



Exploring Speech Signal Analysis Techniques for Detection of Progesterone and Estrogen Hormone Levels in Adolescent Females: A Review

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Abstract

Hormone level fluctuations significantly influence physical and psychological development during adolescence, with marked effects on physiological signals, including voice. This review explores innovative methods for detecting progesterone and estrogen hormonal levels in adolescent females using speech signal analysis. It discusses the underlying principles, current methodologies, potential applications in clinical settings, and the challenges faced in this emerging field. Analysis of vocal features such as pitch, jitter, shimmer, and formant frequencies has been carried out—that correlate with estrogen and progesterone levels over menstrual cycles. These acoustic features can be used to predict hormone levels, drawing from data collected across diverse linguistic and regional backgrounds. Preliminary findings indicate a strong correlation between hormonal shifts and specific vocal characteristics, suggesting speech analysis as a viable, culturally sensitive tool for hormone level monitoring in adolescent girls. This research has potential applications in personalized healthcare, offering a cost-effective, non-invasive means of tracking hormonal health for health monitoring in adolescent females, allowing for better-informed interventions during critical developmental stages. This review explores innovative methods for detecting hormonal levels—specifically, progesterone, and estrogen, using speech signal analysis.

Keywords: Formant Frequency, Estrogen and Progesterone.

I. Introduction

Over the course of a person's regular life cycle, a variety of endocrine changes might have an impact on their voice, making it extremely susceptible to these changes [1,2]. The finding of progesterone and estrogen receptors in the human vocal fold (VF) may support the theory that hormonal factors account for variances in vocal quality [3,4,5]. Females have major hormonal changes during adolescence, which are essential to their physical, emotional, and psychological growth. The endocrine system—mainly the pituitary, ovaries, adrenal glands, and hypothalamus—produces a variety of hormones that coordinate these changes. To understand the physiological and psychological changes that adolescent females go through, it is crucial to understand these hormone variations [6-7]. The maturation of the hypothalamic-pituitary-ovarian axis, which controls hormone secretion, affects hormonal changes during adolescence. Progesterone levels and the length of the menstrual cycle can fluctuate as a result of these hormonal changes. Progesterone levels and menstrual regularity during this developmental stage can also be influenced by other factors, including genetics, dietary condition, stress, exercise, and general health [8].