Review Article

The Impact of Dietary Patterns on Fertility and Reproductive Outcomes

Abstract:

Introduction

Infertility is one of the rising concerns in terms of reproductive outcomes. The paper systematically reviews and presents information regarding the causes of infertility and its implications due to dietary patterns in the population.

Methods

This paper follows the PRISMA guidelines for systematic review utilising different databases like PubMed, CIHNAL Plus, and BMJ. The specific searching strategy was utilised for abstract search and different inclusion and exclusion criteria in terms of keyword or date of articles published the region of review is considered. In association with this, the methodological approach and choice regarding maintaining ethical considerations are also taken into context.

Results

The search yielded around 550 articles based on which the full article review considered uses of 160 of them out of which 30 are considered for the final synthesis of the systematic review and therefore indicating towards the developed flowchart utilised in the process. In association with this, the results implicated a direct impact of dietary patterns on the fertility of an individual associated with influencing the reproductive outcome in a long-term context.

Conclusion

The review identified substantial evidence in relation to causes for infertility and therefore focused on developed scenarios for outcomes and synthesis of review.

Introduction

Infertility is the disease condition within the male and female reproductive system wherein the pair fails to achieve pregnancy even after 12 months of unprotected sexual intercourse[1]. The cause of infertility is primarily linked with hormonal disbalance, which delays ovulation in women, leading to a reproductive outcome with no offspring produced[2]. The prominent cause for infertility is associated with the low-quality sperms produced by males, which is also linked with the causes for inadequate levels of certain hormones[3]. However, in contrast to this, the term fertility is referred to as producing offspring[4]. According to the World Health Organisation (WHO) scientists, it is estimated that cases of infertility have recently increased, with almost 48 million cases for couples, and it is also evident that the cases for infertility among individuals are estimated to lie around 186 million individuals[5 6]. The main cause for the increase of infertility issues among males and females is always evident due to the shift of lifestyle leading to the development of a low-quality oocyte in the case of females[7]. Alongside this, the lower sperm count in men is also a result of a changed lifestyle and, most importantly, an increase in stress in the lives of those individuals[8]. Furthermore, several studies have suggested a clear linkage with the changing dietary patterns across men and women as one of the primary reasons for the development of the disease[9 10 11].

In contrast to the current claims, there is no clear reference in the systematically content-analysed and reviewed papers containing different authentic sources for supporting this claim. Henceforth, this paper is focused on providing a detailed scientific explanation and reviewing outcomes linked with the propositions and claims. In addition to this, the evidence-based studies suggest an explanation for linkage between the lower intake of quality food with that of influencing physical health conditions and overall wellbeing[12]. In this consideration, the biopsychosocial model clearly explains that an individual's wellbeing is directly linked with the physical, mental, and social conditions, which is again highly

influenced by the quality of the regularly occurring intake[13]. In this purview, the modifiable risk factor of the dietary patterns in human health is identified as the basis for developing the disease infertility in men and women[14]. Therefore, considering such claims and outcomes as depicted by the researcher, the aim is set to create a systematic review of the articles and present the findings in the form of lucrative graphical and tabulated data forms. However, the article sources for this study and primary overview of sources suggest the impact of dietary patterns for identifying the research outcomes. In alignment with this, the article for systematic review focuses on identifying the results from analysing different data sources, mainly secondary ones, and a few primary research-based articles to explain the impact of dietary patterns on fertility and reproductive outcomes.

Methods

Literature search

The authors followed the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines utilising the keyword search for papers that were published since 2007. The authors, therefore, used different databases such as PubMed, CIHNAL Plus, BMJ databases. The search for articles was carried out in the time period of October 2021 and December 2021, with no certain linguistic barriers for the research papers. However, certain inclusion and exclusion criteria were set up prior to the search that included the usage of certain keywords like infertility, diagnosed reasons, reproductive outcomes. In this situation, only certain kinds of secondary and primary research were included in the research, and each author has undertaken abstract-based search criteria for evaluating the information provided in the abstract of the selected papers. Moreover, the primary data where no information regarding the ethical consideration for handling the patients or data storage/transparency was mentioned were straightaway rejected by the board of reviewers

(authors). Moreover, certain kinds of secondary material like literature review or rapid review kind of papers were also excluded during this process. Subsequently, after analysing, the abstracts were moved to EndNote, and the duplicates from those were removed post-analysis. During the secondary stage of the review process, publications with languages other than English, Spanish, and French were excluded from the study, along with all other non-peer-reviewed studies that included commentaries or opinion-based reviews. Afterwards, the primary research papers, lacking a possible explanation for choosing a certain sample size and ill-reporting standards for sampling and methodological choice, were excluded from the review in order to maintain transparency in the results. Furthermore, after a detailed analysis of the studies selected for the systematic review process, the papers with substantially lower quality research data and insignificant approach for the study was rejected end excluded from the process.

Data extraction

The process of data extraction is considered to be one of the most crucial steps in the review process, and the extraction sheet was curated and developed as the standard for protocol with the help of MS-Excel software, wherein the data is extracted on the basis of obtained information. The process utilised the CL and ML data extraction, which therefore classified the studies as per the requirement, specifically under the terms of methodological approach. Moreover, in certain cases, the data was unclear, regarding which the paper was excluded on grounds for unclear data. In association with this, the Zotero external tool was used for citing and referencing purposes. Each study's information regarding the ethical consideration and source of funding related information was also extracted simultaneously, which clearly helped in judging the levels of biasness in the respective studies.

Data analysis

The data analysis is performed as per the standards of research, and the levels of severity detect the condition of infertility, and consequences are measured as per the classification of impact. The thematic analysis module is utilised for identifying the impact of the dietary pattern on the fertility levels and, therefore, the overall impacts on the reproductive outcome of both males and females. Moreover, it is also identified that the necessary changes are made to the overall searching patterns and evaluation mechanism that is currently based on the patient care for the cause of infertility. Moreover, the analysis of data is linked with the cost of treatment and therefore related to the disease cause for the person suffering from the disease of infertility. The direct impacts of shifting patterns for dietary intake is analysed as per the current reporting standards, and analysed outcomes are therefore included in the study so as to effectively implicate the process of review and synthesis. The thematic-based analysis also helps identify the possible causes for the development of the disease triggered by the subsequent shift of dietary patterns across the lifestyle. The data obtained from the primary research articles were also included through designing the standards of results obtained in the tabulated and graphical method form. Henceforth, the basis of data analysis is understood as per this section.

Results

The search strategy for the literature search yielded about 550 abstracts, which were identified as unique in terms of their design. Therefore, several of them were excluded from the systematic review after the screening process.

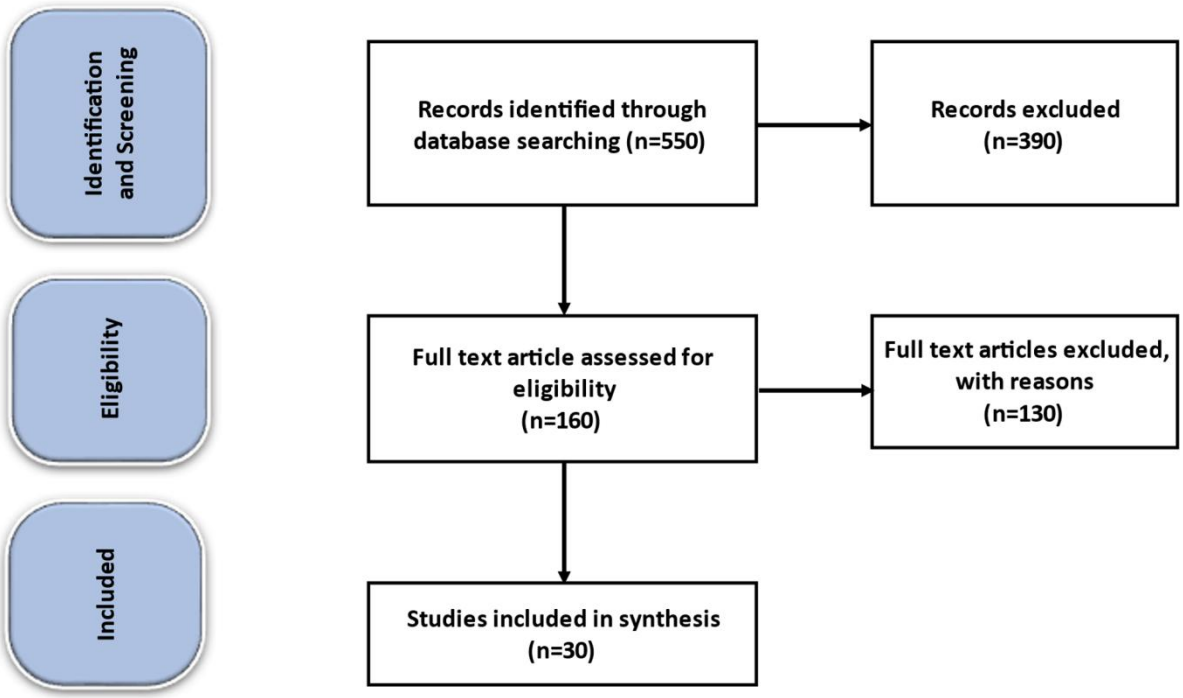

Figure 1: Flowchart depicting abstract and article selection process; Source: Author

As shown in Figure 1, after the process of identification and screening process, around 390 articles, out of 550, were disregarded and excluded, either due to their abstract not matching the researcher's perspective or the keywords not entirely as per the tool used by the reviewers (authors). However, certain reasons are included, such as the unavailability of a full text-based article for the process of the systematic review. Subsequently, the authors carried forward around 160 articles towards the second phase that constitutes the full text analysed ones and are deemed to be eligible prior to the full-text analysis. On the contrary, out of these, only (n=30) articles are selected for the study subsequently, out of which every article is scrutinised to find any potential factors having the ability and capability to jeopardise the whole study after the process of article selection. Upon subsequent analysis and observation being made for the study, it is identified that the issue of dietary pattern changes and aspects of the development of infertility among men and women has increased significantly in recent

years. From the sources, it is well evaluated that the issue of dietary pattern changes and their subsequent impact on the patient population is impactful in nature.

In the systematic review for 30 articles, it is found that one of the studies concerning the case-controlled approach has implicated 400 males diagnosed with infertility and researchers have adopted an approach to analysing the dietary patterns associated with the fertility outcome in the subject[15]. The dietary patterns have been implicated towards analysis utilising the food frequency questionnaire which consists of 168 semi-structured and quantitative interview model questions which help in detail synthesis of approach for dietary patterns of the subjects[16 17]. According to this study, it is also found that the major dietary patterns indicate the mix of traditional and western dietary patterns which therefore analyses the perspectives of the scenario related to the dietary pattern and reduced risk[18]. In association with this, the systematic review has also found out that the Western diet patterns indicate an increased risk of variance towards 11.37% in terms of adoption of the daddy scenario and usage of high protein diet sources like fish eggs and dairy products[19 20]. The article is also based its studies on identifying the impact of traditional diet on infertility which has depicted 8.47 per cent of the variance in the study explaining towards developing outcomes in terms of carbonated drinks and potatoes which contain carbohydrates at a higher level[21 22].

Food groups	Dietary pattern			
	Western diet	Healthy diet	Traditional diet	Mixed diet
Red meat	0.624	–	0.275	–
Processed meat	0.830	–	– 0.209	–
Organ meat	–	–	–	0.775
Fish and other seafood	0.343	0.724	–	–
Poultry	–	–	–	–
Fast food	0.740	–	–	0.468
Eggs	– 0.348	0.548	–	–
Carbonated drinks	–	0.252	0.306	–
Dairy products	–	0.345	–	–
Fruits and dried fruits	–	0.619	–	–
Vegetables	–	0.658	0.213	0.241
Potatoes	–	–	0.508	–
Legumes	0.802	–	–	–
Nuts	–	0.415	–	–
Whole grains	–	– 0.226	0.427	–
Refined grains	0.465	0.306	–	– 0.363
Salty snacks and vegetables	0.223	0.728	–	–
Animal fat	–	–	–	0.543
Vegetable oils	–	0.533	–	0.381
Olives	–	–	–	–
Sugar, sweet, and desserts	–	–	0.774	–
Condiments and pickles	0.299	0.695	–	–
Tea and coffee	–	–	0.688	–

Figure 2: The dietary patterns identified in the PCA

It is also found that the shift in dietary patterns from a meat-based diet to a vegetative one is therefore implicated with reduced risk and focused on the identification of the variance at a greater level which has therefore been a necessity for reducing the risk of infertility in men and women[23 24]. Furthermore, the healthy scenario also provides a contextual approval for the synthesis of effectiveness regarding the use of dairy products and vegetables in terms of reducing the risk of infertility across different gender roles.

Dietary pattern	Adjusted models			
	Crude model	Model I	Model II	Model III
Healthy diet (18.05% of variance)				
> Median (Case: 174; Control: 328)	0.64 (0.50–0.83)	0.90 (0.64–1.28)	0.92 (0.64–1.34)	0.52 (0.33- 0.83)
< Median (Case: 226; Control: 276)	1	1	1	1
Western diet (11.37% of variance)				
> Median (Case: 206; Control: 295)	1.11 (0.86–1.43)	1.09 (0.78–1.52)	1.34 (0.93–1.92)	2.66 (1.70–4.17)
< median (Case: 194; Control: 309)	1	1	1	1
Mixed diet (6.52% of variance)				
> Median (Case: 303; Control: 191)	6.75 (5.07–8.98)	7.19 (4.94–10.45)	7.36 (4.87–11.04)	2.82 (1.75–4.56)
< Median (Case:97; Control: 413)	1	1	1	1
Traditional diet (8.47% of variance)				
> Median (Case: 223; Control: 277)	1.48 (1.15–1.91)	1.89 (1.34–2.66)	1.50 (1.03–2.18)	1.36 (0.86–2.16)
< Median (Case: 177; Control: 327)	1	1	1	1

Figure 3: Multivariate odds ratio and 95% confidence interval for infertility

In figure 3 the model I is adjusted for several factors like BMI age and physical activity what is the model II is currently associated with the findings found from a model I along with added levels of education smoking and the current socio-economic status. Furthermore, model III is implicated with the associated increase of the conditions related to model II and subsequently links the study with 140 infertile Iranian women with major dietary issues regarding identified healthy and unhealthy status[25 26]. The implications have focused on the development of P trends of around 0.009 in the total number of sides in metaphase II and have compared the healthy diet context with the first cycle of reproduction. In association with this women with a high level of fat content showed reduced adherence and were implicated towards reduced chances of pregnancy for a long time period. In this regard the study evaluates the scenario according to the implications of perspectives regarding the associated multivariate odd ratios to the infertile male and female population.

Food groups	Healthy	Western	Unhealthy
		dietary pattern	
Fruits	0.750	-	-
Nuts	0.672	-	-
Vegetables	0.597	-	-
Meat	0.535	-	-
Dairy	0.418	-	-
Green olive	0.443	-	-
Cream	0.272	-	-
Legume	0.142	-	-
Sweet drinks	-	0.782	-
Sweets	-	0.519	-
Caffeinated drinks	-	0.480	-
Potato	-	0.416	-
Fast foods	-	0.344	-
Whole grain	-	-0.334	-
Refined grain	-	0.303	-
Liquid oil	-	0.298	-
Salt	-	0.237	-
Mayonnaise sauce	-	-	0.777
Butter	-	-	0.738
Egg	-	-	0.509
Junk foods	-	-	0.320
Solid oil	-	-	0.279
Variance explained (%)	12.679	8.892	7.133

Figure 4: The dietary pattern in the study

The data obtained from the systematic review of articles clearly depict a higher variance in terms of data obtained in the literature and therefore linked with the increased cases of infertility in terms of effective analysis. In addition to this, it is also identified that the contextual support for reduced quality of men's condition is related to the disrupted perspective of the condition.

The thematic analysis is referred to as the practice for gaining the knowledge regarding the specific approach obtained from reviewing literature and studying the papers obtained by

application of the search terms and criteria. The formation of the thematic analysis is based on identifying certain codes, extracts, and themes, upon which the analysis is done as per the specific theme and results obtained from the search.

Table 1:Table for thematic analysis, Extracts, codes, and themes.

Sl. No.	Extract	Code	Theme
1	High consumption of whole grains, monounsaturated and polyunsaturated oils improve fertility conditions [27] [28]	More whole grains and unsaturated oils help improve the condition of fertility	Whole grains and unsaturated oils improve fertility
2	"Fertility diet" comprises of plants, minerals, and irons reduce chances for infertility[29]	The NHS study took place on nurses having fertility diet lowering infertility rates	The fertility diet is a choice of preference among nurses
3	Intake of vegetables and fish as per the Mediterranean diet reduces infertility chances[30]	More number of vegetables and fish in a disciplined diet helps reduce infertility across all genders	Quality food reduces chances for the development of infertility
4	Healthy and regular diets, therefore, have the capability to improve health standards and indirectly reduce infertility[31]	Healthy habits are useful in nature and improve health conditions	Healthy dietary patterns directly increase the condition of infertility.
5	Intake of caffeine and alcohol greater than 272mg and 22g per day impacts fertility levels in men [32]	Intake of alcohol and caffeine regularly relates to negative implications in men	Irregular life standards and dietary patterns result in reduced fertility among males

Theme 1: Whole grains and unsaturated oils improve fertility

The study, conducted in form of a randomised control study has implicated the development of improved conditions of infertility among females, directly implicating the increased ability to instigate the levels of hormonal secretions and therefore increasing the levels of fertility-related hormones.

Theme 2: Fertility diet is a choice of preference among nurses

The Nursing Health Survey (NHS) showed an increase in a tendency among professionals to intake the fertility diet consisting of several other and nutritious including fish and vegetable

options rather than the products like chicken or turkey, seemingly unpopular in terms of improving the health conditions towards the development of infertility.

Theme 3: Quality food reduces chances for development of infertility

The quality food standards help in reducing the condition of infertility in terms of men and women both and specifically improve the condition of health standards so as to improve the conditions of infertility issues by the intake about the Mediterranean diet, again comprising the vegetable sources and therefore, improving the condition for the health standards and addressing the condition for infertility across the all-gender groups.

Theme 4: Healthy dietary patterns directly increase the condition of infertility.

The issues linked with those of infertility and childbirth directly relates to a reduced condition of health, lifestyle, and dietary patterns and therefore, relate to the specific condition of reduced condition in terms of health standards, however, the results from primary clinical studies suggest that the condition linked with

Theme 5: Irregular life standards and dietary patterns result in reduced fertility among males

The excessive consumption of caffeine by males have been regarded towards the development of infertility issues leading to the development of certain aspects for the development of complications in the formation of quality sperms and therefore indicate the effective strategies for the development of the disease from the long-term perspectives.

Discussion

The systematic review has involved thirty articles after several uses of inclusion and exclusion criteria which is implicated towards reviewing the articles related to fertility and reproductive outcomes. In the general context, the peer-reviewed articles focus on data collected from different ethnicities specifically from Iranian and USA based contacts in association with UK based scenarios [33] [34]. Furthermore, the article has found that the lifestyle factors such as dietary patterns play an important role in determining the reproductive outcomes of males and females [35]. This review has also revealed that there is a direct implication of dietary outcome in the context of highlighted adherence to the dietary pattern which therefore significantly decreases the risk of infertility in humans[36]. [37]also, in association with this, the study developed highlighted the lower possibility of reduced sperm motility in terms of impacted dietary patterns. In association with this, the study has also found out that the Polish population belonging to 20 to 55 years of age has been implicated towards the association of adherence in terms of healthy dietary pattern and reduced context scenario for the progressive increase in sperm count and concentration[38]. Therefore, the studies focused on different scenario has implicated a vegan diet, which has the possibility to increase semen quality. In this time, it is also found that study conducted over 7882 Iranian and Taiwanese men have regarded that there is a significant decrease in sperm quality and motility and development of azoospermia relating to the main focus on a western diet[39]. In women, on the other hand, it is discussed that the changes in dietary pattern relates directly to the dysfunctional ovulatory system and increase the concentration of progesterone hormone which therefore inhibits the mechanism for follicular response at a greater level[40]. However, in terms of dietary fibres and patterns, it is found that processed meats have a serious implication on health-related to the higher concentration of hormonal reduced which directly in the function for fertility[41]. The impact of dietary fibres and fertility status is also found to

be associated with the implications related to not only those issues but also to investigation is related to different ethnicities and focus on developed randomised controlled studies which would help in synthesis and drawing connections between the two variables of dietary pattern and infertility.

Conclusion

In conclusion, it is therefore obtained that the development of infertility is mainly due to the disruptive shift which has occurred on the basis of the westernised lifestyle and impacts of the reduced condition of health conditions. In this light, it is also concluded that the situation of infertility, which is currently on the rise is highly impacted by stress factors, which further reduce the quality of sperm and ovum over the long term. Furthermore, in conclusion, it is found that there is a direct influence of dietary patterns on the fertility and reproductive status of the individuals.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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