

# Why do people overeat? Hunger, psychological eating and type 2 diabetes

In this article, Dr Sean Wheatley and Matthew Whitaker discuss key drivers of hunger, explore why individuals overconsume certain foods, and introduce practical methods for identifying and addressing psychological eating.

Recent research has helped us understand the physiology of type 2 diabetes mellitus (T2DM), including how remission is possible for many.<sup>1-4</sup> This allows for a more positive perspective in the management of T2DM, which until recently was considered to be a progressive condition.<sup>5</sup> But increased knowledge of the relevant physiology will have little practical application if the psychological and social factors that cause individuals to overconsume certain foods are not addressed. For many people these factors are the true cause of T2DM.

## What causes hunger?

True hunger is an important mechanism to ensure individuals consume enough energy and nutrients to meet their body's needs, but people often perceive hunger for entirely different reasons. It is arguably these reasons that lead to the overconsumption of food. There are a large number of factors that influence these drivers of hunger; a simplified representation of the relationships between some of them can be seen in Figure 1. Some relevant factors, such as genetic,<sup>6-11</sup> environmental<sup>12-14</sup> and socio-economic factors<sup>15,16</sup> are largely non-modifiable, at least on an individual level. The current review will focus on psychological, social and physiological elements which may be more within the control of the patient.

## Psychological stimuli of overeating

It is likely that the psychological stimuli of eating in individuals with T2DM, and particularly during the development of this condition, are similar to those of the non-diabetic population. Certain traits may be more likely in overweight and obese individuals than those without excess adiposity.<sup>17-24</sup>

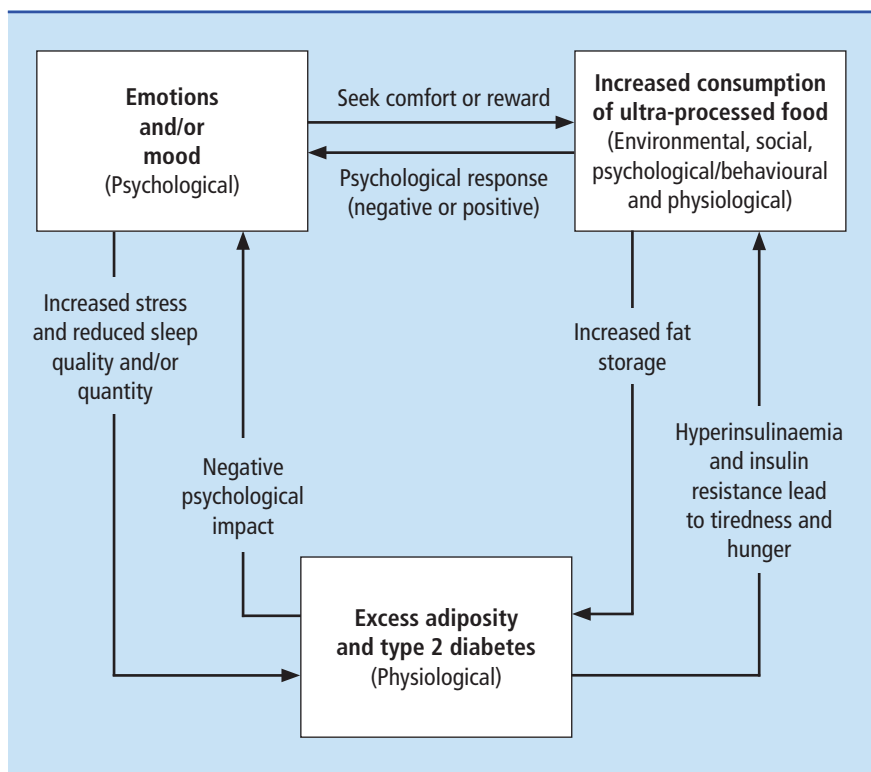


Figure 1. A simplified overview of how factors related to hunger and type 2 diabetes impact on each other

However, the differences between those with and without T2DM are likely down to whether their personal fat threshold has been exceeded,<sup>25</sup> i.e. are physiological, rather than being determined by any unique psychological or emotional factors.

Certain psychological drivers of overeating are influenced by conscious perceptions, for example formed opinions and judgements regarding flavour, energy content, cost and healthfulness will play a role;<sup>26,27</sup> but we will largely be focusing on factors that influence eating behaviour on a sub-conscious level. An important issue that is beyond the scope of the current review is the role of eating disorders, though many others have addressed this (for example<sup>28-30</sup>). Where disordered eating is present it is essential that specialist care is provided.

## Hedonic eating

When an individual continues to eat even after their body's energy and

nutrient demands have been met it is called hedonic eating. Hedonic eating is often driven by the rewarding properties,<sup>31,32</sup> palatability,<sup>33-35</sup> and even the availability, variety or convenience of foods.<sup>36-39</sup> For many people hedonic eating is a major cause of food overconsumption, with the desire to seek the pleasurable effects of consuming foods being able to override homeostatic feedback mechanisms.<sup>11,40</sup>

Hormones known to be pivotal in the homeostatic regulation of feeding are also thought to play a role in the motivation to obtain food<sup>41-43</sup> and in determining the hedonic responses to foods.<sup>44,45</sup> In fact, it has been suggested by some studies that the primary action of leptin on the control of body fatness is through its influence on the brain rather than the rest of the body; with dysfunctional responses seen in overweight and obese individuals.<sup>46-49</sup> The influence of these hormones on the regulation of eating is likely at least in

part due to their influence on the pleasure seeking, habit forming neurotransmitter dopamine<sup>41</sup> which is associated with the desire for food.<sup>50,51</sup> Obese individuals have been shown to have irregular dopamine responses<sup>17</sup> and a reduced reward response after consuming foods.<sup>19,31</sup> They may therefore need to consume more to experience the same pleasure sensations, increasing the tendency to overeat.<sup>52,53</sup> The activation of reward pathways has also been shown to be different in people with T2DM compared to insulin sensitive individuals,<sup>54</sup> which may help to explain relationships observed between hedonic eating and T2DM control.<sup>55</sup>

The impact of eating for pleasure is not limited to the immediate impacts of food choices, as a single case of hedonic eating can trigger increased food intake over several days.<sup>11</sup> The perspective that 'a little treat won't hurt' may therefore be more damaging to certain individuals than realised. Research has also found differences in anticipatory responses to food between overweight and normal weight participants,<sup>18,19</sup> including in dopamine level changes,<sup>56</sup> and between people with and without T2DM.<sup>54</sup> These differences affect the perception of reward, increasing the motivation to seek out and consume certain foods.

### Palatability

Food selection is heavily influenced by the sensory properties of the food,<sup>57–60</sup> and as such food palatability is an important driver of eating behaviour.<sup>14</sup> Certain foods are developed to be hyper-palatable<sup>61,62</sup> and elicit higher reward responses than other foods. These foods can override the body's homeostatic feedback mechanisms, leading to overconsumption. The foods that are deemed to be most palatable are those that are rich in fats *and* refined carbohydrates, as well as tending to contain more sodium and less protein and fibre,<sup>63–65</sup> rather than any individual macronutrient being the driver in isolation or independent of its source and quality. The negative influence of ultra-processed foods has been demonstrated by a recent study which found individuals had a significantly greater energy intake

when ultra-processed foods (defined according to the NOVA classification<sup>66</sup>) were provided compared to when unprocessed foods were made available.<sup>67</sup>

The palatability of foods influences the perception of appetite,<sup>68–71</sup> eating frequency and portion sizes,<sup>11,72,73</sup> with appetite returning more quickly following a meal when it is perceived to be more palatable.<sup>68,69</sup> This means it is less likely for there to be a subsequent compensatory reduction in food intake following a palatable meal.<sup>14</sup> Other evidence supports this, with palatable foods leading to reduced satiation after meals (generally speaking the more palatable a food is, the lower its satiety index<sup>74</sup>) and promoting excess energy intake in both the short<sup>63,75</sup> and long term.<sup>63</sup> Importantly, food palatability has a greater impact on food intake when people are satiated than when they are hungry.<sup>76</sup> This supports the important role of food palatability as a driver of hedonic eating,<sup>33–35</sup> and thus as a possible principal cause of food overconsumption. Evidence suggests that obese individuals consume more highly palatable foods than normal weight participants.<sup>77–79</sup>

### Habitual eating

The body has anticipatory mechanisms, or cephalic phase responses, to prepare for meals.<sup>80</sup> But as well as priming the body for digestion these responses influence when we feel hungry (both ghrelin, a hunger hormone, and leptin, a satiety hormone, appear to have a cephalic phase<sup>81,82</sup>) and affect meal size and duration.<sup>80</sup> In practice this means our body will stimulate hunger at times when we are used to eating,<sup>83–85</sup> independent of energy or nutrient requirements. The regular consumption of more palatable foods results in stronger cephalic responses,<sup>80</sup> driving appetite.

Importantly, these cephalic phase responses can be conditioned through experience and learning.<sup>80,86,87</sup> It may therefore be possible for individuals to be re-trained so they do not expect meals at the same times each day, or of the same size at each meal. Although resisting the urge to consume food in

response to this cephalic phase driven hunger may be difficult, evidence shows that an increase in hunger due to the anticipation of a meal subsides if the expected food does not arrive.<sup>80</sup> A reliance on will power should not be considered a long-term strategy for the management of weight, but in the short term this may be necessary while these cephalic responses are being reconditioned.

### Stress, sleep and emotional eating

Links have been reported between psychosocial stress and the drive to eat, consumption of palatable foods, and fat gain,<sup>88–91</sup> while individuals with higher cortisol levels report more frequent snacking.<sup>92</sup> These associations are observed more often in overweight and obese individuals.<sup>20,22</sup> Importantly, the foods individuals choose when eating in response to stress tend to be hyper-palatable foods with a high energy density<sup>93–96</sup> which are consumed even in the absence of hunger or homeostatic requirements.<sup>97</sup> Stress also appears to have an impact on the perceived palatability of foods, and the associated reward response, which may help to explain these findings.<sup>98</sup> The response to stress appears to have a highly individualised effect on food intake,<sup>20,99,100</sup> though the degree of stress may impact on this with mild stress being more likely to prompt increased consumption.<sup>101</sup> More research is required to confirm these links, though the reduction of stress is a worthwhile pursuit regardless as other health benefits are likely.

Certain emotions can also lead to hedonic eating.<sup>102</sup> In response to negative emotions such as grief, distress or reduced mood, for example, many people turn to food for comfort.<sup>103,104</sup> The response to using foods as a coping mechanism is often guilt and worsening mood,<sup>105</sup> creating a vicious cycle. It is therefore important that individuals have appropriate support and can identify non-food related coping strategies to avoid this occurring regularly. T2DM is often associated with negative emotional states, including mood disorder<sup>106</sup> and depression,<sup>107</sup> thus individuals with T2DM may be more likely to eat for emotional reasons. Diabetes UK has

recently launched a resource to help health care professionals address these issues with their patients.<sup>108</sup>

The use of food as a reward is also common, and certain foods (alongside peer pressure and reduced inhibitions) are ubiquitous at celebrations and during festive periods.<sup>109</sup> One study found that weight gained during the festive period was responsible for a large proportion of total weight gain, and that the number of social engagements attended in this period was predictive of how much weight was gained.<sup>110</sup> As well as hedonic eating, social and cultural factors may help to explain why people often overeat at such occasions.<sup>111</sup> It is important for individuals who are susceptible to over-consuming foods at events like these to identify non-food related rewards and strategies for preventing this.

Sleep is another important factor, with sleep deprivation increasing reward sensation and willingness to spend money on food.<sup>112</sup> Having insufficient sleep can also have a direct impact on leptin and ghrelin, increasing hunger.<sup>113</sup> Supporting these observations, sleep duration has been shown by some studies to be a predictor of body mass index.<sup>114,115</sup> Taking measures to improve sleep quality and quantity may therefore be another useful strategy to help regulate eating behaviour.

**Food ‘addiction’**

Although some authors have concluded food addiction should be classified as a clinical condition,<sup>116,117</sup> whether or not someone can truly be addicted to food is still controversial<sup>118</sup> with knowledge around the behavioural and biological consequences of repeated consumption of palatable foods limited.<sup>41</sup> It has been demonstrated that the impact of palatable foods shares certain pathways, for example those within the limbic system increasing dopamine signalling, with drug abuse.<sup>119–124</sup> Addiction to drugs occurs when prolonged activation of these systems results in cellular and molecular changes,<sup>120</sup> but there is limited evidence in humans of comparable chronic adaptations in relation to food consumption. Evidence supporting the presence of food addiction includes that changes in sensory responses to

**Box 1. Possible indicators of non-physiological eating**

- Craving certain foods despite feeling full
- Preoccupation with food
- Eating certain foods in large amounts whenever they are consumed
- Often eating to the point of feeling uncomfortable and/or bloated
- Feeling guilty after eating
- Making excuses to justify eating
- Hiding eating behaviours from others
- Understanding that eating behaviours are causing health problems but being unable to stop them
- Being unable to stop eating at certain times, e.g. during the evening
- Using certain foods as a reward or to suppress negative emotions

food in obese individuals can impair their ability to gain pleasure from non-eating related activities,<sup>21</sup> while cravings and relapses have also been observed.<sup>125–127</sup>

Whether or not we consider it to be a true addiction, addictive-like behaviours in humans can be measured using the Yale Food Addiction Scale (YFAS). (The scale is reproduced in Appendix 1, available online at [www.practicaldiabetes.com](http://www.practicaldiabetes.com).)<sup>128</sup> Food addiction as assessed using this method was nearly five times higher in overweight and obese people than the general population in one systematic review (33% versus 7%),<sup>24</sup> and was as high as 70.7% in people with T2DM in another study.<sup>129</sup> The YFAS may therefore be a useful tool to help identify individuals who have an unhealthy relationship with food.

**Weight loss and hunger**

Although the impact of changing body composition on hunger is not well understood,<sup>130</sup> hunger during weight loss is consistently associated with changes in lean and fat-free mass.<sup>131–137</sup> Therefore, consuming sufficient protein and incorporating resistance training may be important to maintain lean mass and help prevent compensatory increases in hunger.<sup>138</sup> The loss of fat mass may also have a counterproductive influence on certain hormones. For example, as leptin is primarily secreted by adipose tissue a reduction in fat mass reduces leptin levels (and thus satiation).<sup>41</sup> Leptin is also associated with dopamine production, so reduced levels may trigger overeating as individuals may seek a return of the reward response dopamine facilitates.<sup>41</sup> Overweight and

obese individuals often have elevated leptin levels yet also have high levels of hunger<sup>139</sup> highlighting that these relationships are not linear, however, with this picture being complicated by the fact we have an incomplete understanding of the role of leptin resistance.<sup>140,141</sup>

It is often asserted that increasing physical activity to create an energy deficit will result in a compensatory increase in appetite, but, in relation to acute bouts of moderate intensity exercise at least, this is not supported by the literature.<sup>142,143</sup> There is evidence of inter-individual variability in the behavioural response to changes in physical activity (as well as changes in diet) though<sup>144,145</sup> which may be important in determining long-term success. Even beyond this controversy in relation to the stimulation of hunger, the role of physical activity in promoting weight loss is still debated.<sup>146</sup> Evidence suggests that, in isolation, diet may play a more significant role, though combining dietary interventions with increased activity does appear to be a superior approach.<sup>147</sup> However, after any initial weight has been lost maintaining, or even increasing, physical activity levels and/or intensity has been suggested by some studies to be crucial for weight maintenance.<sup>148,149</sup> The role of physical activity in weight maintenance may therefore be even more significant than its role in reducing body weight to begin with. This is again not universally accepted though, and, as is often the case, more research is required. Despite this uncertainty over the importance of physical activity for weight control, the role of physical activity in promoting health improvement is clear and thus it should continue to be widely promoted.

### Identifying psychological eating

Many people are not aware that they are eating for psychological reasons, so the first step is for them to consider if this might be the case. The YFAS can help with the identification of addiction-like behaviours,<sup>128</sup> but there are also a number of other indicators. A selection of these are summarised in Box 1. One practical method that can help identify these behaviours is to keep a food diary: noting the time, circumstances and any feelings and thoughts that coincide with eating. This method can also help to identify whether an individual is eating due to habit or boredom, or in response to other stimuli (positive or negative).

### Managing psychological eating

It is important that individuals find a solution that works for them: there is no one size fits all approach. Making better food choices more often, particularly avoiding ultra-processed foods, is one factor that should be universally promoted; while identifying non-food related responses to positive and negative stimuli may also be important. General factors we have discussed that are associated with health improvement but may also help to reduce psychological eating include reducing stress, improving sleep quality and quantity, and increasing physical activity. Due to the holistic health improvements associated with such measures they should be promoted widely.

Techniques specifically related to behaviour modification can also be effective. It is possible for individuals to improve self-regulatory skills, helping them to make better choices when faced with the kind of tempting food environments that are commonplace.<sup>150</sup> Motivational interviewing<sup>151,152</sup> has been suggested as a good way to encourage individuals to make sustainable changes, while

### KEY POINTS

- Although type 2 diabetes is physiologically due to excess adipose accumulation, the importance of psychological and social drivers of overeating in causing this should not be overlooked
- Seeking food for reasons other than homeostatic requirements is a major driver of overeating. Factors that can cause this include hedonism, habitual eating, and/or eating in response to negative or positive stimuli
- Hyper-palatable and ultra-processed foods should be avoided as much as possible as they can override the body's homeostatic feedback mechanisms, leading to susceptible individuals overconsuming food (which usually has high energy, but low nutrient, density)
- Where psychological eating problems, including disordered eating, are identified support from appropriately trained health care professionals may be required
- Recommendations in line with general health advice can help reduce hunger and overeating – including improving diet quality, increasing physical activity, reducing stress and improving sleep quality and/or quantity. Behavioural interventions such as motivational interviewing and cognitive behavioural therapy can also be effective

mindfulness can be employed to help individuals consider their decisions more acutely.<sup>153</sup> Empowerment approaches can also be a suitable tool for facilitating lifestyle changes<sup>154</sup> and have been demonstrated to be efficacious in the context of structured diabetes education.<sup>155</sup> For individuals who require additional support, cognitive behavioural therapy (CBT) may be a suitable option.<sup>156</sup>

### Summary

Overeating is a multifactorial issue driven by a number of psychological, physiological, social, environmental and genetic factors; but by addressing the drivers that are most relevant to an individual it may be possible to help them modify their behaviours and make sustainable lifestyle changes. Recent evidence showing that it is possible to place T2DM into remission allows positive messages to be communicated to people with this condition, which may help motivate individuals to make any necessary changes.

Changes that may help are consistent with changes associated with other health improvements. These include improving diet, increasing

physical activity, managing stress and improving sleep quality and quantity, though behavioural and motivational support may also be necessary for some people. Food choices may play a particularly important role due to the impact of certain foods (particularly hyper-palatable, ultra-processed foods) on the ability of an individual to control hunger.

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### Declaration of interests

There are no conflicts of interest declared.

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References are available in *Practical Diabetes* online at [www.practicaldiabetes.com](http://www.practicaldiabetes.com).

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**Yale Food Addiction Scale**

Gearhardt, Corbin, Brownell, 2009  
Contact: ashley.gearhardt@yale.edu

This survey asks about your eating habits in the past year. People sometimes have difficulty controlling their intake of certain foods such as:

- Sweets like ice cream, chocolate, doughnuts, cookies, cake, candy, ice cream
- Starches like white bread, rolls, pasta, and rice
- Salty snacks like chips, pretzels, and crackers
- Fatty foods like steak, bacon, hamburgers, cheeseburgers, pizza, and French fries
- Sugary drinks like soda pop

When the following questions ask about 'CERTAIN FOODS' please think of ANY food similar to those listed in the food group or ANY OTHER foods you have had a problem with in the past year

In the past 12 months:	Never	Once a month	2–4 times a month	2–3 times a week	≥4 times or daily
1. I find that when I start eating certain foods, I end up eating much more than planned	0	1	2	3	4
2. I find myself continuing to consume certain foods even though I am no longer hungry	0	1	2	3	4
3. I eat to the point where I feel physically ill	0	1	2	3	4
4. Not eating certain types of food or cutting down on certain types of food is something I worry about	0	1	2	3	4
5. I spend a lot of time feeling sluggish or fatigued from overeating	0	1	2	3	4
6. I find myself constantly eating certain foods throughout the day	0	1	2	3	4
7. I find that when certain foods are not available, I will go out of my way to obtain them. For example, I will drive to the store to purchase certain foods even though I have other options available to me at home	0	1	2	3	4
8. There have been times when I consumed certain foods so often or in such large quantities that I started to eat food instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy	0	1	2	3	4
9. There have been times when I consumed certain foods so often or in such large quantities that I spent time dealing with negative feelings from overeating instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy	0	1	2	3	4
10. There have been times when I avoided professional or social situations where certain foods were available, because I was afraid I would overeat	0	1	2	3	4
11. There have been times when I avoided professional or social situations because I was not able to consume certain foods there	0	1	2	3	4
12. I have had withdrawal symptoms such as agitation, anxiety, or other physical symptoms when I cut down or stopped eating certain foods. (Please do NOT include withdrawal symptoms caused by cutting down on caffeinated beverages such as soda pop, coffee, tea, energy drinks etc)	0	1	2	3	4
13. I have consumed certain foods to prevent feelings of anxiety, agitation, or other physical symptoms that were developing. (Please do NOT include consumption of caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc)	0	1	2	3	4
14. I have found that I have elevated desire for or urges to consume certain foods when I cut down or stop eating them	0	1	2	3	4
15. My behaviour with respect to food and eating causes significant distress	0	1	2	3	4
16. I experience significant problems in my ability to function effectively (daily routine, job/school, social activities, family activities, health difficulties) because of food and eating	0	1	2	3	4

**Appendix 1.** The Yale Food Addiction Scale questionnaire. (Reproduced from Gearhardt AN, *et al.* Preliminary validation of the Yale Food Addiction Scale. *Appetite* 2009;52:430–6). *Continued on the next page*



## SHORT REPORT

Why do people overeat? Hunger, psychological eating and type 2 diabetes

In the past 12 months:	No	Yes			
17. My food consumption has caused significant psychological problems such as depression, anxiety, self-loathing, or guilt	0	1			
18. My food consumption has caused significant physical problems or made a physical problem worse	0	1			
19. I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems	0	1			
20. Over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure	0	1			
21. I have found that eating the same amount of food does not reduce my negative emotions or increase pleasurable feelings the way it used to	0	1			
22. I want to cut down or stop eating certain kinds of food	0	1			
23. I have tried to cut down or stop eating certain kinds of food	0	1			
24. I have been successful at cutting down or not eating these kinds of food	0	1			
In the past 12 months:	≤1 time	2 times	3 times	4 times	≥5 times
25. How many times in the past year did you try to cut down or stop eating certain foods altogether?					

**Appendix 1.** The Yale Food Addiction Scale questionnaire. (Reproduced from Gearhardt AN, *et al.* Preliminary validation of the Yale Food Addiction Scale. *Appetite* 2009;52:430–6). *Continued from the previous page*