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DOES SHORT TERM DIETARY INTERVENTION CHANGE DIETARY CARBON FOOTPRINT?

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Abstract: In this study, we aimed to observe whether short-term weight loss program changes dietary carbon footprint (CF) and its effect on the risk of chronic disease. This study was carried out between April 2019 and January 2020. Participants received a diet intervention for four weeks. Their anthropometric measurements and food records were evaluated before and at the end of the study. 61 individuals (51 female; 10 male) aged 19-59 years and with a Body Mass Index (BMI) of ≥25 kg/m^2. Their dietary CF of sweets/snacks, drinks, potatoes/bread/pasta, meat, and butter/oil also decreased statistically significantly according to the eight major food groups. The total dietary CF increased in this study (P=0.018). This increase resulted from the increase in the consumption of dairy/egg food group. At the end of the study the body weight, BMI, waist, hip and neck circumference, waist-hip ratio, and the waist-height ratio of participants decreased statistically significantly after the weight loss program (P<0.001). In conclusion, participants lost weight and their health risks were reduced by the short-term weight loss program. However, total dietary CF increased, which can be related to the increase in the consumption of dairy/egg food group in this study. We think that more research into nutrition is required for the prevention of health and the environment.

Keywords: Carbon footprint, Weight loss, Sustainability, Dietary intervention, Chronic disease

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1. Introduction

Food system (cultivation, processing, packaging, distribution, consumption, and waste), which is mainly associated with Greenhouse Gases Emission (GHGEs), water requirements, and land use, may affect the environment negatively (Vermeulen et al., 2012; Gustafson et al., 2016; Huseinovic et al., 2017; González-García et al., 2018). The food system is responsible for more than a quarter of all GHGEs (Vermeulen et al., 2012; Springmann et al., 2016). Moreover, different foods and diets affect GHGEs in a variety of ways. Animal-based products (meat, fish, and dairy products) make a greater contribution to GHGEs than plant-based products (fruit, vegetables, cereals, etc.) (Garnett, 2006; Cederberg et al., 2013). Similarly, less meat consumption decreases both land use and GHGEs (Stehfest et al., 2009; Tilman and Clark., 2014). Therefore, plant-based diets are considered more environmentally friendly than animal-based diets (Baroni et al., 2007; Tilman and Clark, 2014). Springmann et al. claimed that higher consumption of plant-based diets could lead to a 29%-70% reduction in food-related GHGEs (Springmann et al., 2016).

The carbon footprint (CF), which is an important term for the environment, is considered as an indicator of environmental impact (González-García et al., 2018). A product's carbon footprint indicates the total amount of greenhouse gases (GHGs) emitted throughout its lifecycle. Also, CF is stated in kilograms of CO2 equivalents (FAO, 2013). Diet composition has a significant effect on CF values (González-García et al., 2018). Some studies showed that transitioning toward more plant-based products is the best choice for decreasing GHGEs (Garnett, 2011; Westhoek et al., 2014). In other words, less meat consumption and high plant-based food consumption contributes positively to the environment by decreasing GHGEs (Tilman and Clark, 2014). However, studies investigating the sustainability of diets, showing their effects on environment, and nutrition differ according to the type of food (Huseinovic et al., 2017). Drewnowski et al. (2015) reported that although many foods such as sugar have low climate impact, they also have low nutritional value. On the contrary, while some foods, for example meat and dairy products, have high nutritional value, they have high climate impact. However, meat obtained from monogastric animals such as poultry has lower CF than meat obtained from ruminant animals such as lamb (Tilman and Clark, 2014; Westhoek et al., 2014). Furthermore, although legumes have GHG emissions around 250 times lower than those of ruminant meats, some plant products, for example rice, could emit high GHG emissions (FAO, 2013; Tilman and Clark, 2014).

We must consider nutrition not only because of its effects on the environment, but also because of its effects on health (Springmann et al., 2016; González-García et al., 2018). Nutrition and overweight/obesity play a major important role in health improvement (Baroni et al., 2007; Cederberg et al., 2013). Several anthropometric measurements are used for the risk of chronic diseases for healthy individuals. For example, an increase in BMI, waist, hip and neck circumference, waist-hip ratio, and the waist-height ratio is associated with rising risk of chronic diseases (WHO/FAO, 2003). Besides, high consumption of red and processed meat, high sodium and sugar intake, low consumption of vegetables, fruits, whole grains, nuts, and seeds are risk factors for mortality in chronic diseases such as diabetes and cancer (Lim et al., 2012). Springmann et al. (2016) claimed that higher consumption of plant-based diets has been associated with reduction a 6-10% mortality in 2050. In another study, less red meat, high fruit, and vegetable consumption are associated with decreasing mortality (Lim et al., 2012). Besides, a reduction in total energy intake because of preventing overweight/obesity has a positive impact on mortality (Prospective Study Collaboration, 2009; Springmann et al., 2016).

Weight loss dietary intervention improve health and decrease the risk of chronic diseases (WHO/FAO, 2003; Wass and Owen, 2014). Also, a weight loss diet might affect a sustainable environment by reducing food intake and increasing the consumption of healthy plant-based foods. Increased obesity prevalence may contribute to GHGEs by increased food production/consumption and higher weight of individuals (Underwood and Zahran, 2016). Besides, Magkos et al. reported that obesity is associated with nearly 20% higher GHGEs than normal weight due to oxidative metabolism, food consumption, and fossil fuel use for transport. Obesity contributes extra to nearly 1.6% of GHGEs globally (Magkos et al, 2020). Gryka et al. (2012) claimed that CO2 production has a positive correlation with body weight. They showed that CO2 production reduces 1% for every per kg of body mass loss in individuals. In the same study, researchers estimated that if overweight and obese individuals lose 10 kg, the global GHGEs decrease by 0.2%. Weight loss in obese/overweight could help the reduction in the CO2 emission. This reduction may help the improvement of global health (Gryka et al, 2012; Underwood and Zahran, 2016).

As far as we know, no previous research has investigated the effect of weight loss dietary intervention on dietary CF and health risk in healthy people. Thus, the present study was carried out to observe whether short-term weight loss diet changes dietary CF and its effect on the risk of chronic disease.

2. Material and Methods

2.1. Subjects

The research was carried out between April 2019 and January 2020 with 61 individuals (51 female; 10 male) aged 19-59 years and with a Body Mass Index (BMI) of ≥25 kg/m^2 (Power analysis: For 56 individuals; Type 1 error (alpha)=0.05, test power (1- Type 2 error (beta))=0.85). The individuals participating in the study were students and staff selected from Gazi University Faculty of Health Sciences. Individuals with any chronic diseases did not participate in the study. At the beginning of the research, a questionnaire consisting of general information (age, gender etc), food consumption records, and anthropometric measurements was applied to the participants with a face-to-face interview technique.

2.2. Anthropometric Measurements

Body weight (kg) of the participants was measured with an electronic scale and height was measured by a stadiometer. Body weight measurement is taken at the beginning of the study and continued to be measured weekly after starting the diet. Measurement was taken in the morning when the person was hungry and was wearing thin clothes. Body Mass Index (BMI) was calculated using the body weight/height (kg/m^2) equation. World Health Organization (WHO) reference is taken for body mass index cut off values (World Health Organization, Body mass index-BMI). Similarly, the measurement method for waist circumference and hip circumference was taken from the report of the WHO. The report shows that if the waist circumference and waist-hip ratio increases, the risk of chronic disease also increases (waist circumference' cut off: for female (F):80 cm, male(M):94 cm; waist-hip ratio' cut off F:0.85, M:0.90) (WHO, 2008). Neck circumference was measured by researchers. The cut-off values for identifying cardiometabolic risk was higher than 34 cm in female and higher than 37 cm in male (Ben-Noun et al., 2001). Waist height ratio is used as a health risk indicator in adults. Ashwell et al. states that if this value is ≥0.5, early health risk increases (Ashwell and Gibson, 2016). Waist circumference, hip circumference, waist-hip ratio, waist-height ratio, and neck circumference values were evaluated at the beginning and the end of the study.

2.3. Evaluation of Nutritional Status and Planning of Dietary Intervention

The dietary intervention implemented during the study were individually planned by the researchers for all residents. In order to determine the energy value of the weight loss diet, the energy needs of individuals were calculated. Basal metabolic rates of the participants were calculated with the practical formula of 24 x body weight (kg) x factor (this factor is taken as 1 for men, 0.95 for women). Ideal body weight or formula weight is used in the formula. Daily energy requirement was obtained by multiplying the basal metabolic rate by the coefficient of physical activity. This coefficient was accepted as 1.4 for individuals with sedentary activity level and 1.6 for individuals with high activity level (United Nations University/ World Health Organization, 2001). In our country, the average physical activity level (PAL) for individuals between the ages of 18-59 has been determined as 1.45-1.5 (Türkiye Beslenme Rehberi, 2015). Considering these data, the physical activity level was accepted as 1.4 in individuals who spent half of the day sitting down, did not walk long distances, and used public transportation. The physical activity level was taken as 1.6 in individuals who spend more time walking and exercise, although not regularly. Statement-based expressions were used to determine the level of physical activity.

After calculating the energy needs of the individuals, the energy content of the diet programs was decided by reducing this value by 20% (Baysal et al., 2008). Macronutrient distribution of the diet was calculated as 55-60% of carbohydrates, 15-20% of proteins, and 25-30% of fats, and a sample menu was created (Türkiye Beslenme Rehberi, 2015; European Food Safety Authority, 2017). Nutritional habits of all individuals were questioned at the beginning of the study and three days of food consumption records (two days on weekdays and one day on weekends) were taken from participants and while preparing the dietary intervention these records were taken into account. The amounts of milk and dairy products, meat, egg, cheese, bread, pasta, fruits and vegetables that should be consumed by individuals according to their determined energy needs are explained through the sample menu. It has been suggested that consumption of brown bread instead of white bread, adding salad to the lunch and dinner, reducing the consumption of sweet/snacks, etc. The dietary intervention was explained to all individuals one by one by the researchers using face-to-face interview method. Individuals applied this program for 4 weeks. Control interviews were conducted with all individuals every week during the study. During these interventions, 24-hour food consumption records were taken to evaluate the participants' compliance with the diet. The average energy and nutrient intakes of the individuals were calculated from the food consumption records obtained during the control interviews and at the end of the study. From food consumption records, dietary energy, macronutrients, and food groups that are used to calculate the CF were analyzed using the 'Computer-Aided Nutrition Program, Nutrition Information System (BeBIS) (Pasifik Company). The participants were not given any suggestions for physical activity by researchers.

2.4. Calculation of Dietary Carbon Footprint

Dietary carbon footprint was calculated according to study of Huseinovic et al (Huseinovic et al, 2017). Eight major food groups and 30 subgroups were created from the data obtained from the food consumption records (major food groups; 1-fruits and vegetables, 2-drinks, 3-meat, 4-fish, 5-dairy and egg, 6-potatoes, bread and pasta, 7-butter/oil and 8-sweets, snacks). The total CF of the diet was calculated by multiplying the CF value of the food in each group by the consumption amount of the food. The CF contents of food groups are based on the results obtained in life cycle analysis. Life cycle analysis is a standardized method by https://www.iso.org/home.html International Organization for Standardization (ISO). Some foods are excluded because of their small amount or because they do not belong to the certain food group (Huseinovic et al., 2017).

2.5. Statistical Analysis

The data obtained from the research were analyzed with the appropriate statistical methods using the SPSS 22.0 program. Descriptive values were specified as number (n), percent (%), arithmetic mean ($\bar{x}$), and standard deviation (SD). The suitability of variables to normal distribution was examined by visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). While using paired samples t-test to compare data with normal distribution, Wilcoxon signed-rank test was used to compare data without normal distribution. The statistical significance level was determined as $P<0.05$.

3. Results

The mean age of participants was 30.2±11.39 years (19-59 years). The demographic characteristics of the participants are shown in Table 1. A total of 61 individuals (10 male, 51 female) participated in this study. Most of the participants (72.1%) are high school graduates. Of the participants, 78.3% do not smoke and 88.3% do not drink alcohol. Besides, 78.3% have obese individuals among their first-degree relatives and 46.7% applied for a dietary intervention before the study.

The change in anthropometric measurements of participants after the dietary intervention is given in Table 2.

Table 1. Demographic characteristics of participants

Demographic characteristics	Number(n)	Percent (%)
Gender		
Male	10	16.4
Female	51	83.6
Educational status		
High school	44	72.1
University	13	21.3
Postgraduate	4	6.6
Smoking		
Yes	13	21.7
No	47	78.3
Drink alcohol		
Yes	7	11.7
No	53	88.3
The presence of obese individuals in the family		
Yes	47	78.3
No	13	21.7
Apply weight loss diet before		
Yes	28	46.7
No	32	53.3

Table 2. Change in anthropometric measurements of participants after weight loss program

Anthropometric measurements	Basal measurement $\bar{x}$±SD	1st week $\bar{x}$±SD	2nd week $\bar{x}$±SD	3rd week $\bar{x}$±SD	4th week $\bar{x}$±SD	Z/t	P[a]
Body weight (kg)	80.6±13.32	79.6±13.19	78.8±13.15	78.2±13.16	77.0±12.29	-6.511	<0.001
BMI (kg/m^2)	29.9±3.22	29.4±3.14	29.2±3.13	28.8±3.08	28.6±3.02	-6.509	<0.001
Anthropometric measurements	Basal measurement $\bar{x}$±SD			Final measurement $\bar{x}$±SD			P[b]
Waist circumference (cm)	95.5±10.42			91.8±10.39		10.106	<0.001
Hip circumference (cm)	110.4±8.23			108.8±5.92		10.872	<0.001
Waist- hip ratio	0.9±0.08			0.8±0.07		5.804	<0.001
Waist – height ratio	0.6±0.05			0.5±0.05		10.287	<0.001
Neck circumference(cm)	36.4±5.00			35.5±3.31		-3.600	<0.001

BMI= body mass index, [a]= Wilcoxon signed-rank test, [b]= paired samples t-test. It was considered significant for P<0.05.

Table 3. Effect of dietary intervention on dietary pattern and carbon footprint

Variables	Baseline $\bar{x}$±SD	After dietary intervention ($\bar{x}$±SD)	Z/t	P †
Dietary pattern				
Energy (kcal)	1948.0±425.66	1587.5±254.98	-6.346	<0.001
Protein (g)	67.6±18.20	65.9±12.86	-0.761	0.446
Protein (%)	14.4±2.71	17.1±1.63	-5.477	<0.001
Fat (g)	86.8±22.86	60.1±11.74	-6.669	<0.001
Fat (%)	39.6±4.97	33.9±3.65	-5.562	<0.001
Carbohydrate (g)	217.8±53.63	187.8±32.31	-4.450	<0.001
Carbohydrate (%)	45.8±5.73	48.9±3.74	-3.381	<0.001
Dietary fiber (g)	20.6±6.45	32.8±6.24	-6.777	<0.001
Major food groups (g)				
Sweets/snacks	61,7±43,24	6,0±13,23	-6.559	<0.001
Drinks	31,6±68,00	2,9±16,37	-3.191	0,001
Fruits/vegetables	453,5±217,87	955,0±235,62	-13.971	<0.001 ‡
Potatoes/bread/pasta	267,7±101,14	224,3±50,57	-2.988	0.003
Fish	12,1±28,53	10,8±30,02	-0.611	0.541
Meat	57,1±60,28	39,9±29,33	-1.942	0.052
Butter/oil	41,1±16,00	24,3±7,75	-6.425	<0.001
Dairy/egg	227,0±103,83	349,4±93,86	-5.727	<0.001
Carbon footprint (CO_2eq/kg)				
Dietary total carbon footprint	1.6±0.47	1.8±0.32	-2.360	0.018
Sweets/snacks	0.1±0.07	0.01±0.02	-6.555	<0.001
Drinks	0.01±0.05	0.0±0.00	-3.216	<0.001
Fruits/vegetables	0.2±0.11	0.5±0.12	-13.896	<0.001 ‡
Potatoes/bread/pasta	0.2±0.06	0.1±0.04	-1.981	0.048
Fish	0.02±0.06	0.02±0.06	-0.634	0.526
Meat	0.5±0.39	0.3±0.19	-2.578	0.010
Butter/oil	0.06±0.03	0.03±0.01	-6.330	<0.001
Dairy/egg	0.6±0.20	0.7±0.19	-4.422	<0.001

†= Wilcoxon signed rank test, ‡= paired samples t-test. It was considered significant for P<0.05.

The body weight, BMI, waist, hip and neck circumference, waist-hip ratio, and the waist-height ratio of participants decreased statistically significantly after the dietary intervention (P<0.001).

The effect of the dietary intervention on dietary patterns and carbon footprint are shown in Table 3. The dietary energy and macronutrients (fat (g, %), and carbohydrate (g, %)) intake of individuals reduced significantly (P<0.001). The percentage of protein's contribution to energy and the amount of fiber intake is increased (P<0.001 and P<0.001). In addition, the dietary total CF increased in this study (P=0.018). The consumption of sweets/snacks, drinks, potatoes/bread/pasta, and butter/oil groups significantly decreased. Although meat and fish consumption decreased, it cannot be regarded statistically significant. Besides, consumption of dairy/egg groups increased significantly.

As for the eight major food groups, their dietary CF of sweets/snacks, drinks, potatoes/bread/pasta, meat, and butter/oil significantly decreased. Also, dietary CF of fruits/vegetables and dairy/egg increased significantly. The effect of the dietary intervention on carbon footprint change (CO_2eq/kg) is shown in Figure 1.

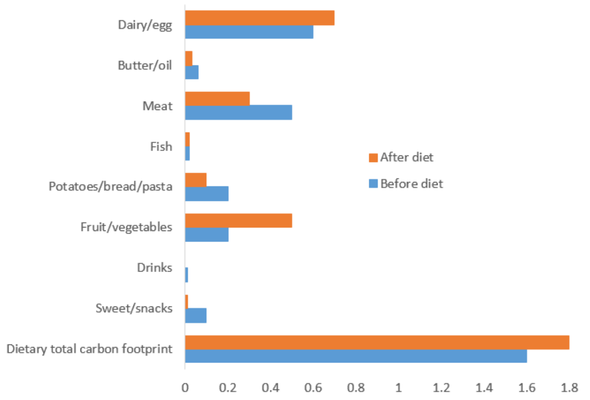

Figure 1. The effect of the dietary intervention on carbon footprint change (CO_2eq/kg).

4. Discussion

Our study was carried out to observe whether a short-term dietary intervention for weight loss changes the dietary carbon footprint and its effect on the risk of chronic disease. A total of 61 individuals (10 male, 51 female) with a BMI ≥25 kg/m² and mean age of 30.2±11.39 years participated in this study. Of the participants, 78.3% have obese individuals in their family and 46.7 of individuals applied weight loss diet before this study (Table 1). After diet intervention, participants statistically significantly lost their body weight (P<0.001). Besides BMI; waist, hip and neck circumference, waist-hip ratio, and waist-height ratio of participants decreased significantly after the weight loss diet (P<0.001) (Table 2). The reduction in anthropometric measurements contributes reduces the risk of many diseases (WHO/FAO, 2003). The weight loss (5-10%) can reduce the risks of developing type 2 diabetes mellitus (T2DM) and obesity-related cancers by improving blood pressure and lipid profiles (Wass and Owen, 2014). In a systematic review and meta-analysis study examining the health effects of a weight loss dietary intervention in obese individuals, high quality evidence showed that weight loss interventions decrease all-cause mortality (Ma et al., 2017). However, in our study at the end of four weeks, although there was a significant decrease in variables such as BMI and waist/height ratio; final values still pose a risk for the development of chronic disease. In order to achieve the desired change in these variables, the study can be continued for a longer time. It should be noted that adequate and balanced nutrition and ideal body weight should be maintained throughout life to prevent chronic diseases.

In this study, energy and macro-nutrients intake (fat (g, %), carbohydrate (g, %)) of individuals was reduced after weight loss diet (P<0.001 and P<0.001). The percentage of protein and dietary fiber intake was increased (P<0.001 and P<0.001) (Table 3). The energy, micro, and macronutrient intake should be balanced in a healthy diet. Increased energy, fat, and carbohydrate intake are related to the ratio of obesity and obesity-related disorders (WHO/FAO, 2003). The increase in dietary fiber consumption is important because of its health-improving and protective effects from many chronic diseases. Studies have reported that dietary fiber has important effects on obesity, diabetes, cardiovascular diseases, various types of cancer and gastrointestinal system diseases (Merenkova et al., 2020).

Obesity prevalence may contribute to GHGEs by increased food production/consumption, oxidative metabolism, and fossil fuel use for transport (Underwood and Zahran, 2016; Magkos et al., 2020). So, it was reported that decreasing carbon dioxide production from the body by weight loss diet can have a positive impact on the environment (Gryka et al., 2012). Dietary carbon footprint is expected to decrease if plant-based foods are consumed instead of animal-based foods. However, the energy intake reduction achieved through a reduced intake of sweets, snacks, and drinks effect on CF is not clear (Huseinovic et al., 2017). One of our aims in our study was to examine the effect of dietary intervention applied to achieve weight loss on dietary carbon footprint change. The consumption of plant-based foods such as legumes, quinoa, and chia instead of animal proteins may have contributed to the decrease in dietary CF (López et al., 2018). Besides, although a diet including low red meat, high fruit, and vegetable has been shown to have a little environmental affect, in some cases the increase in the amount of fruits, vegetables, and cereals consumed to replace animal protein may cause a similar environmental impact (Reynolds et al., 2014). In one study showed that there was no difference in dietary CF between lactating women who participated and not lose weight program after 12 weeks (Huseinovic et al., 2017). However, dietary CF from fruit and vegetables increased in weight-loss group compared to the non-weight-loss group (Huseinovic et al., 2017). In another study conducted on university students, aiming to reduce the dietary carbon footprint by changing their eating habits, the increase in vegetable consumption and the decrease in the consumption of ruminant meat and sugar-sweetened beverages resulted in a significant 14% reduction in the dietary carbon footprint (Malan et al., 2020). However we found that at the end of four weeks dietary total CF was increased significantly (P=0.018). Although in our study, the consumption of meat decreased, fruit and vegetable significantly increased (P<0.001) and sweets/snacks (P<0.001) and drinks (P=0.001) significantly decreased, the total carbon footprint of the diet increased. Even though potatoes/bread/pasta (P=0.003) and butter/oil groups significantly decreased (P<0.001), dairy/egg groups significantly increased (P<0.001) (Table 3). Especially in our study, increased consumption of fruits/vegetables and dairy/egg may have caused an increase in dietary total carbon footprint. Because as it is shown in Table 3 dietary CF of fruits/vegetables and dairy/egg was increased significantly (P<0.001 and P<0.001, respectively). However, according to the Food and

Agriculture Organization (FAO), a sustainable diet is not just a diet with little impact on the environment. Sustainable diets are also expected to be healthy, accessible, and affordable (Burlingame and Dernini, 2012). Therefore, although the carbon footprint seems to have increased at the end of the study, making the diets healthier also supports the concept of a sustainable diet in another way. Despite the environmental benefits of plant-based diets, more attention should be paid to the intake and nutritional values of macro and micronutrients in a balanced diet, as it is necessary to think in terms of individual nutritional habits (Rosi et al., 2017). Wilkinson et al. reported that a reduction in carbon emissions and climate change will improve the health and wellbeing of the people (Wilkinson et al., 2010). Furthermore, preventing health problems may have a positive impact on the environment (Gryka et al., 2012).

This study has several limitations. First, although the food system is responsible for more than a quarter of all GHGEs, some parameters such as land or water use could not be evaluated. Second, the sample size is not representative to generalize the results. More research is required for the dietary intervention on the environment. Third, the number of females and males was not equal, a number of males did not agree to participate in the study. Finally, the duration of dietary intervention is short. Longer-term studies are needed to better observe the study results.

5. Conclusion

In conclusion, body weight and in anthropometric measurements that warn of significant health risks were reduced by short term weight loss dietary intervention of the present study. Also, total dietary CF increased, which can be related to the increase in the consumption of dairy/egg food group in this study. However, different results should be obtained in longitudinal studies. Dieticians should plan dietary intervention considering both healthy weight loss and sustainable environment. More research should be conducted on nutrition to prevent health and the environment with larger scale and a more representative sample.

Author Contributions

Concept: F.A. (34%), B.A. (33%) and H.Y. (33%), Design: F.A. (34%), B.A. (33%) and H.Y. (33%), Supervision: F.A. (34%), B.A. (33%) and H.Y. (33%), Data collection and/or processing: F.A. (34%), B.A. (33%) and H.Y. (33%), Data analysis and/or interpretation: F.A. (25%), B.A. (50%) and H.Y. (25%), Literature search: F.A. (34%), B.A. (33%) and H.Y. (33%), Writing: F.A. (34%), B.A. (33%) and H.Y. (33%), Critical review: F.A. (34%), B.A. (33%) and H.Y. (33%), Submission and revision F.A. (34%), B.A. (33%) and H.Y. (33%). All authors reviewed and approved final version of the manuscript.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Approval/Informed Consent

Ethical approval of the study was obtained from Gazi University Ethics Committee with the research code number “2019-035” on March 12, 2019. Participants signed an informed consent form.

References

Ashwell M, Gibson S. 2016. Waist-to-height ratio as an indicator of ‘early health risk’: simpler and more predictive than using a ‘matrix’based on BMI and waist circumference. BMJ Open, 6: e010159.

Baroni L, Cenci L, Tettamanti M. 2007. Evaluating the environmental impact of various dietary patterns combined with different food production systems. Eur J Clin Nutr, 61: 279-286.

Baysal A, Aksoy M, Besler H. 2008. Diyet El Kitabı. 5. Ed. Hatipoğlu Yayınevi, Ankara, Türkiye, pp: 67-143.

Ben-Noun L, Sohar E, Laor A. 2001. Neck circumference as a simple screening measure for identifying overweight and obese patients. Obes Res, 9: 470-477.

Burlingame B, Dernini S. 2012. Sustainable diets and biodiversity directions and solutions for policy, research and action. FAO Headquarters, Rome, Italy.

Cederberg C, Hedenus F, Wirsenius S. 2013. Trends in greenhouse gas emissions from consumption and production of animal food products–implications for long-term climate targets. Animal, 7: 330-340.

Drewnowski A, Rehm CD, Martin A. 2015. Energy and nutrient density of foods in relation to their carbon footprint. Am J Clin Nutr, 101: 184-191.

European Food Safety Authority (EFSA). 2017. Dietary reference values for nutrients summary report (2397-8325).

FAO. 2013. Food wastage footprint: Impacts on natural resources. Summary Report In: FAO Rome, Italy. URL: http://www.fao.org/publications/card/en/c/000d4a32-7304-5785-a2f1-f64c6de8e7a2/ (accessed date: February 23, 2022).

Garnett T. 2006. Fruit and vegetables & UK greenhouse gas emissions: exploring the relationship. UK: Food and Climate Research Network, University of Surrey. URL: https://www.tabledebates.org/research-library/fruit-and-vegetables-and-uk-greenhouse-gas-emissions-exploring-relationship (accessed date: February 23, 2022).

Garnett T. 2011. Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? Food Policy, 36: S23-S32.

González-García S, Esteve-Llorens X, Moreira MT. 2018. Carbon footprint and nutritional quality of different human dietary choices. Sci Total Environ, 644: 77-94.

Gryka A, Broom J, Rolland C. 2012. Global warming: is weight loss a solution? Int J Obes, 36: 474-476.

Gustafson D, Gutman A, Leet W. 2016. Seven food system metrics of sustainable nutrition security. Sustain, 8: 196.

Huseinovic E, Ohlin M, Winkvist A. 2017. Does diet intervention in line with nutrition recommendations affect dietary carbon footprint? Results from a weight loss trial among lactating women. Eur J Clin Nutr, 71: 1241-1245.

Lim SS, Vos T, Flaxman AD. 2012. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study

2010. Lancet, 380: 2224-2260.

López DN, Galante M, Robson M. 2018. Amaranth, quinoa and chia protein isolates: Physicochemical and structural properties. Int J Biol Macromol, 109: 152-159.

Ma C, Avenell A, Bolland M. 2017. Effects of weight loss interventions for adults who are obese on mortality, cardiovascular disease, and cancer: systematic review and meta-analysis. BMJ, 359: j4849.

Magkos F, Tetens I, Bügel SG. 2020. The environmental foodprint of obesity. Obesity, 28: 73-79.

Malan H, Amsler Challamel G, Silverstein D. 2020. Impact of a scalable, multi-campus "Foodprint" seminar on college students' dietary intake and dietary carbon footprint. Nutrients, 12: 2890.

Merenkova S, Zinina O, Stuart M. 2020. Effects of dietary fiber on human health: A review. Human Sport Medic, 20: 106-113.

Pasifik Company. Beslenme Bilgi Sistemleri (BeBİS). URL: https://bebis.com.tr/bebis-1 (accessed date: February 23, 2022).

Prospective Study Collaboration. 2009. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet, 373: 1083-1096.

Reynolds CJ, Buckley JD, Weinstein P. 2014. Are the dietary guidelines for meat, fat, fruit and vegetable consumption appropriate for environmental sustainability? A review of the literature. Nutrients, 6: 2251-2265.

Rosi A, Mena P, Pellegrini N. 2017. Environmental impact of omnivorous, ovo-lacto-vegetarian, and vegan diet. Scientific reports. 7,1-9. Rome, Italy, 3-5 November 2010. URL: http://www.fao.org/3/i3004e/i3004e00.htm (accessed date: February 23, 2022).

Springmann M, Godfray HCJ, Rayner M. 2016. Analysis and valuation of the health and climate change cobenefits of dietary change. Proc Natl Acad Sci, 113: 4146-51.

Stehfest E, Bouwman L, Van Vuuren DP. 2009. Climate benefits of changing diet. Clim Change, 95: 83-102.

T.C. Sağlık Bakanlığı. 2016. Türkiye Beslenme Rehberi TÜBER 2015. TC Sağlık Bakanlığı Yayını (1031): 172-217.

Tilman D, Clark M. 2014. Global diets link environmental sustainability and human health. Nature, 515: 518-522.

Underwood A, Zahran S. 2016. The climate co-benefits of obesity reduction. American Economist Association Conference Presentation San Francisco, CA ,US.

United Nations University/ World Health Organization (UNU/WHO). 2001. Human Energy Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation: Rome, 17-24 October 2001 (Vol. 1): Food & Agriculture Org. URL: https://www.who.int/nutrition/publications/nutrientrequirements/9251052123/en/ (accessed date: February 23, 2022).

Vermeulen SJ, Campbell BM, Ingram JS. 2012. Climate change and food systems. Annu Rev Enviro Resour, 37: 195-222.

Wass J, Owen K. 2014. Oxford handbook of endocrinology and diabetes. Oxford University Press, London, UK, pp: 1104.

Westhoek H, Lesschen JP, Rood T. 2014. Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. Glob Environ Change, 26: 196-205.

Wilkinson RG, Pickett KE, De Vogli R. 2010. Equality, sustainability, and quality of life. BMJ, 341: c5816.

WHO. 2008. Waist circumference and waist–hip ratio. Report of a WHO expert consultation. URL: https://www.who.int/nutrition/publications/obesity/WHO_report_waistcircumference_and_waisthip_ratio/en/. (accessed date: February 23, 2022).

WHO/FAO. 2003. Diet, nutrition and the prevention of chronic diseases. World Health Organ Tech Rep Ser, 916(i-viii),1-149 URL: https://apps.who.int/iris/bitstream/handle/10665/42665/WHO_TRS_916.pdf?sequence=1 (accessed date: February 23, 2022).