different social standards regarding weight status for men and women (Miller & Lundgren, 2011). One other limitation of the current research was the use of photographs throughout all studies. We used front and side on pictures but future research could aim to replicate these findings using video footage as opposed to static images. Replicating the present studies in more diverse populations would be informative and enable us to understand whether the general public know what ‘healthy’ and ‘unhealthy’ weight statuses look like and if correcting visual misperceptions could help improve the identification of, and intervention efforts against, obesity.

Conclusions

The findings of the present studies suggest that individuals are poor at visually identifying overweight and obesity in men and systematically underestimate weight status. A causal mechanism explaining this effect may be exposure to obesity adjusting visual perceptions of body weight.

Notes

[1]We also examined whether the same pattern of results was observed when using number of times participants underestimated weight status as the main outcome variable, as well as analyses for underestimation of BMI in overweight and obese photographs separately. Regardless of the analysis method used, size of peers significantly predicted underestimation.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Supplementary Material

Data sets for all three studies are available on request. Please contact the corresponding author.

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