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## Weight “locus of control” and weight management in an urban population

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### ABSTRACT

**Background:** To assess the extent to which weight locus of control (WLOC) relates to BMI and socioeconomic status in an urban population.

**Methods:** Two hundred and thirty-two people responded to a questionnaire relating to body weight, health, weight management, and the “WLOC.” Questionnaires were sent to a sample of 2,600 people in Sheffield, United Kingdom. The questionnaires were distributed into diverse “ward” areas; data were collected in 2016.

**Results:** In the present investigation, body mass index (BMI) correlated with ward area ( $p < 0.001$ ) (BMI was  $27.5 \text{ kg/m}^2 \pm 6.8$  in ward area 1 versus  $23.6 \text{ kg/m}^2 \pm 4.1$  in ward area 4). The higher an individual’s BMI, the more “external” they were in relation to their perception of factors affecting weight control ( $p = 0.024$ ). Higher status occupation was correlated with a greater likelihood of having an internal WLOC ( $p = 0.004$ ). Having a high BMI was correlated with a concern over health ( $p = 0.041$ ).

**Conclusions:** People of higher weight and lower occupational status have more external loci of control. Key theoretical and clinical approaches to behavior change (e.g., Self-Determination Theory and Motivational Interviewing) suggest that “internality” is a desirable locus of control orientation. Consideration of the findings from the present investigation concludes that for weight management practice, professionals could focus on developing “internality.”

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### Introduction

Body mass index (BMI) and specifically “obese” ( $\geq 30 \text{ kg}\cdot\text{m}^2$ ) BMI categories are inextricably linked to health [1]. The situation is complex as BMI alone does not necessarily denote the level of body fat; however, high BMI levels amongst the western population almost certainly are not explained by high lean tissue values [2]. Clarity over the specific behaviors relating to morbidity and mortality clearly need to be understood, with some commentators suggesting that BMI is not a causative factor of ill health but rather serves as a proxy indicator of poor diet and low levels of physical activity [3]. Yet the link between BMI and poor health including all-cause mortality persists and estimates of obesity suggest 2.1 billion adults worldwide are overweight or obese [4]. Despite the existing high levels of obesity in the developed world, some individuals remain lean and maintain

leanness throughout adult life. The present paper seeks to understand the perception of control people have in socio-economically diverse urban locations in relation to weight management.

Locus of control (LOC) first identified by Rotter [5] relates to the extent to which an individual feels control in a given domain of their life, this sense of control can be broadly either “externally” or “internally” focused. Early confusion over whether LOC is more or less internal in obese subjects [6] may have been confounded by that fact that LOC may be domain specific—i.e., we may have differing levels of internality and externality to different aspects of life. For example, a feeling of internal control in relation to personal finances and an external sense of control for an ability to eat healthily. In support of this point, Stotland and Zuroff [7] argued that the general LOC scale is too broad to investigate specific dynamics involved with weight loss and that a

more specific scale would allow the study of an individual's perception of their ability to lose and control their body weight. The concept of LOC has been applied to bodyweight in the weight locus of control (WLOC) scale [7,8]. The WLOC scale, according to Elfhag and Rossner [9], predicts that internally orientated individuals are more likely to feel in control of their weight; however, externally orientated individuals are more likely to believe that their weight is being influenced by factors outside their control, with more influence from significant others or the society in which they live, for example. Despite the development of a measure to identify the specific domain of bodyweight, research often uses the broader Health LOC [10] for studies carried out on weight management.

Holt et al. [11] suggest that individuals with an internal WLOC orientation are more likely to seek information regarding weight loss, review this information, and incorporate learning into their weight loss efforts. Holt et al.'s [11] study suggests participants with an internal LOC orientation generated more positive thoughts compared to those with external orientations. Internality was also correlated with an individual's perceived readiness to attend a weight management intervention.

Theoretically, under the circumstances of experiencing a repeated sense of low internal control, an individual may develop learned helplessness, essentially, the result would be the belief that the individuals own actions do not make a difference and that control over what happens to that individual is highly external e.g., influenced by God, the government, or other powerful external forces rather than influenced by the self. The opposite, therefore, may also be true in an individual who experiences success at achieving results through self-effort and control formed from their own actions i.e., this individual may experience a learned sense of internal control. An argument exists, therefore, to suggest affirmation of an individual's strengths and competencies, and efforts to build a sense of internal control are warranted as it may help build self-determination. These concepts fit with self-determination theory (SDT) [12] and the clinical approach of motivational interviewing [13].

WLOC is concerned with success in losing weight and maintaining weight loss; with internally orientated individuals suggested as more likely to maintain weight loss and externally focused individuals more likely to regain lost weight [14]. Weight and socio-economic status have been linked previously in the UK [15] with the suggestion being that the

lower an individual's socio-economic status the more likely they are to be overweight or obese. Previous work has sought to examine the relationship between LOC and exercise and weight control [17] making significant contributions to the understanding of LOC in specific groups (weight loss participants, for example) this, however, has been done with relatively small samples. The present study seeks to examine a relationship between BMI and LOC in a stratified sample from the region of Sheffield in South Yorkshire in the United Kingdom. Our hypothesis was that ward areas signifying lower socio-economic class (SEC) would have both higher BMI levels and a more externally focused LOC when compared to areas of higher SEC.

Sheffield is the fourth largest city in the UK and is divided into different areas known as wards, the ward areas are associated with SEC and other domains such as access to shopping facilities and green spaces. The prevalence of overweight and obesity in adults in Sheffield is similar to the national average. In 2014, 65% of men and 58% of women were overweight or obese in England [18]. In Sheffield, in 2012, 24.9% of residents were classed as obese and 59.9% of adults were predicted to be overweight in 2015. Obesity-related spending within Sheffield was estimated as exceeding £95.9 million in 2015, highlighting the importance and value of further study into factors influencing obesity [19].

Interventions aimed at tackling overweight are criticized for being overly focused on the bio-medical issues involved and on giving education and information and not so much on the essential behavioral aspects of overweight/obesity [20]. From an efficacy point of view, there is a limited success of weight management interventions with mild weight loss sustained long-term in around 20% of participants considered successful [21], the present investigation aims to fill a gap in understanding correlates of weight and LOC. Essentially, we wanted to clarify whether an individual's weight increase was related to a LOC which was more external.

### **Methodology**

We distributed a questionnaire across ward areas separated into four quartiles. These areas represent areas of greater and lesser affluence in accordance with city council's stratification of ward area. The questionnaire was delivered by three methods: 1) a flyer which had the option of accessing the questionnaire online via either a Universal Resource Locator (URL) link or a Quick Response (QR) code accessed

by a smart device, 2) a postal questionnaire with an addressed paid return envelope included, and 3) a URL link to the online version of the questionnaire sent via social media. A total number of 2,200 households and 400 individuals were targeted via the three methods combined.

### **Recruitment processes**

Participant recruitment was completed at three separate levels; initially, leaflets were distributed to 2,200 households. Secondly, a post was made on the researcher's personal social media page to 200 people (primary contacts only) and finally, 200 postal questionnaires were distributed.

### **Recruitment one: Leaflet distribution sampling**

The targeted electoral wards within Sheffield were separated into four levels; quartile 1 was the lowest SEC ward consisting of wards from 0% to 24.9%, quartile 2 consisted of mid-low SEC wards from 25% to 49.9%, quartile 3 consisted of wards of mid-high SEC from 50% to 74.9%, and finally, quartile 4 contained the highest SEC wards from 75% to 100%. For statistical analysis and presentation of findings, these quartile ranges were analyzed for comparison.

All electoral wards within Sheffield were numbered and included for possible selection; an individual not involved in the present investigation randomly selected two numbers from each quartile, corresponding electoral wards were identified, providing sampling areas. This method of area framing to cluster target populations has been utilized previously [22–24].

### **Leaflet distribution**

Once identified, using an online map service, all street names in a sampling area were numbered, these numbers were entered into a random number generator to select 15 streets to be identified, and placed into order for questionnaire delivery.

A total of 2,200 leaflets were distributed by hand to selected streets, leaflets were distributed unequally between quartiles. Quartile 1 received 800 leaflets, quartiles 2 and 3 received 550 leaflets, respectively and quartile 4 received 300 leaflets. This stratification has been adjusted from previous research where a representative sample was successfully obtained by issuing greater proportions of marketing materials to individuals residing within a lower SEC area due to an increased likelihood of non-response [25].

Following identification, randomization, and ordering of streets, researchers distributed leaflets using a skip interval method of visiting two houses and missing every third property. This interval was adapted from previously published methodologies [26,27]. This interval continued within selected streets until houses had been exhausted before moving to the next designated street. This process continued within each ward until all leaflets had been distributed.

The skip interval was not utilized in instances where access was limited (no visible post box, for example) or presence of a dog, or notification for no leaflets or junk mail, maintaining Sheffield Hallam University safety and best practice regulations.

### **Leaflet design**

Distributed leaflets were designed in line with previous research regarding gaining a maximum response rate and effective postal questionnaire design [30,31]. As a result, leaflets included the Sheffield Hallam University emblem were printed one sided in color on A5 paper and provided information in a clear and concise manner.

Leaflets invited individuals to complete the online questionnaire by providing a web address for an internet-enabled device or computer. A further option allowed individuals to scan a QR code using a compatible device. The QR code directed individuals to the same online questionnaire as the URL link. QR codes are similar to barcodes and are simple and effective ways to distribute information [31]. Modern day smartphone ownership has increased even amongst those within low SEC areas, alongside increased QR code exposure [30]; their ease, speed of use, and cost-effectiveness influenced and justified their inclusion in the present investigation.

Leaflets also provided individuals with a URL link to a webpage designed to disseminate results following research completion. This webpage provided contact details for the first author alongside detailed information regarding the nature of the study. Following the final statistical analysis, this webpage was updated to disseminate the results. All data were reported as mean values to maintain individual level anonymity.

### **Questionnaire detail**

Individuals were asked to relate to the last 6 months when responding to questions regarding weight loss efforts and any conversations regarding their

bodyweight with primary care providers. Previous research has utilized a 12-month recall period which may allow longer-term trends to be identified; however, to minimize recall bias and to identify more recent trends, a 6-month timeframe was considered most appropriate [33]. Where relevant individuals were asked what strategies had been used to assist in weight loss, response options were provided to individuals based on previous findings identifying common weight loss practices [34].

The questionnaire aimed to investigate WLOC orientations. Individuals were asked to rate their level of agreement regarding the four statements included in the WLOC scale. This scale utilizes a six-point numbered Likert scale anchored with strongly disagree (1) to the left and strongly agree (6) to the right. An individual's WLOC orientation is the combined total of each rating. The scale is scored in the external direction with internally worded statements reverse scored, possible scores range from 4 to 24 [8]. Individuals with scores of 4 are considered extremely internal, whilst individuals with scores of 24 are considered extremely external. In a similar manner to the work of Elison and Ciftci [34], we did not place individuals into internal or external categories, instead, data were considered using the scale to determine the degree to which an individual may be considered internal or external. The internal validity of the WLOC scale has been questioned due to its length; however, previous research has indicated that it is a validated measure into LOC orientations surrounding weight management [36].

Self-report of height and weight could be made in either metric or imperial units which were then transferred into metric units by the authors. This method has been demonstrated as helpful in gaining accurate data [37,38].

A single question from the general well-being scale was included, asking participants to rate how concerned they had been regarding their health in the last 6 months. A numbered Likert scale was provided anchored with very concerned (1) to the left and not at all concerned (6) to the right. Including individual and amended questions from this scale have been utilized previously [39].

#### **Recruitment two: Social media**

Following leaflet distribution, the second named author posted directly onto their social media profile asking for contacts (residents of Sheffield only) to complete an online based questionnaire. The post provided a link to the online questionnaire and was

accessible to 200 contacts. The link was not shared outside the immediate contacts of the researcher.

The use of social media recruitment e.g., Facebook within research has grown in recent years, most commonly used by advertisers and specialized groups to target specific populations [40,41].

#### **Recruitment three: Postal questionnaire**

Two hundred postal questionnaires were issued to residents with a Sheffield postcode of S6, corresponding to 100 individuals residing within quartile 1 and 100 in quartile 2. Although the postal questionnaire was identical to the online version, it was also accompanied by a covering letter explaining the study as well as providing contact details for the first named author.

This recruitment method allowed us to compare the response rate of the flyer containing a URL link and QR code versus a pen and paper response. The 200 individual households who received a questionnaire were obtained by random selection from the Sheffield Residential Phone Book. The use of the phone book to provide a random sample has been adapted from previous research regarding random digit dialing and is regarded as a valid process to provide a random sample from a specific area [42–44].

Postal questionnaire cover letters were personalized to each recipient in a hand-written manner, for example, "Dear M. Smith" residential addresses were also hand-written, and questionnaires contained a pre-paid return envelope addressed to researchers involved in the study. Previous research regarding response rates highlights that these practices are part of the effective questionnaire design and distribution [40].

#### **Statistical analysis**

Prior to statistical analysis, data were cleaned with responses originating outside of the Sheffield electoral area and incomplete responses not included in the final analysis. Weight and height were converted to the metric system where necessary. BMI was calculated using the formula:  $\text{Weight (kg)}/\text{Height}^2 \text{ (m)}$ . As per the original WLOC scale [8], internally worded questions, one and four, were reverse scored, the sum of each statement was totaled and recorded for statistical analysis. Respondent's postcodes were cross-referenced to ward areas and identified within the indices of deprivation to identify their quartile [19]. An individual's profession was classified with reference to SOC2010 classification, this has been used within

previous research, and ranges from long-term unemployed or never worked to higher managerial professions [22,23].

Responses from each recruitment modality were collated and analyzed using a multiple linear regression with WLOC score inputted as the dependent variable and BMI, ward area, gender, the perception of worry around health, having had a conversation with a healthcare practitioner about weight, taking action to control weight, and occupation classification as independent variables.

All statistical analysis was completed using IBM SPSS statistics version 24.0 (IBM, USA). Alpha was set at ( $p < 0.05$ ). Reliability analysis shows that within respondents of the current study, the WLOC scale had a Cronbach Alpha score of 0.503. The original WLOC scale reported a Cronbach Alpha score of 0.56, due to the number of statements within the WLOC scale, this score was considered acceptable [8].

We wanted to know whether a stratified sample of Sheffield residents from differing ward areas would show:

1. An internal or external LOC based on ward area.
2. Whether, locally, BMI and WLOC are correlated.
3. Are obese people more or less likely to be taking action in relation to their weight?
4. What percentage of low versus high bodyweight individuals have spoken to their healthcare provider in the last 6 months about their bodyweight?
5. What if any interaction occurs between gender and WLOC/action to control body weight and contact with a healthcare provider?
6. To what extent does BMI relate to an individual's perceived state of "healthiness"

## Results

### **WLOC multiple linear regression**

WLOC was not correlated with ward area ( $p = 0.125$ ) taking action within the last 6 months around weight ( $p = 0.473$ ) or talking to a primary healthcare professional within the last 6 months ( $p = 0.067$ ). WLOC is positively correlated with BMI ( $p = 0.024$ ) occupation ( $p = 0.004$ ) and perceived worry about health ( $p = 0.041$ ). 31.5% of the entire sample had attempted to lose weight in the last 6 months, 62.3% of the sample were overweight or obese.

### **BMI multiple linear regression**

Multiple linear regression analysis indicates an interaction between ward area and BMI showing ward area to be negatively correlated with BMI ( $p < 0.001$ ) indicating higher BMI in "lower" status ward areas. BMI is also positively correlated with whether the participant had spoken with a healthcare professional about their weight in the last 6 months ( $p < 0.001$ ), indicating higher BMI individuals as more likely to talk to healthcare professionals more often and that their WLOC ( $p = 0.024$ ) is more "external." Feelings of concern over health ( $p < 0.001$ ) are also greater in the high BMI individuals and higher BMI subjects are more likely to be acting to control weight during the last 6 months ( $p < 0.001$ ).

Results summary:

1. Obese people were much more likely to be taking action in relation to controlling their weight ( $p < 0.001$ )
2. High BMI individuals were more likely to have spoken to their healthcare provider about their weight in the last 6 months ( $p < 0.001$ )
3. Gender did not correlate with WLOC, action to tackle weight, the perception of health, or BMI ( $p > 0.05$ )
4. Higher weight individuals had more concern over their weight than the healthy BMI individuals ( $p = 0.001$ )

WLOC score did not appear to predict whether people were taking action in relation to controlling weight in the last 6 months; despite more people taking action (151 taking action versus 81 not) the mean value for WLOC ( $9.04 \pm 3.38$  versus  $8.98 \pm 3.31$ ) did not differ  $p = 0.880$ .

## Discussion

Table 3 shows that the responses through the QR code or URL link were low, comprising 3.7% of the study sample. The QR code, to date, seems to have predominantly been used as a consumer marketing tool [45] and the likely response from a mailshot such as the one employed in the present paper was unknown. The suggestion from our results is that the response to QR codes or URL links increases alongside an increase in ward area with higher ward areas responding in greater numbers to the QR code and URL link. We speculate that phone ownership and internet connections are potentially part of the reason for greater

**Table 1.** Socio-demographic and physical characteristics of the entire sample ( $N = 232$ ).

|                           | Whole sample<br>( $n = 232$ ) | Quartile 1<br>( $n = 29, 12.5\%$ ) | Quartile 2<br>( $n = 97, 41.8\%$ ) | Quartile 3<br>( $n = 67, 28.8\%$ ) | Quartile 4<br>( $n = 39, 16.8\%$ ) |
|---------------------------|-------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| WLOC score                | 9.0 ± 3.3                     | 9.2 ± 2.8                          | 9.2 ± 3.4                          | 9.0 ± 3.5                          | 8.4 ± 3.4                          |
| Mean BMI                  | 25.5 ± 5.4                    | 27.5 ± 6.8*                        | 26.2 ± 5.6°                        | 24.9 ± 4.8                         | 23.6 ± 4.1                         |
| %underweight < 18.5       | 17.2 ± 1.1                    | NA                                 | 17.3 ± 1.4                         | NA                                 | 17.1 ± 1.4                         |
| %healthy 18.5–24.9        | 22.3 ± 1.5                    | 21.8 ± 1.3                         | 22.6 ± 1.5                         | 22.2 ± 1.6                         | 21.8 ± 1.4                         |
| %overweight 25–29.9       | 27.1 ± 1.4                    | 26.9 ± 1.3                         | 27.3 ± 1.4                         | 27.0 ± 1.5                         | 27.0 ± 1.7                         |
| %obese > 30               | 35.2 ± 5.9                    | 35.1 ± 5.4                         | 35.0 ± 6.7                         | 36.6 ± 5.9                         | 33.6 ± 2.9                         |
| Gender                    |                               |                                    |                                    |                                    |                                    |
| Male                      | 93 (40.1%)                    | 10 (34.5%)                         | 48 (49.5%)                         | 25 (37.3%)                         | 29 (74.4%)                         |
| Female                    | 139 (59.9%)                   | 19 (65.5)                          | 49 (50.5%)                         | 42 (62.7%)                         | 10 (25.6%)                         |
| Age                       |                               |                                    |                                    |                                    |                                    |
| 18–24                     | 49 (21.1%)                    | 7 (24.1%)                          | 12 (12.4%)                         | 26 (38.8%)                         | 4 (10.3%)                          |
| 25–44                     | 71 (30.6%)                    | 7 (24.1%)                          | 26 (26.8%)                         | 26 (38.8%)                         | 12 (30.8%)                         |
| 45–64                     | 67 (20.2%)                    | 9 (31.0%)                          | 25 (25.8%)                         | 13 (19.4%)                         | 20 (51.3%)                         |
| 65±                       | 45 (19.4%)                    | 6 (20.7%)                          | 34 (35.0%)                         | 2 (2.9%)                           | 3 (7.7%)                           |
| Recent weight management? |                               |                                    |                                    |                                    |                                    |
| Yes                       | 73 (31.5%)                    | 5 (17.2%)                          | 40 (41.2%)                         | 16 (23.9%)                         | 12 (30.8%)                         |
| No                        | 159 (68.5%)                   | 24 (82.3%)                         | 57 (58.8%)                         | 51 (76.1%)                         | 27 (69.2%)                         |

**Table 2.** Percentage of respondents by occupation.

| Employment classification                   | Total sample % $n$ 232 | Ward 1 | Ward 2 | Ward 3 | Ward 4 |
|---|------------------------|--------|--------|--------|--------|
| Higher managerial                           | 6.90                   | 10.34  | 7.22   | 5.97   | 5.13   |
| Lower managerial                            | 37.93                  | 24.14  | 31.96  | 46.27  | 48.72  |
| Intermediate occupations                    | 9.05                   | 13.79  | 9.28   | 4.48   | 12.82  |
| Small employers                             | 18.10                  | 24.14  | 20.62  | 14.93  | 12.82  |
| lower supervisory and technical occupations | 8.19                   | 13.79  | 8.25   | 8.96   | 2.56   |
| Semi-routine occupations                    | 10.34                  | 6.90   | 9.28   | 13.43  | 10.26  |
| Routine occupations                         | 2.16                   | 3.45   | 2.06   | 1.49   | 2.56   |
| Never worked long-term unemployed           | 7.3%                   | 3.45%  | 11.34% | 4.48%  | 5.13%  |

\*Employment classification is based upon the current standard occupational categories devised by the Office for National Statistics (SOC-2010).

response in these areas and whilst further exploration is beyond the scope of this investigation, response rates will be of interest to researchers using web-based applications for data gathering. By comparison, there was a 29.5% response rate from 200 postal questionnaires sent out in the present investigation. A postal questionnaire, sent without prior contact from the questionnaire's authors, was analyzed recently in Yorkshire and yielded a 15.9% response [46] higher than our technologically focused recruitment method, but lower than a similar postal strategy. The link sent by social media to the contacts of one of the researchers (200 people) received a 45.5%

**Table 3.** The method of delivery and response rates.

| Sample Mode          | Total Distributed | Response Rate |
|----------------------|-------------------|---------------|
| QR/URL code leaflet  | 2,200             | 82 (3.7%)     |
| Postal questionnaire | 200               | 59 (29.5%)    |
| Social media         | 200               | 91 (45.5%)    |

response rate, again here we can only speculate that personal contact will increase response rate.

Although an individual's WLOC and ward area did not appear to be correlated, Table 1 clarifies the disparity in response from the four different wards with far fewer responses from ward 1. There was a clear interaction between an individual's body weight and the likelihood of having an externally focused LOC in higher BMI subjects. Table 2 shows the interaction between occupation and WLOC is a clearer indication that socio-economic status relates to WLOC in the present investigation ( $p = 0.004$ ) with higher status occupations recording a more internal LOC score. The limits of the sample size and its sole locality (Sheffield, South Yorkshire) and the lack of balanced response from the different wards preclude drawing broader conclusions over interactions between ward area and WLOC as shown in Table 4. As lower BMI individuals have a more internally focused LOC (see Fig.

**Table 4.** Response rate by ward area (quartile).

| Sample mode          | Returned sample<br>(n = 232) | Quartile 1<br>(n = 29) | Quartile 2<br>(n = 97) | Quartile 3<br>(n = 67) | Quartile 4<br>(n = 39) |
|----------------------|------------------------------|------------------------|------------------------|------------------------|------------------------|
| QR/URL code leaflet  | 82 (35.3%)                   | 12 (41.4%)             | 20 (20.6%)             | 21 (31.3%)             | 29 (74.4%)             |
| Postal questionnaire | 59 (25.4%)                   | 4 (13.8%)              | 55 (56.7%)             | NA                     | NA                     |
| Social media         | 91 (39.2%)                   | 13 (44.8%)             | 22 (22.7%)             | 46 (68.7%)             | 10 (25.6%)             |

Quartile 1 is the lowest socio-economic ward area and 4 the highest.

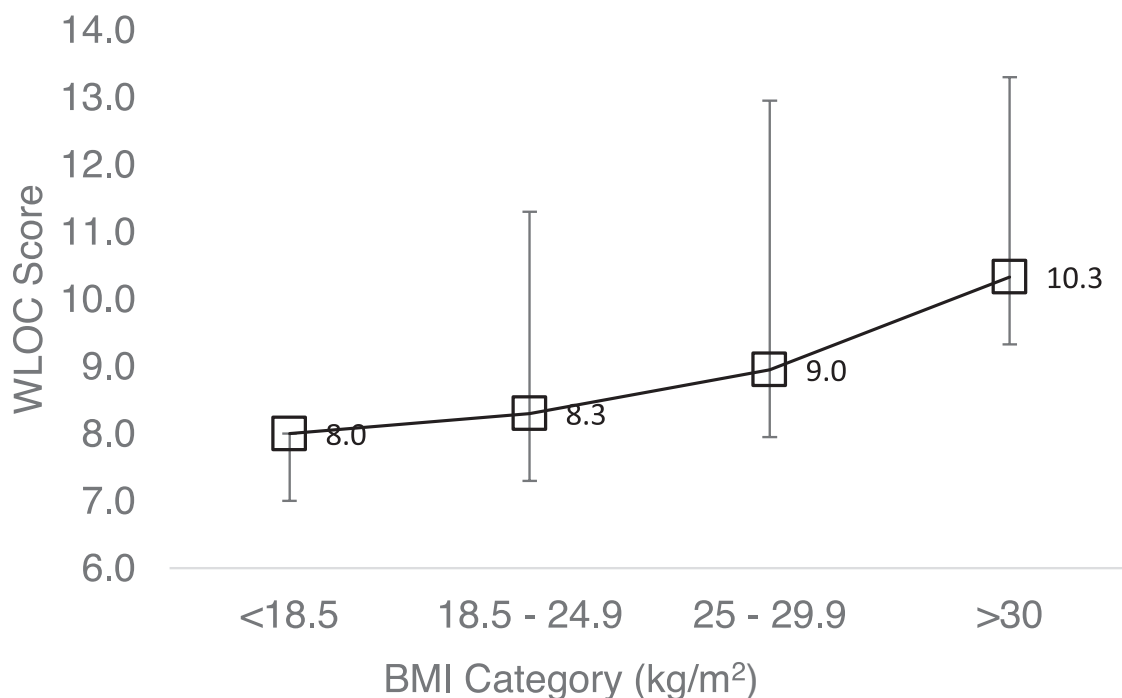
1), strategies for developing “internality” may be warranted. The findings are supportive of the SDT which suggests that sustained change is wrought by focusing on motivation and success being achieved via the actions of the self [12]. Weight management interventions might focus attention on developing an internal LOC in participants over (for example) focusing on “education”.

Historically, work in this area has suggested that obese and overweight individuals appear to have a similar LOC to lower, healthy weight individuals. This is not supported by the present study which suggests that lower BMI individuals have greater internality relative to those with a higher BMI.

SDT posits that individuals are ultimately intrinsically motivated to behave in a way which supports health [12]. Alongside SDT, motivational interviewing is a clinical approach which has been described as a “kissing cousin” of SDT [13] and is a clinical method focusing on the internal “self” determined reasons for making a change [13].

As internality appears to connect with success in weight management—further exploration of how SDT and motivational interviewing might combine in weight management interventions is warranted and needs further consideration. Studies underpinned by the theory of SDT using the motivational interviewing approaches may offer help in increasing the sense of internal LOC in weight losers and weight maintainers.

The ability to control body weight is not equal amongst individuals, in either human or animal studies. Weight loss, even under the conditions of equal caloric restriction and energy expenditure is not the same, it seems plausible that WLOC is affected by the individual’s response to lifestyle (e.g., repeated failed attempts at weight loss leading to a greater degree of externality). As the ability to control body weight is potentially more in the gift of one individual than another, then LOC will be potentially experienced differently with some individual efforts resulting in greater weight loss than others.



**Figure 1.** WLOC moves from internal to external as BMI rises error bars show the standard deviation for WLOC scores by BMI category.



Researchers should consider the possibility that LOC orientations may be influenced by life experience. Further investigations could, for example, test the association between WLOC and the LOC in people of differing BMI to answer whether the sense of control is domain specific in relation to weight or rather a trend in general.

A clear limitation of the present investigation is the self-reporting of height and body weight and the inherent probability of inaccuracy with a subjective recording of data. Height and weight obtained by self-report are unlikely to be 100% accurate [47], however, under-reporting is modest and the “trend” of high and low BMI probably persists i.e., is not likely to have a major impact on our findings. Furthermore, we note that our protocol for recruitment two (social media) means there was an inherent bias introduced to the sample. The social media contacts of one of the researchers (MK) were used; the rationale for this is that the scope of contacts gathered whilst completing a post-graduate degree, and working at a local football stadium, and having relocated from Scotland to England meant a wide and varied group of contacts.

## Conclusions

WLOC does appear to be associated with control of body weight, with internally focused individuals reporting lower BMI values. WLOC did not appear to be associated with an area of residence but responses from different wards were not proportionately representative and the very limited response from ward 1 is a significant limitation in drawing broad conclusions. Socioeconomic status in this study, however, does appear to predict BMI as individuals in lower status occupations had higher BMI scores. Weight management interventions might focus on the concepts of self-efficacy and self-determination with a clear initial focus on building these domains within the individuals presenting for treatment over and above factors such as quantified weight loss. The process of weight loss is advised as a slow [45] process with the intention of changes being sustainable, this seems to fit with the process of developing internalized control and success around behaviors ultimately leading to weight loss (e.g., responding to environmental cues around food and physical activity). Currently, the paradigm of bodyweight management focuses on altering behavior directly: eat less, move more with less consideration of building long-term ability to

cope with stumbling blocks along the path to long-term weight control.

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