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Diet-induced obesity: When does consumption become overconsumption?

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1 Diet-induced obesity: When does consumption become overconsumption?

2

3 Running Head: Defining overconsumption

4

5 overconsumption; obesity; methodological assessment; hyperphagia

6

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25

26 Abstract

27

28 Overconsumption is commonly implicated in the aetiology of obesity; however there is a lack
29 of consensus on a definition and the most appropriate methodology for assessing it. The aim
30 of this communication is to highlight the need for theoretical consensus on the assessment of
31 overconsumption, which may lead to improved methodological standards in obesity research.
32 In laboratory studies, overconsumption is most frequently inferred from the comparison of
33 food intake within or between individuals against a single control. Measurement often relies
34 on a single eating episode with limited consideration of preceding or subsequent intake. An
35 alternative approach is to consider food intake in the context of energy requirements, within
36 an energy balance framework. One such marker of chronic overconsumption is body weight.
37 There is a need for agreement on the definition and measurement of overconsumption, so that
38 its role in weight gain and obesity can be more precisely delineated.

39

40 Introduction: Relevance of overconsumption to obesity

41

42 Overconsumption of food is a widely discussed phenomenon with reference to the aetiology
43 of weight gain and obesity. A positive energy balance driven by dietary overconsumption is
44 thought to largely account for the marked increase in the prevalence of obesity [1-3].
45 However, for a term so widely used in obesity research, the concept of overconsumption
46 remains surprisingly ill-defined. It is by definition a relative term; but relative to what? At
47 what point does 'consumption' become 'overconsumption', and when is it significant and
48 meaningful with respect to weight gain and obesity?

49

50 Understanding the aetiology of obesity is vital for effective treatment and prevention. It is
51 proposed that research examining factors in the aetiology of obesity, such as
52 overconsumption, must do so within an energy balance framework [4]. It is agreed that when
53 energy intake consistently exceeds expenditure a positive energy balance and weight gain
54 will occur; increased energy intake that is matched by increased energy expenditure, or a
55 compensatory reduction in intake, will not. Therefore, research into overconsumption must
56 necessarily consider its relationship with energy requirements, even if it is posited that energy
57 intake is the most potent driver of imbalance.

58

59 Current assessment of overconsumption

60

61 Currently, no formal scientific definition of overconsumption exists, and the methodologies
62 used in studies that claim to measure overconsumption differ substantially. Therefore,
63 comparison between studies is difficult, and the role of overconsumption in the aetiology of
64 obesity is obscured.

65

66 Overconsumption is commonly studied in experimental paradigms by comparing food intake
67 between two independent groups of participants. In this way, the lower energy intake is used
68 as benchmark, against which significantly higher energy intake is often classed as
69 ‘overconsumption’. While a complete review of the literature is beyond the scope of this
70 paper, several laboratory studies have used comparisons in this way to assess
71 overconsumption. For example, *ad libitum* food intake has been compared between
72 participants identified as being high and low in sensitivity to food reward (e.g. [5]), high and
73 low in dietary restraint (e.g.[6]), disinhibition (e.g. [7]) or self control ([8]). A related
74 paradigm compares intake between-subjects or within-subjects in a control condition with

75 those subjected to an experimental manipulation, in order to determine its effects upon
76 propensity to overconsume (e.g. [9-11]).

77

78 While illustrative, these comparative approaches to assessing overconsumption pose several
79 problems. Although the laboratory environment allows high precision, unfamiliar conditions
80 and possibly foods may provoke atypical eating behaviours [12], so that observation of a
81 single episode of eating behaviour in the laboratory is not a guarantee that it is typical of the
82 individual. More importantly, high levels of individual differences in compensatory
83 behaviours, habitual diet and activity-induced energy expenditure are likely to negate any
84 sustained differences in caloric intake observed in a laboratory. It can be argued that it is
85 meaningless to compare absolute food consumption between subjects, as energy intake and
86 expenditure are so highly variable between individuals. Therefore, the preferred method of
87 assessing overconsumption should be within the context of each individual, with reference to
88 individual energy requirements. However, the issue of for how long consumption should be
89 tracked in order to reveal meaningful changes remains to be addressed.

90

91 What is an appropriate time period for determining overconsumption?

92

93 Evidence has demonstrated that food consumption is also highly temporally variable within,
94 as well as between, individuals [13, 14]. A major issue in the prevailing measurement of
95 overconsumption is that assessment of energy intake is often limited to a single eating
96 episode, but that the reliability of these measures is rarely assessed (although see [15]).
97 Examining food consumption on an 'episode by episode' basis may mirror how obesity can
98 occur ('It's only one small piece of cake;' 'It's only one extra glass of wine,' etc.), if each

99 episode is sufficiently repeated. However, in terms of overall risk for obesity, it is clear that
100 the frequency and magnitude of overconsumption episodes are fundamentally important.

101

102 Moreover, an immediate limitation of relying on a single assessment is that there is often
103 little or no consideration of the individual's eating and activity behaviours outside the
104 laboratory. When considering risk factors for overweight and obesity, the key issue is
105 therefore whether episodes of overconsumption are compensated for by subsequent
106 behavioural adjustments. Therefore, overconsumption as defined by a single eating episode
107 is insufficient and invalid to classify a person as an 'overconsumer'. That is, a person may be
108 at greater risk of weight gain, but it is not inevitable if the individual is able to regulate their
109 eating or activity to compensate for episodic overconsumption. Only a small number of
110 studies to date have examined behavioural compensation for laboratory food intake (e.g. [16,
111 17]).

112

113 Overall energy balance, including compensation for changes in energy intake or expenditure,
114 can be observed only over a longer period [18]. Therefore, when drawing conclusions of
115 practical and clinical significance, instances of overconsumption relative to energy
116 requirements must be examined on multiple occasions over a longer time period.

117

118 Body weight and composition as markers of overconsumption

119

120 In the context of chronic energy imbalance, a robust and objective marker of
121 overconsumption is an increase in body weight. It is acknowledged that in the short term,
122 body weight is influenced by hydration levels, and that weight changes conceal changes in
123 body composition. Increased body weight implies a chronic positive energy balance, which

124 results from an excess of energy consumed relative to need (overconsumption). However,
125 simply tracking body weight or fat mass will conceal the acute episodic processes and
126 mechanisms that cause overconsumption. Further, body weight and composition are unlikely
127 to alter measurably in response to single overconsumption episodes. Therefore, while body
128 weight is a useful indicator of overconsumption, it should be applied with caution.

129

130 Overconsumption assessed relative to energy requirements

131

132 As discussed, research is increasingly concluding that overconsumption and obesity must be
133 considered within an energy balance framework [4]. Only consumption that consistently
134 exceeds energy requirements will lead to a positive energy balance, and for analysis of its
135 role in the aetiology of weight gain, it is critical that food intake is considered in the context
136 of individual energy requirements.

137

138 Currently, this approach is applied in very few contexts. Overfeeding studies tend to consider
139 total energy requirements when determining how much surplus energy to add to the habitual
140 diet (e.g. [19, 20]). Similarly, food consumed within a single eating episode may be
141 considered as a proportion of total daily intake. This approach is utilised by food
142 manufacturers to indicate recommended serving sizes, which are based on a nominal
143 percentage of the average adult's daily energy intake requirements. While this rough
144 estimate may serve as a consumer guide, it is insufficient and invalid for the purposes of
145 research into overconsumption; not least as it is based on a single-episode assessment and
146 ignores issues of individual variability. Further, the percentage required for consumption in a
147 single session to be excessive (relative to energy requirement) is necessarily subject to a
148 range of factors. For example, if the food eaten comprises the main meal, it would be

149 expected to contain a larger proportion of the day's energy, whereas the same percentage of
150 total energy intake extra-meal (i.e. as a snack) might indicate an excess. These issues
151 highlight the problem of assessing overconsumption within a single eating episode, and
152 imposing a daily time-frame on total energy requirements.

153

154 Conclusion

155

156 In summary, while overconsumption is a relative term, it is only meaningful for obesity risk
157 when considered relative to individual energy requirement. Only food intake that
158 consistently exceeds energy expenditure will foster a positive energy balance and lead to
159 weight gain. At present, surprisingly few laboratory studies of behavioural obesity research
160 take these considerations into account in their design and interpretation. A standardised
161 methodological platform to measure overconsumption is required.

162

163 **** Conclusion for what to be done in clinical setting to detect overconsumption of food****

164

165 The issues raised here, together with the importance of the study of overconsumption in
166 obesity research, suggest a need for further review and consensus on methodology. An
167 accurate and testable working definition of overconsumption is necessary in order to properly
168 investigate its role in the aetiology of obesity. Further research within the field should give
169 adequate consideration to the reliability and reproducibility of measures of food intake, as
170 well as the validity of any measure within the wider context of its role in energy balance and
171 weight gain.

172

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177

178

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