Research Article

Changes in Rheological and Biochemical Properties of Saliva and Semen in Relation to Increasing Body Mass Index (BMI) of Human Subjects

Parasar P[1], Dubey, A.K[1]., Singh H.R[2]., Jha S.K[2]
[1]Department of Zoology, G.N.M. College, Parsathua, Rohtas (Bihar), India.
[2]Department of Bio-Engineering, Birla Institute of Technology, Mesra, Ranchi (Jharkhand), India
***Corresponding author's E-mail:** hrsingh@bitmesra.ac.in

Accepted on: 30-01-2016; **Finalized on:** 29-02-2016.

ABSTRACT

When rheological (viscosity) and biochemical (Carbohydrate content) properties of saliva and semen of 126 human subjects of 21-50 yrs age group, divided into four BMI range groups (18-21; 22-25; 26-29; and ≥ 30) symbolized as a, b, c and d respectively were analyzed, the seminal viscosity showed its highly significant ($p < 0.001$) decreased level in c and d BMI range group in comparison to a BMI – range group of human subjects, while salivary viscosity showed its ($p < 0.01$) increased level in b in comparison to a, but in higher BMI range group i.e. in c and d, it showed its decreased level in comparison to b. The glucose content of saliva showed its ($p < 0.05$) decreased level in b and d in comparison to a and seminal fructose level showed a ($p < 0.001$) decreased level in c and d BMI range groups of human subjects in comparison to the subjects of lower BMI range group. All such findings might be an indication of adverse impact of fatness on fertility which may be depicted by decreased level of glucose and viscosity of saliva, which is an easily available biological fluid from human subjects.

Keywords: Rheological, Biochemical Properties, BMI, Semen, Saliva.

INTRODUCTION

Human semen is the holocrine secretion of accessory reproductive organ and act as a vehicle for sperm nutrition, physiology and metabolism. On the other hand, human saliva is an easily available non-invasive biological fluid and a trans-epithelial composite biological feature indicates that these glands possess androgen receptors and act as an endocrine gland. The rheological and biochemical properties of both these biological fluid (saliva and semen) have been studied for a variety of reasons (e.g. diagnosis of conditions such as prostatitis, infertility, cancer, ovarian function fertility and fecundity of females). Agha-Hosseini recognised this saliva as a unique diagnostic fluid for assessment of the severity of various ailments in human being[1].

On the other side, the global incidence of increasing body mass index upto the level of overweight and obesity is currently exhibiting a dramatic increase worldwide in children adolescents and adults[2]. Obesity (i.e. body mass index ≥ 30 kg/m^2) is well defined pathological state due to excessive accumulation of lipids in white adipose tissue, however, its main cause remain as area of intense debate. The increase in body mass index in human population is a heritable neurobehavioral disorder that is highly sensitive to environment condition[3-5].

A survey by WHO (2000) indicated that over 1.7 billion people around the globe are overweight 310 million are obese[6]. In Indian population 20% of population showed high body mass index[7]. Abdullah and Bakry (2008) reported that increasing body mass index significantly negative effects on reproductive physiology of men and interfere with hypothalemo-pituitary-testicular axis causing alteration in semen parameters and sex hormones in Egyptian population[8].

Therefore, the present proposed investigation has been undertaken to know how far rheological and biochemical properties of saliva and semen is affected by increasing body mass index in human subjects.

MATERIALS AND METHODS

126 healthy human subjects of age group (21 – 55 yrs) were employed in this investigation. All the human subjects were divided in four different body mass index range groups (18 – 21; 22 – 25; 26 – 29 and ≥ 30)

Body Mass Index Measurement:

Body mass index of male human subjects were calculated by taking their body weight in kg. (Kilogram) divided by the squares of their heights in meters.

BMI = Wt. of body in Kg/Square of height in meters

On the basis of different body mass index, all the experimental human subjects were divided into four BMI – range groups having following symbols indicated below:

(18 – 21) = a, (22 – 25) = b, (26 – 29) = c, ≥ 30 = d

Collection of saliva and semen

(a) **Method of saliva collection**: Saliva of all the BMI range group of human subjects were collected in fasting state daily early in the morning (7 AM to 9 AM). The saliva was regarded as mixed and unstimulated. The saliva donors were free from disease and leads normal healthy life without taking any drug or vitamins and antioxidants.

Samples were collected by having the subject split into a sterile plastic cup after the mouth was rinsed thoroughly with distilled water. The weight and height were written on the sterilized vials and processed for its viscosity measurement and glucose estimation by the method of Dubois[9].

(b) **Method of semen collection**:-Semen samples from the human subjects of different BMI – range groups were collected by masturbation in an abstinence minimum of 5 days as per protocol of WHO (2003)[10]. Semen samples were collected in a dry clean & sterilized graduated centrifuge tube and was left for 1 hour to liquefy at room temperature and processed for its viscosity measurement and level of fructose by colorimetric method[11].

RESULTS AND DISCUSSION

Table 1: Salivary and seminal viscosity and Glucose in saliva and fructose in semen of different body mass index range groups of human subjects.

S. No.	Different BMI range	Symbol of BMI range group	Viscosity of semen in cm/sec	Viscosity of saliva in cm/sec	Level of fructose in semen (in mg/dL)	Level of glucose in saliva (in mg/dl)
1	18 – 21(40)	a	68.29 ± 1.15	31.02 ± 1.25	163.059 ± 2.32	7.33 ± 1.44
2	22 – 25(40)	b	63.42 ± 1.52	48.24 ± 3.53	158.115 ± 1.94	6.49 ± 1.16
3	26 – 29(40)	c	57.92 ± 1.20	30.11 ± 1.47	150.081 ± 0.576	4.89 ± 0.72
4	≥ 30(40)	d	55.81 ± 0.75	32.78 ± 1.49	149.070 ± 1.524	4.52 ± 0.39

No. in paranthesis indicate the no. samples, Mean ± SE of 10 samples for each parameter.

P. Value: Viscosity of saliva – a to b – ($p < 0.01$); b to c – ($p < 0.01$); b to d – ($p < 0.02$)

Viscosity of semen – a to c & d – ($p < 0.001$); Glucose in saliva – a to b & d – ($p < 0.05$); Fructose in semen – a to c & d – ($p < 0.001$)

As indicated in Table–1, rheological and biochemical properties of saliva and semen showed a significant trend of increase and decrease in subjects of higher BMI range groups in comparison to lower BMI – range group of human subjects.

Positive energy balance related to excessive energy intake or decreased energy expenditure results in excessive fat accumulation in adipose tissue leading to increase in the body mass index in human subjects. The adipose tissues play a positive role in energy homeostasis as well as in the regulation of different physiological aspects of reproduction[12]. Few reseachers having opinion that these adipocytes regulates some aspects of cell metabolism by synthesizing and secreting numerous hormones and cytokines collectively known as adipokines and adipose tissue act as an endocrine organ[13-15].

The rheological properties of a fluid assessed in terms of viscosity reflects the resistance experienced by one layer of fluid in moving over another layer. Various factors are responsible for affecting this fluid property. Among all the factors, temperature and chemical composition are predominant. The viscosity of fluid generally depends upon the size, shape and chemical nature of their molecules. It is greater with larger than with smaller molecule, with elongated with spherical molecules. Larger amounts of dissolved solids generally increase the viscosity of the fluid. The earlier reports of Laine (1991) indicated that the composition of saliva may also be modified by hormones[16]. Glass reported that massively obese men showed low serum testosterone and low sex hormone – binding globulin level[17]. Thus, in our findings, a highly significant increased viscosity in b – BMI range group to a, and later on highly significant decreased viscosity of saliva in c & d in comparison to b might be due to the change in biochemical make up of saliva which is transcellular fluid of salivary gland. A significant decreasing level of salivary glucose level in higher BMI range group in comparison to lower BMI range group of subjects might be due to decreased level of insulin receptors in subjects of higher BMI range.

As earlier reports indicated that obesity in animals is associated with decrease in the number of insulin receptors on salivary gland cells. This hyper – insulinemic condition might be responsible for decreased level of salivary glucose in subjects of higher BMI range group[18].

Decreased seminal viscosity in higher BMI – range group of human subjects i.e. in c and d - BMI range group of subjects to 'a' might be due to disturbed endogenous sex hormone profile. The report of Kay and Barratt (2009) indicated that excess body fat, genetic and endocrinological factors contribute to semen quality and quantity[19]. A highly significant decreased level of seminal fructose in higher BMI range group of subjects in our findings might be an indication of seminal vesicle dysfunction. This condition may affect the seminal quality and ultimately caused sterility. Earlier reports of Jansen also observed higher prevalence of oligospermia in overweight and obese men[20].

Acknowledgement: Authors are thankful to Dr. K.N. Tiwary, Head, P.G. Dept. of Zoology, H.D. Jain College, Ara(Bihar), India for providing laboratory facilities and Apolo Lab., Ara for help in collection of the sample.

REFERENCES

1. Agha – Hosseins F, Dizgah M, Mmirkhans S. The composition of unstimulated whole saliva of healthy sental students. J Contem Dent Pract, 7(2), 2006, 104-111.
2. Sébert SP, Hyatt MA, Chan LL, Yiallourides M, Fainberg HP, Patel N, Sharkey D, Stephenson T, Rhind SM, Bell RC, Budge H, Gardner DS, Symonds ME. Influence of prenatal nutrition and obesity on tissue specific fat mass and obesity associated FTO-gene expression. Reproduction, 139(1), 2010, 265-274.
3. Blackmore AI, Frongel P. Is obesity our genetic legacy? J Clin Endocrinal Metab, 93(11), 2008, S51-S56.
4. Dina C. New insights into the genetics of body height. Current opinion in Clinical and Nutrition and Metabolic Care, 11, 2008, 378-384.
5. O'Rahilly S, Farroqui IS. Human obesity: A heritable neurobehavioural disorder that is highly sensitive to environmental conditions. Diabetes, 57(11), 2008, 2905-2910.
6. WHO. Obesity: Preventing and managing the global epidemic: Report of WHO consultation. WHO Tech. Report.Sev. 894, 2000, 1-253.
7. Srivastava N, Lakhan R, Mittal B. Pathophysiology and genetics of obesity. Indian J Expt Biol, 45(11), 2007, 929-936.
8. Abdullah A, Bakry S. Obesity and infertility in Egyptian men. Res J Med Medical Sci, 3(2), 2008, 135-139.
9. Dubois, Gilles M.KA, Hamilton JK., Rebers PA, Smith F. Calorimetric method for determination of sugars and related substances. Anal Chem, 28, 1956, 350-356.
10. WHO (2003): WHO laboratory manual for the examination of human serum and sperm cervical mucus interaction. 5th Eds 2003; New York, NY: Cambridge University Press.
11. Karvonen MJ, Malam M. Colorimetric determination of fructose with indol. Scand J Clin Lab Invest 7(4), 1955, 305-307.
12. Friesch RE. Fatness and fertility. Sci Am, 258(3), 1988, 88-95.
13. Wajchenberg BL. Subcutaneous and visceral adipose tissue: this relation to the metabolic syndrome. Endocr Rev. 21(6), 2000, 697-738.
14. Ahima RS, Flier JS. Adipose tissue as an endocrine organ. Trends Endocrinol Metab, 11(8), 2000, 327-332.
15. Ahima RS. Adipose tissue as an endocrine organ. Obesity (Saliva-spring), 14(5), 2006, 2425-2495.
16. Laine M. Female sex steroid hormones, salivary gland and saliva, Published by University of Turku, Turku, 1991, 7-34.
17. Glass AR, Swerdloft RS, Bray GA, Dahrms, WT, Atkinsion RL. Low serum testosterone and sex hormone-binding globulin in massively obese men. J Clin Endocrinol Metab, 45(6), 1977, 1211-1219.
18. Freychet P, Laudat MH, Laudat P, Roseelin G, Kahn Gorden P, Roth J. Impairment of insulin binding to the fat cell plasma membrane in the obese hyperglycemic mouse. FEBS (Fed. Eur. Biochem. Ser.) Lett, 25(2), 1972, 339-342.
19. Kay VJ, Barratt CL. Male obesity: Impact on fertility. British J Diabetes Vascular Disease, 9(5), 2009, 237-241.
20. Jansen TK., Anderson AM., Jorgensen N, Anderson AG, Carlsen E, Petersen JH. Body mass index in relation to semen quality and reproductive hormones among 1,558 Danish men. Fertil Steril, 82(4), 2004, 863-870.

Source of Support: Nil, **Conflict of Interest:** None.