

Association Between Meat Intake and Semen Parameters Among Iranian Infertile Men: A Cross-sectional Study

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Research

Keywords: Diet, Male infertility, Semen Analysis, Meat Intake

Posted Date: May 27th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-29618/v1>

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Version of Record: A version of this preprint was published on October 6th, 2020. See the published version at <https://doi.org/10.1186/s12937-020-00633-w>.

Abstract

Objective: Previous studies have proven the effect of dietary patterns on semen quality indicators, but research on the relationship between meat intake and semen quality is limited. Therefore, this study was conducted to investigate the relationship between Meat intake with semen quality.

Methods: In this cross sectional study, 400 infertile men were recruited into study during their fertility investigation in Yazd Reproductive Sciences Institute Diagnosed by an andrologist according to the inclusion criteria. Multivariate logistic regression was used to determine the relationship between meat intake and semen parameters. All data were analyzed using SPSS V. 22 software.

Results: We found that intake of canned tuna can have two different effects on sperm motility in infertile male. Intake of canned tuna according to the serving size stated in quartile 2, leads to a decrease in the percentage of immotile sperm from 52.93 (CI95%, 51.15-54.71) to 46.55 (CI95%, 44.56-48.54) (Ptrend=0.036). On the other hand, there is an increase in the percentage of immotile sperm from 46.55 (CI95%, 44.56-48.54) to 52.88 (CI95%, 50.94-54.82) in the highest quartile of canned tuna intake. Also, no significant relationship was observed between intake other types of meats and sperm quality indices.

Conclusions: We found that intake of canned tuna, base on serving size of quartile 2, is associated with lower percentage of immotile sperm, on the other hand high intake of canned tuna increase percentage of immotile sperm in Iranian infertile men. More extensive studies are recommended in this regard.

Introduction

Infertility affects 7% of the total men population(1). More than 25% of infertility due to decrease semen quality causes are related to male fertility disorders(2). According to a meta-analysis, involving 185 studies and 42,000 men, semen quality has decreased over the last 40 years(3). However, according to previous studies men infertility might be due to anatomical disorders such as varicocele, obstruction of the ducts, or ejaculatory disorders(4, 5). But about 40–90% of the causes of male infertility are due to a decrease in semen quality and abnormal sperm health indicators(4, 5). Several reasons have been suggested for semen quality decline, but smoking, alcohol consumption, pesticides in food, unhealthy eating habits, inadequate intake of many essential micronutrients and vitamins are the main causes of this reduction(6). According to previous studies, diet can affect spermatogenesis, which is measured by evaluating the quality of semen. For example, red meat intake reduces the concentration and number of sperm. Fish consumption, on the other hand, is associated with higher sperm morphology(7–9). Increased intake of processed meats is also associated with oligoasthenoteratospermia and asthenospermia(10). Therefore, for further evaluation, we examine the relationship between meat consumption and sperm quality indicators in infertile men.

Materials And Methods:

Study Population

In the cross-sectional study, 400 infertile men according to approved andrologist's indices participated to our study from July 2019 to December 2019, from Yazd Reproduction Research Institute. Inclusion criteria include age between 20 to 55 years, sperm count less than 15 million per milliliter, normal morphology less than 4%, semen volume less than 1.5 ml and progressive motility less than 40%. Also, exclusion criteria include chronic diseases, testicular atrophy, ejaculatory disorder, hypospadiasis, stenosis, varicocele, adherence to specific diets, non-response to more than 35 items of food frequency questionnaire and underreporting and over-reporting of energy intake (less than 800 and more than 4,200)(11, 12). General and dietary information was collected by a trained nutritionist. All subjects completed the consent at the baseline of the study .

Physical Examination And Lifestyle Variable

Physical activity data were collected using a validated and reliable questionnaire (International Physical Activity Questionnaire)(13). The IPAQ provides information about levels of inactivity, moderate activity, strenuous activity and walking. In addition, we gathered the data regarding frequency (days per week) and duration (minutes per day) for all type of activities.

Socioeconomic status (SES) of the study participants was determined according to variables, such as home situation variables situation (landlord-tenant), washing machine and dishwasher (yes-no), number of overseas trips, has car (yes-no), individual occupation, education (number of years of study).

Anthropometric Data

Anthropometric data were measured by standard methods. The body mass index (BMI) and Waist to Hip Ratio (WHR) calculated according to standard protocol of World Health Organization (WHO), based on minimal clothing and no shoes, using Falcon scales (Seca, Hamburg, Germany) to the nearest 0.1 kg. Also, all measurements were recorded with an accuracy of 0.1 cm. Hip Circumference (HC) was measured since the hips are the widest part of buttocks and Waist Circumference (WC) was measured midpoint between the last rib and the iliac crest (umbilical level). BMI and WHR were calculated based on this formula: weight (kg)/height (m²) and WC (cm)/HC (cm), respectively (14).

Dietary Assessment

Dietary intake was assessed by using a semiquantitative Food Frequency Questionnaire (FFQ). The validity of this questionnaire is confirmed in Iran(15). The FFQ including 168 food items which was designed according to frequency of consumption of the common foods of one's country during the past 12 months (Loading [MathJax]/jax/output/CommonHTML/jax.js) onthly, and annually). FFQ was filled out by a trained dietitian, by interviewing. The validity of meat assessments,

using this questionnaire has been confirmed according to the food pattern records over the past year. The total meat intake was defined as red meat, poultry, fish, tuna, processed meats and organ meats. Household measurements were monitored by a nutritionist to calculate the total energy and nutrients consumed in actual food consumption (grams per day). Information on alcohol use was not collected for cultural reasons and was therefore not analyzed. The dietary habits of each person were assessed one year prior to infertility diagnosis.

Semen Analysis

Semen samples should be collected after 3 days of abstinence. Before transferring the samples into the container, the temperature of the container should be close to the body temperature of 37 ° C. Semen samples were kept in sterile containers at 37 ° C for 30 minutes. They were then evaluated and analyzed according to the WHO Fifth Edition Laboratory Guidelines(16). Four parameters related to semen and sperm including semen volume, sperm concentration, normal sperm morphology and sperm motility were measured.

Statistical Methods:

In the present study, the anthropometric, demographic and semen quality indicators of participants were categorized and summarized using KruskalWallis test. Fisher's exact test was also used to classify them into meat consumption quarters. Mixed linear models were used to investigate the relationship between meat consumption and semen quality indicators.

In these regression models, semen quality indicators such as semen volume, sperm count, sperm motility types and normal sperm morphology were compared with meat intake quartiles. quartile 1 was considered as the lowest and quartile 4 was considered as the highest consumption. Variance calculations were evaluated as 95% CI. Participants' information, including age, BMI, WHR, physical activity, pesticide use, and smoking, which had been shown to be a risk factor for decreased semen quality, were monitored as a confounding variables. All models were adjusted for age, BMI, WHR, use of toxins, energy intake, physical activity and smoking. P-value < 0.05 was considered as the level of significance. Statistical analysis was determined using SPSS software (version 22, Chicago, IL, USA).

Results:

Based on the Table 1, infertile men with an average age of 33.66 years, were in the age range of 20 to 55 years, who entered the study without a history of chronic diseases and the use of any medication or dietary supplement. 34.5% were smoker and 25% were previous smokers. In this study, we concluded that decreased semen quality was significantly associated with increased BMI, WHR, and age.

Table 1
 Characteristics of 400 infertile men (number (%) unless stated otherwise).

	Total meat intake				P-value*
	Quartile 1 (lowest)	Quartile 2	Quartile 3	Quartile 4 (highest)	
Participants, n	109	91	101	99	
Range, servings/d	0.96-0	1.32-0.97	2.15-1.32	4.57-2.16	
Demographics					
Age, y	32.44(31.84-33.00)	35.31(34.57-36.05)	35.33(33.93-36.03)	31.80(31.34-32.26)	< 0.001
BMI, kg/m ²	23.74(23.36-24.12)	28.24(27.82-28.66)	27.47(26.76-28.18)	25.44(24.99-25.89)	< 0.001
WHR	0.94(0.91-0.97)	1.13(1.09-1.17)	1.08(1.03-1.13)	0.96(0.93-0.99)	< 0.001
SES	4.81(4.62-5)	4.99(4.84-5.14)	4.40(4.22-4.58)	3.85(3.61-3.91)	< 0.001
Education, y	9.10(8.57-9.63)	10.22(9.88-10.56)	12.21(11.79-12.63)	3.85(3.61-4.09)	< 0.001
Smoker					< 0.006
Never smoked	49 (44)	55 (60)	62 (61)	52 (52)	
Past smoker	1 (0.09)	3 (3)	5 (4)	9 (9)	
Current smoker	59 (54)	33 (36)	34 (33)	38 (38)	
Physical Activity ^a					< 0.001
Low	46	25	45	20	
Moderate	35	13	88	21	
Extreme	54	0	21	32	
Diet					
Total energy intake, kcal/d	1570(1300-1810)	1960(1630-2290)	2330(2020-2650)	2826(2566-3086)	< 0.001

* From the Kruskal-Wallis test for continuous variables, Fisher's exact test for categorical variables.

According to Table 2, there is a significant relationship between reduced sperm motility and tuna consumption. Thus, the consumption of tuna in the specified serving of quartile two, reduces the percentage of immobile sperm from 52.93 (CI95%, 51.15-54.71) to 46.55 (CI95%, 44.56-48.54). None of other semen quality indices were associated with tuna intake.

Table 2

Adjusted semen quality indicators in 400 infertile men according to intake of differ

Meat intake (servings/d)
$\beta_1 + \beta_2 \times \text{meat intake} + \beta_3 \times \text{meat intake}^2 + \beta_4 \times \text{meat intake}^3 + \beta_5 \times \text{meat intake}^4$
Quartile 1 [0.00-0.38]
Quartile 2 [0.39–0.81]
Quartile 3 [0.82–1.14]
Quartile 4 [1.15–1.46]
P-trend
$\beta_1 + \beta_2 \times \text{meat intake} + \beta_3 \times \text{meat intake}^2$
Quartile 1 [0.00-1.17]
Quartile 2 [1.18–1.59]
Quartile 3 [1.60–2.41]
Quartile 4 [2.42–2.79]
P-trend
$\beta_1 + \beta_2 \times \text{meat intake} + \beta_3 \times \text{meat intake}^3$
Quartile 1 [0.00-1.73]
Quartile 2 [1.74–1.96]
Quartile 3 [1.97–2.20]
Quartile 4 [2.21–2.42]
P-trend
fish
Quartile 1 [0.00-0.13]
Quartile 2 [0.14–0.34]
Quartile 3 [0.35–0.52]
Quartile 4 [0.53–0.76]
P-trend
$\beta_1 + \beta_2 \times \text{meat intake} + \beta_3 \times \text{meat intake}^4$

¹ included sausage and bologna

² included hamburger, beef and lamb meat as a mixed or main dish

³ included chicken with or without skin, as a main dish, sandwich, or frozen dinner

Meat intake (servings/d)
Quartile 1 [0.21–0.36]
Quartile 2 [0.37–0.59]
Quartile 3 [0.60–0.97]
Quartile 4 [0.98–1.74]
P-trend
Tuna
Quartile 1 [0.00-0.49]
Quartile 2 [0.50–0.76]
Quartile 3 [0.77–0.95]
Quartile 4 [0.96–1.23]
P-trend
¹ <i>included sausages and bologna</i>
² <i>included hamburger, beef and lamb meat as a mixed or main dish</i>
³ <i>included chicken with or without skin, as a main dish, sandwich, or frozen dinner</i>
⁴ <i>included liver and chicken liver</i>

Contrary to our expectations of quartile 3, the percentage of immobile sperm increases from 46.55 (CI 95%, 44.56–48.54) to 52.88 (CI 95%, 50.94–54.82). Also, no significant relationship was observed between intake of other types of meat and sperm quality indicators.

Discussion:

We found that intake of canned tuna, has two different effects on sperm motility in infertile male. Intake of canned tuna according to the serving size stated in quartile 2, is associated with decrease in the percentage of immotile sperm from 52.93 (CI 95%, 51.15–54.71) to 46.55 (CI 95%, 44.56–48.54) (P trend = 0.036). There is an increase in the percentage of immotile sperm from 46.55 (CI 95%, 44.56–48.54) to 52.88 (CI 95%, 50.94–54.82) in the highest quartile of canned tuna intake. In addition, there were no significant association between intake of canned tuna and other indicators of sperm quality. Based on our data, inconsistent with our hypothesis, intake of other types of meat, such as red meat, poultry, fish, processed and organ meat had no significant association with semen quality indicators.

Interestingly, Myriam C Afeiche et al, indicated that high intake of processed meat was associated with reduction of total sperm count and progressive motile count. In this study organ meat intake was related to higher total sperm count, higher sperm concentration and greater sperm motility(17). Also other studies indicated high intake of organ meat was associated with higher total sperm count, concentration and motility. Whether nutrients concentrated in organ meats such as vitamin B12, iron, animal fat, animal protein manganese and copper explained these associations and may have a role in spermatogenesis(10). Studies that evaluated the relationship between meat intake and sperm quality indicators, are limited and their findings are not consistent with the results of the present study(17–21). A study in Boston found that higher fish intake was associated with increased sperm count and normal sperm morphology(17). Another study in the Netherlands found that fish and seafood intake is effective on sperm motility and can increase the percentage of motility sperm(19). One study in Iran reported that highest intake of processed meats is associated with an increased risk of developing asthenospermia compared to lower intakes. But among men who consume the highest tertile of fish and seafood, asthenospermia was less in comparison with who intake less(21).

Canned foods are one of the most important dietary items as rich sources of micronutrients(22). Canned tuna is also widely consumed by the general public because it is rich in polyunsaturated fatty acids (PUFAs)(22, 23). The polyunsaturated fatty acids in fresh fish are unstable and may oxidize rapidly(22, 24, 25). One of the eating habits of residents of Yazd province is the consumption of fried fish, in this cooking method a large amount of polyunsaturated fatty acids are oxidized. So the dietary intake of these fatty acids is low. Therefore, dietary intake of these fatty acids through canned tuna can be a protective and improving factor on sperm motility. However, according to our findings, increasing the consumption of canned tuna increases the percentage of immobile sperm. Another possibility is that many pollutants, such as heavy metals, are highly stable, toxic, and not easily degradable(26). Continuous contact of the gastrointestinal tract with these toxins is one of the ways they affect the functioning of the human body system(22). Among the various food groups, fish and its products contain higher levels of heavy metals than other groups, especially lead and cadmium(27). Food processes that are performed on fish to produce canned tuna may affect the concentration of pollutants before consumption(22, 23). In this regard, Ahmed Zaki et al. have shown that infertile men with higher

blood levels of lead and cadmium had lower serum levels of the hormones including and testosterone in comparison with healthy healthy men. they also have found that sperm count, motility, and semen volume were significantly lower in infertile men(28). So many other studies suggested the relationship between higher serum levels of lead and cadmium and attenuated sperm quality(29–32).

This study has several strengths, including high sample size in new diagnosed patients (in past 1 year), with minimum error in dietary recall history, using FFQ with high validity for estimating food intake and eating habits, repeating semen analysis for men with infertility in laboratory. However, the present study has some limitations. FFQ depends on the memory of the participants being interviewed also it does not allow precise estimation of portion size of foods consumed. Moreover the effect of stress on men was not evaluated in this study.

Conclusion

We found that Consumption of tuna has two different effects on sperm motility. intake of canned tuna, based on serving size of quartile 2, is associated with lower percentage of immotile sperm due to canned tuna is a rich source of unsaturated fatty acids. But on the other hand high intake of canned tuna increase percentage of immotile sperm in Iranian infertile men. The proposed mechanism in this regard is related to the high concentration of metal pollutants in canned tuna. further investigations are needed to confirm these results and to recognize the underlying mechanisms.

Declaration

Ethical Approval and Consent to participate

The study protocol was approved by the Ethics Committee of Isfahan University of Medical Sciences code IR.MUI.RESEARC H.REC.1398.264.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

competing interests

The authors declare that they have no competing interests" in this section.

Funding

This study was supported by a grant from the Isfahan University of Medical Sciences, Islamic Republic of Iran.

Authors'contributions

FH, RGh: designed research; FH: conducted research; FH,LDM: provided essential materials;SPSH: analyzed data; FH: wrote paper; FH: had primary responsibility for final content. The authors read and approved the final manuscript.

Acknowledgement

The author of the article would like to thank all the participants in this project. We knowledge of the researchers of Yazd Reproduction Research for providing data from this study.

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