

# Unveiling Physiological Markers in Forensic Gynecology: Exploring Biomarkers as Indicators in Sexual Assault Investigations

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## Abstract

**Objective:** To investigate the potential of physiological biomarkers as indicators in sexual assault investigations within the field of forensic gynecology. Specifically, the study sought to identify biomarkers that could provide valuable insights into the occurrence of sexual assault and aid in the determination of relevant legal outcomes.

**Material & Methods:** The study was conducted at Liaquat University of Medical & Health Sciences, Jamshoro from January 2023 to December 2023. Study population was 120 individuals who were survivors of sexual assault. Participants underwent comprehensive forensic examinations, including the collection and analysis of physiological samples to identify potential biomarkers associated with sexual assault.

**Results:** Through rigorous analysis, several physiological markers were identified as potential indicators of sexual assault. These markers encompassed various biological systems, including hormonal, immunological, and genetic factors. The study revealed significant correlations between certain biomarkers and the occurrence of sexual assault, providing valuable insights for forensic investigations.

**Conclusion:** The findings of this study underscore the potential utility of physiological biomarkers in forensic gynecology for elucidating cases of sexual assault. By incorporating these markers into standard forensic protocols, investigators can enhance the accuracy and reliability of sexual assault investigations, ultimately facilitating the pursuit of justice for survivors.

**Keywords:** Forensic gynecology, Sexual assault, Physiological markers, Biomarkers, Investigation, PIMS Islamabad..

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## Introduction

Forensic gynecology, a branch of forensic medicine, plays a pivotal role in unraveling the mysteries shrouded within sexual assault investigations. In the relentless pursuit of justice, forensic experts have long sought methods to enhance the precision and reliability of evidence collection and analysis.<sup>1</sup> Among the myriad tools and techniques at their disposal, the exploration of physiological markers stands out as a promising avenue, offering insights into the intricacies of sexual assault cases that may otherwise remain concealed.<sup>2</sup>

The quest to uncover physiological markers indicative of sexual assault has been driven by the imperative to provide survivors with a voice, to validate their experiences, and to hold perpetrators accountable.<sup>3</sup>

Historically, forensic gynecology has relied heavily on traditional methods of evidence collection and examination, such as DNA analysis and physical assessments. While these methods have undoubtedly been instrumental in many investigations, they are not without limitations.<sup>4</sup> DNA evidence, for instance, may be compromised or inconclusive in certain circumstances, and physical assessments alone may fail to capture the full spectrum of trauma experienced by survivors.<sup>5</sup>

Enter biomarkers – a diverse array of molecules and substances within the body that can serve as indicators of biological processes or pathological conditions. In recent years, the exploration of biomarkers in the

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context of sexual assault investigations has gained considerable traction, offering a promising complement to traditional forensic techniques.<sup>6</sup> By delving into the physiological responses triggered by sexual violence, researchers have begun to identify potential biomarkers that may hold valuable clues for forensic gynecologists and investigators.

The journey to unraveling physiological markers in forensic gynecology has been marked by a multifaceted approach, encompassing a broad spectrum of disciplines and methodologies.<sup>7</sup> Researchers have drawn upon insights from fields such as endocrinology, immunology, and neurobiology, leveraging advances in technology and analytical techniques to explore the intricacies of the body's response to trauma.<sup>8</sup> Through meticulous experimentation and clinical observation, they have sought to identify patterns and correlations that may distinguish cases of sexual assault from other forms of trauma or consensual sexual activity.<sup>9</sup>

In the pages that follow, we embark on a journey into the fascinating realm of forensic gynecology, where the convergence of science and justice illuminates the path toward truth and accountability.<sup>10</sup> Through the lens of physiological markers, we explore the intricate tapestry of the human body's response to sexual violence, unveiling a wealth of potential insights that may revolutionize the landscape of forensic investigation.<sup>11</sup> As we research deeper into this captivating field, we bear witness to the profound impact of interdisciplinary collaboration and scientific innovation in the pursuit of justice for survivors of sexual assault.

## Methodology

A was a cross-sectional study conducted at Liaquat University of Medical & Health Sciences, Jamshoro. from January 2023 to December 2023, involving a study population of 120 individuals. The study aimed to investigate physiological markers in forensic gynecology, particularly focusing on biomarkers as potential indicators in sexual assault investigations.

Convenient sampling technique was utilized to recruit participants from the pool of individuals reporting sexual assault incidents. Collected samples were transported to the designated laboratory for analysis. Specialized techniques, such as polymerase chain reaction (PCR) for DNA analysis, were utilized to detect genetic material relevant to sexual assault cases.

Participants included individuals aged 18 years or older who reported experiencing sexual assault within the past 72 hours and sought medical evaluation. Both male and female victims were included in the study to capture gender-specific differences in biomarker responses.

Individuals with a history of chronic medical conditions or recent traumatic injuries unrelated to sexual assault were excluded from the study to minimize confounding variables. Additionally, participants unwilling to provide informed consent were not eligible for inclusion.

## Results

Table I presents the distribution of physiological biomarkers observed in the victims. Salivary cortisol emerged as the most prevalent biomarker, detected in 45.0% of cases, followed by vaginal pH at 26.7%, cervical mucus at 18.3%, and serum progesterone at 10.0%. These findings indicate the potential of these biomarkers to serve as indicators of sexual assault.

**Table I: Distribution of Physiological Biomarkers in Sexual Assault Victims**

Biomarker	(n)	(%)
Salivary Cortisol	54	45.0
Vaginal pH	32	26.7
Cervical Mucus	22	18.3
Serum Progesterone	12	10.0

Further analysis in Table II explored the correlation between these biomarkers and the time elapsed since the assault. Salivary cortisol exhibited a strong negative correlation ( $r = -0.68$ ,  $p < 0.001$ ) with time, suggesting that its levels decrease significantly as time progresses post-assault. This decline in salivary cortisol levels over time aligns with existing literature on stress hormone dynamics in response to traumatic events.

**Table II: Correlation between Biomarkers and Time Since Assault**

Biomarker	Pearson's Correlation (r)	p-value
Salivary Cortisol	-0.68	<0.001
Vaginal pH	0.45	0.002
Cervical Mucus	-0.32	0.031
Serum Progesterone	0.12	0.421

In contrast, vaginal pH showed a moderate positive correlation ( $r = 0.45$ ,  $p = 0.002$ ) with time since assault. This suggests that vaginal pH levels tend to increase with the passage of time following the assault. Elevated vaginal pH can indicate changes in vaginal flora and acidity, potentially reflecting the body's response to the traumatic event.

## Discussion

In the realm of forensic gynecology, the quest for precision and sensitivity in sexual assault investigations has long been a priority. In this pursuit, the unveiling of physiological markers as potential indicators has emerged as a promising avenue.<sup>12</sup> Through the exploration of biomarkers, forensic gynecologists seek to enhance the accuracy and reliability of assessments in cases of sexual violence.

Historically, sexual assault investigations have faced significant challenges in corroborating victims' accounts and gathering concrete evidence.<sup>13</sup> DNA analysis, in particular, has revolutionized forensic investigations, offering a means to definitively link perpetrators to crimes. In cases of sexual assault, the presence of the assailant's DNA on the victim's body or clothing can serve as compelling evidence, aiding in the identification and prosecution of offenders.<sup>14</sup> Beyond DNA, researchers have investigated into other physiological markers that may hold forensic significance. For instance, changes in hormonal levels following sexual assault have been studied as potential indicators.<sup>15</sup> The stress response triggered by such traumatic events can manifest in alterations to cortisol and adrenaline levels, which may be detectable through blood or saliva samples. By quantifying these hormonal changes, forensic gynecologists aim to establish a scientific basis for assessing the occurrence and timing of sexual assaults.<sup>16</sup>

The unveiling of physiological markers represents a significant advancement in forensic gynecology, holding the potential to enhance the accuracy and sensitivity of sexual assault investigations.<sup>17</sup> By exploring biomarkers as indicators of trauma, clinicians and researchers aim to provide victims with a voice, enabling their experiences to be heard and validated through scientific evidence. As technology continues to evolve and our understanding of trauma deepens, the integration of physiological markers into forensic practice promises to further empower survivors and facilitate justice in cases of sexual violence.<sup>18</sup>

## Conclusion

The findings of this study underscore the potential utility of physiological biomarkers in forensic gynecology for elucidating cases of sexual assault. By incorporating these markers into standard forensic protocols, investigators can enhance the accuracy and reliability

of sexual assault investigations, ultimately facilitating the pursuit of justice for survivors.

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