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A health assessment tool for multiple risk factors for obesity: Results from a pilot study with UK adults

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Abstract

Objective: Although many individual health behaviours have been implicated in the current rise in obesity levels, their confounding or cumulative effects have yet to be established. This study piloted a measure of multiple risk factors for obesity, designed to assess their relative importance at individual and population levels.

Methods: A 100-item, user-friendly, self-report questionnaire, was completed by 80 adult volunteers (67% female, age range 19–73 years), and related to Body Mass Index (BMI).

Results: Dietary factors significantly related to BMI were higher amount of food consumption and more non-hunger related eating. BMI was strongly related to both negative attitudes/emotions towards and negative social influences on physical activity/exercise. Higher BMI was also related to less participation in physical activity/exercise, more sedentary leisure pursuits (e.g. TV watching) and lower general activity levels (e.g. more car usage). A regression analysis of all risk factors explained around 56% of the variance in BMI.

Conclusion: The pilot measure was able to differentiate between weight groups on a number of risk factors. The strong associations found between BMI and attitudes, emotions and social influences on eating and activity behaviours may help explain why many diet and exercise regimes are unsuccessful.

Practice implications: Results demonstrate that an easy-to-complete, self-report tool of multiple risk factors for obesity has potential as a health assessment tool for use by health professionals.

Keywords: Obesity; Eating patterns; Physical activity; Multiple risk behaviours; Health assessment

1. Introduction

Rates of obesity are increasing in both adults and children worldwide, a problem described by the World Health Organisation as a global epidemic [1]. The US has some of the highest levels, with nearly two-thirds of the adult population estimated to be either overweight (34%) or obese (31%) in 2001 [2]. The UK is not far behind, with figures for the same year indicating that 59% of all adults were overweight (37%) or obese (22%) [3].

Being overweight is associated with a wide range of health problems, including heart disease, back pain and joint problems, some forms of cancer, higher rates of mortality, hypertension and diabetes as well as psychosocial problems [4,5]. The cost of these health problems, both in terms of direct costs to the NHS for medical treatment, and indirect costs such as sick leave, incapacity benefit and early mortality, are large and getting larger.

It is generally accepted that, at a population level, changes in our eating and activity patterns over the last 20 years have been instrumental in the current obesity epidemic [6]. This assumption has resulted in not only treatment programmes, but also government health initiatives, being aimed at changing one, or both, of these behaviours. However, treatment of obesity has met with limited success, particularly over the longer term. It is therefore becoming increasingly acknowledged that prevention is the best policy for reducing rates of obesity across the population [7]. Early intervention is

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essential and needs to be based upon a comprehensive, comparative assessment of a wide range of risk factors.

1.1. Risk factors

Current evidence supports an association between obesity and a wide range of different risk factors including eating patterns, activity levels, family background and amount of sleep [8].

With regard to eating patterns, the type of food eaten in the modern diet is likely to be a contributory factor to the rise in obesity levels. In particular, a higher proportion of energy dense foods (i.e. fatty and sugary foods and drinks) [9,10], and correspondingly reduced levels of complex carbohydrates [11] have both been associated with obesity. Portion sizes of food have been steadily increasing in recent years, and eating larger portions has been associated with increased weight in individuals [12]. Snacking, eating out and not eating meals as a family have all been associated with increased levels of obesity [13]. Eating in response to emotional rather than hunger cues and eating when bored are both evident in overweight and obese individuals [14]. Finally, dieting behaviour, particularly unsuccessful repeated attempts at weight loss through calorie-intake reduction, has been associated with longer term weight gain, especially in women [15].

The change in activity patterns, with increasingly inactive leisure pursuits and the extensive use of cars even for short journeys has also contributed to the increasing levels of obesity in the UK [6]. The number of hours spent in relatively inactive pastimes such as watching TV and playing computer games have both been associated with obesity, particularly in children [16]. TV may also influence eating behaviour, either indirectly, through adverts for fast and junk food, or directly, by increasing snack consumption [17,18]. In contrast, individuals who take part in regular physical activity or exercise, particularly of moderate or greater intensity, are less likely to be overweight or obese [19]. The tendency for the obese to be less physically active than their normal weight counterparts may be influenced both by psychological factors, such as embarrassment at appearing semi-clad or seeming unfit in public, and by physical difficulties associated with excess weight, such as joint pain or breathlessness, which restrict the ability to exercise.

Parental obesity, particularly maternal, is a key factor in predicting adult obesity in offspring, irrespective of whether they were overweight as children [20,21]. Heavier birthweight and early maturation have also been linked to an increased risk of obesity in later life [22,23]. Being breastfed seems to serve as a protective factor against later obesity [24]. Lower socio-economic status also seems to be a risk factor for increased levels of obesity, particularly in women [25]. Finally, sleep has been associated with obesity levels, with obese people reportedly spending fewer hours asleep than the non-obese [26].

Whilst a number of studies have developed measures relating to eating and activity behaviour, most of the current research looks at only one or two behavioural risk factors, despite evidence that some are inextricably linked (e.g. TV watching and snack consumption) and may have a cumulative effect on increased weight. Our aim is to address this limitation by developing a measure, which will cover as wide a range as possible of currently identified risk factors for obesity, thereby facilitating examination of their relative importance at both an individual and population level.

Studies which have examined more than one of the key risk areas simultaneously, have usually concentrated on aspects of diet and activity. For example, in a large cohort study of US adolescents [27], a model including self-reported food intake, hours spent watching TV, video or playing computer games and physical activity predicted around 19% of the variance in 1-year change in BMI for girls, and 17% for boys. Multivariate analysis showed that for girls, significant predictors were overall calorie intake, TV/video/computer usage and general activity, for boys only TV/video/computer usage reached significance. Time spent in gym classes and fat and fibre intake had no effect. In an Australian study of children aged 5–13 years, Wake et al. [28], found that a multivariate model which included TV and computer usage, organised and general activity levels, food intake and parental BMI explained around 22% of the variance in child BMI, with food intake and parental BMI explaining 11% and 5%, respectively. However, many of the variables were self-report (by parents), which they accepted could be biased in the case of overweight children. They concluded that 'causal paths are likely to be complex and interrelated' (p. 130). In both of these studies, several different self-report measures, each covering one of the risk factors, were used, making it difficult to compare the findings. In addition, factors such as socio-economic status, sleep patterns and family influences (other than BMI) were not examined, and neither were psychological influences on eating and activity behaviours.

Although the individual risk factors for obesity are well-documented, Müller and colleagues, in 2001, highlighted that "their confounding or cumulative effects on the development of obesity, as well as their clustering and their effects over time ... remain unclear with respect to a given individual as well as with a greater population of subjects" [29] (p. 18). In addition, treatment programmes have tended to be based on the amount of weight loss required to attain a 'normal' weight and failed to account for individual differences in dieting history, behaviour patterns and psychosocial factors which may affect both motivation and adherence to treatment programmes [30].

The self-report measure developed for this study, therefore, includes not only assessment of a wide range of reported behaviours, but also influences on those behaviours, particularly for the two main behaviours linked to obesity, i.e. eating or energy-in, and activity or energy-out. These additional items fall into three categories: attitudes towards and motivations for behaviours; social influences on behaviours; perceived control over these behaviours. Although the questionnaire was not designed as

a direct measure of the Theory of Planned Behaviour (TPB) [31], these three categories reflect its constructs of attitudes, subjective norms and control. The TPB has been successfully applied to eating and exercise behaviours in other studies [32].

The measure, which could be easily administered by health professionals prior to treatment, therefore, provides a comprehensive and structured framework for assessment of behaviours and as such would help identify multiple areas of high risk at an individual level. Small changes across a number of these high-risk behaviours (e.g. remove or change content of afternoon snacks, decrease TV viewing by an hour) might be easier for individuals to sustain and therefore lead to longer term successful weight management, than, for example, imposing a very low-calorie diet to effect substantial weight loss, which research shows is very hard to maintain. However, there is little point in telling an obese individual to watch less TV, if their TV viewing is already minimal, so it is important to know which risk factors are most amenable to change at an individual level.

The aim of the current research programme is to develop a psychometrically derived, comprehensive, structured measure of risk factors for obesity, which can be used not only to identify at-risk individuals, but also to determine the relative importance of each risk factor at both an individual and population level. Here, we report on the findings of a pilot study using this measure to assess to what extent multiple risk factors for obesity are related to current BMI, and whether this tool can have potential in assessing the relative importance of these risk factors, as a first step towards establishing its value as a health assessment tool. Once the tool is fully developed, we will then be able to apply structured equation modelling to fully investigate the cumulative and clustering effects of the resulting risk factors.

2. Method

2.1. Procedure

Participants were a convenience sample of volunteers recruited either via response to posters displayed at a Scottish university or via personal invitation. All questionnaires were completed and returned anonymously in sealed envelopes. In addition to the risk factor questionnaire participants provided self-reported weight, height, waist measurement and clothes size, as well as job status of self and partner for assessment of socio-economic status [33]. Of the 166 questionnaires distributed to prospective participants, 80 were returned (48% response rate).

2.2. Participants

Participants were 80 adult volunteers, 67% female, with a mean age of 36.0 years (S.D. 12.2), range 19–73.

2.3. Questionnaire

The questionnaire was developed after extensive literature review of articles (identified by a search of the Medline and PsychInfo databases) which reported on factors found to be related to BMI or to be predictive of obesity. Articles reviewed included systematic reviews of obesity risk factors [e.g. 8,34], and articles describing measures of obesity risk factors currently in use with adults or adolescents [e.g. 35,36]. A 100-item questionnaire was then developed by generating one or more items for all identified obesity risk factors, which it was deemed could be adequately measured by self-report. The questionnaire has been designed to be easy to complete, and, to this end, great care has been taken in wording and layout. During the design process, consultation with both adults and adolescents was carried out, in order to ensure that questions were both understandable and relevant to weight-related behaviours. The adult version of the questionnaire has a Flesch readability score [37] of 69.4, i.e. equivalent to a reading age of approximately 12 years.

Items cover an extensive range of currently proposed risk factors for obesity, to allow comparisons between factors. Because of problems in measuring actual food consumption and activity levels, particularly in the overweight [38], we have adopted a method of using items based on frequency of preferred or typical behaviour, rather than trying to assess actual behaviour over, say, a specified time period. Example of items are: 'I would rather eat out than eat at home: Almost always; Most of the time; Often; Sometimes; Rarely; Almost never' and 'On a typical day I watch TV, videos or DVDs for: At least four hours; Three or four hours; One or two hours; Less than one hour; Not at all'. Specific examples of behaviour were included where it was felt any ambiguity might occur for example: 'I take part in organised sport or other physical activities (e.g. dance class, aerobics class, athletics, football, tennis, rugby, gymnastics)'; 'I tend to eat high-fibre foods (e.g. high-fibre cereal, wholemeal bread, potatoes, brown rice, fruit, vegetables)'.

In addition to items on current behaviour patterns, we have also included items for the two main behaviours linked to obesity (i.e. eating or energy-in, and activity or energy-out) in three additional areas as follows: (1) attitudes towards and motivations for behaviours, (2) social influences on these behaviours and (3) perceived control over these behaviours. These areas reflect the TPB constructs of attitudes, subjective norms and control. Examples of items assessing attitude/motivation are: 'Exercising makes me feel happier: Almost always; Most of the time; Often; Sometimes; Rarely; Almost never'; 'I tend to eat when I'm feeling fed up or anxious: Very often; Often; Sometimes; Rarely; Almost never'. Examples of items assessing social influences on behaviour are: 'My partner makes fun of me when I am physically active: Almost always; Most of the time; Often; Sometimes; Rarely; Almost never' 'My friends eat fast food: Very often; Often; Sometimes; Rarely; Almost

never'. Examples of items assessing perceived control are: 'I find it easy to be physically active when I want to be: Very often; Often; Sometimes; Rarely; Almost never'; 'I find it easy to eat healthily when I want to: Almost always; Most of the time; Often; Sometimes; Rarely; Almost never'.

2.4. Analysis

Cronbach's α was used to investigate the internal reliability of the scale. Pearson correlation coefficients were used to calculate basic relationships between the individual items and the factor subscales with BMI. Stepwise regression analysis was carried out to assess to what extent the factor subscales were predictive of BMI.

As the aim of a health assessment tool is to differentiate at risk populations, the results were also analysed by weight categories (i.e. low weight, normal weight, overweight and obese, as defined in the results section). Chi-squared tests were used to examine weight category differences for individual items, a MANOVA was used to examine weight category differences for the factor subscales and an independent *t*-test to differentiate the obese from other weight categories on the total risk factor score.

3. Results

The pilot sample was skewed towards higher socio-economic groups (SEG) (30% SEG I, 36% SEG II, 23% SEG III, 4% SEG IV or V and 8% students). Participants were resident in a number of regions across the UK, including central Scotland (56%), North-east England (25%) and southern England (19%).

The mean Body Mass Index (BMI) of the pilot sample (i.e. weight (kg) divided by height^2 (m)), was 25.1 (S.D. 4.2) and 49% were considered overweight according to the recommended BMI cut-offs [1] (36% overweight (BMI $\geq$ 25) and 13% obese (BMI $\geq$ 30)), 42% were considered of normal weight (25 $>$ BMI $\geq$ 20) and 9% of low weight (BMI $<$ 20). A BMI of 20 was used as the lower bound of the normal range, in preference to the value of 18.5 recommended by the World Health Organisation, to avoid a very small sample in the low weight group ($n = 2$). This approach has been adopted in other studies [39].

There was no difference in BMI between males and females (both mean = 25.1). BMI was positively correlated with age in the pilot sample, but the association did not reach significance ($r = .13$, ns). Similarly, there was no significant association of BMI with social class in the current sample ($r = .08$, ns).

There was some support for accuracy in self-reported BMI as 100% of the obese group reported thinking that they were overweight (either 'a lot overweight' (70%) or 'a bit overweight' (30%)), compared to 86% of the overweight group (21% 'a lot overweight' and 65% 'a bit overweight'), 41% of the normal weight group (all 'a bit overweight') and none of the low weight group, and this difference was highly significant ($\chi^2(3) = 30.5$, $p < .0001$). With regard to their weight 90% of the obese group would like to be lighter (80% 'a lot lighter' and 10% 'a bit lighter') compared to 86% of the overweight (21% 'a lot lighter' and 65% 'a bit lighter'), 68% of the normal weight group (all 'a bit lighter') and 14% of the low weight group (all 'a bit lighter'), and this difference was also significant ($\chi^2(3) = 16.6$, $p < .001$).

3.1. Individual items

3.1.1. Correlations with BMI

Significant correlations of BMI with individual items on the questionnaire are shown in Table 1. All but one of the correlations shown were in the expected direction, the exception being the frequency of friends eating fast food (i.e. burgers, chips, pizza) where those with higher BMI reported having friends with less frequent consumption. With regard to type of food consumed higher BMI was significantly related to lower reported levels of vegetable consumption and higher consumption of fizzy or sweetened drinks. There were also significant associations with higher BMI for preferring fried foods, not finding it easy to eat healthily, not knowing how to cook many items, reporting eating a less healthy diet than peers, and being more influenced by celebrity food adverts. Those with higher BMI also reported eating higher amounts of food (e.g. eating everything put in front of me, choosing largest size, feeling eaten or drunk more than should, finding it hard to stop eating). Items covering non-hunger related reasons for eating were also consistently significantly related to higher BMI (e.g. eating when bored, eating when not hungry, eating when feeling fed up or anxious, eating making one feel happier).

The only significant physical activity items were concerned with feelings and attitudes rather than reported actual activity (e.g. exercise making me feel happier, unimportance of being physically fit, not finding it easy to be physically active), although there were some significant associations with inactivity levels (e.g. watching TV more than peers, travelling to work by car, not walking or cycling for short journeys). Having a mother who demonstrated infrequent encouragement to be physical active (when growing up) was strongly related to BMI, as was current weight control behaviour.

There were no significant correlations of BMI with smoking, alcohol consumption, parental overweight (when growing up), sleep, childhood factors including being breastfed, birthweight or early maturation, or eating patterns such as family meals, eating home-cooked food, breakfast, eating out or snacking.

3.1.2. Weight category differentiation

Chi-square tests were used to see whether any individual items on the questionnaire could differentiate between weight categories. As the numbers were very small for some cells, item scales were collapsed into two categories (using

Table 1
Significant correlations of individual items with BMI ($n = 80$)

Item	r	p
Rather eat fried than non-fried foods	.26	.021
Infrequency of vegetable consumption	.29	.010
Friends eat fast food	−.23	.049
Diet less healthy than that of peer group	.25	.024
Frequency of drinking fizzy or sweetened drinks	.24	.039
Not knowing how to cook	.25	.018
Not finding it easy to eat healthily when want to	.25	.025
Frequency of choosing foods because advertised by celebrity	.24	.030
Frequency of eating everything put in front of me	.24	.037
Frequency of finding it hard to stop eating when a lot of food is available (e.g. buffets)	.24	.035
Frequency of choosing largest size	.28	.012
Frequency of feeling that eaten or drunk more than should	.40	<.001
Frequency of eating when bored	.30	.007
Frequency of eating when anxious or fed up	.32	.004
Frequency of eating when not hungry	.29	.009
Frequency of eating making feel happier	.28	.012
Unimportance of being physically fit	.30	.007
Find it less easy to be physically active	.28	.012
Watching TV more than peer group	.31	.006
Infrequency of mother liking participant to be physically active when growing up	.34	.001
Frequency of travel to college/work by car, bus or train	.31	.005
Infrequency of walking or cycling to college/work	.29	.009
Infrequency of walking or cycling for journeys of up to one mile	.26	.020
Frequency of dieting or exercising to lose weight	.48	<.001

the median of each item), to provide more robust analysis. A number of individual items on the questionnaire were able to differentiate between the weight categories. Significant results are shown in Table 2.

As can be seen from Table 2, a number of items relating to both diet and activity behaviours were able to differentiate between weight categories, with the obese group consistently reporting the least healthy behavioural patterns. These included more non-hunger related reasons for eating (e.g. eating when bored, eating when not hungry), less motivation for organised activity (e.g. not finding it easy to be physically active), less participation in physical activity (e.g. being less physically active than peers) and lower daily activity levels (such as travelling to work/college by car). Frequency of eating when not hungry differentiated the obese from each of the other three weight categories. Interestingly, the low weight group also reported higher levels of some unhealthy behaviours such as feeling their diet was less healthy than their peers, and preferring to watch TV than got to the gym or for a walk. However, the daily activity levels of the low weight group were higher than other groups.

Table 2
Percentage in each weight category giving specified response to items (responses split by median)

Item	Weight category (BMI, %)				$\chi^2(3)$	p
	Low (<20)	Normal (20–24.9)	Overweight (25–29.9)	Obese (≥30)		
Eat when bored 'very often' or 'often'	29	29	45	80	8.8	.032
Eat when anxious/fed up 'very often' or 'often'	14	26	34	70	7.9	.049
Eat when not hungry 'very often' or 'often'	0	21	28	70	12.5	.006
Diet is healthier than peers	14	71	59	20	13.1	.004
Being physically fit is 'quite important' or 'really important to me'	86	84	85	40	13.0	.005
Play sport with friends 'rarely' or 'almost never'	57	32	38	90	11.4	.010
Am less physically active than peers	57	15	17	60	13.2	.004
Find it easy to be physically active	71	74	59	20	9.7	.021
Would rather watch TV/read than walk/go to gym 'almost always', 'most of the time' or 'often'	71	21	24	70	14.4	.002
Go to work/college by car, bus or train every day	29	44	72	90	11.0	.008
Walk/cycle to work or college < once a month	29	53	79	100	14.4	.002
Walk/cycle for journeys less than 1 mile 'almost always' or 'most of the time'	57	62	45	10	8.7	.034
Diet or exercise to lose weight 'very often' or 'often'	0	15	48	50	13.3	.004

3.2. Risk factors

As the pilot sample is too small for meaningful factor analysis of the 100-item questionnaire, risk factor scores have been calculated based on item content. The final risk factors will be established after extensive factor analysis in a much larger sample. The subscales have been calculated as mean scores of contributing items, adjusted to a scale with a maximum of 100, so that all items have equal weighting. This method has been used in preference to z-scores, as it is independent of the sample distribution. The risk factor subscales, including the internal reliability of contributing items, as measured by Cronbach's α, are shown in Table 3.

3.2.1. Correlations with BMI

Correlations of risk factor scores with BMI are shown in Table 4. High scores on the risk factors indicate higher risk in all cases. It can be seen from Table 4 that higher BMI was significantly correlated with: reporting eating of greater amounts; more frequent non-hunger-related eating; negative attitudes towards physical activity/exercise; negative social influences on physical activity/exercise; greater leisure inactivity; less general activity; current weight control behaviour (see Table 4). The association with poorer eating patterns approached significance ($p = .051$). Higher BMI was also significantly related to the total risk score for all items.

3.2.2. Regression analysis

A linear regression analysis was carried out with BMI as the dependent variable, and the risk factors listed in Table 4 as the predictor variables. Factors were entered in a staged approach, to reflect the potential order of their influences on BMI as follows: (Level 1) being breastfed as a child, family weight background, childhood factors; (Level 2) social influences on: eating, physical activity, daily activity; (Level 3) emotional influences on: physical activity, eating patterns; (Level 4) sleep, smoking, dieting behaviour, daily activity levels, inactive leisure pursuits, food consumption, amount of food consumed, physical activity levels.

The result was significant ($F(16,73) = 6.9, p < .001$), and explained a total of 56% of the variance in BMI. Level 1 (background factors) was not significant. Level 2 (social influences) explained 12% of the variance, with the only significant predictor being social influences on physical activity ($p = .018$). Level 3 (emotional influences) explained 28% of the variance with social influences on physical activity ($p = .030$) and attitudes/emotions towards physical activity ($p = .002$) reaching significance. In Level 4, (less positive) attitudes/emotions toward physical activity/exercise ($p < .001$), current dieting behaviour ($p = .002$), (lower) amount of general activity ($p = .003$), (lower) levels of physical activity ($p = .007$), (negative) influences on physical activity/exercise ($p = .032$), (higher) amount eaten ($p = .033$) and family weight background ($p = .011$) all reached significance.

3.2.3. Weight category differentiation

A MANOVA including all the factors listed in Table 4 was carried out to compare the obese versus the non-obese, with an overall significant effect ($F(16,57) = 4.0, p < .001$). A number of individual effects also reached significance as follows: eating patterns (mean = 53.9 versus 44.8), $F(1,72) = 6.9$, $p = .011$); amount of food consumed (mean = 83.4 versus 63.6, $F(1,72) = 12.4$, $p = .001$); non-hunger-related eating (mean = 84.3 versus 67.9, $F(1,72) = 12.7$, $p = .001$); participation in activity/exercise (mean = 80.7 versus 63.2, $F(1,72) = 10.5, p = .002$); attitude to physical activity/exercise (mean = 66.5 versus 43.0, $F(1,72) = 27.7$, $p < .001$); general activity levels (mean = 72.5 versus 57.6, $F(1,72) = 4.3$, $p = .041$). Results remained significant even after controlling for factors which could affect eating and activity behaviour, i.e. age, gender and social class. Social influences on physical activity approached significance, but there were no effects for the remaining factors including social influences on eating patterns, childhood factors, smoking, current weight control behaviour, leisure inactivity levels and amount of sleep.

The total risk factor score derived from all items, was also able to differentiate the obese group from others (independent t-test: mean = 63.6 versus 56.7, 95% C.I. for difference (3.0, 10.9), $p = .001$).

4. Discussion and conclusion

4.1. Discussion

The current measure is under development and these findings should be viewed as very preliminary. In addition, the study is cross-sectional in design, and so causality cannot be assumed. This was a volunteer sample, which appeared biased towards higher socio-economic groups. Nevertheless, the response rate of 48% was comparable with response rates from other questionnaire-based surveys. A further limitation of the study was the use of self-reported weight and height to calculate BMI as a marker of obesity. Although extensively used in research, BMI does not always reflect actual body fat, for example in athletes such as rowers or rugby players. We plan to verify our use of BMI as an obesity indicator in future research, by accurately measuring weight, height and body fat for a subset of individuals.

Despite these limitations, we have revealed some important relationships of the various risk factors with higher BMI. Whilst there was a tendency to report lower levels of physical activity and higher levels of inactivity amongst the overweight and obese, other influences on activity such as attitude and perceived control (e.g. not viewing being fit as important and finding it hard to be physically active) also had strong associations with higher BMI. Whilst, being cross-sectional, the current research does not shed light on whether these influences on activity behaviour result from physical difficulties associated with

Table 3
List of risk factors in the analysis, including and internal reliability (Cronbach's α)

Factor	Sub-factor	Items	Cronbach's α
Food			
	Eating patterns	Frequency of eating: fast food; take-aways; sugary and/or high fat foods; fried foods; low-fat foods; fruit; vegetables; five servings of fruit/vegetables a day; outside the home (in cafés, pubs, restaurants); fatty and/or sugary foods when eating out; breakfast; healthy breakfast items; unhealthy breakfast items; snacks; sugary and/or high fat snacks; high-fibre foods; healthy foods Frequency of drinking: sugary drinks; milk; alcohol; water or unsweetened tea/coffee Frequency of: feeling hungry with an hour or two of snacking; snacking or drinking sugary drinks or alcohol while watching TV; using vending machines; snacking on same foods; finding it easy to eat healthily Preference for: fast food; fried foods; savoury foods; fruit and vegetables; eating out; healthy lunch items Content of food eaten at home (i.e. proportion of home-cooked versus ready-meals) Comparison of diet quality to same-sex, same-age peers	.88
	Amount consumed	Frequency of: choosing largest portion size; feeling that eaten or drunk too much; finding it hard to stop eating; eating everything put in front of me	.77
	Non-hunger related eating	Frequency of: eating when bored; eating when fed up or anxious; eating when not hungry; eating making feel happier; disliking eating; being a fussy eater	.64
	Social influences on eating patterns	Frequency of: friends eating fast food; eating together as family; eating same meals as rest of family; knowing when food unhealthy; TV adverts influencing food/drink choice; special promotions influencing food/drink choice; celebrity advertising influencing food choice; partner/close family making fun of healthy eating; friends making fun of healthy eating Degree of knowing how to cook	.69
Physical activity/exercise			
	Participation in activity/exercise	Frequency of: half an hour of physical activity hard enough to bring on sweat; taking part in sport or organised activity; comparison of activity levels to same-sex, same-age peers; playing sport or other physical pursuits with family; playing sport or other physical activity with friends	.73
	Attitudes and emotions	Frequency of: enjoying sport or physical activity; finding it easy to be active when want to; exercise making feel happier; feeling lazy Importance of being physically fit	.77
	Social influences on physical activity/exercise	Frequency of: father encouraging physical activity when (I was) growing up; mother encouraging physical activity when growing up; friends making fun (of me) when (I'm) physically active; partner or close family making fun (of me) when (I'm) physically active	.60
Inactivity			
	Leisure inactivity	Hours spent: watching TV; using computer at home Preference for: reading or watching TV rather than being active Comparison of TV watching to same-sex, same-age peers Frequency of: watching TV whilst eating	.65
	Social influences	Frequency of: family encouragement to watch TV Presence of TV in bedroom	.40
	General activity	Frequency of: travelling to work/college by bus, train or car; walking/cycling to work/college; taking the car for short journeys; walking/cycling for short journeys; using the lift rather than the stairs	.73

Table 3 (*Continued*)

Factor	Sub-factor	Items	Cronbach's α
Other factors			
	Smoking	Frequency of smoking	[a]
	Childhood maturity	Birthweight; height at age 7 years compared to others	.47
	Having been breastfed	Recall of being breastfed as child	[a]
	Current weight control behaviour	Frequency of: dieting or exercising to lose weight; dieting or exercising to maintain weight; vomiting, using laxatives or diet pills to control weight	.66
	Family background	Father's weight when (I was) growing up (a lot/a bit overweight, about right, a bit/a lot underweight); mother's weight when (I was) growing up Frequency of: father trying to lose weight; mother trying to lose weight	.49
	Sleep	On a typical night: no of hours of sleep; time of usual waking; time of going to sleep	.32

Note: The remaining items recorded demographic details. Although responses to many of the items were based on frequency, the item wording for most items was prefaced 'I tend', so the responses are measuring frequency of typical (not actual) behaviours. It is possible that, once full factor analysis is carried out, some of the items may load on different factors than those reported above (e.g. 'playing sport or other physical pursuits with family' could load on 'Social influences on physical activity/exercise' rather than 'Participation in activity/exercise'). However, for the purposes of this report, where factors have been established on face validity only, ambiguous items have been grouped according to the strength of their correlations with the remaining items on each sub-factor. It is also envisaged that a full factor analysis will reveal additional sub-factors on eating patterns.

[a] One item only.

being overweight, nonetheless the findings suggest that trying to address obesity by increasing physical activity in the already overweight or obese will not succeed unless these barriers to participation can be overcome.

Unexpectedly, there were only a few significant associations between type of food consumed (e.g. fried) and eating patterns (e.g. snacking) with higher BMI in the current sample. This could in part be due to there being a tendency for the obese to underreport food consumption, particularly of items viewed as unhealthy, as has been found in earlier studies [38]. Alternatively, it could be due to the fact that this relatively high socio-economic sample generally reported having quite healthy diets, making differences between groups less apparent. Nonetheless, the obese were more likely to view their diet as less healthy than their peer group. In addition, there were very strong associations between reported eating for reasons other than hunger and higher BMI, and a strong association with reported amount of food consumed, as assessed by items related to overeating, portion size, clearing plates and difficulty in stopping eating.

A striking finding was that frequency of eating 'when not hungry' was able to differentiate the obese from the low weight, normal weight and overweight categories. In our current Western society of abundance, food has taken on a meaning way beyond its nutrient value, and most of us have, as a result, lost the sensation of what it really means to be hungry. These results suggest that those of lower weight, for whatever reason, may still be best able to tune in to their innate biological need to eat, whilst the obese may be the worst equipped to respond to their biological hunger. The finding that higher frequency of eating whilst bored, fed up or anxious was also strongly related to higher BMI suggests that there may be a psychological element to this. If anything, the low weight group in the pilot study tended to report eating more, not less, unhealthy food, possibly because they did not feel any need to either misreport what they ate, or indeed to consume fewer amounts of foods which are generally deemed as 'fattening'. The low weight group also reported exercising less, though their general activity levels were higher. They did not differ from the other weight categories in respect of gender, age or social class. Given that the low weight group were less likely to report dieting or exercising to maintain their weight, it is conceivable that they simply ate amounts more in tune with their bodily needs.

The pilot sample was skewed towards higher socio-economic groups and this has doubtless contributed to obesity levels which are much lower than current estimates for the UK adult population, although levels of overweight were similar to current population figures. Despite the relatively small numbers of obese in the sample, the pilot measure was able to differentiate between the weight groups on a number of items and subscales.

The strong associations found of higher BMI with influences on eating and activity behaviours such as attitudes, emotions and perceived difficulties in performing behaviours may help explain why diet and exercise regimes

Table 4
Correlations of risk factors with BMI ($n = 80$)

Item	r	p
Food		
Poorer eating patterns	.22	.051
Higher amount consumed	.40	<.001
More non-hunger related eating	.39	<.001
Negative social influences on eating patterns	.18	.105
Physical activity/exercise		
Lower participation in exercise	.11	.335
Negative attitude and emotions	.30	.007
Negative social influences	.27	.017
Inactivity		
Greater participation in leisure inactivity	.23	.038
More social influences to be inactive	.10	.397
General activity	.31	.006
Other factors		
Earlier childhood maturity	.17	.142
Not being breastfed	−.05	.681
Current active weight control behaviour	.35	.001
Heavier family weight background	−.04	.710
Heavier[a] smoker	−.01	.934
Fewer hours asleep	.18	.123
Total risk score	.48	<.001

[a] Only 15% of the sample reported smoking every day.

which ignore these factors have limited success. In the light of these results, we are planning to revise the questionnaire to include more items assessing the Theory of Planned Behaviour constructs of attitudes, subjective norms and perceived control in future research. Other psychological factors such as depression and personality may also impact on eating and activity behaviours and it would be useful to evaluate these in conjunction with identified risk factors and BMI in future research.[1]

Although not psychometrically derived, the sub-factors relating to food and activity had good internal reliability, were for the most part related to BMI, and could differentiate the obese from other weight categories. A regression analysis with these factors as the predictor variables explained around 56% of the variance in BMI.

4.2. Conclusion

The current study demonstrates that an easy-to-complete, self-report tool can have value in assessing multiple risk factors for obesity. Funding is currently being sought to carry out a larger, longitudinal study to further develop and rigorously test the psychometric properties of the scale, as well as its predictive power with respect to weight change.

4.3. Practice implications

Once the tool is fully developed, the measure could be used not only to establish the relevant importance of the various factors in different populations, but also as a health assessment tool for risk factors in individuals.

[1] We are grateful to an anonymous reviewer for raising this point.

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