



International Journal of Pharmaceutical and Clinical Research

ISSN Print: 2664-7591
ISSN Online: 2664-7605
Impact Factor: RJIF 5.2
IJAN 2024; 6(2): 76-82
www.pharmaceuticaljournal.in
Received: 02-08-2024
Accepted: 06-09-2024

Ameh Uyo Praisegod
Department of Medical Laboratory
Science, Faculty of Pure and
Applied Sciences, Kwara State
University, Malete, Nigeria

Akeem Olayinka Busari
Department of Medical Laboratory
Science, Faculty of Pure and
Applied Sciences, Kwara State
University, Malete, Nigeria

Obajemu Babatunde Samuel
Department of chemical pathology,
Nigeria, Edo state University,
Uzair

Adams Osiekafore Adinoyi
Department of Biochemistry,
Prince Abubakar Audu University,
Anyigba, Nigeria

Oladipo Miriam Oluchi
Department of Biochemistry,
University of Agriculture, Makurdi,
Nigeria

Mathias Akoji Godwin
Department of Chemistry, Federal
University, Lokoja Nigeria

Priscilla Onuche Unekuojo
Prince Abubakar Audu University
Anyigba Animal and
Environmental Biology

Okoliko Victor Michael
Department of Biochemistry,
Prince Abubakar Audu University
Anyigba, Nigeria

Ibrahim Gladys Eleojo
Department of Environmental
Management and Toxicology,
Benue State University, Nigeria

Idikwu Jato Faith
Department of Environmental
Management and Toxicology,
Benue State University, Nigeria

Corresponding Author:
Ameh Uyo Praisegod
Department of Medical Laboratory
Science, Faculty of Pure and
Applied Sciences, Kwara State
University, Malete, Nigeria

Evaluation of estrogen and progesterone levels among female fast food consumers in Kwara State University students

Ameh Uyo Praisegod, Akeem Olayinka Busari, Obajemu Babatunde Samuel, Adams Osiekafore Adinoyi, Oladipo Miriam Oluchi, Mathias Akoji Godwin, Priscilla Onuche Unekuojo, Okoliko Victor Michael, Ibrahim Gladys Eleojo and Idikwu Jato Faith

DOI: <https://doi.org/10.33545/26647591.2024.v6.i2b.108>

Abstract

Fast food is a quick serving food consumed by a high population irrespective of age or environment but consumed mostly by University students. Consumption can be based on variety, taste or flavor, social contact or convenience. Fast food sector of the economy rises almost every day and has influenced people's lifestyle and the society at large. This has also increased the prevalence of risk of complications by fast food especially in the female gender. Hormones are highly influenced by the health status of the individual as malnutrition is the major reason for poor health. This study evaluates the effect of fast food consumption on female reproductive hormones (progesterone and estradiol) in Kwara State University Students. A cross sectional comparative study involving frequent, occasional and non-fast food consumers was conducted in Malete, Kwara State. Results showed a statistically significant increase in the estradiol serum concentration ($p=0.004$) and decrease in progesterone (mid-cycle) serum concentrations ($p=0.002$). Anthropometric measurements revealed that female students in their mid-year (200/300 levels) consume fast food more with a mean age of 22 ± 3 years, height 189cm and weight as 58 kg. The study shows that female who consume fast food frequently are more susceptible to menstrual irregularities such as dysmenorrhea, hormonal imbalance, premenstrual syndrome and ultimately infertility.

Keywords: Kwara State, food consumers, estrogen and progesterone levels

Introduction

Fast food is designed for immediate availability, usage, or consumption, with little regard for quality or significance. Fast food is defined as food that can be prepared and served rapidly, according to top websites, while others define it as swiftly prepared, reasonably priced, and easily available alternatives to home cooked food (Habib *et al.*, 2011) [44]. The adolescent stage is the stage of rapid rise of malnutrition among all the stages of a person's life. Globally, malnutrition in all forms, including obesity, under nutrition, and other nutritional hazards, is the primary cause of poor health. A growing number of people's lifestyles have been altered dramatically as a result of growing urbanization and the emergence of modern, cutting-edge technologies. Individuals' eating habits have changed as a result of their relocation (Habib *et al.*, 2011) [44].

The primary worry as we seek to reform health is the well-known fact that most chronic diseases afflicting people are mostly lifestyle-related. Additionally, healthier lifestyles would have a positive impact on a wide range of ailments. Although, whether you are from the lower middle class or the upper class, it has an impact on the entire society. People, particularly adolescents, enjoy fried and roasted foods. Many studies have found that people prefer fast food for a variety of reasons, including convenience, flavor, social contact (Anitharaj, 2018) [6], and pleasure. Restaurants, stadiums, airports, zoos, schools and universities, cruise ships, trains and planes, shops, gas stations, and even hospitals bear witness to its existence.

Not only has the fast food sector influenced our eating, but also our economics and society (Bowman *et al.*, 2004) [18]. Fast food has become a staple of the African diet, with about a third of young people consuming it on a daily basis (Guthrie *et al.*, 2010) [43]. Soda, chips, cookies, candy, breakfast cereals, bars, French fries, burgers, pizza, white flour baked foods (sharwama, donut, eggroll, meatpie), and any other high-calorie, low-nutrient items that individuals eat numerous times per day are all considered fast foods. These are processed foods that are the main source of calories for many people. The calorie count of out-of-home meals consumed by youngsters was 55% higher than that of in-home meals. Fast food intake is also a health problem, according to the World Health Organization (WHO), because most fast foods are high in saturated fats, trans-fats, and LDL cholesterol leading to increase in hormonal level. Fertility for women relies on the ovaries producing healthy eggs. Higher amounts of saturated and trans-fatty acids have been identified in oocytes (an egg cell in ovary) of women undergoing assisted reproduction. Although these dietary components and their relationship to fertility have not been specifically studied in human pregnancies, studies in mice have demonstrated that a high fat diet had a toxic effect on the ovaries.

Estrogen is a category of sex hormone responsible for the development and regulation of the female reproductive system and secondary sex characteristics such as the mammary gland, thickening of the endometrium and other aspects of regulating the menstrual cycle (Huether *et al.*, 2019) [53]. Like all steroid hormones, estrogens readily diffuse across the cell membrane. Once inside the cell, they bind to and activate estrogen receptors. The women's ovaries make most estrogen hormones, although the adrenal glands and fat cells also make small amounts of the hormones. Studies have shown that some dietary patterns may promote estrogen dominance and the risk of medical conditions such as hormonal imbalances.

Progesterone is an endogenous steroid and progestogen sex hormone involved in the menstrual cycle, pregnancy and embryogenesis of humans and other species (Jameson *et al.*, 2015) [54]. It is the major progestogen in the body and a crucial metabolic intermediate in the production of other endogenous steroids, including the sex hormones and the corticosteroid, and plays an important role in brain function as a neurosteroid (Balieu *et al.*, 2000) [13]. Progesterone is involved in many biological functions such as hormonal interactions, reproductive system, secondary sex characteristics and sexuality (Coad *et al.*, 2011) [22].

Hormones are highly influenced by the health status of the individual as malnutrition is the major reason for poor health. Female fertility hormones play critical role in the primary responsibility of the female gender and thus any disruption to that health status should be given utmost importance. Research shows that poor dietary intake is usually likely to be found among University students. This is because university students have greater freedom and control over their lifestyles than ever before and this can translate into poor dietary choices. An official publication of the Federation of Obstetrics and Gynecological Societies of India says that popularity of junk food in adolescence are responsible for the increasing polycystic ovarian syndrome in adolescent girls and is challenge for gynecologists. This study aims to evaluate estrogen and progesterone levels

among female fast food consumers in Kwara State University Students.

Methodology

Study Area: This study was conducted at Kwara State University, Malete. Malete situated in Moro Local Government Area, Kwara State, Nigeria, with geographical coordinates as 8° 42' 0" North, 4° 28' 0" East. Kwara State University is located at 8.7100°N and 4.4666°E. It is dominated by native Fulani and Yoruba people. The journey towards establishing a state university in Kwara State began in November 1990. As at the time of study, the University has a total of about 20,000 students, over 50 academic programmes and 6 faculties. The growing effect of the university has caused drastic springing up of fast food joints and restaurants and also increase in study population giving easy access for subject recruitment and making the area suitable for the study. The Medical Laboratory Science department has standard equipment and infrastructures to aid sample processing, storage and analysis

Study Design

This study is a cross sectional comparative study among female fast food consumers and apparently healthy non- fast food consumers.

Study Population

A total of 120 apparently health female students aged 18 - 35 consisting of fast food consumers and non-fast food consumers attending Kwara State University, Malete.

Ethical Approval

Ethics approval was obtained from the Ethics Committee of Kwara State Ministry of Health with reference number ERC/MOH/2022/06/043 before the commencement of this study (Appendix D). Written inform consent was obtained from each participant prior to enrolment into the study (Appendix B). The participants were adequately informed of their right to choose to or not participate or withdraw at any point they wished (Appendix A). All data were treated with utmost confidentiality and the study lasted for a period of 5 months from May to September, 2022.

Sample Size Determination

The sample size for this study was determined using sample size formula below by (Niang *et al.*, 2008).

$$n = \frac{Z^2 \times p \times (1 - p)}{d^2}$$

Where;

n= required sample size.

Z= confidence level at 1.96 (95% confidence interval).

p= prevalence of fast food consumers in South-West Nigeria (4%) (Arulogun *et al.*, 2011)

d= degree of freedom (5%).

$$n = \frac{(1.96)^2 \times (0.04) \times (0.96)}{0.05^2}$$

$$n = \frac{3.84 \times 0.0384}{0.0025}$$

$$n = \frac{0.1475}{0.0025}$$

n = 59

The minimum sample size was calculated as 59 and was increased to 60 to increase the power of this study. Thus, 60 female fast food consumers and 60 apparently healthy non-fast food consumers was recruited for this study.

Inclusion and Exclusion Criteria

Inclusion Criteria

1. Kwara State University female students aged 18-35 who consume fast food at least four times a week that give informed consent as case subjects.
2. Kwara State University female students who are non-fast food eaters or occasionally fast food consumers as controls.

Exclusion Criteria

1. Subjects with fertility issues.
2. Subjects at the extreme of age.
3. Subjects with known hormonal imbalance.
4. Subjects on medications.
5. Those who do not give consent.

Sampling Technique

The method of convenient random sampling was adopted to recruit participants into the research study. Semi-structured questionnaire (Appendix C) was administered to obtain socio-demographic data after the informed consent was sought.

Height: This parameter was measured using a standard stadiometer manufactured by Seca Company (seca 216 model) against a flat vertical surface with the subject standing without raising the heel from the ground. The feet were brought together without shoes aligned with the stadiometer against a vertical surface. The reading was obtained and recorded at the nearest meter (m).

Weight: The weighing balance made by Seca Company was placed on a parallel horizontal surface. The weighing balance was used to take measurement of each study participants. The subjects were made to stand on the scale with shoe off and the reading was obtained and recorded at the nearest kilogram (kg).

Body Mass Index: This was obtained from the expression;

$$BMI = \frac{\text{Weight (Kg)}}{\text{Height (m}^2\text{)}}.$$

Blood sample collection

Blood sample was withdrawn from the study participants during the day light at day 3 and day 21 for estrogen and progesterone respectively. The venous puncture was performed on the prominent superficial vein of the ante cubital fossa with tourniquet applied on the upper arm for easy access to the vein. About 5.0ml of blood sample was collected following aseptic procedure from each study participant and dispensed into plain bottles. The blood collected was allowed to clot and thereafter centrifuged at

3,000r.p.m for 5minutes. The serum was separated and stored at -20 °C prior to analysis of biochemical parameters in the laboratory.

The sample for estradiol test was collected on day 3 of menstrual cycle while the sample for progesterone test was collected on day 21 of menstrual cycle.

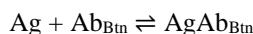
Biochemical Analysis

Determination of Estradiol level (ELISA method)

Serum estradiol level was estimated with the use of assay kit produced by Accubind (Monobind Inc.) following Enzyme-Linked Immunosorbent Assay method described by Staffan *et al.*, 2006.

Principle

The hormone enzyme immunoassay was based on the principle of competitive binding. The essential reagents required for an enzyme immunoassay include antibody, enzyme-antigen conjugate and native antigen. Upon mixing biotinylated antibody with a serum containing the antigen, a reaction results between the antigen and the antibody.

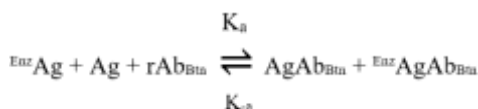


Ab_{B_{in}} = Biotinylated Antibody (Constant Quantity)

Ag = Native Antigen (Variable Quantity)

AgAb_{B_{in}} = Antigen-Antibody immune Complex

After a short period of time, the enzyme conjugate is added (this delayed addition promotes an increase in sensitivity for low concentration samples). Upon the addition of the enzyme conjugate, competition reaction results between the enzyme analog and the antigen in the sample for a limited number of antibody binding sites.



EnzAg = Enzyme-Antigen Conjugate (Constant Quantity)

EnzAgAb_{B_{in}} = Enzyme-Antigen Conjugate Antibody-Complex

rAb_{B_{in}} = Biotinylated antibody not reacted in the first incubation

K_a = Rate Constant of Association

K_{-a} = Rate Constant of Dissociation

K = k_a / k_{-a} = Equilibrium Constant

A simultaneous reaction between the biotin attached to the antibody and the streptavidin immobilized on the microwell occurs. This effects the separation of the antibody bound fraction after decantation or aspiration. The enzyme activity in the antibody bound fraction is inversely proportional to the native antigen concentration. By utilizing several different serum references of known antigen concentration, a dose response curve can be generated from which the antigen concentration of an unknown can be ascertained.

Results

This research was carried out to evaluate the effect of fast food consumption on female reproductive hormones

(progesterone and estrogen) female Fast food consumers of Kwara State University.

Table 1 shows the social demographic distribution of the study participants. The mean age was 22±3 years, mean weight 58 kg and mean height as 189 cm. living status showed that most consumers were off-campus and in their mid-year (200 level).

Table 1: Socio-demographic distribution of study participants

Variable	Frequency	Percentage
Age		
18-21	82	68.3
22-25	36	30
26-32	2	1.7
Weight (Kg)		
46-55	48	40
56-65	53	44
66-75	19	16
Height (cm)		
146-158	52	43
159-177	51	43
178-189	34	28
Body Mass Index (kg/m²)		
Underweight	5	4.2
Normoweight	102	85
Overweight	13	10.8
University Accommodation		
Off-Campus	80	66.4
On-Campus	40	33.6
Academic Level		
100	18	15
200	56	46.6
300	14	11.7
400	14	11.7
500	18	15
Pattern of Fast Food Consumption		
Low	46	38
Intermediate	33	26
High	41	36
Reason for Consumption (*)		
Taste	28	23.3
Convenience	32	26.7
Others	60	50
Categories of Fast Food Consumed (*)		
Fried Snack	32	26.7
Grilled Meat	20	16.7
Chips	18	15
Biscuit	14	11.6
Others	36	30
Total (per data)	120	100

*Multiple answers

Table 2: Comparison of Progesterone and Estrogen between Fast Food Consumers and Control

Parameters	Fast food consumer	Control	P-value
Progesterone (nmol/L)	6.48±0.71	10.60±0.84	0.004*
Estrogen (mIU/mL)	301.34±0.06	246.59±0.31	0.002*

(*) Means significance at $p<0.05$

Comparison of Progesterone and Estrogen between Fast Food Consumers and Control

As shown on Table 2, there was statistically significant difference (decrease) when Progesterone ($p=0.004$). There was a statistically significant difference (increase) when Estrogen ($p=0.002$) was compared between fast food consumers and Controls.

Table 3: Comparison of Mean Concentration of Progesterone and Estrogen between subjects (frequent and occasional fast food consumers) and Control (non-fast food consumers)

Parameters	Frequent	Occasional	Control	P-value
Progesterone (nmol/L)	6.38 ± 0.23	5.56± 1.08	8.30 ±0.69	0.001*
Estrogen (mIU/mL)	482±1.0	334±0.06	206.59±0.31	0.03*

(*) Means significance at $p<0.05$

As shown on Table 3, there was statistically significant difference when mean concentrations of Progesterone ($p=0.0001$) and Estrogen ($p=0.002$) was compared among different categories of fast food consumers.

Discussion

The problem of infertility has turned out to be a traumatizing situation for the female circle. Adolescent age is the turning point where the hormonal and metabolic changes take place, menstruation begins and fertility is achieved. The cyclical hormonal and physical changes that are manifested in the form of the menstrual cycle are highly correlated with the reproductive health of females and any abnormalities not only affect the overall health of individuals but also interfere with social and recreational activities. The physiological cyclical variation in the hormones may cause changes in serum lipid levels and its metabolism. The estrogen major sex hormones involved in the cyclical changes of menstruation also affect the level of HDL and LDL cholesterol positively (Ariadi *et al.*, 2019) [8]. The anthropometric assessment revealed that 85% of participants had normal BMI, while 4.2% were underweight and 10.8% were overweight and reason for consumption of fast food was directed towards convenience and taste which agrees with studies by Hesamedin *et al.*, (2016) and Narayan *et al.*, (2015). It also shows that university students (mean age 22 ± 3 years, weight 58kg and height 189cm) consume fast food frequently (3-4 times/week) which corresponds with several studies by (Sabra *et al.*, 2007; Al-Rethaiaa *et al.*, 2010; Alfawaz, 2012) [3, 1].

In this present study, a significant difference in reproductive hormone levels was found among females who consume fast food regularly, this is in correlation with studies. The overall body weight and in general the health status is also determined by the food habits and the nutritional value of the food consumed. The type of food taken defines not only BMI but also the biochemical parameters like lipid profile, hormone level, stimulate or suppress various sorts of immune response and inflammatory processes. In the present study, it has been observed that overall health and food habits affect the reproductive process in young women which is in line with study by Mohammadbeigi *et al.*, (2018).

Conclusion

In conclusion, this present study suggests that excessive intake of fast food make vulnerable the females to menstrual irregularities and ultimately infertility.

Recommendations

1. The nutritional demands of the women population following education must have to be defined properly and their food habits have to be modified. We recommend strict health guidelines for fast food restaurants to limit exposure to some used ingredients.

- On the other hand, offering healthy and accessible alternative should also be considered as a supportive environment to enhance the adoption of a healthy food choice by university students. This can be done by reviewing the price unit of this cheap food or providing healthy food with a competitive price.

References

- Alfawaz H. The relationship between fast food consumption and BMI among university female students. *Pakistan Journal of Nutrition*. 2012;11(5):406-410.
- Al-Hazzaa HM, Abahussain NA, Al-Sobayel HI, Qahwaji DM, Musaiger A. Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *International Journal of Behavioural Nutrition and Physiology, Act*. 2011;8:1-14.
- Al-Rethaiaa AS, Fahmy AA, Al-Shwaiyat NM. Obesity and eating habits among college students in Saudi Arabia: a cross-sectional study. *Nutrition Journal*. 2010;9(39):1-10.
- American Diabetes Association. Economic costs of diabetes in the U.S. in 2017. *Diabetes Care*. 2018;41(5):917-928.
- American Institute for Cancer Research. Diet, nutrition, physical activity and stomach cancer (Revised 2018). Available from: <https://www.aicr.org/research/continuous-update-project/cup-findings-reports/stomach-cancer/>. Accessed 6th July 2023.
- Anitharaj MS. A study on behavior of youngsters towards fast food restaurants. *International Journal of Emerging Research in Management and Technology*. 2018;7(1):1-7.
- Anjum I, Jaffery SS, Fayyaz M, Wajid A, Ans AH. Sugar beverages and dietary sodas impact on brain health: A mini literature review. *Cureus*, 2018, 10(6).
- Ariadi A, Jamsari J, Yanwirasti Y, Siregar MFG, Yusrawati Y. Correlation between estrogen levels with lipid profile in menopause women in West Sumatera. *Open Access Macedonian Journal of Medical Sciences*. 2019;7(13):2084-2088.
- Atanda O, Dane S. Attitude towards fast food consumption among students in a private Nigerian university by gender, academic level and marital status. *Journal of Research in Medical and Dental Science*. 2020;8(3):248-252.
- Bahado Z, Mirmiran P, Azizi F. Fast food pattern and cardiometabolic disorders: A review of current studies. *Health Promotion Perspectives*. 2016;5(4):231-240.
- Bakas P, Liapis A, Vlahopoulos S, Giner M, Logotheti S, Creatsas G, et al. Estrogen receptor alpha and beta in uterine fibroids: A basis for altered estrogen responsiveness. *Fertility and Sterility*. 2008;90(5):1878-1885.
- Bansal A, Henao-Mejia J, Simmons R. Immune systems: An emerging player in mediating effects of endocrine disruptors in metabolic health. *Endocrinology*. 2018;159(1):32-45.
- Baulieu E, Schumacher M. Progesterone as a neuroactive neurosteroid with special reference to the effect of progesterone on myelination. *Steroids*. 2000;65(10-11):605-612.
- Bawaskar HS, Bawaskar PH, Bawaskar PH. Chinese restaurant syndrome. *Indian Journal of Critical Care Medicine*. 2017;21(1):49-50.
- Benjamin E, Virani S, Callaway C. Heart disease and stroke statistics - 2018 update: A report from the American Heart Association. *Circulation*. 2018;137:e67-e492.
- Bhuiyan MU, Zaman S, Ahmed T. Risk factors associated with overweight and obesity among urban school children and adolescents in Bangladesh: A case-control study. *BMC Pediatrics*. 2013;13:72.
- Bloom M. Consuming fast food and an unhealthy diet in general can cause hormone imbalances. *The Biostation*. 2022;1:1-55.
- Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. Effects of fast-food consumption on energy intake and diet quality in a national household survey. *Pediatrics*. 2004;113:112-118.
- Bray G, Most M, Rood J, Stephen R, Steven R. Hormonal responses to a fast-food meal compared with nutritionally comparable meals of different composition. *Annals of Nutrition and Metabolism*. 2007;51(2):163-171.
- Buckley JP, Kim H, Wong E, Rebholz CM. Ultra-processed food consumption and exposure to phthalates and bisphenols in the US National Health and Nutrition Examination Survey, 2013-2014. *Environment International*. 2019;131:105057.
- Buscail C, Sabate JM, Bouchoucha M. Western dietary pattern is associated with irritable bowel syndrome in the French NutriNet cohort. *Nutrients*. 2017;9(9):986.
- Coad J, Dunstall M. Anatomy and physiology for midwives, with Page burst online access, 3rd edition: Anatomy and physiology for midwives. Elsevier Health Sciences, London, United Kingdom; c2011. p. 413.
- Crawford S, Boulet S, Mneimneh A. Costs of achieving live birth from assisted reproductive technology: A comparison of sequential single and double embryo transfer approaches. *Fertility and Sterility*. 2016;105:444-450.
- Dahlman-Wright K, Cavailles V, Fuqua SA, Jordan VC, Katzenellenbogen JA, Korach KS, et al. International union of pharmacology. LXIV. Estrogen receptors. *Pharmacological Reviews*. 2006;58(4):773-781.
- Deroo BJ, Korach KS. Estrogen receptors and human disease. *Journal of Clinical Investigation*. 2006;116(3):561-570.
- Deschasaux M, Huybrechts I, Murphy N, Julia C, Hercberg S. Nutritional quality of food as represented by the FSAm-NPS nutrient profiling system underlying the Nutri-Score label and cancer risk in Europe: Results from the EPIC prospective cohort study. *Public Library of Science Medicine*, 2018, 15(9).
- Di Renzo GC, Giardinal CG, Brillo E, Gerli S. Progesterone in normal and pathological pregnancy. *Hormone Molecular Biology and Clinical Investigation*. 2016;27(1):35-48.
- Diamanti-Kandarakes E, Bourguignon J, Guidice L, Hauser R, Prins G, Soto R. Endocrine disrupting chemicals: An endocrine society scientific statement. *Endocrine Reviews*. 2009;30(4):293-342.

29. Diaz A, Laufer M, Breech L. Menstruation in girls and adolescents: Using the menstrual cycle as a vital sign. *Pediatrics*. 2006;118(5):2245-2250.
30. Dumanovsky T, Huang CY, Bassett MT, Silver LD. Consumer awareness of fast-food calorie information in New York City after implementation of a menu labeling regulation. *American Journal of Public Health*. 2010;100(12):2520-2525.
31. Edwards L, McCray N, VanNoy B, Yau A, Geller R, Adamkiewicz G, Zota A. Phthalates and novel plasticizer concentrations in food items from U.S. fast food chains: A preliminary analysis. *Journal of Exposure Science & Environmental Epidemiology*. 2022;32(3):366-373.
32. Edwards L, McCray N, VanNoy B, Yay A, Geller A, Adamkiewicz G, Zota A. Phthalate and novel plasticizer concentrations in food items from U.S. fast food chains: A preliminary analysis. *Journal of Exposure Science & Environmental Epidemiology*. 2022;32(3):366-373.
33. Elger W, Beier S, Pollow K, Garfield R, Shi SQ, Hillisch A. Conception and pharmacodynamic profile of drospirenone. *Steroids*. 2003;68(10-13):891-905.
34. Engel S, Patisaul H, Brody C, Hauser R, Zota A, Bennet D. Neurotoxicity of ortho-phthalates: recommendations for critical policy reforms to protect brain development in children. *American Journal of Public Health*. 2022;111:687-695.
35. Fang L, Gu C, Liu X, Xie J, Hou Z, Tian M, Yin J, Li A, Li Y. Metabolomics study on primary dysmenorrhea patients during the luteal regression stage based on ultra-performance liquid chromatography coupled with quadruple-time-of-flight mass spectrometry. *Molecular Medicine Reports*. 2017;15(3):1043-1050.
36. Fontanilla D, Mavlyutov T, Ruoho AE, Jackson MB. Antagonist action of progesterone at σ -receptors in the modulation of voltage-gated sodium channels. *American Journal of Physiology-Cell Physiology*. 2011;300(2):328-337.
37. Fuhrman J. The hidden dangers of fast and processed food. *American Journal of Lifestyle Medicine*. 2018;12(5):375-381.
38. Fuhrman J, Sarter B, Glaser D, Acocella S. Changing perceptions of hunger on a high nutrient density diet. *Nutrition Journal*. 2010;9:51.
39. Fujiwara T, Sato N, Awaji H, Sakamoto H, Nakata R. Skipping breakfast adversely affects menstrual disorders in young college students. *International Journal of Food Sciences and Nutrition*. 2009;60(6):23-31.
40. Gordon L. Foods that are killing your sex drive. *Fox News*. 2018.
41. Granic A, Jagger C, Davies K. Effect of dietary patterns on muscle strength and physical performance in the very old: findings from the Newcastle 85+ study. *PLoS One*. 2016;11(3).
42. Gruner J, DeWeese RS, Lorts C, Yedidia MJ, Ohri-Vachaspati P. Predicted impact of the Food and Drug Administration's menu-labeling regulations on restaurants in 4 New Jersey cities. *American Journal of Public Health*. 2018;108(2):234-240.
43. Guthrie J, Lin BH, Frazao E. Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: changes and consequences. *Journal of Nutrition Education and Behavior*. 2002;34:140-150.
44. Habib QF, Dardak R, Zakaria S. Consumer's preference and consumption towards fast food: evidence from Malaysia. *Business Management Quarterly Review*. 2011;2:14-27.
45. Hannon P, Flaws J. The effects of phthalates on the ovary. *Frontiers in Endocrinology*. 2015;6:8.
46. Haynes-Maslow L, Leone LA. Examining the relationship between the food environment and adult diabetes prevalence by county economic and racial composition: an ecological study. *BMC Public Health*. 2017;17(1):648.
47. Hebbelstrup B, Olsen KE, Struve C, Kroghfelt KA, Petersen AM. Epidemiology and clinical manifestations of enteroaggregative *Escherichia coli*. *Clinical Microbiology Reviews*. 2014;27(3):614-630.
48. Hellesvig-Gaskell K. Definition of fast foods. *LIVESTRONG*. 2021.
49. Hemmingsson E. Early childhood obesity risk factors: socioeconomic adversity, family dysfunction, offspring distress, and junk food self-medication. *Current Obesity Reports*. 2018;7(2):204-209.
50. Holzer G, Riegler E, Hönigsman H, Farokhnia S, Schmidt JB, Schmidt B. Effects and side-effects of 2% progesterone cream on the skin of peri- and postmenopausal women: results from a double-blind, vehicle-controlled, randomized study. *The British Journal of Dermatology*. 2005;153(3):626-634.
51. Hruby A, Hu FB. The epidemiology of obesity: a big picture. *Pharmacoeconomics*. 2015;33(7):673-689.
52. Huang Y, Huang D, Nguyen QC. Census tract food tweets and chronic disease outcomes in the U.S., 2015-2018. *International Journal of Environmental Research and Public Health*. 2019;16(6):975.
53. Huether S, McCance K. Estrogen. In: *Understanding Pathophysiology*. 7th ed. St. Louis, Missouri: Elsevier Health Sciences; 2019. p. 767.
54. Jameson JL, DeGroot LJ. Estrogen and estrogen receptors. In: *Endocrinology: Adult and Pediatric E-Book*. 7th ed. Philadelphia, PA: Elsevier Health Sciences; 2015. p. 2179.
55. Jaworowska A, Blackham T, Davies IG, Stevenson L. Nutritional challenges and health implications of takeaway and fast food. *Nutrition Reviews*. 2013;71(5):310-318.
56. Kabe Y, Handa H, Suematsu M. Function and structural regulation of the carbon monoxide (CO)-responsive membrane protein PGRMC1. *Journal of Clinical Biochemistry and Nutrition*. 2018;63(1):12-17.
57. Kansra S, Yamagata S, Sneade L, Foster L, Ben-Jonathan N. Differential effects of estrogen receptor antagonists on pituitary lactotroph proliferation and prolactin release. *Molecular and Cellular Endocrinology*. 2005;239(1-2):27-36.
58. Kar S, Khandelwal B. Fast foods and physical inactivity are risk factors for obesity and hypertension among adolescent school children in East District of Sikkim, India. *Journal of Natural Science, Biology and Medicine*. 2015;6(2):356-359.
59. Kashyap R, Joglekar A, Verma S. Effect of junk food on physical performance of school children. *Indian Journal of Scientific Research and Technology*. 2014;2(4):21-25.

60. Katta R, Desai SP. Diet and dermatology: the role of dietary intervention in skin disease. *Journal of Clinical and Aesthetic Dermatology*. 2014;7(7):46-51.
61. Kaushik JS, Narang M, Parakh A. Fast food consumption in children. *Indian Pediatrics*. 2011;48:97-101.
62. Khosravi M, Sotoudeh G, Majdzadeh R, Nejati S, Darabi S. Healthy and unhealthy dietary patterns are related to depression: a case-control study. *Psychiatry Investigation*. 2015;12(4):434-442.
63. King TL, Brucker MC. Progesterone. In: *Pharmacology for Women's Health*. 2nd ed. Jones & Bartlett Publishers; c2010. p. 372-373.
64. Kuhl H. Pharmacology of estrogens and progestogens: influence of different routes of administration. *Climacteric*. 2005;8(1):3-63.
65. Lamba A, Garg V. Impact of junk food on health status and physical performance of school-going children (12-16 years). *International Journal of Food Science and Nutrition*. 2017;2(6):49-51.
66. Landau RL, Bergenstal DM, Lugibihl K, Kascht ME. The metabolic effects of progesterone in man. *The Journal of Clinical Endocrinology & Metabolism*. 1955;15(10):1194-1215.
67. Laudan R. A plea for culinary modernism: why we should love new, fast, processed food. *Gastronomica: The Journal of Critical Food Studies*. 2001;1:36-44.
68. Lee KW, Song WO, Cho MS. Dietary quality differs by consumption of meals prepared at home vs. outside in Korean adults. *Nutrition Research and Practice*. 2016;10(3):294-304.