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Title : Body misperception : a complex, multifaceted issue to be taken into consideration in obesity

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Abstract :

Body misperception could predispose to obesity, by masking excess weight and/or hunger and satiety signals, and by promoting emotional eating and difficulties engaging in physical activity. Thus, it may also be an obstacle to the management of persons with obesity. This narrative review describes the different types of troubles of the relationship with the body that can be encountered in obese subjects, and groups them into three main categories, namely: silhouette distortion, alteration of internal bodily signals pertaining to food, and impaired perception of interoceptive input. Each of these categories is detailed in terms of its clinical phenotypes and potential mechanisms involved. The therapeutic challenges posed by these various disorders are also developed, as well as the limitations of the main instruments available to identify them. The authors conclude that body misperception should be systematically investigated in the clinical management of obesity.

Key Words : obesity, silhouette, perception, interoception, body image

Introduction

Obesity is generally defined as a multifactorial disease that leads to an increase in fat mass that is a source of multiple complications⁽¹⁾. This increase in body size is universally measured by the body mass index (BMI). It is a source of social stigmatisation and low self-esteem, which may generate or perpetuate emotional eating, thereby contributing in turn to excess weight gain⁽²⁾. However, excess weight is not always associated with negative stigma⁽³⁾, and on the contrary, may actually be

considered as a marker of social rank^(4,5), which in turn may hamper recognition of obesity as a health problem.

In addition to these issues, the relationship to and with one's body is likely to be perturbed by excess weight, and can negatively influence the main factors regulating weight (namely eating and physical activity). The relationship of an individual with their body is a multi-dimensional concept and is the combined result of sensitivity to exteroceptive stimuli (sensory aspect), interoceptive input (internal body sensations related to the autonomic nervous system functions such as heartbeat, digestive functions...) and proprioceptive information (sensations relating to the position of one's body in space)⁽⁶⁾. All these different elements combine to constitute an unconscious image of the body that is the reflection of the emotions generated by these various sensibilities all through one's life⁽⁷⁾. Body image is not a static phenomenon, but is also an action-image (when the body is moving) that plays an essential role, not only in defining the boundaries of the self, but also in differentiating the self from the surroundings being perceived⁽⁷⁾.

In psycho-analysis, body image and perception of sensations are constituent elements of the psychological self⁽⁸⁾ but are always somewhat out of synch with the objective reality, and this can create narcissistic gaps or an anxiogenic interpretation of certain bodily manifestations^(9,10). Thus, body image is necessarily subjective and varies between individuals.

According to Hilde Bruch⁽¹¹⁾, a distorted body image and an impaired appreciation by the subject of their own capacity are important issues in obesity.

Furthermore, Stunkard et al^(12,13) showed that in adults with obesity, more than half of those who developed obesity before or during puberty, had a distorted image of their body, accompanied by impaired interpersonal relationships, which is rarely the case in those who become obese during adulthood.

A significant association has been shown between body image disturbance and binge eating disorder (BED) in a sample of obese females⁽¹⁴⁾. Poor interoceptive awareness has been shown to be associated with the presence of eating disorders ⁽¹⁵⁾, whereas greater interoceptive awareness is a protective factor against the development of disordered eating⁽¹⁶⁾. Indeed, it has been reported that sensitivity to interoceptive input is associated with the activation of specific brain areas, in particular the anterior insular cortex⁽¹⁷⁾, which plays a key role in the regulation and appraisal of emotions^(18,19).

The relationship of an individual to their body therefore seems to be an avenue worthy of further investigation in obese subjects. However, the evaluation of this relationship is not standardized in clinical practice.

The objective of this narrative review is not to perform a systematic or an exhaustive review of studies concerning body perception in subjects suffering from obesity, but rather to describe the state of knowledge in terms of the different disorders that exist, to describe them and to explain why it is relevant to take them into account in the clinical practice of obesity management.

To this end, a Working Group composed of experts from various disciplines and backgrounds was constituted and convened on three occasions. The group was

comprised of: a psychiatrist-addictologist specialised in obesity; a nutrition physician specialised in the management of subjects with eating disorders; specialists in education science with experience of learning and body perception in chronic disease; a teacher of adapted physical activities specialised in working with obese subjects and who has previously developed various approaches to body-oriented therapies, a specialist in sports science, and a therapist for victims of psycho-sexual trauma specialised in helping victims reclaim their body.

The different types of body misperception likely to be encountered in obese subjects were classed by the Working Group. In addition, a detailed and focused search of the literature in Medline and PsychInfo was performed to ensure that all relevant categories were identified, and also to enrich descriptions of the categories identified by the Working Group. A non-exhaustive review of instruments used to evaluate body perceptions in adults was also performed.

The disturbances to the relationship with the body identified by this Working Group as most likely to be encountered in subjects with obesity were classed into three overriding dimensions, namely: Distortion of the silhouette; Alterations to internal food-related signals; and Impaired perception of interoceptive bodily input. Our search of the literature did not reveal any additional categories likely to be of clinical relevance in this population.

Distortion of the silhouette

The majority of studies investigating silhouette distortion have reported that the parents of obese children tend to under-estimate their child's weight⁽²⁰⁻²²⁾. This finding, widely reported in the literature, certainly cannot in its own right justify considering overweight as a health problem, but may be a contributing factor to weight gain⁽²³⁻²⁵⁾. The under-estimation by parents of their child's weight can be explained by the parent's desire to think that larger infants indicate good health, or reserves to protect against possible shortage⁽²⁶⁾. The fact that children with obese parents are more likely to have misperceptions about what normal weight is⁽²⁷⁾ suggests that this is an acquired disturbance of body image stemming from their environment, where they integrate the family's visual norms⁽²⁸⁾. Accordingly, repeated exposure to heavy body weights was shown to cause overweight men to underestimate their own body weight⁽²⁹⁾, and a positive association has been reported between the prevalence of obesity and the level of weight underestimation in the population⁽³⁰⁾. Failure to perceive a change in weight is frequent in the months following bariatric surgery, whereby the person continues to head for the "large sizes" clothes rack despite having lost a massive amount of weight^(31,32). This pleads in favour of the hypothesis that it takes time to integrate a new extrinsic or intrinsic body weight. However, it has been reported that during weight loss programmes, some patients expressed concerns about their change in body weight, and possible ego boundary permeability⁽³³⁾. Furthermore, people from underprivileged socio-economic groups more frequently tend to under-estimate their body weight^(34,35), which pleads in favour of the idea that the reality of the body is effaced, unconsciously supporting the benefits of eating⁽³⁶⁾ and/or the symbolic dimensions (e.g. social status, protection) that are inherent to large body size^(11,37,38). This situation is similar to anorexia nervosa, where overestimation of body weight serves to legitimize the control

behaviour⁽³⁹⁾. The arguments that underpin this effacing process include the fact that people with obesity often underestimate their own weight⁽⁴⁰⁾, and may suddenly become aware of their weight gain through coincidental discovery of their real image through social networks, for example. Some authors have postulated that this underestimation could be a protective mechanism against depression^(41,42). However, other mechanisms could also be implicated, such as impaired accuracy estimating tactilely-perceived cutaneous stimuli⁽⁴³⁾.

Alterations to internal food-related signals

Intuitive eating involves physiological regulation of food intake in response to the body's needs based on internal physiological cues (hunger and satiety)⁽⁴⁴⁾, but these cues may be subject to a range of impairments. Hunger signals are often poorly recognized, or confused with just wanting to eat in subjects with obesity^(45,46). As reported by Hilde Bruch⁽¹¹⁾, the construction of hunger cues is not innate and is acquired during early interpersonal experiences, which, when appropriate, make it possible to identify that specific bodily sensation in the same way as other bodily needs. A failure to properly integrate the hunger signal can generate confusion between actual hunger and other bodily events (such as those induced by stress and anxiety), leading the person to eat in order to relieve any perceived internal or external sensation of discomfort⁽¹¹⁾. The feeling of hunger can sometimes generate anxiety (archaic anxieties) further to inappropriate responses during early feeding experiences, or due to a period of prolonged starvation, leading the person to systematically eat in anticipation (and thus, excessively) in order to avoid feeling hungry⁽¹¹⁾. Other works have underlined that the feeling of satiety can also be suppressed by "forced" feeding, unconsciously intended to

relieve a mother's anxiety about a potential lack of food for her child⁽⁴⁷⁾. Research by Françoise Dolto showed that certain areas of the organism were not mentally integrated, and the body image was thus incomplete, when the functionality of those areas was not respected⁽¹⁰⁾.

Impaired integration of internal hunger and satiety cues is not, however, the only causal factor in obesity. Indeed, other environmental factors occurring later in life and at different ages can interfere with these signals, such as sleep disorders and stress⁽⁴⁸⁻⁵⁰⁾. Similarly, cognitive restriction, fostered by restrictive diets and the thin-ideal culture, makes it impossible to align with internal signals, and the frustration this creates can in turn foster the onset (or maintenance) of impulsive eating behaviours⁽⁵¹⁾.

Increased eating rate (tachyphagia) is now established as a risk factor for over-eating during meals, and should systematically be screened for, because it mitigates sensitivity to food signals and contributes to altering satiety signals⁽⁵²⁾. Impaired external sensory stimulation, linked to an affective deficiency, may also lead to hyper-hedonic eating and thus, excess weight gain⁽³⁶⁾.

Impaired perception of interoceptive bodily input

A number of emotions can cause a person ingest food to relieve them. This emotional eating, in a more or less impulsive manner, is frequent in case of a feeling of boredom, whose true origin warrants investigation. The boredom in question may indeed often be a feeling of "emptiness" or loneliness reflecting a lack of affection or a history of traumatic abandonment that is relieved by eating, both literally and figuratively, albeit temporarily^(36,53,54).

Based on our own experience and on literature data, poor interoceptive awareness (considered as difficulty identifying internal bodily signals) is associated with alexithymia and contributes to increasing anxiety in these situations⁽⁵⁵⁾.

The intensity and interpretation of emotions are strongly influenced by interoceptive input^(56,57). People who are sensitive to their internal bodily cues have been shown to be better at dealing with their emotions than those who are less sensitive to interoceptive input^(58,59). The most anxious patients are those who are least adept at perceiving their internal bodily cues⁽⁶⁰⁾. Evaluating anxiety sensitivity may contribute to improving our understanding of greater calorie consumption and physical activity avoidance in persons with obesity⁽⁶¹⁾. Indeed, anxiety sensitivity refers to the fear of experiencing anxiety-related symptoms due to the belief that somatic stimulation, and the anxiety itself, will have catastrophic consequences⁽⁶²⁾.

Poor interoceptive sensitivity is also associated with increased body ownership malleability which may influence security perception towards others⁽⁶³⁾. This may be explained by neurophysiological findings showing that body representation requires multi-sensory stimulation (seeing, touching, proprioception)⁽⁶⁴⁾. Feelings of body ownership and kinesthetic memory are related to bodily aptitudes generally acquired through movement- and feelings-based stimulations, such as play, physical/sports activities, physical education⁽⁶⁵⁾.

People with obesity appear to have impaired interoceptive sensitivity compared to normal-weight subjects⁽⁶⁶⁾, although their pain threshold does not appear to be decreased⁽⁶⁷⁾. Obese individuals also appear to have a reduced ability to decode their

emotions than normal-weight individuals⁽⁶⁸⁾.

It is probable that the pervasive pain caused by osteo-articular complications of obesity contributes to amplifying this poor interoceptive awareness. Indeed, the higher the body mass index, the more likely the person is experiencing pain in the lumbar or cervical region, or the feet, hands or hips⁽⁶⁹⁻⁷³⁾. This may lead a person with obesity to engage in eating as a means to respond to the emotions caused by the pain⁽⁷⁴⁾. In addition, kinesiophobia may develop, namely a fear of pain due to movement. This phenomenon needs to be taken into account in the management of patients with obesity⁽⁷⁵⁾, particularly those with morbid obesity ($\text{BMI} \geq 40 \text{ kg/m}^2$)⁽⁷⁶⁾. Kinesiophobia may be present even in individuals who have no real functional impairment of amplitude or strength⁽⁷⁷⁾. This fearful behaviour can be caused by reactions to exercise commonly experienced in people with obesity (that is discomfort, dyspnea, musculoskeletal or joint pain). Cooper *et al.* showed that pain was firstly an important factor in the decision and motivation of obese patients to lose weight, but secondly, it was also a limiting factor on the type and amount of physical activity, and thus, a barrier to weight-loss efforts. This latter effect seems to stem from the belief that physical activity incurs a risk of injury and additional pain⁽⁷⁸⁾.

A history of sexual abuse at the root of obesity, notably when the abuse occurred during childhood⁽⁷⁹⁾, frequently leads to the suppression of sensations that spontaneously arise in the body, such as hunger and satiety (respectively generating a feeling of “filling” while eating, and “relaxation” afterwards), via a phenomenon of disconnection or dissociation from the body^(80,81). This may be improved by approaches based on body-oriented therapy⁽⁸²⁾.

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256 The bodily “me” schematically corresponds to the perception of feelings generated by
257 multiple mental, emotional and physical inter-connections; if all of these stimuli are not
258 harmoniously integrated, then the individual may feel disconnected from their
259 body^(83,84). A distinction has been described between the body one has, and the body one
260 is, in the case of excess body weight^(85,86). The body is under-employed, cumbersome,
261 useless, and becomes a problem. Body awareness is progressively losing its importance
262 in today’s society. Restrictions in both physical activities and sensations, due to this
263 body disconnection, result in limitations on the field of action and initiative and this can
264 cause unhappiness⁽⁸⁷⁾. In the case of obesity, the body comes to the individual’s
265 attention again in the form of symptoms. Thus, certain bodily cues can be felt to
266 generate anxiety, such as the perception of one’s heart beat during exercise^(88,89). This
267 acts as a barrier to the implementation of therapeutic modifications in lifestyle,
268 particularly physical activity, which is recommended in obesity as well as in several
269 other chronic diseases.

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271

272 **Discussion**

273 This narrative review shows that the relationship to the body is complex and
274 multifaceted in individuals with obesity, and there is the potential for disorders among
275 any of the three dimensions identified. The presence of a disordered relationship to the
276 body should prompt suspicion of an impaired overall body image, although without
277 prejudging the semiological heterogeneity of such an impairment, either among the
278 different dimensions, or within each individual dimension.

Accordingly, a subset of individuals with obesity may present, for example, a lack of awareness of the real size of their body, difficulties identifying hunger and satiety cues, a feeling of insecurity towards certain bodily sensations that lead to emotional eating and/or difficulty performing physical activity.

In spite of these important points, which have been well established in the literature in recent years, the majority of diagnostic tools habitually used in the clinical management of obese subjects are mainly focused on diet, physical activity and the various complications of excess weight. The evaluation of the relationship to the body in obese individuals is primarily considered once its consequences are apparent, notably the disability or handicap that it may entail.

Identifying body misperception

Integrating management of body misperception into the pathway of care for subjects with obesity calls for easy and clear identification of such disorders.

Indeed, 43 different means of assessment were found in the non-exhaustive literature review, including scales, questionnaires, one simple question, or other evaluation processes using mirrors or video recording.

Identifying impaired perception of interoceptive bodily input seems the most difficult. The evaluation of interoceptive capacity classically relies on the heartbeat-perception task, which calculates the difference between the number heartbeats counted by the subject (without feeling for their pulse) and the number of heartbeats actually recorded on the ECG, at rest⁽⁹⁰⁾. Specific psychometric scales for interoception have also been developed. The Scale of Body Connection (SBC) is one of the first such tools to have been validated. It includes items measuring body awareness, but also bodily dissociation⁽⁹¹⁾.

Another such tool is the Multidimensional Assessment of Interoceptive Awareness (MAIA), designed to evaluate mind-body awareness⁽⁶⁾, and the MAIA has become a widely-used tool in research in the fields of behavioural therapy and neuropsychology. The 44-item Body Attitude Questionnaire (BAQ) was also developed with a view to assess the range of attitudes women hold towards their bodies⁽⁹²⁾. It explores six distinct dimensions, including feelings of overall fatness, self-disparagement, strength, salience of weight, feelings of attractiveness and consciousness of lower body fat, with this latter dimension being of particular interest in obesity⁽⁹³⁾. Kinesiophobia or fear of movement can be evaluated using the 17-item Tampa Scale for Kinesiophobia (TSK)⁽⁹⁴⁾. Questionnaires have also been designed to assess the efficacy of therapies specifically intended to address interoceptive impairment (e.g. mindfulness interventions), such as the Five Facet Mindfulness Questionnaire (FFMQ)⁽⁹⁵⁾.

Limitations of instruments to detect a disordered relationship to the body

The main criticism levelled at these different tools is that they fail to clearly distinguish between two dimensions of the supposed interoceptive deficit, namely 1, the failure to perceive the signals; and 2, non-acceptance of these sensations in case of affective arousal⁽⁹⁶⁾. According to Merwin and colleagues, non-acceptance of affective arousal, rather than difficulty identifying affective states, was significantly associated with avoidance behaviours, which may take the form of binge eating in obese individuals. This is of particular relevance in the management of eating disorders, where therapy mainly targets the regulation of emotions⁽⁹⁶⁾. Recently, a three-dimensional characterisation of interoception was proposed, comprising: 1, interoceptive accuracy (performance on objective behavioural tests of heartbeat detection); 2, interoceptive sensibility (self-evaluated assessment of subjective interoception, gauged using

interviews/questionnaires); and 3, interoceptive awareness (metacognitive awareness of interoceptive accuracy, e.g. confidence-accuracy correspondence). These three dimensions appear to be relevant, given that they are independent and dissociable⁽⁹⁷⁾.

A further criticism of these psychometric tests is that they fail to explore certain aspects of the deficits in bodily perception described above. Prior sexual abuse is substantially under-estimated, even by the most experienced psychiatrists, due to the phenomenon of post-traumatic dissociation⁽⁹⁸⁾. This generally leads to unconscious resistance to weight loss, or even psychiatric decompensation after bariatric surgery, fully justifying the development of clinical tools that would make it possible to diagnose this type of “defensive” reactional obesity. To this end, the bodily dissociation subscale of the SBC may be relevant to assess bodily dissociation (i.e. disconnection between sensations and emotions), and merits further investigation, since an improvement in the bodily dissociation score has been reported after body-oriented therapy in victims of childhood sexual abuse⁽⁸²⁾.

Improved detection of body misperception in the form of silhouette distortion, should also be explored in the search to deepen our understanding of this category of misperception, often present in individuals with obesity. Detecting distorted body image based primarily on the use of Stunkard’s Figure Rating Scale⁽⁹⁹⁾ is relatively easy to implement, but not very sensitive in clinical practice of obesity management, due to weight cue reactivity^(100,101).

Therefore, it is clearly necessary to better identify body misperception, in order to propose targeted therapeutic solutions, and thus, better meet the needs of individuals with obesity.

Therapeutic avenues towards addressing body misperception

In perspective, several supportive cares can be highlighted, and could be explored in regards to body misperception management.

Therapeutic approaches for silhouette distortion correction have been shown to be promising, such as those based on improving the integration of proprioceptive cues⁽³¹⁾ or body perception using a virtual reality body-swapping protocol⁽¹⁰²⁾.

The body scan, a method derived from mindfulness-based stress reduction techniques was shown to improve interoception⁽¹⁰³⁾ and could have potential for use among obese subjects who eat to control boredom or anxiety. Mindfulness contributes to improving emotion regulation by increasing interoceptive awareness⁽¹⁰⁴⁾, thereby enabling improved integration of psychological distress, limiting the propensity to eat in this context, even reducing binge eating⁽¹⁰⁵⁾. The practice of yoga or meditation has also been shown to be associated with increased mental awareness of, and reactivity to bodily cues⁽¹⁰⁶⁾. Body consciousness and mental representations are often impaired in obese subjects, and these dimensions, as well as body perception at rest or in motion can be improved through a dance therapy workshop, for example, in the framework of specific management programmes⁽¹⁰⁷⁾. Engaging in adapted physical activity could be a promising intervention to reduce kinesiophobia, in addition to being one of the fundamental recommended practices for the management of obesity⁽¹⁰⁸⁾. In addition,

optimising interoceptive awareness could increase the individual's motivation to engage in physical activity by reducing the physical load, and reduce the incidence of musculoskeletal injury⁽¹⁰⁹⁾.

The identification and integration of hunger and satiety signals is a therapeutic strategy that is becoming common practice, and has been used in specific studies targeting meal time to foster more intuitive eating regulation⁽¹¹⁰⁾. The educational approach deserves to be broadened since non-intuitive eating may potentially be the expression of a widespread interoception impairment. Indeed, as Herbert et al. reported, the cardiac awareness was positively related to greater sensitivity for gastric filling⁽¹¹¹⁾.

It should also be underlined that the non-acceptance of their body by obese individuals, because of its "size", is a potential limiting factor that can hamper the efficacy of interventions targeting interoceptive awareness, and can require prior intervention to improve self-esteem. Excess weight limits physical activity⁽¹¹²⁾, while the depressed mood that results from painful comorbidities reduces the feeling of self-efficacy in this population⁽⁷⁸⁾. These are not the only factors involved in cutting off obese individuals from their body, since individuals who have experienced past trauma, or whose education from their parents favoured concealing emotions and ignoring bodily sensations, tend to have a relational deficit with their body, and poorer interoceptive awareness^(113,114).

Conclusion

Body misperception in individuals with obesity is complex, multifaceted and person-dependent. They should be screened for systematically using multidimensional

instruments, in order to offer the most appropriate therapeutic strategies. Such an approach would not only favour multidisciplinary management of obesity, but would also be more meaningful for the patients, and could help the patients to perceive the recommendations given to them as being less restrictive.

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