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A MATHEMATICAL MODEL FOR HORMONE CHANGES LEADS TO OBESITY

ABIRAMASUNDARI, S. AND KOMAHAN, G.

Department of Mathematics, A.V.V.M. Sri Pushpam College (Autonomus), Poondi-613503 Thanjavur-India

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Obesity is a serious problem in our country, particularly among the 25-45 age group people. Normally this age group people is affected by Obesity and then changes in the hormone ratios. The obesity hormones are common for both men and women. In this paper we proposed Monge's method on PDE and Mathematical Statistics. We can see that mostly occurs by the changes of the hormone.

KEYWORDS : Follicle stimulating hormone, Luteinizing hormone, Thyroid hormone, Testosterone, Progesterone, Estrogen.

INTRODUCTION

A Mathematical models describe our beliefs about how world functions, and then we translate those beliefs into the language of mathematics. The process of developing a mathematical model is termed mathematical modeling. Mathematical models are used in the natural science, bio science etc. [1].

Obesity has become more and more widespread increasingly recognized as one of the biggest global health problems, it is growing at an important rate in developed and developing countries [2].

Obesity causes the chronic inflammation weight increases. Excess fat cells release bio chemicals that leads to inflammation and then changes in BMI level [3]. Obesity people suffering from related fetal diseases such as diabetes, cardiovascular disease, hypertension and certain cancers, high blood pressure, high cholesterol, blindness, heart attacks and non fetal related diseases such as respiratory difficulties, arthritis, infertility and psychological disorders.

Hormones are chemical messengers that regulate processes in our body. They are one factor in causing obesity. The hormones leptin and insulin, sex hormones and growth hormone influence our appetite, metabolism (the rate at which our body burns kilojoules for energy) and body fat distribution. People who are observe have levels of these hormones that encourage abnormal metabolism and the accumulation of body fat.

The hormone changes produced in obesity. The natural substance that produced in the body and that influences of the way to the body grows or develops. The hormone is must essential body and mental growth. Obesity is created by six hormones for both men and women. The hormones are follicle stimulating hormone, Luteinizing hormone, Thyroid hormone, Testosterone, Progesterone, Estrogen.

Normal level of six hormones are:

Hormones	Female	Male
1. Folliclestimulating hormone	3-20 MIU/ml	1-18 MIU/ml
2. Luteinizing hormone	< 7 MIU/ml	2-18 MIU/ml
3. Thyroid hormone	T3-80-180 ug/dl T4-4.6-12 ug/dl	T3-80-180ug/dl T4-4.6-12ug/dl
4. Progesterone	0.2-1.4 ng/dl(or) 0.64-4.45nmol/l	0.1-1ng/dl(or) 0.32-3.18nmol/l
5. Testosterone	6-86 ng/dl(or) 0.1-1.2 ng/ml	270-1100ng/dl(or) 2.4-12ng/ml
6. Estrogen	30-120 pg/ml	15-60 pg/ml

The hormones are increased in normal level will go to them an obesity. Now we discuss about the obesity problem from male and female hormone. It is detailed in monge's method and Data analysis.

MONGE'S METHOD

In this paper we propose six hormones for female and male on monge's method.

PARAMETERS

$(1 + np)$-Female hormone change

$(m + nq)$-Male hormone changes

The monge's equation are

$$V = Rr + Ss + Tt$$

Now we consider, the female and male hormone changes in normal level

$$-(m + nq)^2 r + 2(m + nq)(1 + np)s - (1 + np)^2 t = 0 \quad \ldots (a)$$

The Monge's subsidiary equations are

$$Rdpdy + Tdqdx - Vdxdy = 0$$

$$Rdy^2 - Sdxdy + Tdx^2 = 0$$

$$R = -(m + nq)^2,\ S = 2(m + nq)(1 + np),\ T = -(1 + np)^2,\ V = 0$$

The values are sub in subsidiary equation

$$-(m + nq)^2 dpdy - (1 + np)^2 dqdx = 0 \quad \ldots(1)$$

$$-(m + nq)^2 dy^2 - 2(m + nq)(1 + np)dxdy - (1 + np)^2 dx^2 = 0 \quad \ldots(2)$$

$$-[(m + nq)dy + (1 + np)dx]^2 = 0$$

$$-[(m + nq)dy + (1 + np)dx] = 0$$

$$-(m + nq)dy = (1 + np)dx \quad \ldots (3)$$

From equation (1)

$$-(m + nq)(m + nq)dpdy - (1 + np)(1 + np)dqdx = 0$$

$$(m + nq)dp - (1 + np)dq = 0$$

$$\frac{dp}{(l + np)} - \frac{dq}{(m + nq)} = 0$$

$$\frac{l+np}{m+nq} = c_1$$

From equation (3) integrating we get,

$$lx + my + nz = c_2$$

$$\frac{l+np}{m+nq} = F(lx+my+nz)$$

$$\frac{l+np}{m+nq} = \mathrm{F}(c_2)$$

$$(l+np) = (m+nq)\,F\,(C_2)$$

$$np - nqF\,(c_2) = m\,F\,(c_2) - l$$

$$np - F\,(c_2)\,nq = -\,mF\,(c_2) - 1$$

$$\frac{ndx}{1} = -\frac{ndy}{F(c2)} = \frac{(m-l)dz}{F(c2)-1} \qquad \ldots (4)$$

$$ldx + mdy + ndz = 0$$

$$lx + my + nz = c_3 \qquad \ldots(A)$$

The first and third integral part of eqn. (4)is

$$(F\,(c_2) - 1)\,dx = dz$$

$$dx + dz = F\,(c_2)\,dx$$

$$y = F\,(c_2)\,x$$

$$y = xF\,(lx + my + nz) \qquad \ldots(B)$$

From (A) and (B) we get

$$y = M\,(lx + my + nz) + xF\,(lx + my + nz)$$

from (A) and (B) finally we obtained male and female obesity hormones.

Data Analysis

Hormone changes to create a obesity and then Data analysis female and male patient at thanjavur level in particular hospital. The patients suffer from obese. We apply chi-square test on mathematical statistics for following data's.

$$\chi^2 = \sum_{i=1}^{n} ((O.E) - 0.5)^2 / E$$

MONTH	χ^2 = ***M/E*** **[male]**	χ^2 = ***F/E*** **[female]**
JANUARY	120.6016	75.1993
FEBRUARY	65.1701	146.9758
MARCH	155.4558	119.7093
APRIL	52.4801	45.6035
MAY	98.6282	111.3025
JUNE	144.0720	146.5469

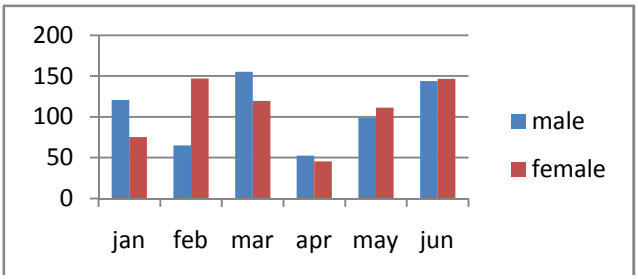

Fig. 1. Represent a obesity patients for male and female

Conclusion

If we conclude that the hormone changes created by a obesity, and then normal level six hormones. The equation xF $(lx + my + nz)$ represent hormones of testosterone, estrogen, progesterone and M $(lx + my + nz)$ are follicle stimulating, luteinizing, thyroid hormones. This hormones are both common for male and female. Previously explained six hormones and it's ratio we are easily find out their hormone level. If you control your obesity hormone in medical treatment, you will succeed your obesity.

References

1. Michael, Alder, *An introduction to mathematical modeling*, Ch-1, Book page no : 1-5.
2. Lucas, Jodar[a*], Francisco, J. Santonja[a], Gilbert, Gonzalez Parra[b], *A Modeling dynamics of infant obesity in the region of Valencia*, Spain, No. **56**, Page No : 679-689, ISSN 0898-1221 19 March (2008).
3. Kaplan, L.M., Body Weight Regulation and Obesity, *Journal of Gastrointestinal Surgery*, **7(4)**, pp 443-51 doi:10.1016/s1091-255x(03)00047-7 (2003).
4. Office of the surgeon general-U.S Department of health and human services. Overweight and obesity; health consequences, from http;//www.surgeongenerdl.gov/libray/calls/obesity/index.html Accessed October (2013).
5. Flegal, K.M., Carroll, M.D., Ogden, C.L., Curtin, L.R., Prevalence and trends in obesity among United States adults, *JAMA*, 303-235- 41.20106 (1999-2008).
6. Cynthia, L. Ogden, *Ph.D*, Molly, M. Lamb, *Ph.D*, Margaret, D., Carroll, M.S., *Ph.D.* and Katherine, M. Flegal, *Ph.D*., Obesity and Socio economics states in adults, 2005-2008, NCHS Data Brief No. : **50**, Page No, 1-8 Dec. (2010).
7. Raisinghania, M.D., M.Sc, Ph.D, Aggarwal, R.S., M.Sc., Ordinary and Partial differential equations, Second edition, Part–II, Chapter-5, Book page no. : 602-615.
8. Kesmodel, U.S., M.D., Ph.D., Overen, P.G., Jensen, D.M. (eds), Kesnodal, Ulrik Schioler, *Maternal obesity and pregnancy*, DOI 10-1007, 1978-3-642-25023-1-25023-1-2, Spiringer-Verlag Heidalberg (2012).
9. Leona, A. Harris, Differential equation models for the hormonal regulation of the menstrual cycle, *Ph.D Thesis*, North Carolina state university, Raleigh, North Carolina. www.lib.ncsu/resolver/1840.1614693 (2001).
10. Daston, P., Gooch, J.W., Breslin, W.J., Shuey, D.L., Nikiforov, A.I., Fico, T.A. and Gorsuch, J.W., Environmental Estrogens and Reproductive Health: A Discussion of the Human and Environmental Data, *Reproductive Toxicology*, 11, 465-481 (1997).
11. Reineeke, L. and Daflhard, P., A Complex mathematical model of human menstrual cycle, *J. Theor. Bio*, **1**, 247, 303-330 (2007).
12. Shah, K. Kabiruzzaman, Laz, N. Begum, Siddique, A. B., Ahmed, F. U., Precocious Puberty - *A Case Report*, Vol. **21**, Page No. : 1-4, ISSN 1019-85555 June (2008).
13. Engelborghs, K., Luzyanina, T., Roose, T.D., Numerical bifurcation analysis of delay differential equations, *Journal of Computational and Applied Mathematics,* **125**, Page No. 265-275 (2000).
14. *Obesity and Hormones*, State of Victoria, www.better health.vic.gov.au (1999/2015).

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