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Sociodemographic, Psychological, and Biochemical Markers and Their Relationship with Psychopathy in Incarcerated Individuals

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Abstract

The current reality that permeates the penitentiary scenario in Brazil raises a series of questions about the well-being of this population in the face of incarceration conditions. In this context, this research aimed to investigate sociodemographic markers, testosterone levels, the 2D/4D ratio, and mental disorders such as stress, anxiety, and depression, and their relationship with psychopathy disorder in incarcerated individuals. An observational cross-sectional study was conducted, and data collection took place in a penitentiary in the Southwest of Paraná, involving a sample of 496 male individuals. The results obtained highlighted the main characteristics of a relatively young population, where the vast majority completed up to elementary education (56.4%), predominantly consisting of unmarried individuals (60.3%), having children (66.4%), and exhibiting a history of recidivism (57.14%). Regarding assessments related to the presence of depression, anxiety, and stress, individuals were characterized by exhibiting normality, with values of 58.31%, 51.71%, and 46.61%, respectively. Primary Psychopathy (mean: 38.88) was notably significant when compared to data from other penitentiaries worldwide, prompting a more detailed examination due to the severity observed. It

correlated with the severity of stress at 5%. On the other hand, Secondary Psychopathy (mean: 21.33) showed a correlation of 13% with depression, and Total Psychopathy expressed 14% significance for stress and the 2D/4D ratio, as per the evaluated sample. Testosterone levels remained within normal ranges, with no apparent relationship with the 2D/4D ratio, psychopathy, and mental disorders. Taken together, the data contribute to the understanding of factors associated with higher psychopathic traits in incarcerated individuals, with a particular emphasis on emotional factors (severity of stress and depression symptoms) and neurobiological factors (2D/4D ratio).

Keywords

Individuals Deprived of Liberty, Psychopathy, Testosterone, 2D:4D Ratio, Mental Disorders

1. Introduction

In the current reality, over ten million individuals are living in incarceration worldwide, with Brazil ranking third among countries with the largest prison population, encompassing approximately 730.000 individuals deprived of liberty (Baccon et al., 2022). In light of the substantial number of detainees, there is a growing imperative to study public health services and strategies for this population.

Maciel (2016) quotes that prisons are predisposed to unhealthy conditions, attributable to factors such as overcrowding, inadequate hygiene, insufficient ventilation and illumination, malnutrition, and the engagement of inmates in risky behaviors, including violence and drug use. Furthermore, access to healthcare is often precarious. The prolonged presence of individuals in prisons, characterized by the aforementioned conditions, in addition to the risky conduct of inmates, creates an environment where the potential for increased harm to individuals is heightened (Silva, et al., 2020).

It is known that health-related changes can induce imbalances in several areas of the body, leading to hormonal dysregulations and changes that affect mental health. Tauchen et al. (2021) emphasizes that Testosterone and its derivatives, function predominantly as androgens, promoting the development and maintenance of male sexual characteristics, such as encompassing the maturation of sexual organs, aspects related to voice, and the growth of facial and body hair. Additionally, it is capable of orchestrating anabolic activities, fostering protein storage and, consequently, stimulating bone and muscle growth. Testosterone also plays a critical role in modulating adult male reproductive health, including sexual function, bone health, lipid metabolism, muscle mass, and strength. Its production is carried out by testicular Leydig cells, intricately regulated by the hypothalamic-pituitary-gonadal axis through the secretion of luteinizing hormone. Once synthesized, this hormone will circulate, either bound or unbound

to proteins (McBride, Carson, & Coward, 2016).

Throughout the intrauterine period, the human brain undergoes sexual differentiation through the direct action of gonadal testosterone from the male fetus, steering development towards the male sex, and by the absence of this hormone towards the female sex. The impact of sex hormones on developing nerve cells results in permanent organizational changes, giving rise to specific synaptic circuits. During this period, sexual differences in cognition and behaviors (such as aggression, for example) are programmed (Eklund et al., 2020). The effects of fetus exposure to testosterone transcend behavioral issues and may encompass morphological traits in infants that differ between males and females. For instance, the digit ratio, a sexually dimorphic trait, typically exhibits lower 2D/4D ratios in men compared to women, indicating that intrauterine testosterone during embryonic development stimulates 4D growth, while female hormones promote 2D growth (Han et al., 2020). This ratio is commonly established as a predictive marker of exposure and sensitivity to the prenatal androgen. Intriguingly, it has also emerged as a predictive marker for athletic performance and behavioral disorders. A negative correlation of 2D/4D ratio has been observed in sports performance and in physical tests such as strength, grip, manual dexterity activities, as well as in activities requiring concentration and patience (Nobari et al., 2021).

In addition, the prevalence of mental disorders within the prison population is distinctive. Still, the combination of emotional detachment with barbaric crimes, paradoxically perceived by some individuals with a semblance of completeness or indifference, underscores the imperative to investigate psychopathic traits. According to Masnini & Macedo (2019), the behavior of individuals with psychopathy can be categorized into four types: 1) aggressive conduct (threats or physical harm to other people or animals), 2) non-aggressive conduct (loss or damage to the property of others), 3) fraud or theft, and/or 4) violation of rules.

As outlined by Vasconcelos et al. (2019), various factors can significantly impact an individual's mental health, particularly those within the prison system. These factors encompass stress, anxiety and depression, sleep disorders, prolonged use of psychotropic medications, idle time, substance abuse (drugs and/or alcohol), sexual abstinence, exposure to violence, coercive norms and routines, as well as the disruption of family ties. Given that deprivation of liberty constitutes a stressful factor itself, and this stress manifests differently depending on the nature of the restraint, often being associated with acute stress characterized by brevity and intensity, typically caused by traumatic situations.

The poor health conditions prevalent in the prison environment, coupled with the impact of different types of incarceration, contribute significantly to heightened levels of stress and anxiety for individuals' psyche, whether they are in a provisional condition or already convicted (Damas & De Oliveira, 2013).

Individuals with psychopathy exhibit an approximately threefold increase in the likelihood of reoffending compared to those with low psychopathic traits, with a fourfold higher likelihood of engaging in violent reoffenses. It is certain

that past antisocial behavior, as indexed by psychopathy assessments, is a crucial predictor of future criminal activity. However, it is the emotional component that distinguishes psychopathy, high levels of antisocial behavior can develop from other factors, including potential neurobiological and socio-environmental aggravating factors (André & Santos, 2023). In summary, adopting a biopsychosocial perspective that integrates public health and prison health domains, this study seeks to explore sociodemographic markers, blood testosterone levels, 2D/4D ratio, and their associations with psychopathy disorders, anxiety, depression, and stress among incarcerated individuals.

2. Materials and Methods

2.1. Study Design

This is a cross-sectional observational study, in which data collection took place ervery Friday throughout the day (morning and afternoon), from July 2022 to May 2023.

2.2. Ethical Aspects

The study underwent submission and approval by the Research Ethics Committee of the Federal University of Southern Border—UFFS, CAAE 13261419.2.0000.5564, which guides research involving human subjects. All participants were provided with the Informed Consent Form (ICF), allowing them an opportunity to read and seek clarification on any uncertainties regarding the research. Once the terms were read and signed, the data collection process commenced. To safeguard participant anonymity, individuals were assigned identification numbers such as P1 (participant 1), with this coding applied consistently to all information incorporated into each individual's database.

2.3. Participants

In this study, 496 incarcerated individuals from a penitentiary located in the South West region of the State of Paraná participated. These inmates were convicted of various types of crimes, incarcerated for at least six months, and had diverse age and race characteristics. The sample size was determined through sample calculation using the Open Source Epidemiologic Statistics for Public Health software, with indicated the need for 493 participants to achieve a power of 99.99%, considering a population of 1.243 inmates. The inclusion criteria were individuals over 18 years of age, male, serving their sentence in closed regime, and who agreed to sign the Informed Consent Form (ICF).

2.4. Instruments for Data Collection

Data collection took place in the prison's classrooms, where inmates were assembled in groups of 21 individuals. This collection process was divided into three moments, administering questionnaires, measuring finger dimensions and collecting blood samples.

2.5. Questionnaires Application

The initial questionnaire used was the Summary Anamnesis Questionnaire, created by the author, based on information from books and scientific articles. It comprised direct inquiries regarding the age, education, marital status, children, and their physical and mental health status.

The subject responded individually, which covered various aspects related to socioeconomic and cultural background, family and personal clinical history, past and present physical and mental health treatments, self-perception of the individual's physical and mental health, with a system-wide approach, and queries related to the prison environment. The questions were of a descriptive nature, with some being multiple-choice, such as "How would you assess your physical health?" "What about your mental health?"

The other assessment instrument used was the Levenson Psychopathy Index, which was validated in Brazil in 2014. This index consists of 26 self-report items, the evaluator read each of the 26 citations and the participants responded by circling the corresponding number next to each statement, the scores range from 1 to 5, where 1 indicates "completely false" and 5 indicates "completely true". The statements pertain to behavioral disorders, evaluated in the dimensions Primary Psychopathy, Secondary Psychopathy or Total Psychopathy, considering < 48: non-psychopatic group, 49 - 57: unsure, and >58 psychopatic group (Hauck, Salvador-Silva, & Teixeira, 2015).

Furthermore, as part of this first stage, the Dass-21 Questionnaire, focusing on mental health statements, was collectively read by one of the evaluators and each participant responded on their own sheet of paper to phrases addressing behavioral disorders related to strees, anxiety and depression. This assessment instrument comprises 21 questions, with statements in each question, scored from 0 to 3 points, with the extremes being 0 meaning "does not apply to me" and 3 meaning "it applies to me", most of the time. Based on the scores obtained, participants are classified into each of the three subscales as follows: Anxiety, normal (0 - 7 points), mild (8 - 9 points), moderate (10 - 14 points), severe (15 - 19 points), and extremely serious (>19 points); Depression, normal (0 - 9 points), mild (10 - 13 points), moderate (14 - 20 points), severe (21 - 27 points), and extremely severe (>27 points); Stress, normal (0 - 14 points), mild (15 - 18 points), moderate (19 - 25 points), severe (26 - 33 points), and extremely severe (>33 points) (Chew et al., 2020).

2.6. Finger Size Measurement

In a subsequent moment, the dimensions of the index and ring fingers were gauged using a 30 cm transparent ruler to compute the 2D/4D ratio, which involved assessing the base of the metacarpal to the distal end of the phalanx for each finger. Then, the measurement of the ring finger (4D) was subtracted from that of the index finger (2D), resulting in a numerical value. The average of these values from both hands was then calculated to derive the final measurement,

representing the 2D/4D ratio for each individual (Pratt, Turanovic, & Cullen, 2016).

2.7. Blood Sampling

In the final phase, blood collection was executed using sterilized needles and syringes. The obtained blood was dispensed into a red-capped tube without anticoagulant to extract serum. Each tube was appropriately labeled, identified, and stored in an upright position within a refrigerated box with ice to ensure the blood's quality.

Blood samples were processed to isolate serum, which corresponds to the liquid part of blood, which contains soluble components including testosterone. This process was done as quickly as possible to avoid changes in results. Centrifugation occurred at 3.400 r.p.m. for 15 minutes and then the serum was separated from the red blood cells using micropipettes in microtubes.

The isolated serum was dispatched to an external laboratory, responsible for conducting the testosterone analysis. The method employed for this analysis involved the chemiluminescence process, which entails the emission of light during a specific chemical reaction related to testosterone. As indicated in laboratory reports, reference values for men encompass blood levels of testosterone ranging from 175 ng/dL to 781 ng/dL (Sobreiro, 2022).

2.8. Data Analysis

The data obtained from the questionnaires, finger measurements, as well as the testosterone levels were entered into Excel spreadsheets, stored in documents, and subsequently imported into SPSS software, version 23. Subsequently, the data underwent analysis utilizing descriptive statistical techniques. The exploration of variable associations involved inferential statistics, including correlation tests, according to distribution of variables. The choice of the normality test, specifically the Kolmogorov-Smirnov test, was determined by sample size. The effect size of the correlation analysis was calculated by using Fisher's Z value. Associations with a p-value equal to or less than 0.05 were deemed significant.

3. Results

The current study examined the sociodemographic characteristics, 2D/4D ratio (the difference between the lengths of the index and ring fingers), blood testosterone levels, and the prevalence of psychopathy within an incarcerated population at a prison institution situated in the southwestern region of the state of Paraná, Brazil. The findings, as presented in **Table 1**, encompass an analysis of sociodemographic traits. It is important to note that the variable "N" may exhibit variation due to omitted cases.

In relation to the overall study sample, a total of 496 subjects were assessed. Concerning participant characteristics, the average age of the subjects was 30.9 years, with a standard deviation of 7.9. The age range spanned from 18 to 63,

Table 1. Sample characterization of incarcerated individuals in a penitentiary in southwest paraná, Brazil.

	n	% valid
Scholarity n = 445		
None or Illiterate	26	5.84
Completed Elementary School	251	56.40
Incomplete High School or Higher Education	168	37.75
Civil Status n = 449		
Single	271	60.30
Married/In a Partnership	129	28.70
Separated/Divorced	46	10.27
Widowed	3	6.66
Any offspring? n = 444		
Yes	295	66.44
No	149	33.56
Physical Health n = 439		
Excellent	85	19.36
Pretty Good	78	17.76
Good	146	33.25
Reasonable	110	25.05
Bad	20	45.55
Mental Health n = 424		
Excellent	94	22.16
Pretty Good	60	14.15
Good	145	34.19
Reasonable	96	22.64
Bad	29	6.83
Recidivism n = 434		
Yes	248	57.14
No	186	42.86

with predominance of adult individuals aged 18 to 59 (n = 473) compared to the elderly group aged 60 to 63 (n = 23).

Concerning marital status, individuals categorized as single constituted the majority (271% - 60.3%), followed by married individuals (129% - 28.7%), in terms of offspring, the majority of participants reported having children (295% - 66.44%).

The findings indicated that 251 of the individuals (56.40%) had completed education up to the elementary school level, a slightly smaller percentage managed to attain a high school diploma (168% - 37.75%), while a minority (26% - 5.84%) were categorized as semi-illiterate, having either never received formal education or possessing limited knowledge, such as basic literacy skills like writing their own name. This classification was self-reported by the inmates themselves during data collection, some participants, facing challenges with literacy, required additional time when answering the questionnaires and, in certain instances, sought assistance.

Associated with several issues, mental health emerges as a noteworthy factor in this study, despite its apparent controversy, when to regards to their mental health, individuals' self-assessment distributed as (145% - 34.19% Good), (96% - 22.64% Fair), and (94% - 22.16% Excellent).

Table 2 presents the means, medians, and standard deviations of primary psychopathy, secondary psychopathy and total psychopaty, measured by the Levenson Psychopathy Scale. Additionally, indicators of 2D/4D ratio and testosterone levels are provided.

Regarding the scores on the Levenson Psychopathy Scale, Primary Psychopathy is characterized as being associated with genetic factors. In other words, it refers to individuals deemed more calculating, who exhibit traits of emotional coldness, alterations in the affective spectrum, and a lack of guilt from birth. This form of psychopathy is more directly linked to physiological aspects (Welker et al., 2014).

Secondary Psychopathy, on the other hand, is characterized by an epigenetic profile and manifests itself during adolescence, a phase marked by rebellion and impulsive behavior. This condition is acquired in the individual's living environment. As for total psychopathy, it can be considered as the sum of primary and secondary psychopathies. The obtained scores are classified as equal to or less than 48 points for "non-psychopaths", 49 to 57 points for "uncertain classification regarding psychopathy", and 58 points or more for "psychopaths" (Hauck, Salvador-Silva, & Teixeira, 2015).

Table 2. Data on psychopathy and Biomarker scores in a sample of individuals deprived of liberty in a penitentiary in the Southwest of Paraná, Brazil.

	Median	Mean	SD	Minimum	Maximum
Primary Psychopathy **n = 496**	41.00	38.88	16.59	0.00	86.00
Secondary Psychopathy **n = 496**	23.00	21.33	8.59	0.00	39.00
Total Psychopathy **n = 496**	64.00	60.22	23.38	0.00	115.00
2D/4D Ratio **n = 487**	0.97	0.96	0.05	0.81	1.14
Testosterone **n = 475**	379.62	397.57	140.47	38.66	1230.02

Note. SD = standard deviation. Testosterone measurement: ng/dL. 2D/4D Ratio Measurement: cm.

The subjects evaluated had a mean 2D/4D ratio of 0.96± cm, with a standard deviation of 0.05± cm. Values similar to the study by Anderson (2012) were found, which evaluated the 2D/4D ratio in 45 inmates with a mean age of 39.02. The mean 2D/4D ratio was 0.95± cm, with a standard deviation of 0.04± cm.

The results of the research indicated a mean testosterone value of 397.57 ng/dL, with a standard deviation of 140.47 ng/dL.

We can see that there was no significant number of participants with depressive, anxiety and stress symptoms according to presented in Table 3, referring to the answers to the DASS-21 Questionnaire. By analyzing the table, it is observed that, in relation to the levels of depression, the item absence of the disease is the most frequent among the participants (58.31%), followed by the levels of mild depression (16.83%) and moderate depression (16.42%), extremely severe depression (4.72%), and only 18 participants presented the severe level (3.69 %). With regard to the classification scores for anxiety, it is also observed that there was a higher number of subjects at the level of absence of the disease (51.71%), with 22.62% presenting a moderate level, and the percentages about extremely severe, severe, and mild were of very similar values, being respectively, 9.89%,

Table 3. Classification of DASS-21 scores in a sample of individuals deprived of liberty in a penitentiary in Southwest Paraná, Brazil.

	n	% valid
Depression		
Absent	284	58.31
Lightweight	82	16.83
Moderate	80	16.42
Grave	18	3.69
Extremely Severe	23	4.72
Anxiety		
Absent	256	51.71
Lightweight	38	7.67
Moderate	112	22.62
Grave	40	8.08
Extremely Severe	49	9.89
Severe		
Absent	227	46.61
Lightweight	159	32.64
Moderate	64	13.14
Grave	31	6.36
Extremely Severe	6	1.23

8.08%, and 7.67%. There is a characteristic increase in severe and extremely severe levels in anxiety, when compared to the same levels in depression. And in the dimension of stress, we were able to notice that almost half of the inmates, 46.61%, are not considered stressed, presenting mild stress (32.64%), moderate stress (13.14%), severe stress to a lesser degree (6.36%), and an almost minimal portion, only 6 individuals (1.23%) extremely severe stress.

As shown in Table 4, the greatest variance explained occurred for the total Psychopathy scores (14%), where the severity of stress and the 2D/4D ratio measure were positive predictors, i.e., as they increased, the higher the total psychopathy scores were also higher.

4. Discussion

In accordance with Table 1, from June to November 2019, in another prison facility in the state of Paraná, Baccon et al. (2023) carried out a study that reported similar findings regarding the age of inmates, the average age was 30.9 with a standard deviation of 10.1, encompassing subjects aged 19 to 64, which underscores a characteristically young prison population when analyzing the age group. A comparative analysis with the study by Costa et al. (2023), which explored the sociodemographic profile of inmates in a penitentiary in Foz do Iguaçu—PR in 2021, revealed striking similarities between the two categories (married and single), the authors found 43.3% single subjects compared to 42.3% married, with 58.6% reporting having children. While our study also indicates a prevalence of single individuals, the difference is more pronounced than in the findings of Costa et al. (2023). Notably, 10.27% of our sample is reported as divorced, suggesting the potential existence of prior marital ties, alongside the presence of children. Compared to the findings of this study Baccon et al. (2023), which explored anthropometric measurements and sociodemographic characteristics of incarcerated individuals in northern Paraná, notable parallels were observed. In their

Table 4. Final predictive models of psychopathy scores in a sample of individuals deprived of liberty in a penitentiary in the Southwest of Paraná, Brazil.

Models	Model Adjustment						
	B	EP	β	t	*p*	R	*p*-value
Primary Psychopathy						5%	0.02
Severity Stress	2.84	1.20	0.24	2.35	0.02		
Secondary Psychopathy						13%	<0.001
Severity Depression	1.89	0.51	0.36	3.69	<0.001		
Total Psychopathy						14%	<0.001
Severity Stress	4.71	1.43	0.32	3.29	0.001		
2D/4D Ratio	56.90	26.82	0.20	2.12	0.03		

Note. B = value of the non-standard estimator; EP = standard error; β = standardized estimator value, R = explained variance.

study encompassing a total of 220 subjects, 115 (52.3%) had educational attainment of less than eight years, signifying that they did not complete primary education. In contrast, 105 (47.7%) of the individuals had studied for at least eight years or more, indicative of those who were able to start secondary education.

The intersection of crime and education is highlighted in a study conducted by Dragomir (2014), who interviewed 20 inmates in Romania, posing the question "What do you believe are the most frequent reasons for committing crimes?" to which the participants unanimously cited poverty, poor education, and an unfavorable family environment as primary contributing factors. Ramones, Gubia-on, & Cagatao (2022), states that the psychological well-being of inmates represents a great burden for many health systems, a problem that has become more evident in times of crisis, as observed after the pandemic period, where challenges manifest at various levels and influence the convicts.

According to the authors, the mental health of individuals is adversely affected by incarceration, characterized by minimal activity, limited mental stimulation, and the challenging prison environment. While the predominant self-classification in this subcategory was "good", it's noteworthy that the proportions of reasonable mental health and excellent mental health were nearly equivalent, which contradicts the observations demonstrated by the mentioned authors, prompting reflection on the possibility that individuals may perceive their health as "good" based on their familiarity with living conditions akin to a penitentiary, as they were already used to living in unhygienic and unsanitary environments.

In this study, the mean found for primary psychopathy was 38.88 with a standard deviation of 16.59 and for secondary psychopathy, a mean of 21.33 and a standard deviation of 8.59. In comparison, the research by Walters et al. (2008) that when evaluating the presence of psychopathy in 1972, high, medium and low risk inmates, through the Levenson Psychopathy Index, they found median values of 28.70 with a standard deviation of 7.60 in primary psychopathy and 21.10, with a standard deviation of 5.64 in secondary psychopathy in a taxometric analysis of the Levenson Psychopathy Scale which shows that the sample of the present study had a much higher score in primary psychopathy, indicating a more clinically severe sample. These data were also observed by Ly et al. (2012) when evaluating 21 inmates, and verifying a mean primary psychopathy of 11.8 and standard deviation of 1.7, secondary psychopathy 17.2 and standard deviation 1.4, and total psychopathy 31.8 and standard deviation 1.7.

Regarding this approach, Miller et al. (2016) studied the Levenson Psychopathy Index (LSRP), where they found the presence of two factors. Factor 1, related to interpersonal and affective aspects of psychopathy, resulting in a decrease in agreeableness, with an increase in narcissistic behavior, characteristics of primary psychopathy, and Factor 2, associated with social deviance related to psychopathy, verifying in this same factor, increased impulsivity and negative emotionality, thus involving an analysis of factors with characteristics that differentiate primary psychopathy from secondary psychopathy.

When analyzing the 2D/4D ratio there are also studies with other types of samples. For example, Han et al. (2020) obtained similar values when evaluating 843 subjects with schizophrenia, and 1.050 individuals in a control group, they analyzed and compared the 2D/4D proportions of the right and left hands, with the group with schizophrenic patients obtaining a mean in the left hand of 0.96 cm and standard deviation 0.04 cm, and in the right hand 0.96 cm and standard deviation 0.04 cm, presenting a 2D/4D ratio higher than that of the group healthy control. However, there was no statistically significant difference, which, in relation to the control group, in its 2D/4D ratio presented mean values in the left hand of 0.95 cm and standard deviation of 0.06 cm, and in the right hand of 0.96 cm and standard deviation of 0.6 cm. In a study carried out by Hone & Mccullough (2012) where 222 students of a Psychology course at the University of Miami were evaluated, including men and women from 17 to 48 years old, the 2D/4D ratio was verified, that is, measures of strength and endurance in both hands, and the results showed a well-established sex difference in the 2D/4D ratio, in which men have lower 2D/4D proportions (0.96 ± 0.03 cm) than women (0.98 ± 0.03 cm). In addition, men also scored higher in strength and endurance, thus suggesting that the 2D/4D ratio is similar in the male population in general, regardless of whether they are incarcerated. The study by Aluja and García (2005), carried out with a sample of 89 inmates, had an average testosterone level of 760.28 ng/dL, a value almost double that of the sample of this study, which can be justified by the fact that in the study by Aluja and Garcia, the collections were carried out in the morning. In our investigation, data and sample collection were adapted to the schedules provided by the penitentiary. Therefore, blood samples were collected a few times in the afternoon as well, which may generate a bias in this case.

Testosterone levels were verified in the study by Aromaki, Lindman, & Eriksson (1999), who evaluated four distinct groups in their sample, namely: Group 1 (G1), considered the control group, with 16 individuals; Group 2 (G2), composed of 15 alcoholics; Group 3 (G3), consisting of 13 subjects described as violent prisoners; and Group 4 (G4), composed of 15 violent men at large. The analyses obtained were categorized into nmol/L measurements, considering 1 nmol/L = 0.015 ng/dL, the conversion of 397.57 ng/dL is characterized by 6.10 nmol/L. The mean values found in the research by Aromaki, Lindman and Eriksson, defined testosterone levels at 10.6 nmol/L for the control group, 11.4 nmol/L for the group of alcoholics, 13.3 nmol/L for violent men who are incarcerated and 11.2 nmol/L for violent men who are not incarcerated, with no significant difference between the groups. Thus, all groups presented values higher than the mean found in the present study, characterizing the sample of this study in low testosterone-related values, but at normal dosage, considering that the values for testosterone range from 175 ng/dL to 781 ng/dL are acceptable.

Upon analyzing the results from **Table 3**, Sharma et al. (2015) evaluated with DASS-21, 72 detainees, murderers and rapists in India. On the depression scale, 56.2% had no symptoms of depression, 25% had mild depression, 9.4% had

moderate depression, and 9.5% had severe depression. On the anxiety scale, 62.5% were found to be "asymptomatic" criminals, 12.5% with a mild level of anxiety, 15.6% with moderate anxiety and 9.4% with severe anxiety. Regarding the stress scale, 56.2% did not show any signs of stress, 18.8% mild stress, 15.6% moderate and 9.4% severe stress.

Based on the findings of **Table 4**, the review conducted by Yildirim & Derksem (2012) cites the relationship between fetal testosterone, responsible for the 2D/4D ratio, and constructions related to empathy during childhood and adolescence. In addition, Lutchmaya et al. (2001) found that higher fetal testosterone is negatively related to eye contact in 12-month-old infants (n = 70), which is associated with decreased affective empathy and psychopathic development in adolescence and adulthood. On the other hand, the lowest variance explained was for Primary Psychopathy (5%), which, according to the literature, has a greater influence of genetic factors and predominantly emotional characteristics. Yildirim & Derksem (2012) associate the classification of primary psychopathy with an aggressive mood style, reactive aggression, angry hostility, and a feeling of being socially excluded, indicating a particular bitterness and neurotic antagonism towards others.

Regarding the limitations found during this study, we can mention that testosterone collection did not occur at the same time of day for all inmates, which may have interfered with the amount of testosterone found in the blood samples. Another relevant factor was the lack of measurement of the use of anabolic steroids, which can interfere with the results, and also the fact that the questionnaires of the scales used were self-reported, that is, the individual could be lying about the answer.

5. Final Consideration

Taken together, these findings advance our understanding of factors associated with higher psychopathic traits in individuals deprived of liberty, with emphasis on emotional factors (severity of symptoms of stress and depression) and neurobiological factors (2D/4D ratio). Also considering the variance explained by the regression models, it is evident that other aspects not evaluated in the present study may become the focus of future investigations, thus obtaining more complete predictive models on the subject.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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