Relationship between Dietary Intake of Antioxidant (Vitamins C, E, and Selenium) with Semen Quality

Khaeria Hussein Al Jebory * *Salwa Hazim Al Mukhtar* **

ABSTRACT

Background and aim: oxidative stress is detrimental to semen quality and has a significant role in the etiology of male subfertility. This study aimed at examine the relationship between dietary intake of antioxidant (vitamins c, e, and selenium) with semen quality.

Materials and method: Dietary intake of antioxidants was compared between 35 men with oligolastheno/ teratazoospermic (cases) and 35 normospermic volunteers (controls) attending fertility clinic in al Batool Hospital in Mosul, Iraq. All participants were nonsmokers and matched according their age and Body Mass Index (BMI). Nutrient consumption was calculated using a semi- quantitative food frequency questionnaire. Semen samples were collected and were assessed by measuring volume, concentration, motility and morphology.

Results: infertile subjects had a significantly lower intake of Selenium compare to control ones ($p<0.001$). Dietary intake of vitamin C and E was lower than recommended values in 59.4% of case group that was significantly different from control ones ($p<0.05$). In the control group, 36.4 and 40.9% of participants had an insufficient dietary intake of vitamin C and E, respectively. Significant correlations were found between Vitamin E ($r=0.5$, $p<0.001$), Vitamin C ($r=0.6$, $p<0.001$) and percentage of motility and also between vitamin E and morphology ($r=0.3$, $p=0.03$), Selenium and concentration ($r=0.4$, $p=0.004$) in all participants.

Conclusion: In summary, a low intake of antioxidants, and vitamin E were related to poor sperm concentration and motility.

Keywords: Dietary antioxidant, Male infertility, Oligasthenoteratozoospermi

INTRODUCTION

Infertility is a condition which is defined as one-year unsuccessful attempt to conceive (Hosseini *et. al*., 2014).Based on the reports by the World Health Organization (WHO), at least 60–80 million couples are suffering from infertility worldwide (Eslamian *et. al*., 2012). A male partner factor plays a role in about 40% of infertility cases (Eslamian *et al*., 2012). A reduction in male fertility has been observed over the recent decades (Anderson *et.al*., 2000). Sperm density has dropped by 40% during the past 50 years (Carlsen *et.al.*, 2000). Studies suggested that congenital and acquired urogenital abnormalities, infections of the genital tract, increased scrotal temperature (Varicocele), endocrine disturbances, genetic abnormalities and immunological factors might lead to a reduction in male fertility (WHO, 2000). However, no causal factor is reported in 60-75% of cases, the condition that defined as idiopathic male infertility (Dohle *et.al*., 2007). These men have no previous history associated with fertility problems and present with normal findings on physical examination and endocrine laboratory testing (Dohle *et.al*., 2007). Semen analysis demonstrates a decreased number of spermatozoa (oligozoospermia) defined as <20 million spermatozoa/mL, reduced motility (asthenozoospermia) defined as <50% motile spermatozoa and various abnormal forms on morphological examination (teratozoospermia) defined as <14% normal forms (Dohle *et.al*., 2007). These abnormalities usually occur together and are described as the oligoasthenoteratozoospermia (OAT) syndrome (Dohle *et.al*., 2007). Infertility caused by idiopathic oligoastheno-teratozoospermia syndrome without any female factor, constitutes one of the greatest patient groups in the daily practice of urologists (Safarinejad *et. al*., 2010). In spite of major advances in the field of infertility, many cases of male infertility have been diagnosed as idiopathic with no particular treatment (Safarinejad *et. al*., 2010). However, it has been suggested that chronic stress, endocrine disruption due to environmental pollution, reactive oxygen species, genetic abnormalities as well as occupational and lifestyle factors may be particularly linked with the pathophysiology of infertility (Connor *et.al.*, 2012). Eating habits, as principle lifestyle factors, in terms of both macro- and micro-nutrients

* *Specialist Nurse / Alhaweja General Hospital*

** *Assistant Professor/ College of Nursing/ University of Mosul*

intake has major effects on normal reproductive function (Connor *et.al.*, 2010; Batra and Bansal,2004). Due to swift changes in eating behavior, the expansion of unhealthy dietary patterns, specifically higher intakes of saturated fat, trans fatty acids and sodium and lower consumption of antioxidant-rich foods such as fruit and vegetables, has an upward trend in reproductive age people (Lioret *et.al.*, 2012). Meanwhile, several studies indicate that higher consumption of fruit, vegetables, poultry, sea foods, skim milk and shellfish as well as lower intake of full-fat dairy, sweets and processed meat specifically with high-saturated fat foods are linked with higher sperm quality (Eslamian et.al.,2012). The main aims of the present study was to examine the relationship between dietary intake of antioxidant (Vitamins C,E, and selenium) with semen quality.

MATERIALS AND METHODS

A case- control study was applied between November and December 2013 in the outpatient clinic of infertility in Mosul city, Iraq. The case group consisted of 35 men (20-40 years) with primary infertility due to idiopathic oligo and/or astheno and/or teratozoospermia (WHO 1999) and 35 age matched normal healthy donors who referred for premarital tests and considered as control ones. The diagnosis of primary infertility was made after medical assessment, which included medical history, clinical examination, semen analysis, Infertility is defined as the inability to conceive after 12 months of unprotected intercourse. Exclusion criteria were: smoking, alcohol consumption, occupational chemical exposure, history or presence of endocrine disorders, testicular disease such as cryptorchidism, orchitis and varicocelle, infectious genital disease, treatment with drugs or using antioxidant supplements within the 3 months before enrollment, leucocytospermia seminal white blood cells (WBC) > 1×106/ml) and azoospermia. The study has been performed in accordance with the ethical standards laid down by the appropriate version of the 1964 declaration of Helsinki and the study protocol was approved by clinical Nursing Sciences Department, College of Nursing, University of Mosul. All participants were given written informed consent. Two questionnaires were completed for each person. The first questionnaire ascertained socio-demographic characteristics and anthropometric data. Anthropometric assessment included measurements of height and weight. BMI was calculated as weight (Kg) divided, height (squared, meter, m2). Dietary information was collected by using a semiquantitative food-frequency questionnaire (FFQ) with 116 food items. Participants were asked to state the portion size of given food and how often they had consumed each of the foods and beverages included in the FFQ during the previous year. The questionnaire had 9 options for frequency of intake, ranging from < 1 time per month to ≥ 6 times per day. Nutrient intakes were estimated by summing the nutrient contribution of all food items in the questionnaire. Then the average for daily energy and nutrient intakes was calculated by using food processor software version II (ESHA Research, 1999, Salem, OR). Semen samples were obtained by masturbation after 48-72 hours of abstinence. Samples were collected into sterile containers and allowed to liquefy at 37□ c for 20 minutes, and evaluated immediately, according to the WHO recommendation (ejaculate volume, pH, sperm concentration, motility and morphology) (WHO 1999). Sperm concentration was expressed as 106 per milliliter of semen, in which motility and morphology expressed as a percentage. Sperm concentration ≥ 20×106 per milliliter of semen, motility ≥ 50% and normal forms ≥ 30% were considered as normal sperm parameters according to WHO criteria (16). *Statistical methods:* Statistical analyses were performed using SPSS 16.0 for Windows statistical software (SPSS Inc. Chicago, IL, USA). Differences between control and infertile groups were assessed using independent t- test. The correlations between sperm parameters and antioxidant nutrient intakes were evaluated by the Pearson correlation coefficient. The results were given as mean ±SD, and correlation coefficients, and $p<0.05$ considered statistically significant.

RESULTS

The mean age of case and control group were (34.66) and (33.91) respectively. Regarding some characteristics of study subject the finding reveals that there no significant differences between case and control groups in relation to their age, Body Mass Index (BMI) (**Table 1**). The case group in comparison with control had significantly higher sperm concentration, motility and morphology (**Table 2**). The correlation between (selenium, vitamin E,C)and semen parameter shows significant differences (**Table 3**).

Table (1): characteristics BMI and Seminal Fluid Parameter for case and control group.

	Case		Control		*t* value	sig
	Mean	**SD**	**Mean**	**SD**		
Age	34.66	2.1	33.91	3.4	**0.04**	**NS**
BMI	24.2	3.7	25.1	2.4	**0.01**	**NS**
Since diagnosis. years	4.1	0.1	3.8	2.8	**0.02**	**NS**
Volume (ml)	2.92	1.25	3.19	2.6	**0.05**	**NS**
Sperm count (million/ml)	36.46	29.02	45.7	19.02	**0.3**	**NS**
Non motile (%)	34.00	20.25	24.37	10.68	**0.1**	**NS**
Abnormal morphology (%)	48.40	14.77	35.2	0.96	**0.2**	**NS**

$p<0.05$

Table (2) Comparison between (Vita C ,Vita E , Selenium level) for both groups .

	Case		Control		*t* value
	Mean	**SD**	**Mean**	**SD**	
Vitamin C	34.66	2.1	33.91	3.4	**3.2***
Vitamin E	24.2	3.7	25.1	2.4	**3.8***
Selenium	4.1	0.1	3.8	2.8	**3.5***

*significant at $p<0.05$

Table (3): Correlation between (Vita C, Vita E, selenium level) and Seminal fluid parameter

	R		
	Vitamin C	**Vitamin E**	**Selenium**
Volume (ml)	0.002	0.1	.086
Sperm count (million/ml)	0.14	0.2	.270*
Non motile (%)	0.06	0.5	-.207*
Abnormal morphology (%)	0.03	0.30*	-.204*

*significant at $p<0.05$

DISCUSSION

This study showed that a low intake of selenium as an antioxidants may have a negative effect on sperm motility and morphology. (Eskenazi et al., 2005) found an association between antioxidant intake and sperm numbers and motility in a healthy population of nonsmoking men. Similarly, Mendiola et al found a positive association between semen quality and vitamin C intake (Mendiola *et.al*., 2010). There was a significant difference in zinc and folate intake between oligo/ astheno/ teratozoospermic and healthy donors ($p<0.000$). He also found a positive association between folate intake and semen quality. Likewise, in study by Young *et. al*. (2008) states that healthy nonsmoker men with high folate intake (≥ 75th percentile) had lower frequencies of sperm aneuploidy compared to men with lower intake (≤ 25th percentile). Some interventional studies showed that oral supplementation with vitamin E, folate and zinc sulfate improve semen quality in infertile patients (Wong *et.al*, 2002-Greco *et.al*., 2005). Folate is an essential micronutrient for DNA synthesis and repair. Inadequate 5, 10-methylenetetrahydrofolate has been shown to cause massive misincorporation of uracil into human DNA (Blount *et.al.*,1997). Moreover, we did not find any association between selenium and semen quality, which is in agreement with Hawkes and Iwanier et al., in which selenium supplementation did not improve semen quality in healthy and subfertile men (Hawkes, 2001-

Iwanier,1995). Finally, there was a significant negative correlation between sperm concentration and beta-carotene. Since we did not assess the concentration of this nutrient in body fluids, our data were not enough to explain the effect. This unexpected result implies that the effect of a single food, nutrient, or food group is not always clear; foods and nutrients are consumed in combination and as a result may have a synergistic effect (Rahman *et.al*., 2002). Analysis of overall dietary patterns may provide a comprehensive correlation with their overall effects on oxidation, inflammation, and disease risk. In spite of the fact that the main sources of beta-carotene and vitamin C are fruits and vegetables, the quantification of antioxidant consumption may be further complicated by food storage, handling, processing, and preparation (Price *et.al.*, 1997). Water-soluble antioxidants such as vitamin C are released into high temperature cooking water and discarded. It has been suggested that high levels of betacarotene might induce DNA damage due to oxidative stress (Murata *et.al*., 2000). Van Helden *et al*. (2009) demonstrated that the anti or pro oxidant effect of beta carotene, is dependent on the type of radicals involved. In their study showed that beta carotene is an anti-oxidant against vitamin C and it can significantly reduce the M1dG levels in vitro as well as in vivo. However, it was not capable to scavenge. The OH agent and even resulted in an increased ROS production in lung epithelial cells.

CONCLUSION

The results of this case-control study suggest that the risk of poor sperm concentration, motility, and morphology are associated with low intake of some antioxidant agents in a group of oligo/ astheno/ teratozoospermic men.

REFERENCES

Andersen, A. (2000). High frequency of sub-optimal semen quality in an unselected population of young men. *Human Reproduction*, *15*(2), 366-372. http://dx.doi.org/10.1093/humrep/15.2.366

Batra, N., Nehru, B., & Bansal, M. (2004). Reproductive potential of male Portan rats exposed to various levels of lead with regard to zinc status. *BJN*, *91*(03), 387. http://dx.doi.org/10.1079/bjn20031066

Carlsen, E., Giwercman, A., Keiding, N., and Skakkebaek, N. (1992). Evidence for decreasing quality of semen during past 50 years. *BMJ*, *305*(6854), 609-613. http://dx.doi.org/10.1136/bmj.305.6854.609

Connor, K., Vickers, M., Beltrand, J., Meaney, M., and Sloboda, D. (2012). Nature, nurture or nutrition? Impact of maternal nutrition on maternal care, offspring development and reproductive function. *The Journal Of Physiology*, *590*(9), 2167-2180. http://dx.doi.org/10.1113/jphysiol.2011.223305

Dohle, g., colpi, g., hargreave, t., papp, g., jungwirth, a., and weidner, w. (2005). Eau guidelines on male infertility. *European urology*, *48*(5), 703-711. http://dx.doi.org/10.1016/j.eururo.2005.06.002

Eskenazi, B. (2004). Antioxidant intake is associated with semen quality in healthy men. *Human Reproduction*, *20*(4), 1006-1012. http://dx.doi.org/10.1093/humrep/deh725

Eslamian, G., Amirjannati, N., Rashidkhani, B., Sadeghi, M., and Hekmatdoost, A. (2012). Intake of food groups and idiopathic asthenozoospermia: a case-control study. *Human Reproduction*, *27*(11), 3328-3336. http://dx.doi.org/10.1093/humrep/des311

Greco, E. (2005). Reduction of the Incidence of Sperm DNA Fragmentation by Oral Antioxidant Treatment. *Journal Of Andrology*, *26*(3), 349-353. http://dx.doi.org/10.2164/jandrol.04146

Hauser, R., Temple-Smith, D., de Kretser, D., and Southwick, J. (1995). Fertility in cases of hypergonadotropic azoospermia. *Fertil Steril., Mar;63*(3), 631-636.

Hawkes, W., Kelley, D., & Taylor, P. (2001). The Effects of Dietary Selenium on the Immune System in Healthy Men. *BTER,81*(3),189-213. http://dx.doi.org/10.1385/bter:81:3:189

Hosseini, B. and Eslamian, G. (2014). Association of Dietary Factors With Male and Female Infertility: Review of Current Evidence.*Thrita,3*(3). http://dx.doi.org/10.5812/thrita.20953

Iwanier, K. and Zachara, A. (1995). Selenium supplementation enhances the element concentration in blood and seminal fluid but does not change the spermatozoal quality characteristics in subfertile men. *Am Soc Androl.*, *16*(5), 441-441.

Jequier, A. (2000). Who manual for the standardized investigation and diagnosis of the infertile male. *the obstetrician and gynaecologist*, *2*(4), 55-55. http://dx.doi.org/10.1576/toag.2000.2.4.5

Lioret, s., McNaughton, A., Crawford, D., Spence, A., Hesketh, K., and Campbell, J. (2012). Parents'dietary patterns are significantlycorrelated: findings from the Melbourne Infant Feeding Activity and Nutrition Trial Program. *Br J Nutr*, *108*(3), 518-526.

Mendiola, J., Torres-Cantero, A., Moreno-Grau, J., Ten, J., Roca, M., Moreno-Grau, S., and Bernabeu, R. (2009). Food intake and its relationship with semen quality: a case-control study. *Fertility And Sterility*, *91*(3),812-818. http://dx.doi.org/10.1016/j.fertnstert.2008.01.020

Mendiola, J., Torres-Cantero, A., Vioque, J., Moreno-Grau, J., Ten, J., & Roca, M. et al. (2010). A low intake of antioxidant nutrients is associated with poor semen quality in patients attending fertility clinics. *Fertility And Sterility*,*93*(4),1128-1133. http://dx.doi.org/10.1016/j.fertnstert.2008.10.075

Murata, M. and Kawanishi, S. (2000). Oxidative DNA Damage by Vitamin A and Its Derivative via Superoxide Generation. *Journal Of Biological Chemistry*, *275*(3), 2003-2008. http://dx.doi.org/10.1074/jbc.75.3.2003

Price, K., Bacon, J., and Rhodes, M. (1997). Effect of Storage and Domestic Processing on the Content and Composition of Flavonol Glucosides in Onion (Allium cepa). *J. Agric. Food Chem.*, *45*(3), 938-942. http://dx.doi.org/10.1021/jf9605916

Rahman, M., Wahed, A., Fuchs, J., Baqui, H., and Alvarez, O. (2002). Synergistic effect of zinc and vitamin A on the biochemical indexes of vitamin A nutrition in children. *Am J Clin Nutr. 2002*, *75*(1), 9298.

Safarinejad, M., Hosseini, S., Dadkhah, F., and Asgari, M. (2010). Relationship of omega-3 and omega-6 fatty acids with semen characteristics, and anti-oxidant status of seminal plasma: A comparison between fertile and infertile men. *Clinical Nutrition*,*29*(1),100-105. http://dx.doi.org/10.1016/j.clnu.2009.07.008

van Helden, Y., Keijer, J., Heil, S., Pico, C., Palou, A., and Oliver, P. et al. (2009). Beta-carotene affects oxidative stress-related DNA damage in lung epithelial cells and in ferret lung. *Carcinogenesis*, *30*(12), 2070-2076. http://dx.doi.org/10.193/carcin/bgp186

WHO. (2000). *WHO Manual for the Standardised Investigation and Diagnosis of the Infertile Couple*. Cambridge: Cambridge University Press,.

Wong, Y., Merkus, M., Thomas, M., Menkveld, R., Zielhuis, A., and Steegers-Theunissen, P. (2002). Effects of folic acid and zinc sulfate on male factor subfertility: a double-blind, randomized, placebo-controlled trial. *Fertil Steril. 2002 ;77(3):491-8.*, *Mar (77)*(3), 491-498.

Young, S., Eskenazi, B., Marchetti, F., Block, G., & Wyrobek, A. (2008). The association of folate, zinc and antioxidant intake with sperm aneuploidy in healthy non-smoking men. *Human Reproduction*, *23*(5), 1014-1022. Retrieved from: http://dx.doi.org/10.1093/humrep/den036