TO FIND THE RELATIONSHIP BETWEEN CONSUMPTION OF ULTRA-PROCESSED FOODS WITH THE OUTCOME OF CARDIOMETABOLIC DISORDER IN ADULTS

Vikramjeet*

Student, Department of Health Sciences, Massey University
Palmerston North, 4442, New Zealand

Email ID: vikramcheema16@gmail.com

Accepted: 09.04.2024 **Published**: 01.05.2024

Keywords: Ultra-Processed Foods, Cardiometabolic Disorder.

Abstract

Food processing alters physical and chemical properties, sometimes compromising health and triggering biological reactions. A review of 23 studies found a strong link between ultra-processed food consumption and negative cardiometabolic outcomes. However, these studies relied on self-reported data, potentially introducing inaccuracies. Food classification followed the NOVA system, differentiating between unprocessed, minimally processed, processed, and ultra-processed foods. A US cohort study of 91,891 participants over 13.5 years found elevated cardiovascular mortality linked to high ultra-processed food intake, though some influencing factors were not fully considered. A Brazilian study proposed reducing CVD deaths by up to 29% by cutting ultra-processed food consumption, based on purchase data. Moreover, ultra-processed foods are associated with increased frailty in older adults and contribute to obesity and CVD risk through various pathways, highlighting a complex relationship. International evidence supports the connection between industrialization, processed foods, and dietary shifts. New Zealand's food consumption has shifted since 1980, emphasizing the need for a systematic nutritional survey to guide health guidelines and reduce healthcare costs through food industry changes.

Paper Identification

**Corresponding Author*

Introduction

The processing of food causes alterations in its physical and chemical structures. The processed foods also include the addition or the use of chemicals that decrease the healthfulness of that food and cause some harmful biological reactions.[1] A systematic review of 23 studies, out of which ten was cross-sectional and thirteen cohort studies, shows an association with consumption of ultra-processed foods and cardiometabolic outcomes.[2] [3] [4] The data collection method in these studies was self-reported, which can lead to wrong information. The food classification is based on NOVA classification, which divides food into four categories: unprocessed or minimally processed, processed culinary ingredients, processed foods, and ultra-processed foods.[5] A cohort study of 91,891 participants in the US for 13.5 years was done; 5490 deaths were documented; among them, 3985 was due to heart disease and 1126 cerebrovascular deaths. The highest quintiles of ultra-processed foods have more deaths from cardiovascular diseases.[6] Some confounders are not adjusted and measured against, and dietary patterns affecting the results are not considered. A Brazilian cardiovascular modelling study aims to reduce deaths caused by cardiovascular diseases by 2030 by modelling three scenarios of reducing consumption of ultra-processed foods as 25%, 50% and 50% reductions. They have estimated to reduce the deaths due to CVD in these groups by 5.5, 11.0 and 29 %, respectively.[7] This study is based on food purchases but not on actual consumption, which could be different. Ultra-processed consumption is linked with causing weakness among older adults, making them delicate and become prone to falls .[8]

[1] Juul, F., Vaidean, G., & Parekh, N. (2021). Ultra-processed Foods and Cardiovascular Diseases: Potential Mechanisms of Action. *Advances in Nutrition (Bethesda, Md.)*. https://doi.org/10.1093/advances/nmab049

[2] Pagliai, G., Dinu, M., Madarena, M. P., Bonaccio, M., Iacoviello, L., & Sofi, F. (2021). Consumption of ultra-processed foods and health status: a systematic review and meta-analysis. *British Journal of Nutrition*, *125*(3), 308–318. https://doi.org/10.1017/S0007114520002688

[3] Nardocci, M., Polsky, J. Y., & Moubarac, J.-C. (2021). Consumption of ultra-processed foods is associated with obesity, diabetes and hypertension in Canadian adults. *Canadian Journal of Public Health: A Publication of The Canadian Public Health Association*, *112*(3), 421. https://doi.org/10.17269/s41997-020-00429-9

[4] Cordova, R., Kliemann, N., Huybrechts, I., Rauber, F., Vamos, E. P., Levy, R. B., Wagner, K.-H., Viallon, V., Casagrande, C., Nicolas, G., Dahm, C. C., Zhang, J., Halkjær, J., Tjønneland, A., Boutron-Ruault, M.-C., Mancini, F. R., Laouali, N., Katzke, V., Srour, B., & Jannasch, F. (2021). Consumption of ultra-processed foods associated with weight gain and obesity in adults: A multi-national cohort study. *Clinical Nutrition*, *40*(9), 5079–5088.

[5] Monteiro, C. A., Cannon, G., Moubarac, J.-C., Levy, R. B., Louzada, M. L. C., & Jaime, P. C. (2018). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *PUBLIC HEALTH NUTRITION*, *21*(1), 5–17. https://doi.org/10.1017/S1368980017000234

[6] Zhong, G.-C., Gu, H.-T., Peng, Y., Wang, K., Wu, Y.-Q.-L., Hu, T.-Y., Jing, F.-C., & Hao, F.-B. (2021). Association of ultra-processed food consumption with cardiovascular mortality in the US population: long-term results from a large prospective multicenter study. *International Journal of Behavioral Nutrition and Physical Activity*, *18*(1). https://doi.org/10.1186/s12966-021-01081-3

[7] Moreira, P. V. L. (1,2), Hyseni, L. (1), Capewell, S. (1), O'Flaherty, M. (1), Guzman-Castillo, M. (1), Moubarac, J.-C. (3), Martins, A. P. B. (3), & Baraldi, L. G. (3). (n.d.). Effects of reducing processed culinary ingredients and ultra-processed foods in the Brazilian diet: A cardiovascular modelling study. *Public Health Nutrition*, *21*(1), 181–188. https://doi.org/10.1017/S1368980017002063

[8] Sandoval-Insausti, H., Blanco-Rojo, R., Graciani, A., López-García, E., Moreno-Franco, B., Laclaustra, M., Donat-Vargas, C., Ordovás, J. M., Rodríguez-Artalejo, F., & Guallar-Castillón, P. (2020). Ultra-processed food consumption and incident frailty: A prospective cohort study of older adults. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences*, *75*(6), 1126–1133. https://doi.org/10.1093/gerona/glz140

A study of 7364 participants in Korea found that the likelihood of obesity is more prevalent among Korean women who consume 26.8% of their total energy intake from ultra-processed foods.[9] A nutritional literature review of 43 studies was done. Out of which 37 studies find a direct link of exposure to UPF and at least one of the cardiometabolic disorder outcomes like overweight, obesity, cancer, type-2 diabetes, depression and frailty condition.[10] The Moli-Sani study was done in Italy in which longitudinal analysis was done from 2005-2010 and then followed for 8.2 years found that 20.1% of biomarkers of renal functions are associated with UPF.[11] All the food items listed in questionaries are not based on NOVA classification leaving many food items. Trans fatty acids which are complex molecules and a part of most the processed foods, are associated with CVD. [12] [13] [14] The National Health and Nutrition Examination Survey done from 2005-2014 with US adults aged from 20-64 years old found that higher consumption of UPF is linked with excess weight, which is more common in women.[15] There is a strong relationship between globalisation which leads to the imports of sugar-rich and processed foods to other countries to the prevalence and increase of overweight and obesity in 172 countries.[16] The cohort study of perspective Framingham offsprings finds that the ultra-processed foods are poor in nutritional quality. [17]

The different pathways how a processed food contributes to cardiometabolic diseases are below:

Storage of excess energy and high glycaemic index of processed foods

A study done by Hall regarding the energy intake from UPF is 50% (48kcal/min)higher as compared to unprocessed foods (31kcal/min).[18] [19] The study does not address the how low cost of ultra-processed foods affect the purchasing

[9] Sung, H., Park, J. M., Oh, S. U., Ha, K., & Joung, H. (2021). Consumption of Ultra-Processed Foods Increases the Likelihood of Having Obesity in Korean Women. *Nutrients*, *13*(2). https://doi.org/10.3390/nu13020698

[10] Elizabeth, L., Machado, P., Zinöcker, M., Baker, P., & Lawrence, M. (2020). Ultra-Processed Foods and Health Outcomes: A Narrative Review. *Nutrients*, *12*(7). https://doi.org/10.3390/nu12071955

[11] Bonaccio, M., Di, C. A., Costanzo, S., De, C. A., Persichillo, M., Sofi, F., Cerletti, C., Donati, M. B., de, G. G., & Iacoviello, L. (2021). Ultra-processed food consumption is associated with increased risk of all-cause and cardiovascular mortality in the Moli-sani Study. *American Journal of Clinical Nutrition*, *113*(2), 446–455. https://doi.org/10.1093/ajcn/nqaa299

[12] Simplicio Revoredo, C. M., Borges de Araújo, C. G., dos Santos Silva, D. F., Duarte Rocha, J. K., Araújo Libânio, J., & de Araújo Santos, A. C. (2017). Nutritional Implications of Trans Fatty Acids on People's Health: A Reflective Analysis Article. *Journal of Nursing UFPE / Revista de Enfermagem UFPE*, *11*(2), 731–735. https://doi.org/10.5205/reuol.10263-91568-1-RV.1102201729

[13] Ali Abd El-Aal, Y., Mohamed Abdel-Fattah, D., & El-Dawy Ahmed, K. (2019). Some biochemical studies on trans fatty acid-containing diet. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *13*(3), 1753–1757. https://doi.org/10.1016/j.dsx.2019.03.029

[14] Ghafoorunissa. (2008). Role of trans fatty acids in health and challenges to their reduction in Indian foods. *Asia Pacific Journal of Clinical Nutrition*, *17*, 212–215.

[15] Juul, F., Martinez-Steele, E., Parekh, N., Monteiro, C. A., & Chang, V. W. (2018). Ultra-processed food consumption and excess weight among US adults. *British Journal of Nutrition*, *120*(1), 90-100. https://doi.org/10.1017/s0007114518001046

[16] Lin, T. K., Teymourian, Y., & Tursini, M. S. (2018). The effect of sugar and processed food imports on the prevalence of overweight and obesity in 172 countries. *Globalization and Health*, *14*(1). https://doi.org/10.1186/s12992-018-0344-y

[17] Juul, F., Lin, Y., Deierlein, A. L., Vaidean, G., & Parekh, N. (2021). Trends in food consumption by degree of processing and diet quality over 17 years: results from the Framingham Offspring Study. *The British Journal of Nutrition*, 1–11. https://doi.org/10.1017/S000711452100060X

[18] Hall, K. D., Ayuketah, A., Brychta, R., Cai, H., Cassimatis, T., Chen, K. Y., Chung, S. T., Costa, E., Courville, A., Darcey, V., Fletcher, L. A., Forde, C. G., Gharib, A. M., Guo, J., Howard, R., Joseph, P. V., McGehee, S., Ouwerkerk, R., Raisinger, K., … Zhou, M. (2019). Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake. *Cell Metabolism*, *30*(1), 67. https://doi.org/10.1016/j.cmet.2019.05.008

[19] Forde, C. G., Mars, M., & de Graaf, K. (2020). Ultra-Processing or Oral Processing? A Role for Energy Density and Eating Rate in Moderating Energy Intake from Processed Foods. *Current Developments in Nutrition*, *4*(3), nzaa019. https://doi.org/10.1093/cdn/nzaa019

of these foods as the participants are provided with cooked food. The high concentration of energy in ultra-processed foods causes the increased intake of calories of adipose tissue, which results in the disruption of metabolic homeostasis. [20] The cooking of food has increased its taste and palatability, but it has also increased its caloric density, but some Mediterranean cuisine can help make food tasty and healthy. [21] The diet consists of whole grains that help reduce the serum concentration of glucose in obese children as it is the biomarker of type-2 diabetes. [22] The average energy expenditure from a whole food meal is 19.9% the food is significantly higher than energy expenditure from processed foods 10.7% of the food after consuming the food.[23] The studies are mainly based on single meals, so more comparisons are needed to validate the data. The ultra-processed foods have a high glycaemic index and low satiety level compared with whole foods, with low glycaemic index and high satiety level.[24] Only a few products are used in this study, while many food products are available in the market.

Alteration in the gut microbiome

The human gastrointestinal tract is the host for millions of bacteria which help in digestion, absorption of energy from food and creating immunity for the body. The food additives can alter the microbiota leading to inflammation and other metabolic disorders.[25] The review of seven trials investigating the effects of low energy ultra-processed foods found that such a diet leads to the depletion of potentially beneficial microbes and an increase of harmful bacteria.[26] Water and fibre are abundant in whole foods that help the gut microbiota flourish, while ultra-processed food is more energy concentrated per 100 g of food.[27] Gut microbes can form toxic uraemic metabolites from a diet high in processed foods, leading to chronic kidney diseases.[28] A diet high in UPF can create inflammatory disease.[29]

Endocrine system dysfunction

---

[20] Lin, J.-N., Lee, P.-S., Mei, N.-W., Cheng, A.-C., Yu, R.-C., & Pan, M.-H. (2019). Effects of ginseng dietary supplementation on a high-Fat diet-induced obesity in C57BL/6 Mice. *Food Science and Human Wellness*, *8*(4), 344–350. https://doi.org/10.1016/j.fshw.2019.01.004

[21] Pellegrini, N., & Fogliano, V. (2017). Cooking, industrial processing and caloric density of foods. *Current Opinion in Food Science*, *14*, 98–102. https://doi.org/10.1016/j.cofs.2017.02.006

[22] Hajihashemi, P., Azadbakht, L., Hashemipour, M., Kelishadi, R., Saneei, P., & Esmaillzadeh, A. (2021). Whole grain intake favorably affects blood glucose and serum triacylglycerols in overweight and obese children: A randomized controlled crossover clinical trial. *Nutrition*, *87–88*. https://doi.org/10.1016/j.nut.2021.111200

[23] Sadie B. Barr, & Jonathan C. Wright. (2010). Postprandial energy expenditure in whole-food and processed-food meals: implications for daily energy expenditure. *Food & Nutrition Research*, *54*(0), 1–9. https://doi.org/10.3402/fnr.v54i0.5144

[24] Fardet, A. (2016). Minimally processed foods are more satiating and less hyperglycemic than ultra-processed foods: a preliminary study with 98 ready-to-eat foods. *Food & Function*, *7*(5), 2338–2346. https://doi.org/10.1039/c6fo00107f

[25] Holder, M. K., & Chassaing, B. (2018). Impact of food additives on the gut-brain axis. *Physiology & Behavior*, *192*, 173–176. https://doi.org/10.1016/j.physbeh.2018.02.025

[26] Lane, Melissa, Gina Howland, Madeline West, Meghan Hockey, Wolfgang Marx, Amy Loughman, Hely, Martin O, Felice Jacka, and Tetyana Rocks. 2020. "The Effect of Ultra-Processed Very Low-Energy Diets on Gut Microbiota and Metabolic Outcomes in Individuals with Obesity: A Systematic Literature Review." *Obesity Research & Clinical Practice* 14 (3): 197–204. doi:10.1016/j.orcp.2020.04.006.

[27] Miclotte, L., & Van de Wiele, T. (2020). Food processing, gut microbiota and the globesity problem. *Critical Reviews in Food Science & Nutrition*, *60*(11), 1769–1782.

[28] Mafra, D., Borges, N. A., Lindholm, B., Shiels, P. G., Evenepoel, P., & Stenvinkel, P. (2021). Food as medicine: targeting the uraemic phenotype in chronic kidney disease. *Nature Reviews Nephrology*, *17*(3), 153. https://doi.org/10.1038/s41581-020-00345-8

[29] Zinöcker, M. K., & Lindseth, I. A. (2018). The Western Diet-Microbiome-Host Interaction and Its Role in Metabolic Disease. *Nutrients*, *10*(3). https://doi.org/10.3390/nu10030365

Many chemicals have been found in the environment and can cause disruptions in the biological system. Some chemicals that can enter into the human endocrine system through food processing are called endocrine disruptors, can enter into the system by processing food.[30] [31] A diet containing a high amount of polyunsaturated fatty acids causes insulin resistance and then leading to cause obesity.[32] Endocrine hypertension is a condition caused by addition to certain foods, sweets, and salts that leads to insulin resistance and malfunctioning of other hormones, including aldosterone, cortisol, growth hormone, thyroid and parathyroid hormone.[33]

Food additives and chemicals

The processing of food changes the food's biological structure but is also exposed to harmful chemicals.[34] The processed meats can have potential carcinogens which cause colorectal cancer. The potent nitrosyl-heme molecules that form N-nitroso compounds are responsible for colorectal cancer.[35] The consumption of UPF is linked with potential exposure to phthalates which are part of food processing.[36] Bisphenol- A is a harmful chemical substance found in the containers' inner lining used to pack fruits.[37] A Norwegian study found phthalates and bisphenol A in all the retailers' traditional food and beverages and their potential exposures to the general public.[38]

Others mechanisms

A study done in the city Karaj in Iran with healthy 139 adolescents shows a high level of 8-hydroxy-2-deoxyguanosine (8-OHdG), a biomarker of oxidative damage of DNA among the group who had a high intake of processed foods in their daily diets.[39] The sample size of this study is small. The national survey in the US found

[30] Ravichandran, G., Lakshmanan, D. K., Raju, K., Elangovan, A., Nambirajan, G., Devanesan, A. A., & Thilagar, S. (2019). Food advanced glycation end products as potential endocrine disruptors: An emerging threat to contemporary and future generation. *Environment International*, *123*, 486–500. https://doi.org/10.1016/j.envint.2018.12.032

[31] Omoruyi, I. M., Kabiersch, G., & Pohjanvirta, R. (2013). Commercial processed food may have endocrine-disrupting potential: soy-based ingredients making the difference. *Food Additives & Contaminants. Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment*, *30*(10), 1722–1727.

[32] Pimentel, G. D., Dornellas, A. P. S., Rosa, J. C., Lira, F. S., Cunha, C. A., Boldarine, V. T., de Souza, G. I. H., Hirata, A. E., Nascimento, C. M. O., Oyama, L. M., Watanabe, R. L. H., & Ribeiro, E. B. (2012). High-fat diets rich in soy or fish oil distinctly alter hypothalamic insulin signaling in rats. *The Journal of Nutritional Biochemistry*, *23*(7), 822–828. https://doi.org/10.1016/j.jnutbio.2011.04.006

[33] Koch, C. A. (2012). Endocrine hypertension: What is new? *Revista Portuguesa de Endocrinologia, Diabetes e Metabolismo*, *7*(2), 52–61. https://doi.org/10.1016/S1646-3439(12)70010-X

[34] Buckley, J. P., Kim, H., Wong, E., & Rebholz, C. M. (2019). Ultra-processed food consumption and exposure to phthalates and bisphenols in the US National Health and Nutrition Examination Survey, 2013–2014. *Environment International*, *131*, N.PAG. https://doi.org/10.1016/j.envint.2019.105057

[35] Jeyakumar, A., Dissabandara, L., & Gopalan, V. (2017). A critical overview on the biological and molecular features of red and processed meat in colorectal carcinogenesis. *Journal of Gastroenterology*, *52*(4), 407–418. https://doi.org/10.1007/s00535-016-1294-x

[36] Buckley, J. P., Kim, H., Wong, E., & Rebholz, C. M. (2019). Ultra-processed food consumption and exposure to phthalates and bisphenols in the US National Health and Nutrition Examination Survey, 2013–2014. *Environment International*, *131*, N.PAG. https://doi.org/10.1016/j.envint.2019.105057

[37] UNGUREANU, E., MUSTĂȚEA, G., & POPA, M. E. (2019). An Overview on Human Potential Exposure to Bisphenol a from Food-Contact Materials Used in Fruits Packaging and Processing. *Scientific Bulletin Series F. Biotechnologies*, *23*, 199–204.

[38] Sakhi, A. K., Lillegaard, I. T. L., Voorspoels, S., Carlsen, M. H., Løken, E. B., Brantsæter, A. L., Haugen, M., Meltzer, H. M., & Thomsen, C. (2014). Concentrations of phthalates and bisphenol A in Norwegian foods and beverages and estimated dietary exposure in adults. *Environment International*, *73*, 259–269. https://doi.org/10.1016/j.envint.2014.08.005

[39] Edalati, S., Bagherzadeh, F., Asghari Jafarabadi, M., & Ebrahimi-Mamaghani, M. (2021). Higher ultra-processed food intake is associated with higher DNA damage in healthy adolescents. *The British Journal of Nutrition*, *125*(5), 568–576. https://doi.org/10.1017/S0007114520

that processed foods contain high levels of phosphorous. Although phosphorous is a nutrient needed for many healthy functions, its excess can lead to renal failure, CVD, and osteoporosis.[40]

New Zealand perspective

The annual market growth of fast food in New Zealand has a constant increase of 1.3% from 2016-2021.[41] The prevalence of ultra-processed foods is on the increase in NZ. In a study in 2016, the Auckland university examined 19000 packaged products and found that 84% of them are ultra-processed. Due to the low prices of these foods, the primary consumers are the low-income group. The food culture has changed since 1980 in many countries due to industrialisation. This has resulted in exporting the packaged food from big countries like the US and UK to low-income countries. The availability of processed foods replaced the traditional locally cooked food with these highly processed foods.[42] Maori and pacific people are inequitably affected by the increase of diabetes type -2.[43] A cross-sectional study of Pacifica people living in New Zealand finds that older people's diet has more diverse food items and the younger generation's diet is mainly processed foods. The small sample size of this study cannot give us a definitive conclusion and cannot be applied to the whole population.[44] Maori households spend less money on fruits and vegetables and spend more money on processed foods. However, it is not easy to get an exact picture due to the absence of nutritional surveys.[45] The salt substitution of sodium with potassium and magnesium can help add 22% of DALY among over 65 years. The benefits are higher in Maori than non-Maori.[46] The salts used in this study was natural salt with higher magnesium as compared with table salt available in New Zealand so the results could be different.

Conclusion

The processed food acts in different pathways to increase the chances of obesity and other CVD. It is very complex to investigate the relationship as these are a cluster of diseases that are interdependent. The international studies and evidence shows a clear relationship. Industrialisation has made way for the processed foods in our supermarkets. The food pattern in New Zealand has changed since 1980, and since there has been a gradual increase in energy consumption from processed foods. A systematic nutritional survey is needed to be conducted. The nutritional

[40] Calvo, M. S., & Uribarri, J. (2013). Public health impact of dietary phosphorus excess on bone and cardiovascular health in the general population. *American Journal of Clinical Nutrition*, *98*(1), 6–15.

[41] *Industry market research, reports, and statistics*. (n.d.). IBISWorld - Industry Market Research, Reports, & Statistics. https://www.ibisworld.com/nz/market-size/fast-food-takeaway-services/

[42] *Unpacking ultra-processed foods*. (n.d.). Activity & Nutrition Aotearoa | Connecting people and knowledge. https://ana.org.nz/unpacking-ultra-processed-foods/

[43] *Diabetes New Zealand*. (2021, March 25). DIABETES NEW ZEALAND. https://www.diabetes.org.nz/news-and-update/new-report-cost-of-diabetes-staggering-but-fixable

[44] Tupai-Firestone, R., Cheng, S., Kaholokula, J., Borman, B., & Ellison-Loschmann, L. (2019). Investigating differences in dietary patterns among a small cross-sectional study of young and old Pacific peoples in NZ using exploratory factor analysis: a feasibility study. *BMJ Open*, *9*(3), e023126. https://doi.org/10.1136/bmjopen-2018-023126

[45] Nghiem, N., Teng, A., Cleghorn, C., & Wilson, N. (2021). 1396Trends in household food expenditure patterns by ethnic and income group in New Zealand. *International Journal of Epidemiology*, *50*, 1–2. https://doi.org/10.1093/ije/dyab168.479

[46] Nghiem, N., Blakely, T., Cobiac, L. J., Cleghorn, C. L., & Wilson, N. (2016). The health gains and cost savings of dietary salt reduction interventions, with equity and age distributional aspects. *BMC Public Health*, *16*(1), 1–13.

survey can help in making stringent guidelines for the health promotion of the people. The changes in the food industry can also help in saving health costs.

Scope of Research

This literature review will help in guiding government to design health interventions which could curb the prevalence of ultra processed foods. The literature will aim to echo the previous studies in the related field. The author intends to bring evidence from some famous research studies across the globe to validate the previous results. The literature intends to bring to the governments to reduce the dependency of their citizens on processed products.

References

1. Can J Public Health Rev Can Sante Publique, 110 (1) (2019 Feb), pp. 4-14
2. https://ana.org.nz/unpacking-ultra-processed-foods/
3. https://www.consumer.org.nz/articles/ultra-processed-foods-are-they-the-latest-nutritional-baddie-on-the-block
4. https://www.frontiersin.org/articles/10.3389/fnut.2022.945591/full
5. https://www.thelancet.com/journals/lanepe/article/PIIS2666-7762(23)00190-4/fulltext
6. J.B. Beserra, NI daS. Soares, C.S. Marreiros, CMRG de Carvalho, M. do C. de CE. Martins, B de JES de A. Freitas, et al., [Do children and adolescents who consume ultra-processed foods have a worse lipid profile? A systematic review], Ciência Saúde Coletiva 25 (12) (2020 Dec) 4979–4989.
7. Lane M M, Gamage E, Du S, Ashtree D N, McGuinness A J, Gauci S et al. Ultra-processed food exposure and adverse health outcomes: umbrella review of epidemiological meta-analyses BMJ 2024; 384 :e077310 doi:10.1136/bmj-2023-077310
8. M. Nardocci, B.S. Leclerc, M.L. Louzada, C.A. Monteiro, M. Batal, J.C. Moubarac Consumption of ultra-processed foods and obesity in Canada
9. P. Pereira, E.M. Steele, R.B. Levy, M.L. da Costa Louzada, A. Rangan, J. Woods, et al. Ultra-processed food consumption and obesity in the Australian adult population Nutr. Diabetes, 10 (1) (2020 Dec 5), p. 39