Research article

Eating habits and nutritional status of women with musculo-skeletal diseases

Irina Motoașcă [1,2], **Laszlo Irsay** [1,2*], **Mădălina-Gabriela Iliescu** [3*], **Lucia Maria Rus** [4], **Ileana –Monica Borda** [1,2], **Rodica –Ana Ungur** [1,2], **Liliana- Elena Stanciu** [3], **Florina-Ligia Popa** [5], **Mihaela Stanciu** [6], **Viorela Mihaela Ciortea** [1,2]

1. Department of Rehabilitation Medicine, University of Medicine and Pharmacy "Iuliu Hatieganu", 8 Victor Babes street, 400012, Cluj-Napoca, Romania
2. Department of Rehabilitation Medicine, Clinical Rehabilitation Hospital, 46-50 Viilor Street, 400337 Cluj-Napoca, Romania
3. Department of Physical Medicine and Rehabilitation, „Ovidius" University of Constanta, Faculty of Medicine, 1 University Alley, Campus – Corp B, 900470, Constanta, Romania
4. Pharmaceutical Analysis Department, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Hatieganu", 6 L. Pasteur Street, Cluj-Napoca, Romania
5. Physical Medicine and Rehabilitation Department, Faculty of Medicine, "Lucian Blaga" University of Sibiu, 2A Lucian Blaga street 55019 Sibiu, Romania
6. Endocrinology Department,Faculty of Medicine, "Lucian Blaga" University of Sibiu, 2A Lucian Blaga street 55019 Sibiu, Romania

* Correspondence: Laszlo Irsay irsaylaszlo@gmail.com ;
Mădălina-Gabriela Iliescu iliescumadalina@gmail.com

Abstract: Different theories link chronic musculoskeletal pain with lifestyle components, including diet. However, nutritional assesment and optimization is not routinely included into the medical management of patients with muskuloskeletal diseases (MSKD). In this study we aimed to evaluate the diet and nutritional status of a group of women with MSKD and to assess the extent to which they comply with the general recommendations for a healthy diet. The results showed that 97% of the subjects included were overweight or obese, and the compliance to different general nutritional recommandations ranged between 3% to 57%. Furthermore, the quality of life of this patients measured through SF-36 question-naire was severly affected and the reported pain intensity on numeric pain scale had a mean of 8 (±1.3) in our study group. Although there are currently no specific guidelines for the nutrition of patients with chronic pain, an important first step would be to guide these patients towards an increase in diet quality and a healthy lifestyle by adhering to general nutritional recommendations regarding healthy eating.

Keywords: diet, nutritional status, musculoskeletal disease, chronic pain

1. Introduction

Chronic musculoskeletal pain treatment is often difficult, with attention increasingly turning to modifying lifestyle components such as stress, sleep habits and diet within a multimodal approach. Although there has been little experimental research into the relationship between diet and pain, dietary modification has great potential to become a key element in pain management as a means of treatment with minimal side effects [1].

Different studies have shown an increased risk of suffering from chronic pain in patients diagnosed with depression, obesity, diabetes, hypertension or cerebrovascular diseases [2]. In terms of perceived pain intensity it appears that both obesity and the consumption of a high-calorie diet lead to alterations in nociception and pain susceptibility. Once chronic pain is set, it leads to eating excesses and sedentarism, limits the ability to procure food and prepare healthy meals and negatively influences food choices thus creating a vicious circle that maintains both pathologies [3,4].

Along with weight gain, the mechanical stress to which the musculoskeletal system is subjected increases [4,5]. This can lead both to new changes such as the degradation of the articular cartilage at the load-bearing joints, damage to the intervertebral discs, muscle overload due to the migration of the center of gravity and postural changes therefore it can also aggravate pre-existing musculoskeletal conditions and the intensity of pain in a direct manner proportional to the body mass index (BMI) [6,7]. The fact that obesity was associated with a higher risk of developing headache, migraine or arthrosis at the level of some joints that are not subjected to the same mechanical stress as the joints of the hand indicates, in addition to the mechanical theory, the existence of other mechanisms involved in musculoskeletal pathology and chronic pain that are induced by obesity [3].

Both obesity as well as type II diabetes and metabolic syndrome determine a pro-inflammatory status that has been implicated in various pathologies such as rheumatoid arthritis, arthrosis, fibromyalgia and low back pain [8,9]. The released inflammatory markers (TNF-α, IL-6, IL-1β) exert a pro-nociceptive effect both at the level of the peripheral nervous system by stimulating nociceptive receptors and at the level of the central nervous system [3,4].

Various mechanisms and signaling pathways could play a role in the relationship between lifestyle (including diet) and chronic pain, elements of this relationship being pro- or anti-inflammatory food, food with oxidative or antioxidant potential, sensitization of the central nervous system by an unhealthy diet [10], psychological status, stress and level of physical activity [6,11]. A diet rich in Omega-6 fatty acids, red meat, sugar, white flour, pastries, processed cereals, fried foods contribute to a pro-inflammatory status of the organism, while foods rich in Omega-3 fatty acids, vegetables, fruits, fish, whole grains, legumes, nuts, olive oil own anti-inflammatory properties [4]. Bioactive compounds such as polyphenols present in fruits and vegetables reduce oxidative stress and inflammation by decreasing the production of pro-inflammatory molecules or have a direct effect on pain signaling pathways, modulating pain perception [2,11]. The studies that analyzed the effect of supplementing with strawberries or blueberries in patients with symptomatic gonarthrosis reported significant decrease in pain [12,13].

Brain et al. [2] brought up the fact that contemporary medical practice does not routinely include dietary assessment of patients suffering from chronic pain. There is very limited information about the dietary intake and eating habits of patients with various conditions. Knowing their nutritional status would help to understand both what are the risk or protective factors and what are the most appropriate recommendations for these patients.

Towery et al. [7] conducted a study to examine whether a plant-based diet could reduce chronic musculoskeletal pain and improve patients' functionality. Through this project a multidisciplinary collaboration between physical medicine and nutrition was achieved, suggesting the importance of multidisciplinary management of patients with chronic musculoskeletal pathology.

VanDenKerkhof et al. [14] observed that women who suffered from chronic pain were more likely to decrease their consumption of fruit and vegetables and consumed unhealthy food much more often than women who did not experience pain. The aforesaid difference was not found in men. At the same time, the unhealthy diet consumed by women who suffered from chronic pain had characteristics that are a risk for cancer and cardiovascular diseases development and this could explain the link between chronic pain and the increased risk of developing cancer or cardiovascular diseases [14].

The motivation of this study was to bring additional information about the nutritional status of patients with musculoskeletal pathology, with the perspective of a better understanding of their needs and the possibility of integrating nutritional medical therapy into the classic approach to these conditions.

The purpose of the study was to evaluate the eating habits, nutritional status and quality of life in patients suffering from musculoskeletal pathology causing chronic pain and to assess the extent to which they comply with the general recommendations for a healthy diet.

2. Results

The average age of the women patients included in the study was 67.7 (54 years old to 80 years old) and the distribution by living environment was approximately equal. The intensity of the pain assessed with the help of the numerical pain rating scale (NRS) at admission had an average of 8 out of 10 points in the study group. Only one patient (3%) was normal weight the rest being overweight or obese, 18 (60%) of them suffering from obesity degree I, II or III. High-risk waist-to-hip ratio (CA/CS) (>0.80) was present in 25 (83%) of the women. Regarding the bone mineral density, it was normal in only 20% of the patients, the rest 80% suffering from osteopenia or osteoporosis (Table 1).

Table 1. Characteristics of the study group

Characteristics of the group	Values
Average age (±SD) (years)	67.6 (±7.2)
The living environment	
Rural, no. (%)	14 (47)
Urban, no. (%)	16 (53)
Pain intensity (NRS), mean (±SD)	8 (±1.3)
BMI, mean (±SD)	32.09 (±4.7)
Normal weight, no.(%)	1 (3)
Overweight, no. (%)	11 (37)
Obesity class I, no. (%)	10 (33)
Obesity class II, no. (%)	6 (20)
Obesity class III, no. (%)	2 (7)
Abdominal circumference (AC), mean (±SD)	105 (±12.8)
Hip circumference (HC), mean (±SD)	116.4 (±10.1)
AC/HC ratio, mean (±SD)	0.9 (±0.06)
Bone mineral density (BMD)	
Normal BMD, no. (%)	6 (20)
Osteopenia, no. (%)	16 (53)
Osteoporosis, no. (%)	8 (27)

The analysis of the 24-hours dietary recall results showed that 40% of the patients did not eat any portion of fruit the day before admission, 77% did not eat any portion of whole grains, 43% did not eat any portion of dairy products and only 10% ate a number of 3 dairy portions recommended for daily intake. 90% do not use olive oil as the main fat for coooking, 87% did not eat any portion of nuts and seeds and 97% did not eat fish. Red or processed meat was present in the diet of 53% of the patients, sweets or sweetened juices at 83%, fried foods at 43%, 47% of patients used animal fat in cooking and 77% ate dishes made from white flour. The maximum number of portions of sweets consumed by a patient in 24 hours was 8.

Table 2. The level of adherence to the recommendations for a healthy diet

Food	Subjects in the studied group with aliments consumption according to recommendations, no. (%)
Fruit	11 (37)
Vegetables and legumes	9 (30)
Whole grains	1 (3)
Dairy	3 (10)
Nuts and seeds	4 (13)
Eggs and poultry	7 (23)
Olive oil	3 (10)
Fish and seafood	1 (3)

Red meat and processed meat	14 (47)
Sweets and sweetened juices	5 (17)
White flour dishes	7 (23)
Preparare prin prăjire	17 (57)
Folosirea grasimii animale la gatit	16 (53)

Table 3. Results of the SF-36 questionnaire

Domain	Score* mean (±SD)
Physical functioning	38.1 (±24.33)
Role limitations due to physical health	11.6 (±21.50)
Role limitations due to emotional problems	17.7 (±28.67)
Energy/fatigue	49 (±14.46)
Emotional well-being	65.4 (±17.08)
Social functioning	53.3 (±26.04)
Pain	32 (±16.87)
General health	50 (±18.42)
Health change	39.1 (±26.81)

*The numerical results in each domain represent the score obtained from a maximum of 100 points, the maximum meaning a favorable health status, and the lowest possible score, 0, representing maximum impairment in that domain.

3. Discussion

Multiple studies have underlined the link between chronic musculoskeletal pain, overweight and obesity [6]. In our study group we observed a majority of overweight or obese women (97%). Out of these, 37% were overweight and 60% with obesity degree I, II or III. The average body mass index of the group of patients was 32 and the waist/hip ratio recorded a value above the treshold of 0.80 [15] in 93% of the women.

It has been noticed that patients with chronic pain and those with an increased BMI often have a diet of poor quality, deficient in calories, protein and micronutrients [10,14]. In our study we observed that there is a very poor quality of the diet of patients with chronic medium and high intensity pain admitted to our center. 24-hours dietary recalls showed a low consumption of whole foods with anti-inflammatory properties, some of which were almost completely absent from the diet of the studied subjects (whole grains, dairy products, nuts and seeds, olive oil, fish and seafood). Thus, these patients did not reach the daily requirement of nutritious foods, rich in micronutrients, anti-inflammatory and anti-oxidant substances that could lower the pain and increase quality of life. The majority of food intake should be based on basic, whole, nutrient-dense food and only 10% of energy intake should come from high-calorie processed food [2]. The presence of unhealthy, pro-inflammatory and neurosensitizing food in our study group was mainly represented by white bread, sweets, fried food, red meat and the use of animal fat in cooking. 53% of patients consumed at least one portion of red or processed meat in the last 24 hours, only 17% of patients did not consume any portion of sugar or sweets, the remaining of 83% consumed between 1 and 8 portions of sugar in a day. Regarding frying as a food preparation technique, 43% of the patients used it in the last 24 hours and 47% of them used animal fat for cooking and only 10% used olive oil. Overeating is also associated with chronic pain which may be caused by the painful sensation itself that triggers eating for pleasure or as a coping strategy. Eating food leads to dopamine secretion and activation of reward pathways that lead to distraction from anxious thoughts [2]. Disturbance of the body's homeostasis can influence the pleasure created by food and eating behavior by activating circuits at the brain level. Alteration of circuits in the ventral striatum and medial prefrontal cortex alters the enjoyment of certain foods, with chronic pain sufferers more likely to consume sweets. These foods may increase the pain threshold by activating the endogenous opioid system hence they may have a mild analgesic effect that may partially explain the link between pain and obesity [4].

Patients with chronic musculoskeletal pain admitted to our center also had a poor quality of life according to the scores obtained in all domains of the SF-36 questionnaire. The lowest score was obtained in the domain "Limitation of activities due to physical ailments" where the average score obtained was 11.6%, which could be explained by the fact that all patients suffered from musculoskeletal ailments. In the domain "Pain" a low mean score of 32% was also obtained in accordance with the values indicated by them on the NRS. Low values in all domains of the SF-36 questionnaire and especially in those that specifically reflect physical functioning and pain demonstrate the important impact that these conditions have on patients' lives and the need to find complemntary treatment options.

Among the patients included in the study, 20% had normal bone mineral density and 80% had a diagnosis of osteopenia (53%) or osteoporosis (27%). Adequate consumption of calcium and vitamin D is particularly important to achieve maximum bone mineral density and to prevent osteoporosis. For women over 50, a daily consumption of 1200 mg calcium and 600 IU vitamin D is recommended. I was shown that 60% of adult women do not consume enough calcium and more than 90% of them do not consume enough vitamin D [16]. The richest foods in calcium are cheese, yogurt, milk, tofu, sardines and those rich in vitamin D: salmon, trout, swordfish, fish oil, cod liver, cisco, mackerel, tuna, herring, sardines, pork, mushrooms, eggs. In the studied group, the 24-hours dietary recall showed a sufficient dairy consumption in only 10% of the patients and only one patient consumed fish or seafood in the last 24 hours before the interview.

Although there are national and international recommendations for a healthy diet, most people do not follow these recommendations and adopt a suboptimal diet. Patients with chronic musculoskeletal pain who do not currently have specific recommendations for their condition may benefit from being taught and following general population recommendations [17].

The theoretically formulated hypotheses related to the role of nutrition in this pathology together with the evidence that the diet of the patients included in the study needs to be improved lead to the formulation of a new hypothesis: Is it possible that by lifestyle changing to be possible to succeed in reducing the need for the administration of substances drugs and therapeutic interventions that often involve the appearance of additional risks [18–20] simultaneously with increasing the functionality and quality of life of patients through methods that require few resources and involve minimal risks? Although there are currently no specific guidelines for the nutrition of patients with chronic pain, an important first step would be to guide these patients towards an increase in diet quality and a healthy lifestyle by adhering to general nutritional recommendations regarding healthy eating [2]. Nutritional recommendations and beneficial interventions for patients with chronic musculoskeletal pain are described in the literature as being based on decreasing the consumption of pro-inflammatory foods and increasing the consumption of anti-inflammatory foods, recommendations compatible with the Mediterranean diet or with healthy food pyramids [4,21]. Walrabenstein et al. [22] evaluated the effects of a multidisciplinary lifestyle intervention which included a plant-based diet, on disease activity in patients with rheumatoid arthritis, observing a decrease in disease activity and an improvement in metabolic status after 16 weeks of intervention. Both the appearance and progression of rheumatoid arthritis, as well as the systemic inflammation that accompanies it causing the appearance of other chronic diseases, have been associated with an unhealthy diet, obesity or metabolic syndrome. The studies that analyzed the effects of the vegetarian diet [23] or the Mediterranean diet [24] observed a clinical improvement in patients with rheumatoid arthritis.

The meta-analysis by Brain et al. [6] concluded that the most significant reduction in pain was achieved in studies that had as a nutritional intervention the change of the entire diet with a shift towards a healthier one. In comparison, restricting one category of macronutrients (protein or fat) had contradictory results, while the administration of dietary supplements had weaker results and in studies that used fasting as an intervention, no statistically significant results were obtained.

Nutritional intervention in patients with chronic pain is part of an approach to the patient as a whole. Therefore, the collaboration with a dietician in the treatment of patients with chronic pain in order to provide a complex and complete multidisciplinary management, in order to sum up the effects of drug therapy with those of physiotherapy [25,26], healthy eating, lifestyle changes, physical exercise and psychotherapy should be considered.

One of the limits of this study is the fact that for each participant in the study only one 24-hours dietary recall was carried out, this being sufficient to identify the average consumption in the studied group. On the other hand several dietary surveys carried out on the same person would be needed to capture eating habits and daily or seasonal variations. Another limitation of this study is the fact that the food survey was carried out in the 24 hours before a scheduled admission to the hospital, a period in which there is a possibility that the patients were more stressed, more anxious, determined to travel from home to the city where the hospital was located, factors that could have influenced their usual eating behavior. There is also the possibility that some of the subjects may have changed their food intake or the type of food consumed on the day before admission on purpose, with the intention of having the desired results in the blood tests that are done at admission. It should be mentioned that we used a method of estimating food intake, which is not as precise as weighing, but does not cause subject's reactive changes in intake. The 24-hour dietary recall method has as a disadvantage the increased risk of omitting or underestimating food intake [27].

4. Materials and Methods

In this retrospective observational study, after signing the informed consent, 30 consecutive adult women hospitalized in a medical rehabilitation department who suffered from musculoskeletal pathology and chronic pain were included.

The criteria of inclusion in the study were female sex, the age over 18 years, the presence of a diagnosis of a chronic musculoskeletal pathology and the presence of chronic musculoskeletal pain for at least 3 months.

The exclusion criteria consisted in the presence of a comorbidity that requires a specific diet or other eating disorders.

The information collected was age, anthropometric data: weight, height, abdominal circumference and hip circumference which were measured by the same examiner and with the same instruments for all subjects included in the study. Bone mineral density was also collected and was measured by the biphoton X-ray absorptiometry (DXA) method in the same center and with the same device for all included subjects. The dietary recall was carried out for the last 24 hours before admission to the hospital, and the SF-36 questionnaire was applied to evaluate the quality of life.

The 24-hour dietary recall was carried out in the form of a structured interview with open questions, obtaining details about the type, quantity and preparation method of the food and drinks consumed during the 24 hours prior to the scheduled presentation at the hospital. The interview was conducted by the same appropriately trained evaluator for all subjects. The interviewed subjects appreciated the size of the portions by referring to calibrated kitchen utensils such as spoons, teaspoons, cups, mugs, ladles or number of slices or pieces for certain foods [28,29]. From the answers received, we extracted the number of portions consumed by each subject in 24 hours from the following food categories: fruit, vegetables and legumes, whole grains, dairy, fish and seafood, nuts and seeds, eggs and poultry, red meat and sausages, sweets and sweetened juices, refined carbohydrates (white bread, pastries, snacks) according to the standard portion sizes available in the American Dietary Guidelines [16]. We also noted if the interviewed subject consumed food prepared by frying, the use of animal fat or olive oil in cooking. The patients were not informed in advance that a 24-h retrospective dietary recall would be implemented in order not to be predisposed to change their eating behavior the day before the assessment.

The number of portions obtained from the food survey in each food category was compared with the nutritional recommendations for the general adult population with a daily energy consumption of approximately 2000-2200kcal (Table 1) [16,21].

In order to assess the quality of life, we gave each subject the SF-36 questionnaire to fill in, and the score was calculated according to the official protocol.

Each patient was asked to indicate on the numerical pain rating scale (NRS) the intensity of the pain.

Data analysis was carried out using Microsoft Excel 2019.

Table 1. General recommendations used to analyze the diet of study subjects (16,17)

Food	Number of servings/day for an adult/ 2000-2200kcal/zi
Fructe	2
Vegetables and legumes	3
Whole grains	3
Dairy	3
Nuts and seeds	1
Eggs and poultry meat	4
Olive oil	1*
Fish and seafood	1*
Red meat and processed meat	0*
Sweets and sweetened juices	0*
Refined carbohydrates	0*
Preparation by roasting	0*
Use of animal fat in cooking	0*

* Absence from the diet of foods from the categories: red meat and processed meat, sweets and sweetened juices, refined carbohydrates, foods prepared by frying, and animal fat used for cooking was marked with a '0' and the presence of olive oil and fish or seafood was marked with a '1'.

5. Conclusion

The evaluation of nutritional status and diet of patients with musculoskeletal diseases and chronic pain in our center showed a high percentage of patients with overweight or obesity and a poor adherence to general recommendations for a healthy diet. This could help to better understand their needs and to integrate nutritional medical therapy into the classic approach of these conditions.

References

1. Elma, Ö.; Yilmaz, S.T.; Deliens, T.; Coppieters, I.; Clarys, P.; Nijs, J.; Malfliet, A. Nutritional Factors in Chronic Musculoskeletal Pain: Unravelling the Underlying Mechanisms. *British Journal of Anaesthesia* **2020**, *125*, e231–e233, doi:10.1016/j.bja.2020.03.024.
2. Brain, K.; Burrows, T.L.; Bruggink, L.; Malfliet, A.; Hayes, C.; Hodson, F.J.; Collins, C.E. Diet and Chronic Non-Cancer Pain: The State of the Art and Future Directions. *JCM* **2021**, *10*, 5203, doi:10.3390/jcm10215203.
3. Marques Miranda, C.; de Lima Campos, M.; Leite-Almeida, H. Diet, Body Weight and Pain Susceptibility – A Systematic Review of Preclinical Studies. *Neurobiology of Pain* **2021**, *10*, 100066, doi:10.1016/j.ynpai.2021.100066.
4. Elma, Ö.; Yilmaz, S.T.; Deliens, T.; Clarys, P.; Nijs, J.; Coppieters, I.; Polli, A.; Malfliet, A. Chronic Musculoskeletal Pain and Nutrition: Where Are We and Where Are We Heading? *PM&R* **2020**, *12*, 1268–1278, doi:10.1002/pmrj.12346.
5. Walsh, T.P.; Arnold, J.B.; Evans, A.M.; Yaxley, A.; Damarell, R.A.; Shanahan, E.M. The Association between Body Fat and Musculoskeletal Pain: A Systematic Review and Meta-Analysis. *BMC Musculoskelet Disord* **2018**, *19*, 233, doi:10.1186/s12891-018-2137-0.
6. Brain, K.; Burrows, T.L.; Rollo, M.E.; Chai, L.K.; Clarke, E.D.; Hayes, C.; Hodson, F.J.; Collins, C.E. A Systematic Review and Meta-Analysis of Nutrition Interventions for Chronic Noncancer Pain. *J Hum Nutr Diet* **2019**, *32*, 198–225, doi:10.1111/jhn.12601.
7. Towery, P.; Guffey, J.S.; Doerflein, C.; Stroup, K.; Saucedo, S.; Taylor, J. Chronic Musculoskeletal Pain and Function Improve with a Plant-Based Diet. *Complementary Therapies in Medicine* **2018**, *40*, 64–69, doi:10.1016/j.ctim.2018.08.001.
8. Totsch, S.K.; Waite, M.E.; Sorge, R.E. Dietary Influence on Pain via the Immune System. In *Progress in Molecular Biology and Translational Science*; Elsevier, 2015; Vol. 131, pp. 435–469 ISBN 978-0-12-801389-2.
9. Tomaino, L.; Serra-Majem, L.; Martini, S.; Ingenito, M.R.; Rossi, P.; La Vecchia, C.; Bamonti, F.; Vigna, L. Fibromyalgia and Nutrition: An Updated Review. *Journal of the American College of Nutrition* **2021**, *40*, 665–678, doi:10.1080/07315724.2020.1813059.
10. Nijs, J.; Elma, Ö.; Yilmaz, S.T.; Mullie, P.; Vanderweeën, L.; Clarys, P.; Deliens, T.; Coppieters, I.; Weltens, N.; Van Oudenhove, L.; et al. Nutritional Neurobiology and Central Nervous System Sensitisation: Missing Link in a Comprehensive Treatment for Chronic Pain? *British Journal of Anaesthesia* **2019**, *123*, 539–543, doi:10.1016/j.bja.2019.07.016.
11. Bjørklund, G.; Aaseth, J.; Doşa, M.D.; Pivina, L.; Dadar, M.; Pen, J.J.; Chirumbolo, S. Does Diet Play a Role in Reducing Nociception Related to Inflammation and Chronic Pain? *Nutrition* **2019**, *66*, 153–165, doi:10.1016/j.nut.2019.04.007.
12. Schell, J.; Scofield, R.H.; Barrett, J.R.; Kurien, B.T.; Betts, N.; Lyons, T.J.; Zhao, Y.D.; Basu, A. Strawberries Improve Pain and Inflammation in Obese Adults with Radiographic Evidence of Knee Osteoarthritis. *Nutrients* **2017**, *9*, E949, doi:10.3390/nu9090949.
13. Du, C.; Smith, A.; Avalos, M.; South, S.; Crabtree, K.; Wang, W.; Kwon, Y.-H.; Vijayagopal, P.; Juma, S. Blueberries Improve Pain, Gait Performance, and Inflammation in Individuals with Symptomatic Knee Osteoarthritis. *Nutrients* **2019**, *11*, E290, doi:10.3390/nu11020290.
14. Vandenkerkhof, E.G.; Macdonald, H.M.; Jones, G.T.; Power, C.; Macfarlane, G.J. Diet, Lifestyle and Chronic Widespread Pain: Results from the 1958 British Birth Cohort Study. *Pain Res Manag* **2011**, *16*, 87–92, doi:10.1155/2011/727094.
15. Lear, S.A.; James, P.T.; Ko, G.T.; Kumanyika, S. Appropriateness of Waist Circumference and Waist-to-Hip Ratio Cutoffs for Different Ethnic Groups. *Eur J Clin Nutr* **2010**, *64*, 42–61, doi:10.1038/ejcn.2009.70.
16. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition. December 2015. Available at https://health.gov/our-work/food-nutrition/previous-dietary-guidelines/2015.
17. Polak, R.; Dacey, M.; Phillips, E. Time for Food - Training Physiatrists in Nutritional Prescription. *J Rehabil Med* **2017**, *49*, 106–112, doi:10.2340/16501977-2178.
18. Irsay, L.; Chechiceş, A.; Perja, D.; Borda, I.M.; Dogaru, G.; Onac, I.; Ungur, R.; Ciortea, V. Pharmacological Pain Management in Patients with Chronic Kidney Disease. *Balneo* **2019**, *10*, 12–16, doi:10.12680/balneo.2019.232.
19. Irsay, L.; Chechiches, A.; Perja, D.; Borda, I.M.; Dogaru, G.; Ungur, R.; Ciubean, A.; Ciortea, V. Pharmacological Pain Management in Patients with Chronic Hepatic Disease. *BALNEO* **2019**, *10*, 119–123, doi:10.12680/balneo.2019.249.
20. Ungur, R.A.; Borda, I.M.; Codea, R.A.; Ciortea, V.M.; Năsui, B.A.; Muste, S.; Sarpataky, O.; Filip, M.; Irsay, L.; Crăciun, E.C.; et al. A Flavonoid-Rich Extract of Sambucus Nigra L. Reduced Lipid Peroxidation in a Rat Experimental Model of Gentamicin Nephrotoxicity. *Materials* **2022**, *15*, 772, doi:10.3390/ma15030772.
21. Rondanelli, M.; Faliva, M.A.; Miccono, A.; Naso, M.; Nichetti, M.; Riva, A.; Guerriero, F.; De Gregori, M.; Peroni, G.; Perna, S. Food Pyramid for Subjects with Chronic Pain: Foods and Dietary Constituents as Anti-Inflammatory and Antioxidant Agents. *Nutr. Res. Rev.* **2018**, *31*, 131–151, doi:10.1017/S0954422417000270.
22. Walrabenstein, W.; Wagenaar, C.A.; van der Leeden, M.; Turkstra, F.; Twisk, J.W.R.; Boers, M.; van Middendorp, H.; Weijs, P.J.M.; van Schaardenburg, D. A Multidisciplinary Lifestyle Program for Rheumatoid Arthritis: The 'Plants for Joints' Randomized Controlled Trial. *Rheumatology* **2023**, keac693, doi:10.1093/rheumatology/keac693.

23. Hafström, I.; Ringertz, B.; Spångberg, A.; von Zweigbergk, L.; Brannemark, S.; Nylander, I.; Rönnelid, J.; Laasonen, L.; Klareskog, L. A Vegan Diet Free of Gluten Improves the Signs and Symptoms of Rheumatoid Arthritis: The Effects on Arthritis Correlate with a Reduction in Antibodies to Food Antigens. *Rheumatology (Oxford)* **2001**, *40*, 1175–1179, doi:10.1093/rheumatology/40.10.1175.

24. Sköldstam, L.; Hagfors, L.; Johansson, G. An Experimental Study of a Mediterranean Diet Intervention for Patients with Rheumatoid Arthritis. *Ann Rheum Dis* **2003**, *62*, 208–214, doi:10.1136/ard.62.3.208.

25. Ungur, R.A.; Ciortea, V.M.; Irsay, L.; Ciubean, A.D.; Năsui, B.A.; Codea, R.A.; Singurean, V.E.; Groza, O.B.; Căinap, S.; Martiș (Petruț), G.S.; et al. Can Ultrasound Therapy Be an Environmental-Friendly Alternative to Non-Steroidal Anti-Inflammatory Drugs in Knee Osteoarthritis Treatment? *Materials* **2021**, *14*, 2715, doi:10.3390/ma14112715.

26. Ungur RA, Borda IM, Codea RA, Ciortea VM, Nasui BA, Muste S, Sarpataky O, Filip M, Irsay L, et. al., A Flavonoid-RichExtract of Sambucus nigra L. Reduced Lipid Peroxidation in a Rat Experimental Model of Gentamicin Nephrotoxicity, Materials, 2022, 15 ,772, https://doi.org/10.3390/ma15030772

27. DAPA Measurement Toolkit Available online: https://dapa-toolkit.mrc.ac.uk/diet/subjective-methods/24-hour-dietary-recall (accessed on 14 July 2022).

28. 24-Hour Dietary Recall (24HR) At a Glance | Dietary Assessment Primer Available online: https://dietassessmentprimer.cancer.gov/profiles/recall/ (accessed on 14 July 2022).

29. Vossenaar, M.; Lubowa, A.; Hotz, C.; Deitchler, M.; Moursi, M.; Arimond, M.; Patricia, S.; Arsenault, J. Considerations for the Selection of Portion Size Estimation Methods for Use in Quantitative 24-Hour Dietary Recall Surveys in Low- and Middle-Income Countries. 87.