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How does Food Affect Mood at Work?

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Research Article

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ABSTRACT

The importance of studying the effect of different types of food on mood, especially at work, has become greatly needed over recent years; this is in great part due to the link between positive mood and different types of organisational spontaneity (giving help to other colleagues, keeping an eye on the organisation's safety, making valuable propositions, developing one's own performance, and fostering goodwill). The present study addressed this need, by investigating whether consuming carb-based foods, protein-based foods, fat-based foods, and not consuming any food had different effects on the mood of working individuals. On the basis of the growing body of research, it was hypothesised that individuals who eat foods high in carbs will have a better mood than those who eat foods high in protein and those who do not consume any food. Due to the discrepancies in the literature findings, it was hypothesised that fats will have an effect on mood; however the direction of this relationship was yet to be assessed. 218 participants completed a food diary sheet, at midday (from 12 pm to 1:30 pm), which included questions about the type of food they had, their mood, their level of fatigue, and their caffeine consumption. Results showed that employees who didn't have any food had a better overall mood than those who had carbs and those who had proteins. Those who had carbs reported better mood than those who had protein. Finally, participants who had fats reported better mood than those who had proteins, controlling for the effects of caffeine and fatigue on mood. There were no significant differences between no-food group and fat-based food group and between carb-based food and fat-based food on employees' mood. In conclusion, no food resulted in the best mood, followed by fat-based foods and carb-based foods, with protein-based foods resulting in the worst reported mood.

INTRODUCTION

The importance of studying the effect of different types of food on mood has become increasingly acknowledged over recent years. Food can be divided into three main food groups: Carbohydrates, fats, and proteins [1]. There are various forms of carbohydrates: Complex carbohydrates (also known as polysaccharides; poly=many and saccharide=sugar), simple carbohydrates (also known as monosaccharide; mono=one and saccharide=sugar) and fibers. The body breaks down complex carbohydrates into more simple units in order for them to be absorbed; this process takes time which means that the body feels satiated for a longer time and the brain receives a constant source of energy. Complex carbohydrates include bread, potatoes, pasta, rice, cereals, oats, maize, muesli, yams, sweet potatoes, and noodles. Simple carbohydrates cannot be broken down to smaller carbohydrate units and therefore these foods are absorbed instantly; this process is immediate and provides a high boost in energy levels, however this boost is only short-term. Shortly after consuming simple carbs, the body will feel hungry again. Simple carbs include chocolate, cakes, candies, soda, jam, fruit juice, and fruits. And finally, fiber-type foods cannot be broken down and digested by the body's enzymes. These foods provide health benefits and increase the feeling of fullness for a longer period of time. Fibers include brown rice, skins and seeds from fruits, and wholemeal cereals [2].

While carbohydrates boost energy levels and contain important nutrients, they do not contain "essential" nutrients for

the body. Unlike carbs, fats are made of essential fatty acids like omega-3, omega-6, linoleic and α-linolenic. In fact, it has been estimated that 10% of the brain's matter is composed of omega-3. Omega-3, omega-6, α-linolenic, and other fatty acids cannot be created by the body and therefore need to be obtained from food. Sources of fatty acids include fish such as Atlantic mackerel, shrimps, tofu, black cod, sardines, Albacore tuna, pacific halibut, arctic char, anchovies, kippers, oysters, and mussels. Other sources comprise vegetable oils such as canola oil, safflower oil and corn oil, as well as soybeans, winter squash, walnuts, avocado, peanuts, peanut butter, coconut, and olives [3].

Finally, proteins, like fats, contain essential nutrients for the body. They contain 6 essential amino acids that cannot be produced by the human body like arginine, cysteine glycine, glutamine, proline, and tyrosine. Amino acids can help in muscle growth and in the formation and the repair of damaged cells. Sources of protein include milk, cheese, yoghurt, eggs, beans, quinoa, white-meat poultry, lean beef, soy, and pork tenderloin [4].

Some researchers suggest that mood affect food choices [5,6], however there is an overall consensus amongst researchers that food precedes mood in the chronological order of the food–mood liaison [6-9]. Mood is defined as the current psychosomatic state (persistent or short-term) [10] or as the prolonged emotion that affects a person's awareness, reasoning, and judgment [11]. Mood can be described in either positive or negative terms (for example, "I feel positive today" or "I am in a bad mood"). Research suggests that positive and negative moods not only bias a person's perceptions of the world and the environment, but they can also influence a person's behaviour as a result of these perceptions. Taking it a step further, mood can and does harm or protect an individual's mental and physical health [12-14].

As mentioned above, there is an overall consensus amongst researchers that food precedes mood in the chronological order of the food–mood liaison. This means that having food influences one's mood (positively or negatively). And although the importance of food (especially breakfast) has been acknowledged by most researchers who argue that having any type of breakfast, compared to not having any food, leads to a more positive mood [15], more and more people are nowadays getting habituated to skipping meals [16]. In fact, the literature on this matter suggests that the habit of omitting breakfast, as opposed to eating breakfast, produces metabolic stress, and therefore leads to a decrease in overall mood [2].

While most researchers agree that having breakfast is essential and positively affects mood, some researchers argue that the beneficial effect of breakfast is present regardless of its components [17]; for example, some studies show that ingesting a high-protein as opposed to a high-carbohydrate meal does not influence the psychological mood reaction differently and that both food groups lead to a better mood [18,19]. Whereas other researchers believe that mood changes reflect the nutrients' content of the breakfast consumed; for instance, many studies show that carbohydrates, compared to protein, can enhance a person's mood [20-22]. In fact, Fernstrom et al. [20] found that eating foods rich in carbohydrates can activate the discharge of serotonin in the brain. Given the fact that serotonin is linked to feelings of happiness and well-being, having carbohydrates was found to increase positive mood. Moreover, Yokogoshi et al. [23] found that slight amounts of protein can inhibit the discharge of serotonin. This serotonin deficiency therefore leads to the blockage of the mood enhancement mechanism. In more recent studies, Smith et al. [24] found that the consumption of a 100% carbohydrate cereal bar, compared to a 100% protein bar, leads to a more positive mood with less stress and less fatigue perceived, and Beezhold et al. [25] argued that limiting the consumption of meat and chicken (sources of protein) enhanced short-term mood states (2-3 h) in omnivores (humans and rats).

As for essential fats, the literature findings about their effect on mood are inconsistent and contradictory. Grose et al. [26] found that foods which are high in essential fats have a positive impact on overall mood, not by increasing positive affect like interest, excitement, and alertness, but by decreasing negative affect like anger, anxiety and irritation. Taking it a step further, Pouwer et al. [27] found that fat-based foods not only increase overall mood, but that these types of food help in the treatment as well as the prevention of depression. In fact, Grenyer et al. [28] and Timonen et al. [29] argued that the risk of being depressed was significantly lower amongst people who consume seafood regularly compared with people who rarely eat fish. In fact, the risk of depression increased by 27% for women who were occasional seafood consumers compared with regular seafood eaters. Futhermore, Suzuki et al. [30] found that the risk of depression amongst sufferers of different types of cancer (breast cancer, liver cancer and leukemia) was significantly lower for those with the highest total ω-3 dietary intake. And finally, Hibbeln [31] found that 78% of countries with low rates of major depression had particularly high rates of fish consumption. However, Hakkarainen et al. [10] discounted this link and found that the consumption of omega-3 fatty acids did not have any effect whatsoever on low mood. Jacka et al. [3] also discounted this link and found no significant differences in self-reported quantities of avocado, olives, vegetable oils and fish consumed between depressed (0.10 g/day) vs. non-depressed (0.12 g/day) individuals.

One should not forget to take into consideration the effect of the covariates, caffeine and fatigue, on mood, and to control for these when examining the effect of food on mood, especially in the workplace where large amounts of caffeine are consumed regularly (in the UK, on average, an employee consumes 2 cups of coffee and one cup of tea every day at work [32]) and where the reported fatigue levels are relatively high [33].

In fact, literature findings consistently show that caffeine has a beneficial effect on mood, as it leads to improved strength, energy, efficacy, and precision, restored thought processes, reduced levels of drowsiness and tiredness [34,35] and better cognitive processes, after the consumption of only one cup of a certain caffeinated beverage (tea, coffee or even soft drinks) [36]. The

positive effects of caffeine on mood are not only temporary. In fact, researchers found that caffeine's beneficial effects can be sustained when consumed at regular periods throughout the day [37]. The biological theory about caffeine's influence on mood explains that caffeine can and does increase the discharge of both serotonin and gamma-aminobutyric acid (GABA) transmitters; this process helps in regulating the central nervous system (CNS) and hence, normalising anxiety and worry [38-40]. Furthermore, caffeine has been found to boost alpha brain wave activity (healthiest brainwaves) during rest among those under stress and work pressure, which could be translated into feelings of "wakeful" relaxation for both the body and the mind [41,42]. Decreased self-reported assessments of anxiety and other states of psychological strain verify these findings [43,44]. For instance, a recent study by Steptoe et al. [45] found a strong relationship between caffeine consumption, anxiety and job demands in both genders. In men, the higher the job demands were, the more anxious they felt, and the more caffeine they consumed. In contrast, in women, the higher the job demands were, the more anxious they felt and the less caffeine they consumed. Men drank, on average, 2 more cups of coffee and 1 more cup of tea when they were worried and stressed at work, while women drank, on average, 1 more cup of coffee and 1 more cup of tea when they felt relaxed at work.

As for the association between fatigue levels and mood, elevated levels of fatigue and declining energy were found to result in feelings of tension and high anxiety, but this is true only up to a point. When fatigue levels become severe, and when physiological resources decline, people may feel apathetic and uninterested. A decline in sociability, activity, and talkativeness can be observed at this point [46]. This may be due to the fact that, when there is a decline in energetic arousal, individuals try to preserve psychological and physical resources (generally unconsciously), and thus may restrict the energy expenditure which results from high expressed emotion (EE) [47]. In studying the effect of food on mood, one should therefore take into account different levels of fatigue, as elevated fatigue levels might lead to anxiety and tension, whereas severe fatigue levels might lead to apathy and low interest.

The importance of studying the effect of food on mood is in great part due to the link between mood and cognition. As a matter of fact, low and high mood states yield different information processing abilities that can affect performance on diverse reasoning exercises. Subjects in the low mood condition, for example, perform significantly slower than those in the neutral mood group and the elated mood group on inductive reasoning tasks [12-14]. Moreover, mood can regulate the cognitive attentional filter, meaning that only stimuli which match an individual's views and thoughts draw attention to them. These stimuli therefore have a higher likelihood of being captivated by the brain [48]. According to Becker et al. [48] "this attentional bias toward mood-congruent stimuli demonstrates that one's temporary mood can influence the attentional filter, thereby affecting the information that one extracts from and how one experiences the world" (p. 5). This initial filtering of information may therefore provide one's mood an ability to control more advanced cognitive mechanisms such as belief and decision making [49,50]. Positive mood was also found to be the primary originator of different types of organisational spontaneity (giving help to colleagues, keeping an eye on the organisation's safety, making valuable propositions, developing one's own performance and fostering goodwill). In fact, as discussed above, mood affects one's attentional filter and perception; therefore, being in a positive mood may lead an individual to perceive his surroundings more optimistically [48]. A good mood may result in an employee perceiving others in a more positive light, and therefore he or she is more likely to be help his or her co-workers when needed [51]. Another explanation of why subjects in good mood are more likely to help colleagues is that helping may be self-reinforcing. This means that individuals who feel positive are more likely to look out for ways to sustain these positive emotions. Helping is seen as one way to sustain good mood for a longer period of time. Thus, the strength of the positive mood-helping behavior association, as well as the psychological mechanisms underpinning it, propose that employees in a positive mood are more likely to provide help to their colleagues [52].

It is surprising to note that, despite the recognised effects that different types of food have on mood in general, and despite the substantial evidence demonstrating the effect of mood on productivity and organisational spontaneity, little research has been dedicated to study the effect of food on employees' mood in the setting of work. The investigation of the effect of food on mood, specifically at work, is therefore greatly needed to enhance our academic understanding of how food affects mood and hence affects employees' productivity in the workplace, and to give recommendations to business owners on the types of food that should be offered in the workplace to enhance mood and optimise employees' work performance.

The present study aims to address this need, by investigating whether consuming carb-based foods, protein-based foods, fat-based foods, and not consuming any food have different effects on the mood of working individuals. Previous investigations have examined the effect of beverage consumption on mood in the workplace [33] and the effect of food on mood in an experimental laboratory [2,5,7,26,27,53,54]. Most of the studies looking at the relationship between food and other emotional outcomes have applied the "short-term laboratory-based intervention" method. Even though the results of such studies have high internal reliability, whether or not their findings can be generalised to the more complicated psychological needs of daily life remains uncertain.

This is the first study to look at the effect of food on mood in the naturalistic context of work. This eliminates the generalisability obstacle faced by laboratory-based studies.

On the basis of the growing body of research, it is hypothesised that, after controlling for caffeine and fatigue levels (covariates), individuals who eat foods high in carbs will have an increase in overall mood, and therefore a better mood than those who eat foods high in protein and those who do not consume any food (hypothesis 1). Due to the discrepancies in the literature findings, it is hypothesised that the consumption of essential fats will have an effect on mood; however the direction of this relationship is yet to be assessed (hypothesis 2).

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METHODS

Participants

300 employees were asked to fill out a food survey during midday (12 pm to 1:30 pm). Employees were included in the study if they were over the age of 18 and if they had been working for at least 6 months. Participants were excluded from the study if they suffered from bullying (by managers or colleagues) during the preceding 6 months, if they had a physical illness that might have interfered with their work (example: cold/flu) before or during the completion of the study, and if their first or second language was not English (this is because the food survey questions were in English and they were not translated in order to avoid reducing the survey's internal validity) [55]. 246 employees out of the 300 chosen were interested in the study and filled the survey (82% response rate). Out of 246 subjects, 28 participants' answers were excluded. These participants have completed the study before 12 pm or after 1:30 pm and thus did not meet to the time-frame requirement. This time inconsistency might have biased the study's results, and therefore, these answers could not be included in the analysis. The final sample included 218 subjects (age: 43 ± 9 (mean ± SD), range: 18-61; gender: 108 females, 110 males; nationality: 80 Lebanese, 50 UK, 35 English, 20 Polish, 10 American, 10 Jordanian, 8 Danish and 5 Spanish). All subjects completed every question in the food survey and no missing data was obtained.

Study design

Since the present study drew on a quantitative research design, the best option was the use of a probability sampling technique like the simple random sampling, as these techniques permit the researcher to make statistical inferences (i.e., generalisations) from the chosen sample [56].

Participants were individually emailed the food diary sheet. They were asked to complete it at midday (from 12 pm to 1:30 pm) and to resend it to the researcher immediately after completion via email. As this is a naturalistic study, participants were asked to complete the questionnaire at work. Participants wrote down the food they consumed, assessed their level of fatigue/exhaustion, and rated their mood in the middle of the working day. Participants were also asked to specify their gender (males, females, or other), their nationality, their working status (part-time or full-time), their employment years, and their overall health status (poor, fair, good, very good and excellent).

Variables and measures used

Different assessment tools were used to collect data. All measures were taken during midday (from 12 pm to 1:30 pm).

Food intake (IV, independent variable):

Subjects were required to write down everything they ate from the morning until midday. Using the Food Pyramid Guide, the food they consumed was later divided into 4 categories: "no food", "high-in carbohydrates foods", "high-in protein foods" and "high-in fat foods" [57].

Mood (DV, dependent variable): The BMIS Mood Introspection Scale (pleasant-unpleasant), a 16-item factor-valid scale, was used. Participants were given a list of 16 terms which described their current mood (lively, happy, sad, tired, caring, content, gloomy, jittery (anxious), drowsy, grouchy, peppy, active, fed up, loving, calm and nervous) and they were asked to circle the number that reflected how they felt right at that moment (i.e., mid-day) (XX=definitely do not feel, X=do not feel, V=slightly feel, VV=definitely feel). The results on the 8 positive mood states (lively, happy, caring, content, peppy, active, loving and calm) were added up and the scores on the unpleasant adjectives (sad, tired, gloomy , jittery (anxious), drowsy, grouchy, fed up and nervous) were reversed and then added up, to finally obtain the total score that reflected the overall mood of each participant. Possible scores ranged from 16–64 for the pleasant and the unpleasant scales, with higher scores reflecting higher positive mood. The scale used has high internal validity (Cronbach's α ranged from 0.76 to 0.83) [58].

Fatigue/exhaustion (CV, confounding variable): Fatigue and exhaustion levels were assessed via the 8-item measure created by van Gelderen et al. [59]. Subjects rated the extent to which different statements were true for them, on a scale of 1="*Yes, that is true*" to 7="*No, that is not true*". Participants had to rate 8 items: *("I feel tired", "physically, I feel exhausted", "I feel fit", "I feel powerless", "I am rested", "physically, I feel I am in bad form", "I get tired easily", and "physically, I feel I am in an excellent condition"*). Potential scores ranged from 8–26 (normal), 27-35 (elevated) and 36-56 (severe), with higher scores reflecting advanced levels of fatigue. This scale also has good internal validity (Cronbach's α=0.68) [33].

Caffeinated-beverage consumption (CV, confounding variable): Participants were asked to answer a one-item general self-rating question: "have you had any tea, coffee, energy drink, hot chocolate or soft drink from the time you woke-up till midday (now)?" [33].

RESULTS

Participants' characteristics

Participants' characteristics appear in **Table 1** below. The final sample included 218 participants. For 108 females and

110 males, age ranged from 18 to 61 years, with a mean of 30.6 years and a SD of 9.5 years. Working years ranged from 1 to 46 years, with a mean of 8.3 years and a SD of 8.6 years. Self-rated health ranged from 2 (fair) to 5 (excellent), with a mean of 3.8 (very good) and a SD of 0.9. Finally, working status ranged from 0 (full-time) to 1 (part-time), with most participants being full-timers (part-time: 55, and full-time 163; mean 0.75; SD 0.44) **(Table 1).**

Table 1. Participants' descriptive statistics: Age, working years and status, and self-rated health.

Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age	218	43	18	61	30.59	9.481
working_years	218	45	1	46	8.33	8.549
self_rated_health	218	3	2	5	3.81	0.857
working_status	218	1	0	1	0.75	0.435
Valid N (list wise)	218					

The final sample included 80 Lebanese employees (40 males and 40 females), 50 Italian employees (30 males and 20 females), 35 English employees (15 males and 20 females), 20 Polish employees (10 males and 10 females), 10 American employees (3 males and 7 females), 10 Jordanian employees (4 males and 6 females), 8 Danish employees (4 females and 4 males), and 5 Spanish employees (2 males and 3 females) **(Tables 2-6).**

Table 2. Participants' descriptive statistics and frequencies: nationalities and gender.

Descriptive Statistics and Frequencies			
Nationality	N	Males	Females
Lebanese	80	40	40
Italian	50	30	20
English	35	15	20
Polish	20	10	10
American	10	3	7
Jordanian	10	4	6
Danish	8	4	4
Spanish	5	2	3
Total	218	108	110

Cross-tabulations

Looking at **Table 3**, we can understand that 7.3% of participants have reported a "fair" health status, 25.7% reported a "good" health status, 45.4% reported a "very good" health status, and 21.6% reported an "excellent" health status.

Table 3. Cross tabulation of post-prandial meal mood effects by overall health status.

BMIS_groups * self_rated_health Crosstabulation							
			self_rated_health				Total
			Fair	Good	Very Good	Excellent	
BMIS_groups	16-39	Count	9	44	51	28	132
		% within BMIS_groups	6.8%	33.3%	38.6%	21.2%	100.0%
		% within self_rated_health	56.2%	78.6%	51.5%	59.6%	60.6%
		% of Total	4.1%	20.2%	23.4%	12.8%	60.6%
	40-64	Count	7	12	48	19	86
		% within BMIS_groups	8.1%	14.0%	55.8%	22.1%	100.0%
		% within self_rated_health	43.8%	21.4%	48.5%	40.4%	39.4%
		% of Total	3.2%	5.5%	22.0%	8.7%	39.4%
Total		Count	16	56	99	47	218
		% within BMIS_groups	7.3%	25.7%	45.4%	21.6%	100.0%
		% within self_rated_health	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	7.3%	25.7%	45.4%	21.6%	100.0%

In the "fair", the "very good" and the "excellent" health categories, the percentage of people (56.2%, 51.5%, 59.6% respectively) reporting a relatively low mood (between 16 and 39) was somewhat similar to the percentage of people (43.8%, 48.5%, 40.4%, respectively) reporting a relatively higher positive mood (between 40 and 64). However, in the "good" health category, the percentage of people (78.6%) reporting a relatively low mood (between 16 and 39) was much higher than that (21.4%) of people reporting a relatively higher positive mood (between 40 and 64).

Table 4 indicates that there is a statistically significant association between self-reported fatigue and post-prandial meal mood ($\chi(3)=11.14$, $p=0.01$); that is people with different perceived health statuses differ in their reported post-prandial meal mood (with the majority of people in the "good" health group reporting a poorer post-prandial meal mood).

Table 4. Significance of the association between fatigue and post-prandial meal mood.

Chi-Square Tests			
	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	11.140[a]	3	0.011
Likelihood Ratio	11.735	3	0.008
Linear-by-Linear Association	2.202	1	0.138
N of Valid Cases	218		
[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.31			

Looking at **Table 5**, we can understand that 56.4% of participants have reported a normal fatigue level, 30.3% have reported an elevated fatigue level and 13.3% have reported a severe fatigue level. In the "normal" fatigue group, the percentage of people (51.2%) reporting a relatively low mood (between 16 and 39), was somewhat similar to the percentage of people (48.8%) reporting a relatively higher positive mood (between 40 and 64). However, in the "elevated" and "severe" fatigue groups, the percentage of people (72.7% and 72.4% respectively) reporting a relatively low mood (between 16 and 39) was much higher than that (27.3% and 27.6% respectively) of people reporting a relatively higher positive mood (between 40 and 64).

Table 5. Cross-tabulation of post-prandial meal mood effects by level of self-reported fatigue.

BMIS_groups * Fatigue_level Crosstabulation						
			Fatigue_level			**Total**
			Normal	**elevated**	**Severe**	
BMIS_groups	16-39	Count	63	48	21	132
		% within BMIS_groups	47.7%	36.4%	15.9%	100.0%
		% within Fatigue_level	51.2%	72.7%	72.4%	60.6%
		% of Total	28.9%	22.0%	9.6%	60.6%
	40-64	Count	60	18	8	86
		% within BMIS_groups	69.8%	20.9%	9.3%	100.0%
		% within Fatigue_level	48.8%	27.3%	27.6%	39.4%
		% of Total	27.5%	8.3%	3.7%	39.4%
Total		Count	123	66	29	218
		% within BMIS_groups	56.4%	30.3%	13.3%	100.0%
		% within Fatigue_level	100.0%	100.0%	100.0%	100.0%
		% of Total	56.4%	30.3%	13.3%	100.0%

Table 6 indicates that there is a statistically significant association between self-reported fatigue and post-prandial meal mood ($\chi(2)=10.29$, $p=0.006$); that is people with an elevated/severe fatigue levels reporting a poorer post-prandial meal mood than those in the normal fatigue level group.

Table 6. Significance of the association between fatigue and post-prandial meal mood.

Chi-Square Tests			
	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	10.289[a]	2	0.006
Likelihood Ratio	10.483	2	0.005
Linear-by-Linear Association	8.319	1	0.004
N of Valid Cases	218		
[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.44			

Analyses

A one-way analysis of covariance (ANCOVA) was administered for this research. The independent variable, food, included four levels: no food, carb-based food, protein-based food and fat-based food. The dependent variable was employees' mood and the covariates were fatigue levels and caffeine consumption.

The group source (labelled "food", see **Table 7**) assessed the null hypothesis that the population adjusted means are similar, or in other words, that there was no effect of food on mood, after controlling for the covariates. The outcomes of the analysis provided evidence that this hypothesis should be rejected. ANCOVA was found to be significant: $F(3, 212)=15.223$, $p<0.001$. The measure of association $\omega^2=0.15$, meaning that the four different groups of food (IV) explained about 15% of the total variance in workers' mood (DV), after adjusting for the effect of their fatigue levels and caffeine intake on mood. At this point in the analysis, it was confirmed that the main effect for the IV (food) on the DV (mood) was significant, after controlling for the effect of the covariates (fatigue+caffeinated beverages).

After finding a significant main effect and rejecting the null-hypothesis, follow-up tests were conducted to assess pairwise differences among the adjusted mood means (means after controlling for the covariates' effect). This analysis was used to test

hypotheses 1 and 2 (that individuals who eat foods high in carbs will have an increase in overall mood compared to those who eat foods high in protein and those who do not consume any food (hypothesis 1), and that fats will have an effect on mood (hypothesis 2)).The Bonferroni method was employed to adjust for Type I error (the false rejection of a true null hypothesis, or in other words, finding a significant effect when there is any) across the six pairwise comparisons (α/6=0.01/6=0.0017).

Table 7. The overall effect of food on mood after controlling for fatigue and caffeinated beverages.

Tests of Between-Subjects Effects					
Dependent Variable: Mood					
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Corrected Model	7791.765[a]	5	1558.353	14.340	0.000
Intercept	37988.432	1	37988.432	349.561	0.000
Caffeinated_beverages	0.053	1	0.053	0.000	0.982
Fatigue	3136.854	1	3136.854	28.865	0.000
Food	4963.043	3	1654.348	15.223	0.000
Error	23039.024	212	108.675		
Total	302662.000	218			
Corrected Total	30830.789	217			
[a] R Squared=0.253 (Adjusted R Squared=0.235)					

The results showed that employees who didn't have any food had better overall mood than those who had carbs (M=9.41, p<0.001, 95% CI [4.04, 14.78]) and those who had proteins (M=12.98, p<0.001, 95% CI [7.58, 18.38]), after controlling for the effect of caffeine and fatigue. Those who had carbs reported a significantly better mood than those who had proteins (M=3.57, p=0.04, 95% CI [5.85, 10.71]) (hypothesis 1 tested). Finally, those who had fats reported a significantly better mood than those who had proteins (M=7.83, p=0.001, 95% CI [2.36, 13.29]), controlling for the effects of the covariates (caffeine and fatigue) on employees' mood (hypothesis 2 tested). The effects sizes for these significant adjusted mean differences were 0.90 (no food-carbs; large effect size), 1.25 (no food-protein; large effect size), 0.34 (carbs-protein; medium effect size) and 0.75 (fat-protein; large effect size), respectively **(Table 8).**

Table 8. A comparison between the effects of every two types of food on mood.

Pairwise Comparisons						
Dependent Variable: Mood						
(I) Food	**(J) Food**	**Mean Difference (I-J)**	**Std. Error**	**Sig.[b]**	**95% Confidence Interval for Difference[b]**	
					Lower Bound	**Upper Bound**
no food	carb-based	9.408*	2.017	0.000	4.035	14.781
	protein-based	12.979*	2.028	0.000	7.579	18.380
	fat-based	5.151	2.078	0.084	-0.384	10.687
carb-based	no food	-9.408*	2.017	0.000	-14.781	-4.035
	protein-based	3.571	1.983	0.039	10.710	5.852
	fat-based	-4.257	1.998	0.206	-9.578	1.064
protein-based	no food	-12.979*	2.028	0.000	-18.380	-7.579
	carb-based	-3.571	1.983	0.039	5.852	10.710
	fat-based	-7.828*	2.052	0.001	-13.293	-2.363
fat-based	no food	-5.151	2.078	0.084	-10.687	0.384
	carb-based	4.257	1.998	0.206	-1.064	9.578
	protein-based	7.828*	2.052	0.001	2.363	13.293
Based on estimated marginal means						
*The mean difference is significant at the 0.05 level						

No significant differences were found between no food and fat-based food on employees' mood (p=0.084>0.05) and between carb-based food and fat-based food on mood (p=0.21>0.05), controlling for the effects of caffeine consumption and levels of fatigue on mood.

The Profile Plot gave a visual picture of the results of the study. This graph showed that no food results in the best mood (M=42.33), followed by fat-based foods (M=37.17), and carb-based foods (M=32.92), with the foods that resulted in the worst reported mood being the protein-based foods (M=29.35). Covariates appearing in the graph were assessed at the following values: caffeinated beverages=0.76 and fatigue 25.86 **(Figure 1).**

DISCUSSION

The present study was the first to investigate the possible effects of the dietary intake of 4 different food groups on an employee's mood in the workplace (naturalistic setting), controlling for the effects of caffeine consumption and levels of fatigue on mood. The importance of studying the effect of food on mood is in great part due to the link between mood and cognition.

Mood was found to be linked to work productivity and to different forms of organisational spontaneity. Given the link between different types of food and mood, and the link between mood and work productivity, the consumption of certain types of food can indeed be linked to an employee's productivity. Based on studies by Fernstrom et al. [20] Yokogoshi et al. [23], Benton et al. [2] and Widenhorn-Müller et al. [17], it was hypothesised that subjects who eat foods high in carbs in the morning will have a better mood than those who eat foods high in protein and those who do not consume any food. Due to the discrepancies in the literature findings (Grenyer et al. [28]; Grose et al. [26]; Hakkarainen et al. [10]; Hibbeln [31]; Jacka [3]; Pouwer [27]; Suzuki et al. [30]; Timonen et al. [29]), it was hypothesised that fats will have an effect on mood, however the direction of this relationship was not determined.

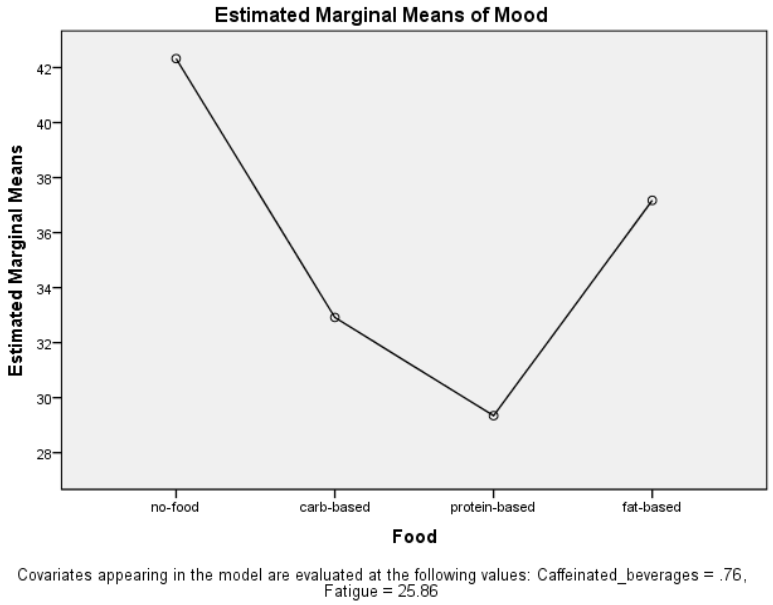

Figure 1. A visual comparison between the effects of each type of food on mood.

Interestingly, the study's results showed that having no food in the morning led to the best mood during midday, followed by the consumption of foods high in fats (like Atlantic mackerel, shrimps, tofu, black cod, sardines, Albacore tuna, pacific halibut, arctic char, anchovies, kippers, osyters and mussels, soybeans, winter squash, walnuts, avocado, peanuts, peanut butter, coconut and olives), then the consumption of foods high in carbs (like bread, potatoes, pasta, rice, cereals, oats, yams, sweet potatoes, cakes, fruits, fruit juice, candies and biscuits), while the worst reported mood followed the consumption of protein-based foods (eggs, milk, meat and beans).

In line with previous studies [20-24], the present study's results showed that consuming carbohydrates, compared to protein, can and does enhance employees' mood. One possible explanation for this phenomenon could be the description provided by Fernstrom et al. [20] and Smith et al. [24]. In fact, researchers found that consuming carbohydrates can activate the discharge of serotonin in the brain. For employees who face stress on a daily basis (like in our example, DRC employees who are in contact with Syrian refugees and who deal with war tragedies every working day [60]), an increased activity of the serotonin neurotransmitter's level is a vital physiological phenomenon which helps the brain with the management of stress. When stress levels are regulated, less stress and fatigue will be perceived, and an increase in overall mood levels can be expected.

In times where stress lasts for long periods of time, the brain will need to produce and release more and more serotonin neurotransmitters to regulate stress. The release of serotonin can therefore exceed its production, and the brain will have a deficiency in serotonin levels. This decline of serotonin activity in the brain can lead to more stress being perceived, and therefore will lead to disturbances of mood. Mood and productivity levels can deteriorate. Consequently, consuming carbohydrates, which aid in the release of serotonin, can compensate for this deficiency and result in less stress being perceived and better mood being experienced [20,24].

In accordance with this explanation, the reduction of tryptophan, the predecessor of serotonin production, can be associated with a development of a depressive mood in healthy subjects. Yokogoshi et al. [23] found that small amounts of protein can decrease levels of tryptophan in the brain and interrupt the serotonin boost process, and hence, can lead to the disruption of the mood enhancement mechanism.

In addition to serotonin levels, there seems to be a strong link between mood and blood glucose levels [61]. This could provide another possible explanation of the finding that carbohydrates lead to a better mood than protein. Benton [53] assessed the mood of healthy subjects before and after the completion of two cognitively demanding exercises: an assessment of "hand-eye" synchronisation and fast information processing exercises which necessitated the continual tracking of stimuli (every second for 20 min). During both assessments, low levels of blood glucose were linked to lower perceived physiological energy and lower mood. Benton [53] confirmed that, during short-term (15 to 20 min) and long-term (1 h) tasks, participants with a low blood

glucose level reported more tension than those whose blood glucose was relatively high. Benton [53] argued that negative mood states are linked to low blood glucose whereas better moods are linked to higher levels of blood glucose. He explained that the biological mechanism that may be underpinning the strong relationship between mood-blood glucose levels is the stimulation of the autonomic nervous system. When blood glucose levels drop, the body activates the autonomic nervous system in an effort to balance blood glucose levels; this improved activation can explain the heightened feelings of tension and the depressed levels of self-reported energy. Carbohydrate foods which contain high amounts of sugar lead to an increase in blood glucose levels as opposed to protein, and therefore can lead to less tension and more energy being experienced, and an overall better mood being reported [53].

As for fat-based foods and according to this study, fatty foods led to an increase in overall mood. There was a significant difference between fat-based foods and protein-based foods, but there were not any significant differences between fat-based foods and carb-based foods. These results could in fact give some explanation to the discrepancies in the literature findings about the effect of fat (essential fats) on mood. In fact, the present study's results are in line with Grose et al. [26] who found that foods which are high in essential fats, compared to proteins, have a positive impact on mood, not by increasing positive affect like interest, excitement, and alertness but by decreasing negative affect like anger, anxiety and irritation; and with Grenyer et al. [28], Hibbeln [31], Pouwer et al. [27], Suzuki et al. [30] and Timonen et al. [29] who found that fat-based foods can, in fact, help in the treatment as well as the prevention of depression. The present study's results could also give an explanation to Hakkarainen's et al. [10] findings that led them to discount this link. Researchers found that dietary intake of omega-3 fatty acids did not have any effect whatsoever on low mood. Nonetheless, one should note that in Hakkarainen's et al. [10] study, researchers only compared fat-based foods to carb-based foods; and consistent with our study, did not find any effect. Had they compared fat-based foods to protein-based foods, different results were to be expected. Our results also give an explanation to Jacka et al. [3] who found no significant differences in consumption levels of fish oil and seafood between depressed=0.10 g /day vs. non-depressed=0.11 g / day (on average) individuals. Although these subjects did not differ on fat consumption levels, depressed people had significantly higher protein consumption levels (50 g/day) than non-depressed people (30 g/day).

Taking it a step further, researchers found that a high-fat and low-protein breakfast (not lunch) was also related to differences in mood, and that participants felt significantly friendlier, more sociable, more comfortable, more excited, and more relaxed two hours after a high in essential fats breakfast than they did after an isoenergetic low fat breakfast [62]. This is an important finding as the results of this study showed that mood changed significantly after breakfasts of distinct fat and protein compositions, even when these meals were specifically designed to look and taste extremely alike. Furthermore, the results of this investigation also showed that the time of the day at which food is consumed can have a control over the resulting mood. Results showed that fat led to relaxation when consumed in the morning rather than during lunch. This could be due to the participants' familiarisation and habituation to specific food macronutrients at specific times of the day. Breakfast is probably the meal of the day at which individuals are less likely to consume essential fats (fish and oils) as opposed to proteins (eggs, bacon and nuts). Thus, ingesting fat at this time of the day might have significantly higher physiological effects than fat ingestion at lunch time.

One possible explanation of why fat results in a good mood can also be attributed to physiological mechanisms which include serotonin levels' regulation. That is, regular fat consumption and the ingestion of lipids lead to a boost in cholecystokinin (CCK) concentrations in the body [63,64]. Cholecystokinin controls a number of biological states including satiety and relaxation via the regulation of serotonin activity in the brain. High concentrations of CCK can indeed lead to a better perceived mood [65]. When people consume low-fat meals, the serotonin receptor sensitivity becomes lower, and this low sensitivity of serotonin is linked to depression, aggression, and suicidal thoughts [66]. The present explanation is in line with the finding that monkeys who regularly consume low-fat meals are more aggressive than those who consume high-fat meals [67].

Given the fact that both carbs and fats control mood via the same mechanism (serotonin level regulation), the study's results which showed no significant difference between the effect of fat and carbs on employees' mood are not surprising and seem logical.

The most surprising result is that the "no food" group reported the best mood compared to the "carb" group, the "protein" group, and the "essential fat" group. This result is inconsistent with most research in the literature which suggests that omitting breakfast, as opposed to eating breakfast, induces metabolic stress and therefore leads to a decrease in overall mood [2,17]. One possible explanation of the present study's result is that the consumption of breakfast might indeed be related to a better overall mood, however, its effect on mood is more likely to be large soon after the meal is ingested. In a study by Zeng, et al. [68] the effect of breakfast on mood was larger after 45 min rather than after 2 h. Moreover, Benton et al. [2] compared seven breakfasts of various glycemic compositions; mood was reported as better after 30 min of the meal consumption instead of 90 min. This was true for all meals regardless of their composition. In fact, studies looking at the effect of breakfast on mood are generally short-term laboratory-based; this means that these studies usually examine this effect right after food consumption [15]. The present study is methodologically different as it is a naturalistic study and the mood of the participant is evaluated at midday and not right after breakfast consumption. Another methodological difference that should be taken into consideration and might also explain the present study's result is that, baseline mood (before the consumption of any food) was not measured in the present study. As a matter of fact, the comparison of two studies, one by Benton et al. [54] who found a significant favorable effect of breakfast consumption on mood and one by Smith et al. [69] who, uncommonly, found no effect of breakfast consumption on mood, supports

this explanation. The baseline total mood score (mean score of 20 out of 60) in Benton et al. [54] was lower than the baseline score (mean score of 36) in Smith et al. [69] study. The baseline mood in Smith et al. [69] study was already high and almost equal to the mood reported in the present study after the consumption of carbohydrates (mean score of 33) and fats (mean score of 37). Thus, breakfast consumption may selectively help mood when the baseline mood is low. Consistent with this interpretation, Macht et al. [70] compared the effect of a cereal bar on the mood of subjects in an anxiety provoking situation (where baseline mood was low) and subjects in a relaxing situation (where baseline mood was relatively high). Raising blood glucose levels as a result of the cereal bar consumption had a significantly greater impact on mood for subjects who were in the anxiety provoking situation. The present study's baseline mood could've been already high and that could be one of the reasons why omitting breakfast did not have a depressive effect on mood. Another plausible explanation to the present study's "no food" result is that a one-time only incidence of missing breakfast might not have a significant effect on mood, but the habit of always skipping meals and the gradual build-up of nutritional deficiency might then have a negative effect on mood [71]. If the present study was done over a longer period of time, and if the same subject skipped breakfast for multiple days consecutively, "no food-mood" results might have been lower.

Having given all these possible explanations, however, it still remains quite difficult to reconcile the positive mood effects of having no meal, when compared with numerous prior studies that touted breakfast as the most important meal of the day; Future studies which involve case-control studies and prospective/longitudinal studies (in naturalistic studies) as well as the collection of baseline mood measurements would present a more convincing explanation or even rejection of our no-breakfast results.

As for the practical side of the study and based on the results of our study, we offer the following recommendations: business owners are mainly advised to offer employees fat-based foods like walnuts, peanuts, peanut butter, olives, as well as carb-based foods like cake, cereals, bread and fruits, and to avoid offering employees eggs, bacon, and milk. Fat-based foods and carb-based foods were found to be the best food that can lead to an increase in the overall mood during midday, and hence can improve different types of organisational spontaneity (giving help to colleagues, keeping an eye on the organisation's safety, making valuable propositions, developing one's own performance, and fostering goodwill) [51,52,72-74], can improve the quality of service to customers, and can increase a leaders' job satisfaction and job involvement [75]. Increasing positive mood and avoiding negative moods is benefecial for organisations as negative moods can sometimes be associated with antisocial behaviors like aggression and hostility [76]. Offering the right types of food at work may indeed help address one aspect of the emerging/ increasing number of violent episodes in many workplaces. Moreover, the study's findings may also be useful as a guide for airline companies in their debates on whether or not, and if so what, to feed airplane passengers while in transit. As discussed above, airline companies, like business owners, are advised to offer passengers fat-based foods and/or carb-based foods. These foods were shown to increase people's overall mood during midday, and positive mood, in turn, was shown to play a significant role in explaining customer loyalty towards airline companies [77]. Moreover, positive mood could also function as a buffer for diminishing loyalty as a result of lower levels of service satisfaction.

To our knowledge and from the extensive literature review search performed, this is the first and the only study to look at the effect of the consumption of food on mood at the naturalistic setting of work. It is a very comprehensive study because it looked at 3 different types of food (carbohydrates, proteins and fats) as well as the "no food" group as opposed to most studies in the literature which only compare two types of foods; for example, carbs vs. proteins [20-24], and fats vs. carbohydrates [61,63]. Furthermore, the exceptionally high response rate (82%) and the diversity in the participant's characteristics (age, nationality and working years) are two additional key strengths of this study.

Limitations

Some of the limitations of the study include the following: First of all, the answers on the food survey were all self-reported; therefore, people might have underreported the amount and the variety of food they consumed, and employees in particular might have reported a better overall mood. This effect is called the "social desirability bias" (a form of response bias that pushes a subject to deny unattractive characteristics and refer to traits that are socially desirable like a positive mood [78]. Nonetheless, the effect of the social desirability bias was rather controlled for in the present study. As a matter of fact, participants were reminded, in the beginning of every question, that they should answer as accurately and as honestly as possible, and that their answers were completely anonymous and confidential (only the researcher had access to the data). According to Lippitt et al. [79], one of the most efficient methods to deal with social desirability bias is anonymity, as the perception of complete anonymity is supposed to help collect more accurate answers by reducing social desirability pressures and improving reassurance, objectivity, and personal detachment.

Second of all, since the present study was self-reported, extreme responding was also expected to be another limitation. Extreme responding is a type of response bias that stimulates participants to only select the maximum or the minimum options available [80,81]. Since the present study used a Likert scale with potential scores ranging from 1 to 5, some respondents were expected to only give answers as 1's or 5's ("strongly disagree" or "strongly agree"). Timothy et al. [81] found that Middle East and Latin respondents are more prone to extreme responding bias while European respondents are the least prone to this bias. However, fortunately, no extreme responding was detected in the present study. This effect might have been controlled for and balanced due to the variety in participants' characteristics: 118 participants Europeans while 100 participants were Middle Eastern. Finally, one of the potential limitations of the study was the use of surveys as opposed to the use of a randomised

controlled trial where more control over the quality of the food given and over possible confounding variables could have been achieved. Meaning that causality as opposed to a correlational relationship could have been established. The present study's data collection method was chosen due to the practicalities of cost and time. Nevertheless, the simple random sampling technique, one of the best probability sampling techniques, was used in the present study and a large number of participants were included in this study (power analysis showed that 93 subjects were needed, however 218 subjects were included in this study). Using the simple random sampling method, all subjects had an equal chance (probability) of being chosen, and the 300 subjects included in the study were chosen randomly using probabilistic methods. This reduced the potential for human bias in the selection of cases to be included in the sample, and the chosen sample was highly reliable and representative of the population which allowed the possibility to make generalisations from the sample to the population.

Future studies may involve case-control studies and prospective/longitudinal studies (in naturalistic studies), and/or a mixed methodology design which includes the use of both interviews (qualitative) and food surveys (quantitative). These studies could benefit from looking into the effect of food on mood at work, taking into account differences between males and females. For example, carbohydrate consumption was found to positively affect mood for males, but not for females [2,22]. These findings introduce the possibility that different genders may experience the consequential effect of a carbohydrate breakfast rather distinctively. Furthermore, since an individual's mood may be affected by pre-existing medical conditions, by medications or by drugs and other factors, then future studies may need to ascertain the presence or absence of these and other possible confounding factors and variables on post-prandial mood effects. More part-timers should be included in future studies as most studies examining the mood of employees use full-time workers. More blue-collar participants should also be included as studies looking at mood generally examine white-collars exclusively. In this study, it is concerning that no baseline mood measurements were collected before participants' meal ingestion and the subsequent measurement of post-prandial mood effects. These baseline measurements which would have been useful for the interpretation of the study findings were not collected due to practical reasons. However, future studies are advised to compare the effect of different types of food on mood, immediately after consumption of a certain meal as well as two hours after consumption, and to take into account baseline mood (before the consumption of food) when examining the effect of breakfast on mood, as having breakfast may selectively help the mood of those in a low mood but not those who had a relatively better mood in the morning [71].

CONCLUSION

The current study was the first to examine the possible effects of the consumption of 4 different food groups on an employee's mood in the workplace (naturalistic setting), controlling for the effects of caffeine and fatigue on mood. The study's results showed that consuming carbohydrates, compared to protein, can and does enhance employees' mood. Two possible explanations for this finding were given. The first was that carbs, compared to proteins, can activate the discharge of serotonin in the brain. This discharge can lead to less stress being perceived, and thus can increase positive mood in stress-prone subjects. The second was that there is a strong association between positive mood and high blood glucose levels, and hence, carbohydrates which contain more glucose (sugar) can be associated with an increase in overall mood. Fat resulted in an overall good mood. This can be due to the fact that the ingestion of lipids leads to a boost in cholecystokinin (CCK) concentrations in the body. Cholecystokinin can control satiety and relaxation via the regulation of serotonin activity in the brain, and hence can increase overall mood. The most surprising result was that the "no food" group reported the best mood compared to the "carb" group and the "protein" group. This result is inconsistent with most research in the literature which suggests that omitting breakfast induces metabolic stress, and therefore leads to a decrease in overall mood. Different explanations were given: breakfast might indeed be related to a better overall mood, but its effect on mood might be larger shortly after the meal has been ingested; and/or breakfast consumption may selectively help mood when the baseline mood is low (the present study's baseline mood could have been already high); and/or skipping breakfast for one time only might not have a significant effect on mood, but the habit of always skipping meals and the gradual build-up of nutritional deficiency might then have a negative effect on mood.

In summary, no food resulted in the best mood, followed by fat-based foods and carb-based foods, with protein-based foods resulting in the worst reported mood. To enhance different types of organisational spontaneity, business owners are advised to offer fat-based foods (walnuts, peanuts and olives) or carb-based foods (cake, bread and fruits) for breakfast and to avoid offering protein-based foods (eggs, milk and bacon) at work.

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