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Relationship between serum levels of testosterone, zinc and selenium in infertile males attending fertility clinic in Nnewi, south east Nigeria

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Abstract

In the recent years, male infertility and sub-fertility have increased, which is attributable to many factors. Some trace elements such as zinc and selenium have been shown to play a role in reproduction. The study was designed to determine the serum levels of zinc, selenium and testosterone in infertile males attending fertility clinic in Nnewi. We investigated fifty apparently infertile males (subjects) and twenty apparently healthy fertile males (controls) between the ages of twenty five and fifty five years. The serum levels of zinc and selenium were determined using Atomic Absorption Spectrophotometer while the serum level of testosterone was determined using Enzyme Immunoassay techniques. The results showed that there were significant differences in the mean serum zinc, selenium and testosterone when compared between the two groups. The results also showed a strong positive correlation between serum levels of zinc and selenium, a negative correlation between serum levels of testosterone and zinc, and a strong positive correlation between serum testosterone and selenium in the infertile males. We therefore conclude that there is a relationship between the serum levels of zinc, selenium and testosterone in infertile males and that these parameters be considered when investigating cases of infertility in males.

Keywords; *Serum testosterone, zinc, selenium, male infertility*

Résumé

La stérilité et la sous-fertilité chez les hommes ont augmenté au cours des dernières années, dont plusieurs facteurs en sont responsables. Quelques éléments tels que le zinc et le sélénium ont été prouvé comme jouant un rôle dans la reproduction. Cette étude a été conçue dans le but de déterminer les niveaux de sérum du zinc, du sélénium et de la testostérone chez les hommes stériles qui fréquentent la clinique de fertilité à Nnewi. Nous avons étudié cinquante hommes apparemment stériles (sujets) et vingt hommes apparemment fertiles (pilotes) dans la tranche d'âge de vingt-cinq à cinquante-cinq ans. Les niveaux de sérum du zinc et du sélénium ont été déterminés grâce au spectrophotomètre d'absorption atomique tandis que le niveau de sérum de la testostérone a été déterminé grâce aux techniques d'immuno-analyse d'Enzyme. Les résultats ont montré qu'il y avait des différences considérables des niveaux du sérum du zinc, du sélénium et de la testostérone lorsqu'ils sont comparés entre les deux groupes. Les résultats montrent également qu'il y a un rapport fort positif entre les niveaux de sérum du zinc et du sélénium, et un rapport négatif entre les niveaux de sérum de la testostérone et du zinc, et un rapport fort positif entre le sérum testostérone et le sélénium chez les hommes infertiles. Nous déduisons donc qu'il existe un rapport entre les niveaux de sérum du zinc, du sélénium et de la testostérone chez les hommes infertiles et que ces paramètres soient pris en considération lorsqu'on enquête sur les cas d'infertilité chez les hommes.

Introduction

Infertility has been defined as the inability to conceive after 12 months of unprotected sexual intercourse [1]. Infertility can be primary, secondary or idiopathic. Primary infertility exists if no pregnancy has occurred after attempts at conception for 12 months whereas secondary infertility implies that a previous pregnancy has occurred, regardless of the outcome of the pregnancy.

Infertility is a worldwide problem affecting about 8% to 12% of the world's population and it is complex with multiple causes and consequences. The prevalence of infertility is high in sub – Saharan Africa and it has been suggested that the increased incidence of infertility in Africa is due to high prevalence of sexually transmitted diseases [2]. Besides, male infertility declines with increasing age; although the decline is less marked than in the female [3]. In the recent years, male infertility and sub-fertility has increased, which is attributable to many factors [3].

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The causes of infertility in men are numerous; the primary causes of male infertility entail problems with spermatozoa production or delivery that may result from certain type of hormonal dysfunction as well as trauma, anatomical defects in the reproductive system and other illnesses. Unfavorable environmental factors of industry in the cities can cause changes in male reproductive system leading to infertility [4]. It has also reported that the majority of chemical substances released in the atmosphere and in the ground of cities and regions are reprotoxicants with damaging effects on different stages of germinal cells maturation. Besides the environmental factors, some occupational pollutants can have gonadotropic activity and also result in the disturbances of spermatogenesis [4].

The male germ cells produce spermatozoa which are dependent on both normal sertoli cell function and on testosterone secretion by leydig cells. Testosterone is the primary sex hormone of the male reproductive system which is involved in spermatogenesis [5]. Some trace elements such as zinc and selenium have been shown to play a role in reproduction [6]. Zinc in seminal plasma stabilizes the cell membrane and nuclear chromatin of spermatozoa [7,8]. Selenium on the other hand has a positive influence on the leydig cell influencing the secretion of testosterone [8,9]. Deficiency of zinc and selenium have been shown to decrease testosterone levels which are involved in spermatogenesis which will also lead to decreased sperm count [7,9]. The study therefore aims to determine serum levels of zinc and selenium in relation to serum testosterone in male infertility since the levels of zinc and selenium may provide a novel approach to treating trace element deficiency-related male infertility.

Materials and methods

Subjects and blood sampling

A total number of fifty (50) adult males who present with infertility (primary infertility) at the fertility clinic of the Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, were investigated while twenty (20) apparently healthy adult males who have had children (fertile) were used as control. All the subjects were between the ages of twenty five and fifty five years. The participants gave informed consent and the study design was approved by the NAUTH Ethical Committee. Blood samples (5ml) were collected from each of the subjects and delivered into dry, clean specimen containers for the analysis. The blood specimen in the plain containers were allowed to clot, retracted and centrifuged to obtain serum for estimation of serum testosterone, zinc and selenium. Adequate precautions were taken while handling the specimens so as to get reliable results.

Analytical technique

Serum Zinc and Selenium levels were estimated using Atomic Absorption Spectrophotometer (BUCK MODEL 205) after the samples were digested using acid mixture before analysis. The digested samples were analyzed in pairs and the average concentrations of the metals were calculated after extrapolation from the standard curve.

Testosterone on the other hand was determined using Enzyme immunoassay (EIA) technique for the quantitative determination of testosterone concentration in human serum. The Testosterone is based on the principle of competitive binding between Testosterone in the test specimen and Testosterone-HRP conjugate for a constant amount of rabbit anti-testosterone .The test was carried out according to the manufacturer's instruction (Immunodiagnostics testosterone test kit, Germany)

Results

The results obtained from the subjects were expressed as Mean and Standard deviation (SD) Testosterone (ng/ml), Zinc (μg/dl), and Selenium (μg/dl) in Infertile and Control subjects (Table 1). We observed significant decrease in the levels of serum zinc and serum testosterone while there was a significant increase in the serum levels of selenium in the subjects compared with the control subjects. The relationship between the serum levels of zinc, selenium and

Table 1: The Mean ± Standard deviation of serum Testosterone, Zinc, and Selenium in Infertile male and Control subjects

	Serum Testosterone (ng/ml)	Serum Zinc (μg/dl)	Serum Selenium (μg/dl)
Infertile SubjectsN=50	3.48 ± 1.99	46.09 ± 6.97	25.80 ± 4.05
Control SubjectsN=20	5.89 ± 0.80	61.63 ± 3.42	18.40 ± 1.29
t - value	-5.193	-9.483	7.979
p-value	P < 0.05*	P<0.05*	P<0.05*

* = *significant*

testosterone were carried out using Pearson's correlation (Table 2). The results revealed that there is a strong positive correlation between serum levels of zinc and selenium, a negative correlation between serum levels of testosterone and zinc, and a strong positive correlation between serum testosterone and selenium in the infertile males.

Table 2: Relationship between serum testosterone, zinc and selenium in the infertile subjects

Parameters	N	Correlation	p- value
Testosterone and Zinc	50	r = -0.030	0.834
Testosterone and Selenium	50	r = 0.750	0.000
Zinc and Selenium	50	r = 0.563	0.000

N= number
Correlation is significant at á=0.01

Discussion and conclusion

Infertility is a worldwide problem affecting about 8% to 12% of the world's population and it is complex with multiple causes and consequences. Male infertility and sub-fertility has increased, which is attributable to many factors [3]. Testosterone is the primary sex hormone of the male reproductive system which is involved in spermatogenesis. In this study, we found that the serum testosterone was significantly low in the infertile subjects compared with the control. A lot of factors have been shown to be responsible for this such as problems with spermatozoa production or delivery that may result from certain type of hormonal dysfunction as well as trauma, anatomical defects in the reproductive system and other illnesses. Furthermore, some trace elements such as zinc and selenium have been shown to play a role in reproduction [6]. Zinc in seminal plasma stabilizes the cell membrane and nuclear chromatin of spermatozoa. Our results showed significantly low serum zinc levels when compared with the control ($p<0.05$). This is consistent with the findings of a study [5] that reported the effects of zinc administration on plasma testosterone, dihydrotestosterone and sperm count in adult males who were experimentally deprived of zinc. They reported that the leydig cell synthesis of testosterone was reduced which may be attributable to a decrease activity of the zinc-dependent metalloenzyme 5alpha reductase which is responsible for the conversion of testosterone to the biologically active form [5]. Other workers [7,8] also reported that low zinc levels have a negative effect on serum testosterone and seminal volume. Apart from this, our results revealed that there was a negative correlation between testosterone and zinc showing that low zinc levels can adversely affect the testosterone level leading to either a depletion of testosterone or inhibition of spermatogenesis [8]. Our results also revealed a significantly high levels of serum selenium ($p<0.05$) in the infertile subjects compared with the control. Selenium has been shown to have a positive influence on the leydig cell thereby influencing the secretion of testosterone [9]. We observed a strong positive correlation between the levels of selenium and testosterone when these parameters were compared in infertile males indicating that selenium can have a positive correlation with testosterone. Furthermore, we observed a strong positive correlation in the levels of zinc and selenium showing that zinc and selenium have a positive relationship and are important in male infertility [10]. Reduced levels of zinc and selenium have been shown to affect the level of testosterone and consequently bring about reduced fertility. We therefore conclude that there is a relationship between the serum levels of zinc, selenium and testosterone in infertile males and that these parameters be considered when investigating cases of infertility in males.

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