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Estimation of the Parameters of Bivariate Minification Process for Ghrelin suppressed secretion of LH and FSH in Women

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Abstract:- In this paper we present a bivariate minification process with Marshall and Olkin exponential distribution . The process is given by $X_n = K \min(X_{n-1}, Y_{n-1}, \eta_{n1})$, $Y_n = K \min(X_{n-1}, Y_{n-1}, \eta_{n2})$ where $\lambda_1 >0$, $\lambda_2 >0$, $\lambda_{12} >0$, $K > \lambda/\lambda_{12}$, $\lambda = \lambda_1+\lambda_2+\lambda_{12}$ and $\{ (\eta_{n1}, \eta_{n2}), n \geq 1\}$for $m < n$. Formula for the estimation of the parameters of the process is obtained in the first section. The application part is given in the second section. Ghrelin could play a physiological role in suppressing the HPG axis in women. Therefore, secretion patterns of LH and FSH were determined in young women after injection of ghrelin and placebo respectively. The Mathematical curves for Standard Deviations are obtained in the third section for the corresponding Medical curves.

Keywords:- Minification Process, Ghrelin, LH and FSH.
Mathematical Subject Classification: $60G_{XX}$, $62H_{XX}$, $62P_{XX}$

I. INTRODUCTION

A Minification process of the first order is given by $X_n = K \min (X_{n-1}, \varepsilon_n)$, $n \geq 1$, where $K > 1$ and $\{\varepsilon_n , n \geq 1 \}$is an innovation process of independent and identically distributed (i.i.d) random variables. Several authors have introduced minification process with given marginals. Tavares [16] introduced the minification process with exponential marginal distribution. Sim [15] introduced the minification process with weibull marginal distribution. Arnold and Robertson [1] introduced a Pareto minification process. Arnold and Robertson [1] introduced a logistic minification process. Lewis and McKenzie [8] introduced the minification process with marginal distribution function $F_{x_0}(x)$. In this paper we consider a stationary bivariate minification process with the bivariate Marshall and Olkin [9] exponential distributions BVE $(\lambda_1,\lambda_2,\lambda_{12})$.The process is given by $X_n = K \min(X_{n-1}, Y_{n-1}, \eta_{n1})$,
$Y_n = K \min(X_{n-1}, Y_{n-1}, \eta_{n2})$.

Where $\lambda_1 >0$, $\lambda_2 >0$, $\lambda_{12} >0$, $K > \lambda/\lambda_{12}$, $\lambda = \lambda_1+\lambda_2+\lambda_{12}$, $\{ (\eta_{n1}, \eta_{n2}), n \geq 1 \}$is a sequence of i.i.d. random vectors and random vectors (X_m , Y_m) and (η_{n1}, η_{n2}) are independent for $m < n$. Consider the estimation of the parameters λ_1, λ_2, and λ_{12}. We will use the estimates

$\bar{X}_N = \frac{1}{N}\sum_{i=0}^{N-1} X_i$, $\bar{Y}_N = \frac{1}{N}\sum_{i=0}^{N-1} Y_i$, $\bar{I}_{N-1} = \frac{1}{N-1}\sum_{i=0}^{N-1} I(X_i > \min(X_{i-1}, Y_{i-1}))$ where $I(X_i > \min(X_{i-1}, Y_{i-1})) = 1$, $X_i > \min(X_{i-1}, Y_{i-1})$, and the standard deviation is 0, $X_i \leq \min(X_{i-1}, Y_{i-1}))$.

$$\sigma_{xy} = \frac{\lambda_{12}}{\lambda(\lambda_1+\lambda_{12})(\lambda_2+\lambda_{12})} + \frac{1}{K-1}\left[\frac{1}{(\lambda_1+\lambda_{12})^2} + \frac{1}{(\lambda_2+\lambda_{12})^2}\right].$$

1. Mathematical Model

2. Application

2.1 Introduction

The orexigenic hormone ghrelin has been frequently shown to reduce the activity of the hypothalamic pituitary-gonadal (HPG) axis in animals and humans. Plasma levels of ghrelin, the only peripheral hunger hormone, are inversely correlated with body mass index and increased during enhanced appetite. Consequently, they are strongly elevated in states of under nutrition [3]. Thus, ghrelin could play a physiological role in suppressing the HPG axis in women. Considering this potential physiological role of ghrelin during under nutrition and that a suppressing effect of ghrelin on the HPG axis has already been shown male and female animals and in men, we postulated that ghrelin also suppresses the activity of the HPG axis in women, which

has not been demonstrated until now. Therefore, secretion patterns of LH and FSH were determined in young women after injection of ghrelin and placebo respectively.

II. DISCUSSION

Ghrelin suppressed the secretion of LH and FSH in young women. These so far unreported results are in accordance with findings in male and female animals and human males as described in the introductory section of [10, 7]. Ghrelin decreased the frequency of LH pulses in all women and of FSH pulses in the one woman who exhibited the clear FSH pulses resulting in a diminished secretion. These findings contrast with those from another study in women reporting no effect of ghrelin on LH and FSH plasma levels [11]. In that study the ghrelin total dose administered was lower, and the observation period was rather short (2h). The effect on FSH secretion was markedly weaker that on LH secretion in this study. This finding could be expected in the same way as it could be expected that ghrelin suppress the FSH secretion at all; whereas release of both LH and FSH is regulated by GnRH , FSH secretion is much less dependent on GnRH release than LH [12].

Although we used pharmacological ghrelin doses in this study, various findings also suggest a physiological relevance of the suppressive effect of ghrelin on the HPG axis in women. Three studies showed significantly increased ghrelin levels in adolescent and adult females with amenorrhea or menstrual disturbances compared with sedentary controls and exercising controls/athletes respectively [3,5,13]. The described studies suggest that ghrelin has an impact on the regulation of the HPG axis in women in vivo.

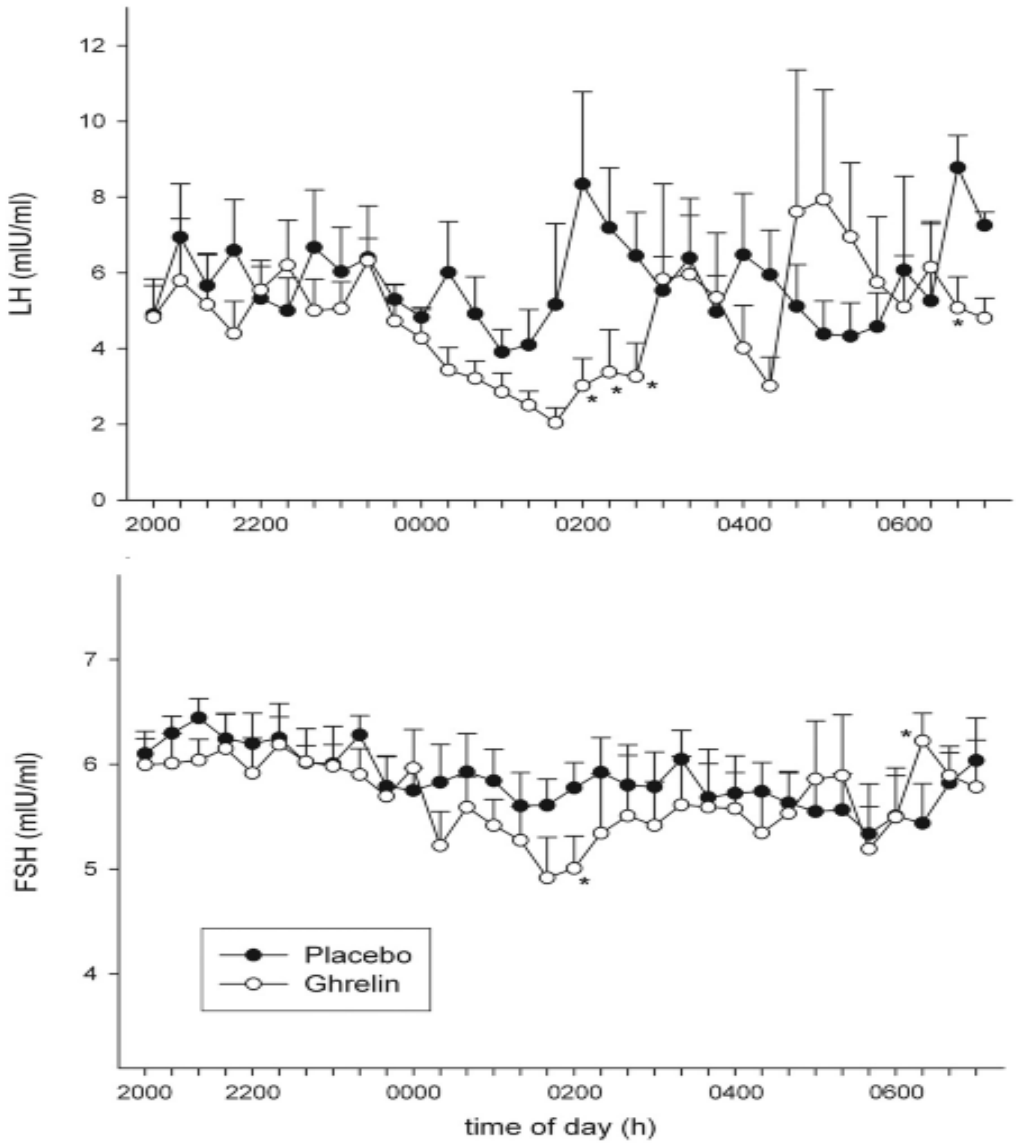


Fig.1 Secretion profiles of LH and FSH (mean, SEM) in six healthy women receiving ghrelin or placebo.

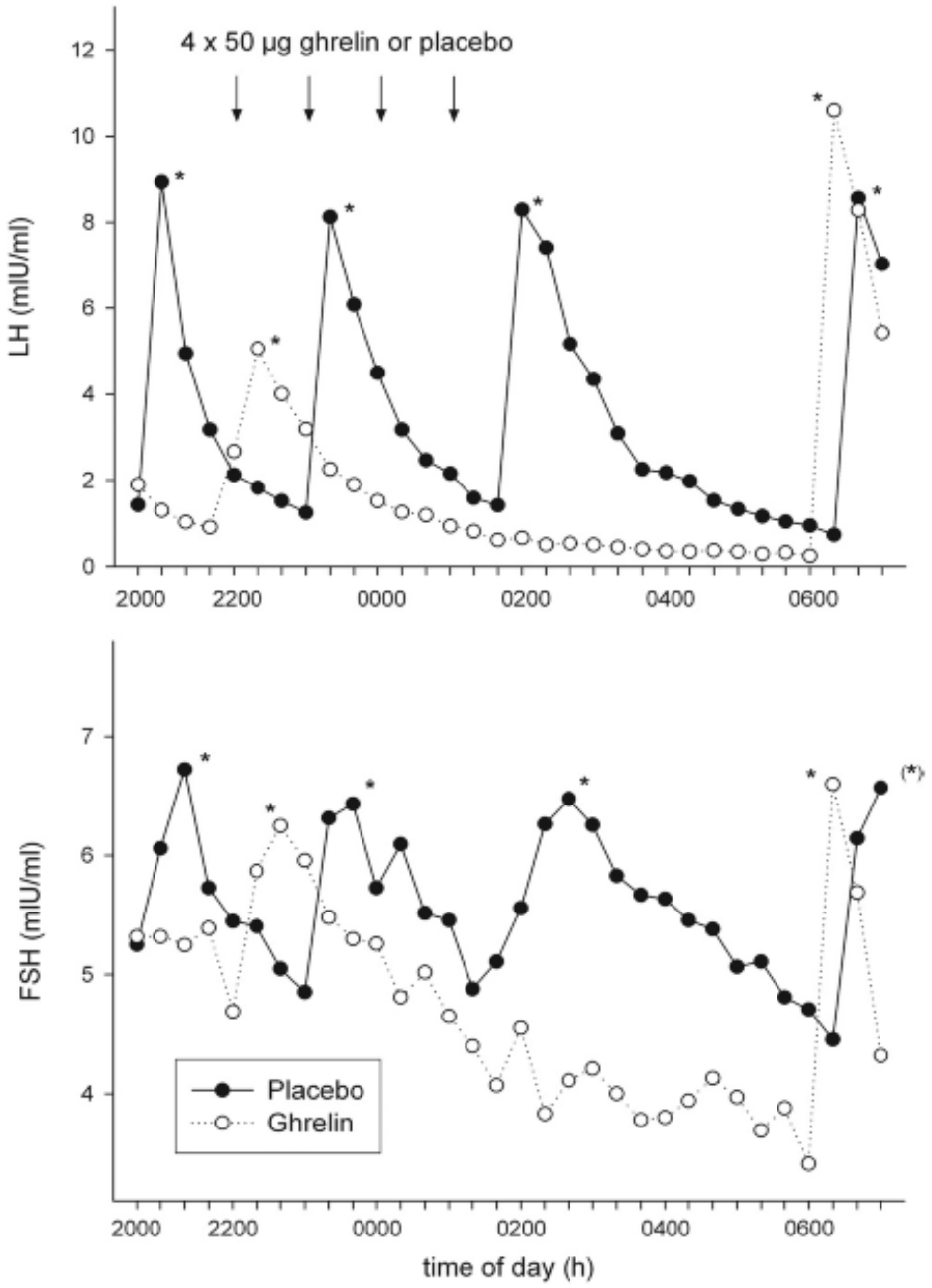


Fig 2: Exemplary nocturnal secretion profiles of LH and FSH of a healthy woman receiving ghrelin or placebo. * pulse.

The area under the curve (AUC) of the secretion of LH and FSH was determined for the intervention period as previously described [7].The intervention period was defined as the time after the first injection of ghrelin/placebo until last injection plus one plasma half life of LH (approximately 60 min) [14] or FSH(distribution half life approximately 120min) [2]; that is the intervention period of LH lasted from 2220 to 0200h, and the intervention period of FSH lasted from 2220 to 0300h. Differences in mean LH and FSH plasma levels subsequent to placebo/ghrelin injection at single points in time were tested for significance by test with contrast in a multivariate ANOVA(level of significance,α=0.05).LH pulses were identified as previously described [7]. The number of peaks after ghrelin/placebo administration, inter peak intervals and peak values were determined. These pulse characteristics were compared between both conditions using paired t test. Metric demographic variables and pulse characteristics are expressed as mean ± SD; hormone variables in fig.1 are depicted as mean ± SEM.

LH secretion after ghrelin injection as assessed by the AUC 4.01±1.37mIu/min.ml) was significantly (P = 0.031) lower than after placebo injection(5.46±1.33mIu/min.ml) during the intervention period. The AUC during preintervention and post intervention periods did not differ significantly (P > 0.480).Mean LH plasma levels after ghrelin injection were significantly lower than after placebo injection between 0200 and 0240h and at 0640h(fig1).FSH pulses in this woman basically paralleled LH pulses just being protracted for 20min. Less pulses occurred after ghrelin injection than after placebo injection (fig 2).

III. MATHEMATICAL RESULTS

Fig .1

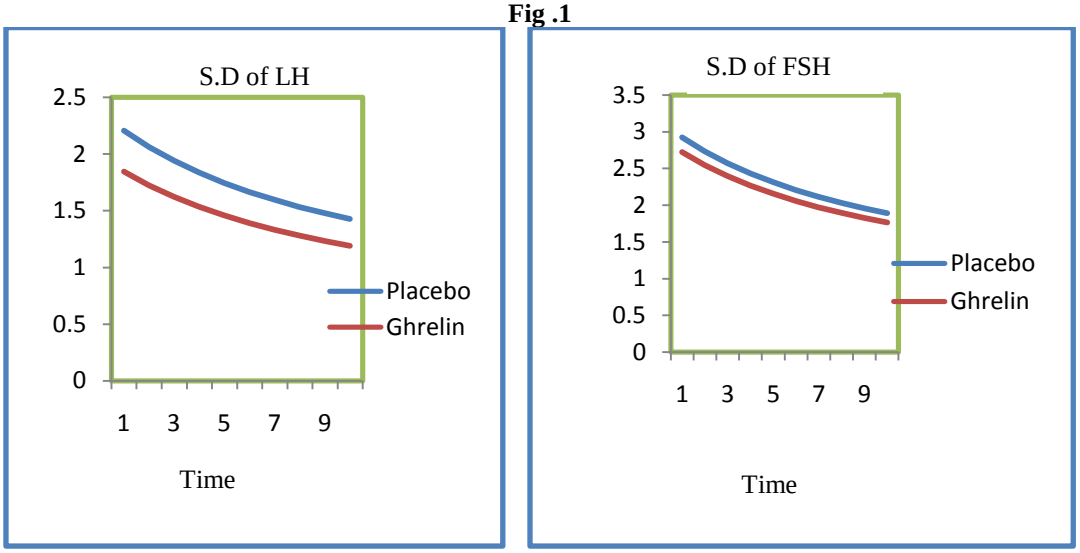
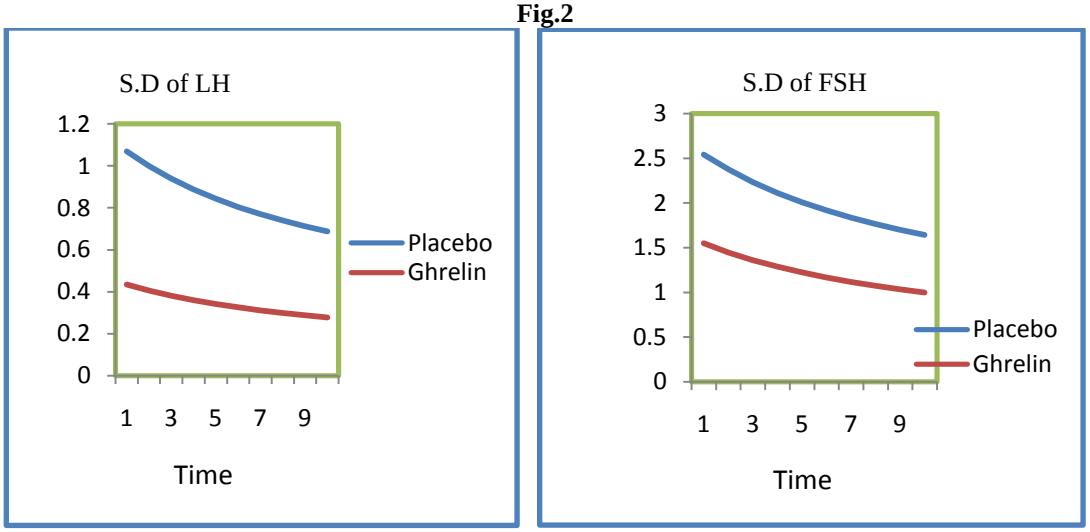


Fig.2



IV. CONCLUSION

A Minification process of the first order is given by $X_n = K \min(X_n - 1, \varepsilon_n)$, $n \geq 1$, where $K > 1$ and $\{\varepsilon_n, n \geq 1\}$ is an innovation process of independent and identically distributed (i.i.d) random variables. In this paper we consider a stationary bivariate minification process of Ristic with the bivariate Marshall and Olkin exponential distributions BVE $(\lambda_1, \lambda_2, \lambda_{12})$. In the application part, the orexigenic hormone ghrelin has been frequently shown to reduce the activity of the hypothalamic pituitary-gonadal (HPG) axis in animals and humans. Ghrelin could play a physiological role in suppressing the HPG axis in women. Therefore, secretion patterns of LH and FSH were determined in young women after injection of ghrelin and placebo respectively. In Section 3, Standard deviations for LH and FSH have been found. Even though the medical curves are zig-zag in nature the mathematical curves Fig. 3.1 and 3.2 show that the standard deviations are decreasing monotonically when the time increase.

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