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Obstructive Sleep Apnea (OSA) and its Association with Depression

Md Adil Faizan[1], K Sri Divya Reddy[2], Geethanjali[3], M Raghuram[4], R Sateesh Babu[5]

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Abstract

Objective: This study investigates the correlation between Obstructive Sleep Apnea (OSA) and depression, examining how OSA impacts psychiatric well-being and quality of life.

Introduction: Obstructive Sleep Apnea (OSA) is characterized by episodes of partial or complete airway obstruction during sleep, leading to fragmented and non-restorative sleep. OSA has significant implications for mental health, including a strong association with depression and other psychiatric conditions. Despite considerable evidence linking OSA with psychiatric symptoms, the precise nature of this relationship remains ambiguous.

Methods: A cross-sectional study was conducted with 182 participants at a tertiary care center in Telangana from July 2022 to June 2023. Tools employed included the Epworth Sleepiness Scale (ESS), Polysomnography (PSG), and the Hamilton Depression Rating Scale (HAM-D). Participants included those referred for PSG who consented to the study. Exclusions were made for patients with nocturnal oxygen supplementation, recent upper airway surgery, or unstable cardiopulmonary, neurological, or psychiatric conditions.

Results: Out of 90 patients who underwent PSG, 23 were diagnosed with depression. These patients were significantly older (mean age 57.30 years) compared to non-depressed individuals (mean age 52.40 years, $P < 0.001$). Depression was associated with higher HAM-D scores (mean 17.25) and poorer sleep efficiency (68.55%) compared to non-depressed patients (HAM-D mean 8.64, sleep efficiency 72.50%). Additionally, depressed patients exhibited longer sleep latency and REM latency. The Apnoea-Hypopnoea Index (AHI) was significantly higher in depressed patients (mean 26.04) compared to non-depressed patients (mean 20.30, $P = 0.005$). The majority of depressed patients had abnormal PSG results, with 91.3% showing aberrant findings.

Discussion: The study confirms a significant association between OSA and depression. Depression exacerbates OSA symptoms and impairs sleep quality, with substantial implications for patient management and treatment outcomes. The link between OSA and psychiatric conditions such as depression highlights the need for integrated treatment approaches that address both sleep and mental health issues.

Conclusion: OSA is prevalent among individuals with depression, and its impact on psychiatric well-being is considerable. Clinicians should be vigilant in screening for OSA

Author's Affiliation: [1]Resident, [2,3]Assistant Professor, [4,5]Professor, Department of Psychiatry, Mamata Medical College, Khammam, Telangana, India.

Corresponding Author: Md Adil Faizan, Resident, Department of Psychiatry, Mamata Medical College, Khammam, Telangana, India.

E-mail: adilmrpr07@gmail.com

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in depressed patients to improve overall treatment outcomes. Further research is needed to explore the mechanisms underlying the OSA-depression connection and to develop comprehensive management strategies.

Keywords: Obstructive Sleep Apnea, Depression, Polysomnography, Psychiatric Co-morbidity, Sleep Disorders.

INTRODUCTION

Episodes of total or partial airway collapse, accompanied by a drop in oxygen saturation or an awakening from sleep, are the hallmarks of obstructive sleep apnea (OSA). A fragmented, non-restorative sleep is the outcome of this disturbance. The effects of OSA on mental illness, driving safety, quality of life and cardiovascular health aresubstantial1.Up to 20% of the society suffers from sleep disordered breathing, according to epidemiological studies. A portion of these patients—4-5% of the middle-aged population—have obstructive sleep apnoea/hypo-apnoea syndrome, which is characterized by concomitant symptoms of excessive daytime sleepiness caused by their nocturnal breathing disorders[2]. OSA may have a harmful impact on a number of organs, leading to the emergence of cardiovascular disorders and cognitive issues[3].

Through the process of sympathetic stimulation brought on by waking from sleep, the disturbed breathing during sleep exerts its multi organ, harmful effects[4]. Recent epidemiological research has demonstrated the link between untreated OSA and a wide range of harmful health issues, including many psychiatric illnesses like depression and anxiety[5]. The majority of investigations have found a strong link between OSA and psychiatric problems[6]. The biological and/or psycho-social effects of OSA may be what causes the mental alterations[7]. It has been noted that psychiatric comorbidity in OSA patients negatively impacts their quality of life and impairs neurocognitive functioning[8]. OSA has been related to psychological issues including as depression, anxiety, impaired cognitive function, and others. Some psychological deficits can be improved with therapy, while others linger even after therapy[9]. A patient with OSA has a high prevalence of personality disorders and depression. We did this study to

Demonstrate any correlation between the two conditions due to the literature's ambiguity regarding the relationship between OSA and psychiatric symptoms[10].

METHODS

This is a cross sectional study done on 182 participants at a tertiary care centre, Telangana from July 2022 -June 2023 .The tools used in this study were the Eps worth Sleepiness Scale (ESS), PSG (Polysomnography), Hamilton Depression rating Scale(HAM-D), sociodemographic data and anthropometric measurements of each participants.

The people who gave their consent and who were referred for polysomnography (PSG) were included. The people who didn't give consent, who were on nocturnal oxygen supplementation, any upper airway surgery, unstable cardiopulmonary, neurological or psychiatric disease are excluded from study.

RESULTS

Out of 90 patients who had PSG, 23 had depression and had a mean age that was notice ably older (P<0.001) than the general population (57.30 vs. 52.40). Between these two groups, there were no statistically significant differences in neck circumference or body mass index (P> 0.005) (*Table 1*).

Basic characteristics of the study population (age, body mass index, and neck circumference)

Table 1: Comparison of different variable in population with or without depression.

	Mean+SD		P-value
	Depression (n=23)	Others (n=67)	
Age (years)	57.30+10.75	52.40+09.97	<0.001**(S)**
BMI	30.45+4.23	31.62+4.23	0.175
Neck circumference (cm)	37.85+3.54	38.41+3.13	0.359

SD: Standard deviation, BMI: Body mass index, S: Significant

When compared to non-depressive patients, patients with depression had considerably higher mean HAM-D scores (P = 0.0001) (mean standard

deviation [SD] = 17.25+5.35) than non-depressive patients (mean SD 8.64 +6.24). In comparison to non-depressives (mean 72.50%), depression patients' sleep efficiency was considerably worse (P< 0.005). those with depression experienced substantially longer mean sleep latency (23.42 min) than those without depression (21.09 min) (P<0.005).

Similar to sleep latency, mean REM sleep latency was also substantially longer inpatients with depression (76.73 min) than in the general population (72.26 min; P =0.018). Individuals with depression had mean room air, awake SpO2 values that were not statistically different from non-depressed individuals (93.49) (P= 0. 195).

The average nocturnal SpO2 of depressive patients was 83.56% against 85.46%, which was not statistically different from awake SpO2 (P = 0.104) in comparison to non-depressive patients. The mean AHI of patients with depression was 26.04 versus 20.30 (P=0.005(S), substantially higher than that of individuals without depression. Although depression patients' mean ODI was significantly higher than depression patients' mean ODI (24.81 compared 20.59; P = 0.096), this difference was not statistically significant (*Table 2*).

Table 2: Polysomnography observation in depressive patients versus those without depression.

	Mean+SD		P-value
	Depression (n=23)	Others (n=67)	
AHI	26.04+10.54	20.30+12.20	0.005**(S)**
ESS	15.70+3.29	14.66+4.11	0.117
HAM–D	17.25+5.35	8.64+6.24	0.0001**(S)**
Sleep efficiency	68.55+9.42	72.50+8.67	0.002**(S)**
Sleep latency	23.42+09.19	20.09+8.50	0.006**(S)**
REM latency	76.73+13.25	72.26+13.9	0.019**(S)**
Awake Spo2	93.49+4.02	93.36+4.00	0.195
Nocturnal Spo2	83.56+6.44	84.46+6.64	0.104
ODI	24.81+14.53	20.59+15.03	0.096

SD: Standard deviation, AHI: Apnoea Hypo-apnoea index, ESS: Epworth Sleepiness Scale, HAM-D: Hamilton Depression Rating Scale, REM: Rapid eye movement, ODI: Oxygen desaturation index, S: Significant, Spo2: Oxygen saturation.

Snoring 30(44.77%), day time drowsiness 27(40.29%) with a mean ESS of 15.3, Disturbed nocturnal sleep 21 (31.34%), nocturia 20 (29.85%), and witnessed apnoea 14(20.89%) were the predominant presenting symptoms of patients without depression. All of these symptoms were more frequent in depressed patients compared to non-depressed patients, and within depressed patients, they were more frequent in OSA patients compared to non-OSA patients. Only 2(8.69%) of our 23 depressed patients had normal PSG results, whereas the remaining 21 (91.3%) had aberrant results (*Table 3*).

Table 3: Prevalence of Obstructive sleep apnoea in Depression

	Depression		
	No (%)	Yes (%)	
OSA			
Yes	56(85.58%)	20(86.95%)	76(84.44%)
No	11(16.41%)	3(13.05%)	14(15.56%)
Total	67	23	90

P=0.089(NS), OSA: Obstructive sleep apnoea, NS: Not significant

Snoring was reported by 23 patients (100%), day time drowsiness by 20 patients (93.6%), disturbed nocturnal sleep by 18 patients (81.8%), nocturia by 16 patients (75%), and witnessed apnoea by 11

patients (52.3%),when compared to people without depression, patients with depression experienced all of these symptoms more frequently. Every patient with depression who also has OSA snores (*Table 4*).

Table 4: Patient presentation in depression with and without obstructive sleep apnoea

	OSA(%)	NOOSA(%)	Total(%)	P-value
Snoring				
Yes	23(100.0%)+	1(33.3%)	24(92.03%)	0.003*
No	0	2(66.7%)	2(7.69%)	
Witnessed apnoea				
Yes	11(47.82%)	0	11(42.30%)	>0.2
No	12 (52.17)	3(100.0%)	15(57.70%)	
Disturbed sleep				
Yes	18(78.26%)	1 (33.3%)	19(73.07%)	>0.1
No	05(21.74%)	2(66.7%)	07(20.92%)	
Day time sleepiness				
Yes	20(86.95%)	3(100.0%)	23(88.46%)	>0.9
No	3(13.05%)	0	3(11.54%)	
Nocturia				
Yes	16(69.56%)	1(33.3%)	17(65.38%)	>0.1
No	07(30.44%)	2(66.7%)	09(34.62%)	

+-percentage from column heading,*-significant value, OSA–Obstructive sleep apnea.

1 (4.34%) of the patients had modest AHI scores. 11 (52%) had severe OSA, while 09(40.9%) had moderate OSA. Depressive individuals significantly had higher moderate and severe OSA than non-depressive patients (P=0. 034(S) (*Table 5*).

Table 5: Severity of obstructive sleep apnoea based on the apnoea –hypo-apnoea index

	All patient (%)	Depression (%)
Mild	23(25.55%)	1 (4.34%)
Moderate	34(37.77%)	09(39.13%)
Severe	33(36.66%)	11(47.82%)
P	0.032**(S)**	

S: Significant

DISCUSSION

Recurrent upper airway obstruction in OSA, a respiratory disorder that affects sleep, frequently results in episodes of reduced (hypo-apnoea) or no (apnoea) airflow. Specific physiological abnormalities, like fragmented sleep and persistent intermittent hypoxia, are the final result.

OSA is a well-known risk factor for a wide variety of metabolic and cardiovascular conditions, which is a major morbidity in psychiatric patients and may shorten projected life duration.

There is widespread agreement that depression and OSA are closely related, and that both of these illnesses can have an impact on a patient's general well being and disease progression.

There are significant repercussions when depression is present in OSA. Depression complicates treatment, is frequently linked to chronicity, and has deleterious impact on how OSA develops.

The majority of research have demonstrated a substantial correlation between OSA and a psychiatric condition, mainly depression. Depression is a widespread medical condition that is yet poorly understood and managed. It is debatable whether depression is more common in OSA patients than in those who have other chronic illnesses.

OSA is thought to be at risk for depression, which serotonergic neurotransmission can explain. Low serotonin levels might lead to decreased upper respiratory tract muscular tone as well as sleep disruption. Psychiatric comorbidity in OSA varies and depends on a number of factors.

The results of our study imply that OSA may be a significant confounding factor for studies on depression. The reason for this is because neither research study routinely determines its presence. For a more accurate comparison to the general population, there is a critical need for more population-based research of OSA in community-dwelling people with depression.

Studies conducted in the community are necessary to gauge the severity of the comorbidity and enhance patient care. The overall results of our study show a significant and direct connection between depression and OSA.

Most doctors fail to recognize this significant depression comorbidity at first, which delays diagnosis. Screening patients for OSA and prompt psychiatric management can greatly enhance OSA sufferers' quality of life. To properly understand the connection between depression and OSA, more prevalent research must be done.

CONCLUSION

According to the results of our study, OSA is a common condition associated with depression but is generally ignored in the primary care context. There could be neuro-psychiatric side effects from OSA.

In high risk patients who present to them with cognitive and/or emotional issues, psychiatrists need to be vigilant to take OSA into account. As a result, regular depression screening should be included in OSA management and can significantly enhance these patients' quality of life.

To determine the severity of the comorbidity and enhance the therapy of these individuals, additional community-based research are necessary. The bed partner's history should be obtained to support any clinical suspicions.

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Psychiatric Morbidity in Postpartum Women: A Hospital Based Cross Sectional Study

Manasa N[1], Bibi Ayesha Kalburgi[2], Narayan R. Mutalik[3]

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Abstract

Context: The transition to motherhood brings about significant psychological and biological changes, making both pregnancy and the postpartum period are particularly susceptible to health challenges. Mental health issues during this time have often been neglected within the realm of reproductive health, despite their substantial contribution to the global burden of illness and disability. These conditions are associated with a range of symptoms including abnormally high or low mood, irritability, disturbed sleep, hallucinations/delusions, and occasionally suicidal or infanticidal ideation, if not treated promptly, they can substantially impact upon the mother's health, mother-infant bonding, and family dynamics.

Aim: To study psychiatric morbidity in women during postpartum period.

Settings and Design: Hospital based cross sectional study.

Methods and Material: This is an observational, hospital-based cross-sectional study conducted on postpartum women visiting immunization clinic for first immunization of their babies within 6 weeks of delivery, who fulfil the inclusion and exclusion criteria.

The sample size estimated is 100. Assessment tools used are Predesigned questionnaire, Edinburgh postnatal depression scale, BPRS and HAM A.

Statistical analysis used: The data were analysed using IBM SPSS version 29. Continuous and categorical variables have been presented as mean ± standard deviation and percentages respectively.

Results: The population studied tends to be younger (mean age of 27.4+5), predominantly from rural areas (65%), and with limited educational attainment (71% either illiterate or with only primary education) and majority come from lower socio-economic backgrounds. Psychiatric morbidity is mainly in the form of depression (31%) followed by anxiety (17%) with very low prevalence of psychosis (3%). This population appears to face socio-economic and educational disadvantages, but in our study no statistical significance was found between variants like socio economic status, religion and psychiatric morbidity.

Conclusions: The study found that postpartum psychiatric morbidity, particularly depression (31%) and anxiety (17%), is common, while psychosis is rare (3%). No significant

Author's Affiliation: [1]Junior Resident, [2]Senior Resident, [3]Professor and Head of the Department, Department of Psychiatry, S Nijalingappa Medical College, Bagalkot, Karnataka, India.

Corresponding Author: Manasa N, Junior Resident, Department of Psychiatry, S Nijalingappa Medical College, Bagalkot, Karnataka, India.

E-mail: drnmanasa@gmail.com

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association was observed between psychiatric morbidity and socio-demographic factors like socio-economic status or religion. These findings highlight the need for broader mental health support for postpartum women, regardless of socio-demographic backgrounds. A larger sample size with prospective assessment is recommended to validate these results.

Keywords: Postpartum women, Psychiatric morbidity, Postpartum depression and anxiety.

Key Messages: The study highlights that postpartum depression and anxiety are common, while psychosis is rare. Socio-demographic factors such as socio-economic status and religion are not significantly linked to psychiatric morbidity, emphasizing the need for universal mental health support for postpartum women.

INTRODUCTION

The transition to motherhood brings about significant psychological and biological changes, making both pregnancy and the postpartum period are particularly susceptible to health challenges.[1-3] Mental health issues during this time have often been neglected within the realm of reproductive health, despite their substantial contribution to the global burden of illness and disability.[4] These conditions are associated with a range of symptoms including abnormally high or low mood, irritability, disturbed sleep, hallucinations/delusions, and occasionally suicidal or infanticidal ideation, if not treated promptly, they can substantially impact upon the mother's health, mother-infant bonding, and family dynamics. The period following childbirth is marked by an increased susceptibility to mood disturbances, particularly depressive symptoms. [2] In the International Classification of Diseases, 10th Edition (ICD-10), postpartum disorders are categorized under behavioural syndromes linked to physiological disturbances and physical factors. They are classified as "mental and behavioural disorders associated with the puerperium, not elsewhere classified" (F53.0–F53.9). According to ICD-10, the duration criterion for these disorders is set at six weeks. In contrast, the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), replaced the specifier "with postpartum onset" with "with peripartum onset." This specifier applies when mood symptoms emerge during pregnancy or within the first four weeks after childbirth. According to a review article done by Upadhyay RP *et al*[5], prevalence of postpartum depression in Indian mothers was 22%.Hence the aim of the study was to assess the psychiatric morbidity and its corelation with specific sociodemographic variables in a tertiary care hospital.

MATERIALS AND METHODS

This is an observational, hospital-based cross-sectional study conducted on postpartum women visiting immunization clinic for first immunization of their babies within 6 weeks of delivery, who fulfil the inclusion and exclusion criteria. After obtaining clearance from Institutional Ethical Committee, study was conducted at S. Nijalingappa Medical College & HSK Hospital from May 2023 to July 2023. The subjects were explained in their language about the purpose of the study and that their identity will not be revealed in the published material. Then, written consent was taken on the consent form before recruiting them. The estimated sample size is 100.

The sample size for the present study was calculated based on the average prevalence of post-partum mental disorders- from a systematic review by Ravi Prakash *et al*[5], using the formula,

$$N' = \frac{N * (Z^2 * P * Q)}{[(d^2 (N-1)) + (Z^2 * P * Q)]}$$

where,

N′ = Sample size adjusted for a finite population size

N = Known finite sample size in the population = Approximately 135 post-partum patients available at the study center for a duration of 3 months (on an average 45 patients per month)

Z = Critical value for a corresponding level of confidence = 1.96 for 95% confidence level

P = Pooled prevalence of post-partum mental disorders from the systematic review and meta-analysis = 20%

q = 100- 20= 80%

d = Acceptable margin of error = 5%

Substituting the above values in the formula,

n = 88

Thus, a minimum sample of 88 patients was required for an error rate of 5% and 95% confidence levels. We rounded it to 100 patients for our study.

All consenting patients who are in the postpartum period (<6 weeks as per ICD 10) were the study subjects. Inclusion criteria: a) women up to six weeks post-partum, b) Age >18 years, c) Willing to give written informed consent, and d) accompanied by attender. Women were excluded if they reported the onset of the current psychiatric disorder prior to pregnancy and during pregnancy or if they had any co-morbid medical illnesses.

Assessment tools used are Predesigned questionnaire, Edinburgh postnatal depression scale, BPRS and HAM A. Predesigned interview questionnaire consisted of sociodemographic details like name, age of the patient, place, socio economic status, educational status, occupation of the patient, date of delivery, past history of psychiatric illness and family history of psychiatric illness. Edinburgh Postnatal Depression Scale (EPDS)[6] was developed to help healthcare professionals identify mothers experiencing postpartum depression, a condition more persistent and severe than the "baby blues," which typically occurs within the first week after childbirth. The scale comprises 10 brief statements, and the mother selects one of four options that best reflects how she has felt over the past week. Most mothers can complete the scale in less than five minutes. Responses are scored from 0 to 3, depending on the severity of symptoms, with items 3 and 5 to 10 being reverse-scored (3, 2, 1, 0). A total score is calculated by summing the individual item scores. Mothers who score above 12 or 13 are likely experiencing depression and should seek medical attention.

The Hamilton Anxiety Rating Scale (HAM-A)[7] is a widely used clinical tool for assessing the severity of anxiety symptoms. It consists of 14 items, each rated on a scale from 0 to 4, measuring both psychological (e.g., mental distress, fears) and physical (e.g., somatic complaints) components of anxiety. In postpartum women, HAM-A can be particularly useful for detecting anxiety disorders, which are common in the postpartum period but often underdiagnosed. By identifying both mental and physical signs of anxiety, the HAM-A helps clinicians evaluate the impact of anxiety on a mother's well-being.

The Brief Psychiatric Rating Scale (BPRS)[8,9] is a clinical tool designed to assess the severity of psychiatric symptoms, including depression, anxiety, hallucinations, and delusions. It consists of 18 items rated on a scale from 1 to 7, providing a comprehensive overview of a patient's mental state. In the context of postpartum psychosis, BPRS is valuable for detecting and evaluating psychotic symptoms, such as delusions, hallucinations, and disorganized thinking, which may emerge during or after childbirth. Timely assessment with the BPRS allows for early diagnosis and intervention, helping prevent severe outcomes for both the mother and infant.

Results: Participants' ages ranged from 19 to 39 years, with a mean age of 27.4 years $\pm$ 5 years (*table 1*). This suggests that the majority of participants were in their late twenties. The majority of participants (65%) came from rural areas, while 35% were from urban settings. This indicates a higher representation of rural residents in the study. The majority of the participants are Hindu (61%), followed by Muslims (32%) and Christians (7%). This distribution may reflect the local demographic characteristics. A significant proportion of participants were either illiterate (35%) or have only primary education (36%). Those with higher educational qualifications, such as higher secondary (5%) and graduates (8%), represent a smaller segment of the study population. This suggests that many participants had a lower level of formal education. The largest group falls into the "upper lower" category (34%), followed by "lower middle" (27%) and "lower" (28%). Only a small portion belongs to the "upper middle" class (11%). This indicates that the majority of participants belong to the lower socio-economic strata. Socio demographic details of participants is depicted in *table 2*. Psychiatric morbidity was mainly in the form of depression seen in 31%, followed by anxiety seen in 17%,with very low prevalence of psychosis seen in 3% of participants (*table 5*). There is no prior psychiatric illness reported in any of the participants (*table 3*) This population appears to face socio-economic and educational disadvantages, but the study found no statistically significant associations between psychiatric comorbidity and participants socio demographic variables like place of residence, religion, or socio-economic status (SES) as indicated by P-values greater than 0.05 in all cases as depicted in *table 6, table 7* and *table 8* respectively. Although there were slight variations in the prevalence of these conditions across different groups, they were not significant. A trend was observed where lower SES was linked with higher prevalence of anxiety, psychosis, and especially depression, but this was not statistically meaningful as shown in *table 8*. Overall, the findings suggest that factors such as place, religion, and SES do not play a decisive role in predicting mental health outcomes in this

population.

Table 1: Descriptive statistics for age in the study

Variable	Minimum	Maximum	Mean	Standard deviation
Age in years	19	39	27.4	5.0

- **Age Range:** Participants' ages ranged from 19 to 39 years, with a mean age of 27.4 years and a standard deviation of 5.0. This suggests that the majority of participants are in their late 20s, with some variability.

Table 2: Socio demographic profile

Socio-demographic variables	Variables classified (N=100)	n (%)
Education	Illiterate	35 (35.0)
	Primary	36 (36.0)
	School	16 (16.0)
	Higher secondary	5 (5.0)
	Graduate	8 (8.0)
Religion	Hindu	61 (61.0)
	Muslim	32 (32.0)
	Christian	7 (7.0)
Occupation	Home maker	100
	Manual	0
	Skilled	0
Socio-economic status	Upper middle	11 (11.0)
	Lower middle	27 (27.0)
	Upper lower	34 (34.0)
	Lower	28 (28.0)
Locality	Rural	65 (65.0)
	Urban	35 (35.0)

Abbreviations: [N = number of participants]

The socio-demographic table presents a breakdown of various characteristics among 100 participants in the study. Here's a summary of each section:

1. **Education**: A significant proportion of participants (35%) are illiterate, with a slight increase (36%) having attained primary education. Only a smaller percentage have completed school (16%), higher secondary (5%), or have graduated (8%).
2. **Religion**: The majority of participants identify as Hindu (61%), followed by Muslims (32%), and a smaller number are Christians (7%).
3. **Occupation**: All participants (100%) are homemakers, with no participants reporting employment in manual or skilled labor.
4. **Socio-economic Status**: Most participants fall into the upper-lower (34%) and lower (28%) socio-economic categories. A smaller proportion belongs to the lower middle (27%) and upper middle (11%) categories.
5. **Locality**: The majority of participants (65%) are from rural areas, while 35% live in urban areas.

Table 3: Distribution of patients based on past history of psychiatric illness

Past history of psychiatric illness	N	%
Yes	0	0
No	100	100.0

The *table 3* shows that none of the patients in the study had a previous history of psychiatric illness. Specifically, 100% of the participants (N=100) reported having no prior psychiatric illness.

Abbreviations: [N = number of participants]

Table 4: Descriptive statistics for number of weeks post-delivery in the study

Variable	Minimum	Maximum	Mean	Standard deviation
No of weeks	1	6	3.5	1.7

Table 4 presents the descriptive statistics for the number of weeks post-delivery among the participants. The postpartum period ranged from 1 to 6 weeks, with an average (mean) of 3.5 weeks and a standard deviation of 1.7 weeks, indicating some variation in how far postpartum the participants were.

Table 5: Distribution of psychiatric morbidity

Psychiatric morbidity	N=100
Anxiety	17
Depression	31
Psychosis	03
Total	51
Absence of psychiatric morbidity	49

Abbreviations: [N = total number of participants]

The *table 5* shows that among the 100 participants, 51 were identified with psychiatric morbidity. Specifically, 17 individuals experienced anxiety, 31 experienced depression, and 3 had psychosis. The remaining 49 participants had no psychiatric morbidity. This indicates that more than half of the participants (51%) experienced some psychiatric

issue during the study period, with depression being the most common, followed by anxiety, and a smaller number experiencing psychosis.

Table 6: Association of place of residence with anxiety, psychosis, and depression

Place	N	Anxiety		Psychosis		Depression	
	%	Present	Absent	Absent	Present	Present	Absent
Urban	N	3	32	34	1	12	23
	%	8.6%	91.4%	97.1%	2.9%	34.3%	65.7%
Rural	N	14	51	63	2	19	46
	%	21.5%	78.5%	96.9%	3.1%	29.2%	70.8%
P value		.100		.951		.602	

- The P-values for anxiety (0.100), psychosis (0.951), and depression (0.602) are all greater than 0.05, indicating **no statistically significant association** between participants' place of residence (urban or rural) and the presence of anxiety, psychosis, or depression.
- Thus, place of residence does not appear to play a major role in the occurrence of these mental health conditions within the studied population.

Abbreviations: [N = number of participants in the study]

Table 7: Association of religion with anxiety, psychosis, and depression

Religion	N	Anxiety		Psychosis		Depression	
	%	Present	Absent	Absent	Present	Present	Absent
Hindu	N	10	51	60	1	22	39
	%	16.4%	83.6%	98.4%	1.6%	36.1%	63.9%
Muslim	N	7	25	31	1	9	23
	%	21.9%	78.1%	96.9%	3.1%	28.1%	71.9%
Christian	N	0	7	6	1	0	7
	%	0.0%	100.0%	85.7%	14.3%	0.0%	100.0%
P value		.370		.178		.135	

The results show that the prevalence of anxiety, psychosis, and depression varies slightly across religious groups, but the P-values (all >0.05) indicate that none of these mental health conditions are significantly associated with religion in this study. Hence, religion does not appear to be a determining factor for anxiety, psychosis, or depression in the study participants.

Abbreviations: [N = number of participants in the study]

Table 8: Association of SES with anxiety, psychosis, and depression

SES	N	Anxiety		Psychosis		Depression	
	%	Present	Absent	Absent	Present	Present	Absent
Upper middle	N	0	11	11	0	0	11
	%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%
Lower middle	N	4	23	27	0	8	19
	%	14.8%	85.2%	100.0%	0.0%	29.6%	70.4%
Upper lower	N	7	27	33	1	12	22
	%	20.6%	79.4%	97.1%	2.9%	35.3%	64.7%
Lower	N	6	22	26	2	11	17
	%	21.4%	78.6%	92.9%	7.1%	39.3%	60.7%
P value		.385		.419		.104	

The data indicates that anxiety, psychosis, and depression are more prevalent in the lower socio-economic groups, but the P-values (all >0.05) show that these associations are not statistically significant. This suggests that, within this study, SES is not a significant factor in predicting anxiety, psychosis, or depression. Nonetheless, there is a noticeable trend where lower SES is associated with higher prevalence rates of these mental health conditions, particularly for depression.

Abbreviations: [N = number of participants in the study]

SES: Socio economic status

DISCUSSION

This is an observational, hospital-based cross-sectional study conducted on postpartum women visiting immunization clinic for first immunization of their babies within 6 weeks of delivery to assess the psychiatric morbidity and its corelation with specific sociodemographic variables in a tertiary care hospital. The postpartum period is a challenging time marked by significant biological, physical, social, and emotional changes[10] During pregnancy and the postpartum period, many women experience a wide range of intense emotions, including anticipation, excitement, happiness, and fulfilment, alongside feelings of anxiety, frustration, confusion, or sadness and guilt. The postpartum phase increases their vulnerability to various psychiatric conditions. Postpartum psychiatric disorders are typically classified into three categories: postpartum blues, postpartum psychosis, postpartum depression and in addition to these, various anxiety and stress-related disorders can occur during the puerperium.[10,11] Postpartum psychosis occurs in approximately 1 to 2 out of every 1,000 women who give birth, typically emerging within the first 2 to 4 weeks after delivery. The onset is abrupt and can appear as early as 2 to 3 days postpartum.[12,13] A community-based prospective study in India reported the incidence of postpartum depression among rural women to be approximately 11%.[14] Postpartum psychiatric syndromes are more prevalent (81%) among women under the age of 25. This trend aligns with the fact that many Indian women conceive during this period, as the average age at marriage tends to be relatively lower. [10,15] The "baby blues," experienced by about 40% of new mothers, involves relatively mild depressive symptoms that usually resolve on their own within a brief period.[16] The symptoms of postpartum depression (PPD) are similar to those of the baby blues but are more intense and last longer. PPD can develop anytime within the first year after childbirth and frequently requires medical intervention.[17] Perinatal anxiety, which is often linked to excessive worries about the baby's well-being, is estimated to affect around 20% of mothers.[18] Postpartum psychosis (PP) is the least common and often considered the most severe, affecting approximately 0.89 to 2.6 out of every 1,000 mothers.[19]

The pathogenesis of postpartum psychiatric disorders is strongly influenced by biological factors.[10] The early postpartum period is marked by a significant decline in gonadal steroids. Notably, progesterone levels decrease between the first and second stages of labour, while estrogen levels sharply drop after the placenta, which secretes estrogen, is expelled. Estrogen plays a key role in modulating the monoaminergic system, particularly affecting serotonin and dopamine, which are linked to mood and psychotic symptoms, respectively.[20,21,22] After the steroid-producing placenta is expelled and the production of gonadal hormones stabilizes post-delivery, there is a sharp and sudden drop in estrogen, progesterone, and the progesterone metabolite allopregnanolone.[23] These hormones typically affect the brain's limbic regions, which are crucial for emotional regulation, cognitive processing, motivation, and arousal, by modulating neurotransmitter activity. Abnormal sensitivity to this hormonal decline, potentially linked to maladaptive functioning of the GABA(A) receptor, has been suggested as a factor contributing to the risk of postpartum mood disorders.[17] Recent studies have highlighted the connection between allopregnanolone levels and depressive or anxiety symptoms, as well as the positive effects of allopregnanolone treatment in women with postpartum depression.[24] Although connections between postpartum mental health risks and other hormones, such as reproductive, stress, and thyroid hormones, have been proposed, they are less consistent and their impact remains uncertain.[17]

In our study, mean age of participants was 27.4 $\pm$ 5 which is similar to a study done by Muneer *et al*,[25] Srivastava AS *et al*,[26] Goyal S[1] and Gupta S *et al*.[27] The majority of participants (65%) came from rural areas, while 35% were from urban settings. This indicates a higher representation of rural residents in our study which is in line with the study done by Srivastava *et al*[26] and was different as compared to a study done by Goyal S *et al*.[1] In our study majority of the participants were Hindus (61%), followed

by Muslims (32%) and Christians (7%) which is similar to the studies done by Srivastava AS *et al*, [26]GK Poomalar *et al*,[28] and Kumar N *et al*[29] and in these studies religion did not have a statistical significance and was not a risk factor for postpartum morbidity. A significant proportion of participants were either illiterate (35%) or have only primary education (36%). Those with higher educational qualifications, such as higher secondary (5%) and graduates (8%), represented a smaller segment of the study population. This suggests that many participants had a lower level of formal education which is similar to a study done by Gupta *et al*[27] and was different when compared with a study done by Goyal S[1] where most of the participants were educated. The largest group falls into the "upper lower" category (34%), followed by "lower middle" (27%) and "lower" (28%). Only a small portion belongs to the "upper middle" class (11%). This indicates that the majority of participants belong to the lower socio-economic strata. A trend was observed where lower SES was linked with higher prevalence of anxiety, psychosis, and especially depression, but this was not statistically significant. This is similar with studies done by GK Poomalar *et al*,[28] Kumar N *et al*[29] and Saldanha D *et al*[30] but different when compared with a study conducted by Gupta S *et al*[27] in North India where low socioeconomic status had significant statistical association and was a risk factor for development of post-partum depression. In one more study done by Wan *et al*[31] involving a survey of Chinese women found that postpartum depression was linked to those in lower-income groups. In our study sample consisting of 100 participants, the overall psychiatric morbidity was 51%,the majority being depression (31%), followed by anxiety (17%), with psychosis being much less common, at only 3%. This finding of psychiatric morbidity in 51 % of the participants and depression in 31 % of our study population is similar to a study done by Kumar N[29] *et al* where 44% (67 of 152 subjects) of study population had psychiatric morbidity and 27% (41 subjects) had depression. Both Indian and Western literature report that the prevalence of postpartum depression ranges from 10% to 15%.[10] In one more study done by GK Poomalar *et al*[28], twenty-six women (10.6%) had postpartum depression among 254 women which is different from our study. The factors such as a woman's age, religion, her husband's age, the educational levels of both the woman and her husband, her occupation, socioeconomic status, and family income do not significantly affect the incidence of postpartum depression. In one more study done by Srivastava AS *et al*,[26] the results of which varied from our results with 16 out of 100 women (16%) developed psychiatric conditions, 12% experienced major depressive disorder, while 4% were diagnosed with anxiety disorder. There were no cases of postpartum or puerperal psychosis which is different when compared with our study where 3 % had psychosis. According to Wan *et al*,[31] the prevalence of postnatal depression was found to be 15.5%, while Ramchandani *et al*,[32] reported a rate of 16.4%. Additionally, Britton [33] observed that 24.9% of mothers experienced anxiety. In one more Indian study done by S Goyal [1] *et al*, 29 (10.3%) out of 289 women had psychiatric morbidity, of which 20 had major depression (7.12%), 4 had anxiety disorder (1.41%), 2 had brief psychotic disorder (0.71%), 1(0.36%) had bipolar disorder, 1(0.36%) had adjustment disorder and 1(0.36%) had obsessive compulsive disorder, these results varied when compared with our study.

CONCLUSION

The study reveals that psychiatric morbidity, particularly depression and anxiety, is prevalent among postpartum women, with depression affecting 31% and anxiety affecting 17% of participants. Psychosis was observed at a much lower rate (3%). Despite the majority of participants coming from rural areas, having lower educational attainment, and belonging to lower socio-economic backgrounds, no statistically significant association was found between socio-economic status, religion, or other socio-demographic factors and psychiatric morbidity. These findings suggest that while mental health challenges are common in the postpartum period, they are not strongly influenced by socio-demographic factors in this population. This underscores the need for broader mental health support irrespective of socio-economic and demographic backgrounds. A larger sample size with prospective assessment is needed to generalize the findings of this study.

Conflict of Interest: None

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How does the Dream Experience (Length, Location, Characters, Social Interactions, and Emotions) Change from Childhood to Adulthood?

Sudhakar Venukapalli

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Abstract

Background: This research study is part of a larger study, which was intended to examine the manifest dream content and meaning representation in children and adults. This part of the study addressed the question, *Are there any significant differences between children's and adults dream reports obtained through the Dream Recording Booklet with respect to the content? And are there any gender differences between children and adult groups.*

Aim and Objectives: To study how does the dream experience (length, location, characters, social interactions, and emotions) change from childhood to adulthood.

Materials and Methods: To study the objective, the researcher adopted the methodology standardized by Margaret Bowman Howard of Iowa State University, Iowa, USA (1978), which in turn is based on the methodology developed by Hall and Van de Castle. The Dream Recording Booklet was circulated among the participants with clear instructions. Children were requested to recall and record their dreams just after the sunrise awakenings. Parents were asked to support reminding children about their daily recordings without interfering with the children's dream experiences. In six to eight months, dream data was collected from all the children and adults in the sample. This home-based data collection method worked out very well in obtaining the data.

Results: In our comparison of assertiveness between children and adults, we observed that children have a mean score of 3.31, accompanied by a standard deviation of 1.65. Adults, on the other hand, exhibit a higher mean score of 4.42, with a standard deviation of 1.15. The analysis yielded a t-value of 3.491 and a p-value of 0.0008. Since the p-value is below the threshold of 0.05, we can confidently conclude that there is a significant difference between the two groups. This leads us to reject the null hypothesis (H0), which posits that there is no substantial difference in the number of dreams experienced by children and adults. Instead, we accept the alternative hypothesis (H1), indicating that children and adults indeed differ in the number of dreams they experience. This insight can guide further research and discussions on the emotional and cognitive development of both age groups.

Conclusion: The findings of this study align with those of several other studies conducted by Avila-White, Schneider, & Domhoff, 1999; Oberst, Charles, & Chamarro, 2005; Saline, 1999; Strauch & Lederbogen, 1999. The scores obtained support the idea that cultural differences influence the dreams of both children and adults. As a result, dream content analysis plays a significant role in understanding the nature of dreams across different age groups.

Keywords: Psychoanalysis, Dream Content, Dream Experience, Emotions in Dreams, Dream Characteristics.

Author's Affiliation: Former Professor & Dean, The English and Foreign Languages University, Hyderabad 500007, India.

Corresponding Author: Sudhakar Venukapalli, Former Professor & Dean, The English and Foreign Languages University, Hyderabad 500007, India.

E-mail: sudhakarvenu.efluniversity@gmail.com

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INTRODUCTION

No one can decipher a dream in its natural form. When dreams are unfiltered, no one can understand them. Psychoanalysts use the disclosed, interpreted, or reported information as the primary corpus to reinterpret and find significance. Therefore, what we see in dreams is an attempt at reconstruction. (Domhoff, 1996). Stanley Krippner and Jan Weinhold (2002) stated that "What is disclosed about the dream may vary considerably, depending on how the dreamer recalls, forgets, embroiders, or reconstructs different portions of the report. In postmodern terms, serial reports of the same dream are *fluid texts* rather than *fixed texts*. Hence, dream work of any type needs to be done with care, with attentiveness, and with humility. Nevertheless, if diligent care is taken, the use of dream reports as data can yield useful information for the social sciences."

AIMS, OBJECTIVES & RESEARCH QUESTIONS

One of the important objectives of this study is to examine the manifest dream content and meaning representation in children and adults. To study this objective, the researcher adopted the methodology standardized by Margaret Bowman Howard of Iowa State University, Iowa, USA (1978), which in turn is based on the methodology developed by Hall and Van de Castle. This part of the study addressed two questions: 1. Are there any significant differences between children's and adults dream reports obtained through the Dream Recording Booklet with respect to the dream content? 2. Are there any gender differences between children and adult groups with respect to the dream experience (length, location, characters, social interactions, and emotions?

HYPOTHESES

- There is no significant difference between children's and adults dream reports obtained through the Dream Recording Booklet with respect to the dream content.
- There are no gender differences between children and adult groups with respect to the dream experience (length, location, characters, social interactions, and emotions.

MATERIALS AND METHODOLOGY

After developing a reasonable amount of rapport with the parents and children, the researcher briefed them about the study process and their sensitive role in data collection. The Dream Recording Booklet was circulated among the participants with clear instructions. Children were requested to recall and record their dreams just after the sunrise awakenings. Parents were asked to support reminding children about their daily recordings without interfering with the children's dream experiences. In six to eight months, dream data was collected from all the children and adults in the sample. This home-based data collection method worked out very well in obtaining the data.

The dream records that are less than 15 words are ignored. From each respondent, five dreams Dream records containing fewer than 15 words are disregarded. From each participant, five dreams are selected for analysis. The researcher examined all available dominant dream analysis tools, including those by Reger *et al.* (1971), Brenneis (1970), Hall & Van de Castle (1966), Hauri, Sawyer, & Rechtschaffen (1967), Langs (1966), Sheppard & Rosenhan (1965), and Tokar, Brunse, Castelnuovo-Tedesco, & Stefflre (1973). Ultimately, Hall and Van de Castle's classification system, recommended by Margaret Bowman Howard (1978), was chosen for rating the dream reports. are selected for the analysis. The researcher surveyed all the available dominant dream analysis tools (Reger *et al.*, 1971; Brenneis, 1970; Hall & Van de Castle, 1966; Hauri, Sawyer, & Rechtschaffen, 1967; Langs, 1966; Sheppard & Rosehan, 1965; Tokar, Brunse, Castelnuovo-Tedesco, & Stefflre, 1973), and finally Hall and Van de Castle's classification system that was suggested by Margaret Bowman Howard (1978) is selected for rating the dream reports.

The researcher employed content analysis to systematically identify, categorize, classify, and quantify qualitative data in an objective manner. The research procedures developed for this portion of the study are based on the Hall-Van de Castle System. According to Dumhoff (1999), "Content analysis is an attempt to use carefully defined categories and quantitative methods to extract meaning from a text, whether it be a newspaper article, a transcribed conversation, a short story, or a dream report." One of the earliest proponents of content analysis, Cartwright (1953), stated that the

fundamental objective of this method is to convert people's symbolic behavior into scientific data. This involves achieving results that are (1) objective and reproducible; (2) measurable and quantifiable; (3) significant for both theoretical and applied purposes; and (4) generalizable.

The researcher was able to systematically quantify various features and written characteristics. The coding categories of the Hall-Van de Castle system are nominal. According to Domhoff (1996), as noted by Dumhoff (1999), "The system contains both empirical and theoretical categories; however, the theoretical categories proved to have no validity or usefulness and have long since been abandoned." It is important to acknowledge that the issues with these theoretical categories are not unique to the Hall-Van de Castle system.

Krippner and Weinhold (2002) state that "the Hall-Van de Castle system is both nominal and empirical; it does not provide information about the level of activity in dreams nor does it include theoretical concepts such as castration anxiety. While it originally included theoretical scales, their usefulness was not demonstrated, leading to their abandonment. These decisions likely contribute to the Hall-Van de Castle system's high inter-coder reliability" (Hall & Van de Castle, 1966, p. 117).

Hall and Van de Castle published their most renowned research in 1966 with the work titled "The Content Analysis of Dreams." In this study, they presented a comprehensive methodology for capturing dream content through a detailed coding system. Their research involved the analysis of 1,000 dreams collected from 200 undergraduate students at Case Western Reserve University and Baldwin Wallace College in Cleveland, Ohio, between 1947 and 1952. Since its release, the Hall-Van de Castle System has been widely used by many dream researchers. Furthermore, both Hall and Van de Castle, along with various other researchers, have demonstrated the reliability and validity of this system worldwide (Winget and Kramer, 1979).

According to Domhoff (1999), developing reliable and valid categories for content analysis is one of the most challenging tasks. Unfortunately, there are no universally applicable guidelines for creating such categories, and those developed for one type of text may not be suitable for another. Typically, content categories are created through a process of trial and error after an in-depth examination of the texts being analyzed. They usually undergo multiple revisions before they are ready for regular use. This was certainly true for the system developed by Hall and Van de Castle, which Hall initially created in the 1940s and later refined with Van de Castle's assistance during two intensive years of work in the 1960s.

As per the Hall-Van de Castle System guidelines, essential content items are identified and converted into frequencies and percentages. To achieve objectivity and reliability, two experts, the researcher, and the researcher are involved in the coding process. Tartz and Krippner (2008) say,According to the Hall-Van de Castle System guidelines, essential content items are identified and quantified into frequencies and percentages. To ensure objectivity and reliability in the coding process, two experts, including the researcher, are involved. Tartz and Krippner (2008) state, "The major Hall-Van de Castle categories coded included characters, aggressive interactions, friendly interactions, sexual interactions, activities, successful outcomes, failed outcomes, misfortunes, good fortunes, emotions, settings, objects, and modifiers."

All the dream reports were coded for all the categories suggested by the Hall-Van de Castle System. The inter-rater reliability was calculated using the percentage-perfect-agreement method, a clear and well-defined process suggested by Hall and Van de Castle (1966, p.146). The results are robust, with inter-rater reliability scores for all the categories falling within a range of 75% to 90%. As Dumhoff (1999) affirmed, "Because categories in a nominal coding system can be clearly defined, there is very high inter-coder reliability in using the Hall and Van de Castle system. This high reliability is determined by the method of perfect agreement, which means that all the similar codings by two independent coders are divided by the number of agreements plus the number of disagreements. For example, if coder A makes 51 codings for characters and coder B makes 49 codings, they make the same coding 48 times. The inter-coder reliability is 48 divided by 52 (48 agreements plus four disagreements), which equals .92. Hall and Van de Castle used this approach by comparing the results with what is found with every other conceivable approach. They show that the outcomes from various methods of determining inter-judge reliability can range from zero to 100% (Hall & Van de Castle, 1966, pp. 145-147). It is, therefore, meaningless to report a reliability finding without stating the method used, and it makes little or no sense to use the other methods with this particular

coding system (Dumhoff, 1996; Hall, 1969b; Hall & Van de Castle, 1966; Van de Castle, 1969)".

For the purpose of study, twenty-eight standard indices were computed and compared between children and adults. The measured empirical categories called "indicators" are presented in an array of percentages and ratios. Except for social interaction ratios, all the items were tested for significance. Since the social interaction ratios are only ratios and not true proportions, the data represents just mathematical differences between one ratio and another. For all other items, two-tailed tests for statistical difference between two independent proportions were employed. The z -score and p-values are interpreted accordingly. The following six areas of dream content are identified for assessment of the dream reports of children and adults of the sample.

1. **Dream Length:** This section includes the total number of dreams reported by respondents over the course of one week, as well as the average number of words used to describe each dream.
2. **Dream Setting:** Dream settings are evaluated based on two criteria. The first criterion is the location of the dreams, categorized as indoor or outdoor. The second criterion assesses familiarity, as dreams often feature people, objects, and events that are both known and unknown to the dreamer are included in this area.
3. **Dream Characters:** This assessment includes four types of dream character scales: i) Central Figure, ii) Sex, iii) Age, and iv) Identity. In adult dreams, dreamers are typically the central figures, while animals are often the central figures in children's dreams. This pattern holds true across various cultures. Dreams may feature male and female characters as well as individuals of different ages, including children, youth, adults, middle-aged individuals, and seniors. According to Dumhoff (1999), "The percentage indicators reveal what parts of an overall category are contained in specific subcategories." For example, to calculate the percentage of animal characters in a series of dreams, the number of animal characters is divided by the total number of characters to determine the animal percentage. Similarly, to find the male/female percentage, one would calculate the number of male and female human characters.
4. **Social Interaction:** In this assessment area, three social interaction scales measure aggression, sexual content, and friendliness. Concerning the measure of social interaction, Dumhoff (1999) says, "The social interaction ratios, on the other hand, provide rates of social interactions per character, not percentages. The friendliness per character ratio, the F/C ratio or F/C index, is typically .22 for women and .21 for men, meaning there is one friendly interaction for every five characters who appear in the overall set of dreams."
5. **Emotions:** The study measures both positive and negative emotions as reported in dreams. Emotions such as anger, apprehension, sadness, confusion, and happiness are included in this analysis. Additionally, factors such as success, failure, internal and external pressures, and the impact of the dreamer on outcomes are examined. This section of the study also addresses issues related to self-negativity, feelings of bad luck, negative emotions, and the percentage of success attributed to the dreamer. Furthermore, the study explores a range of additional emotions, including aggression, friendliness, sexuality, misfortune, good fortune, success, failure, and the pursuit of goals.

According to Dumhoff (1999), some indicators are created by combining various categories. For example, the percentages of aggressive and friendly interactions can be combined to calculate an assertiveness percentage. This is done by dividing the sum of initiated aggressive and friendly interactions by the total number of aggressive and pleasant interactions. One of the newest indicators is the self-negativity percentage, which may be useful in predicting a highly critical attitude toward oneself or certain forms of psychopathology. This concept considers failures experienced by the individual, misfortunes that occur, and the presence of a victim status within aggressive interactions. While these indicators are grounded in empirical research, they can be seen as quasi-theoretical since they involve categorizing various categories based on middle-range conceptualizations.

DATA ANALYSIS AND INTERPRETATION

Measuring Dream Length construed in this study in terms of numbers of dreams and number of words that dreams carry. The analysis of dream reports is based on the number of persons rather than the number of dreams. Means and standard deviations are computed to capture the overall view of the content of dreams of children and adults to

the number of dreams and words in dreams. A t-test determines the mean differences between children (boys and girls) and adults (male and female), and the results are presented accordingly.

As discussed above, two variables, the average number of dreams reported in one week and the average number of words written by the respondents in their dream reports, are considered dream length for assessment. The following table presents the dream length of the children and adults with respect to the number of dreams.

Table 1: Measuring Number of Dreams

Variable	Group	Gender	N	Mean	SD	t-value	p-value
Dream Length	Children	Boys	30	2.65	1.52	2.756	0.0078
		Girls	30	3.82	1.76		
	Adults	Male	30	4.02	0.87	2.877	0.0056
		Female	30	4.82	1.25		

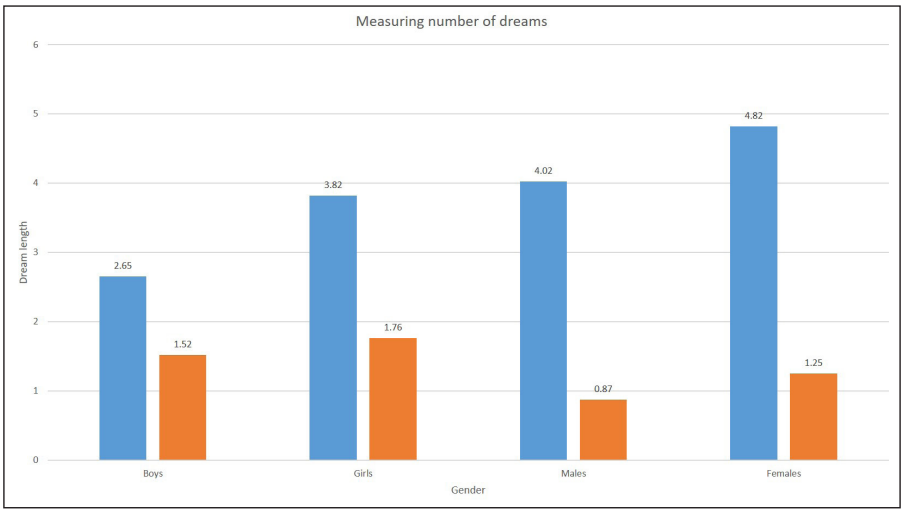
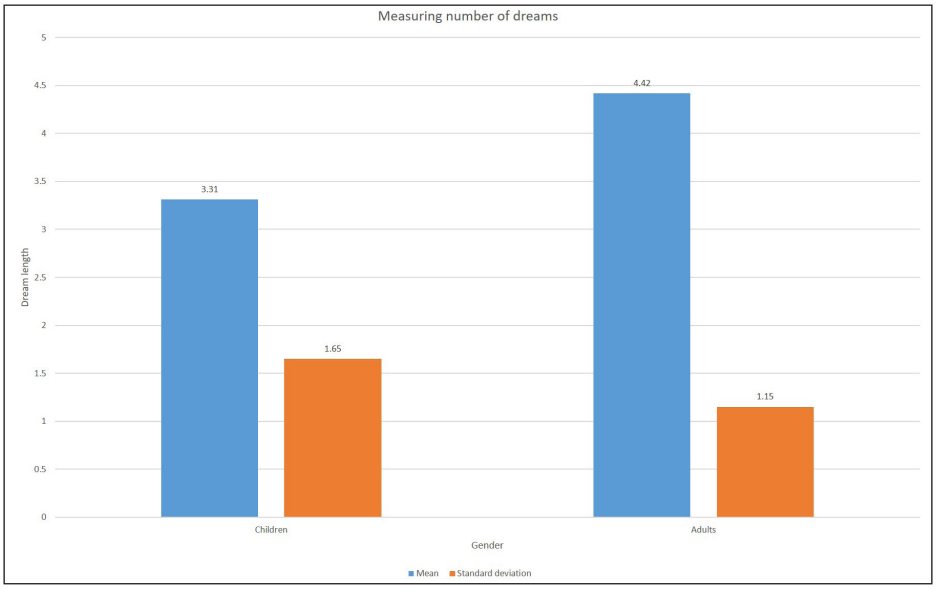


Table 2: Measuring Number of Dreams

Variable	Group	N	Mean	SD	t-value	p-value
Dream Length	Children	60	3.31	1.65	4.275	0.0001
	Adults	60	4.42	1.15		



The above tables indicate that in the case of children, the mean score of boys for the number of dreams is 2.65 with a standard deviation of 1.52 and the mean score of girls is 3.82 with a standard deviation 1.76. The t-value calculated for comparing the means is 2.756 and p-value is .0078. Since the p-value is less than 0.05 (P<0.05), the conclusion is that the two means are significantly different. In other words, boys and girls differ significantly in the number of dreams dreamt. Hence, it is inferred that the null hypothesis (H_0), *Children, both boys and girls, do not differ significantly w.r.t. the number of dreams* is rejected whereas the alternative hypothesis (H_1), *Children, both boys, and girls, differ significantly w.r.t. the number of dreams* is accepted.

In the study of adults, the mean dream length for males is 4.02, with a standard deviation of 0.87, while for females, the mean is 4.82, with a standard deviation of 1.25. The calculated t-value for comparing these means is 2.877, and the p-value is 0.0056. Since the p-value is less than 0.05 ($p < 0.05$), we conclude that the two means are significantly different. Therefore, we reject the null hypothesis (H0), which states that *there is no significant difference in the number of dreams between male and female adults*. Instead, we accept the alternative hypothesis (H_1), which asserts that *male and female adults differ significantly in the number of dreams they experience*.

In the final comparison between children and adults, the mean score for assertiveness in children is 3.31, with a standard deviation of 1.65. In contrast, the mean score for adults is 4.42, with a standard deviation of 1.15. The calculated t-value for comparing these means is 3.491, and the p-value is 0.0008. Since the p-value is less than 0.05 ($p < 0.05$), we conclude that the two means are significantly different. Therefore, we reject the null hypothesis (H_0), which states that there is no substantial difference in the number of dreams experienced between children and adults. We accept the alternative hypothesis (H_1), indicating that children and adults differ in the number of dreams experienced. The following table presents the dream length of children and adults in terms of the number of words in their dreams.

Table 3: Measuring Number of Words in Dreams

Variable	Group	Gender	n	Mean	SD	t-value	p-value
Dream Length	Children	Boys	30	73.42	23.42	3.426	.00011
		Girls	30	96.47	28.45		
	Adults	Male	30	116.72	52.67	2.718	.0087
		Female	30	158.24	65.02		

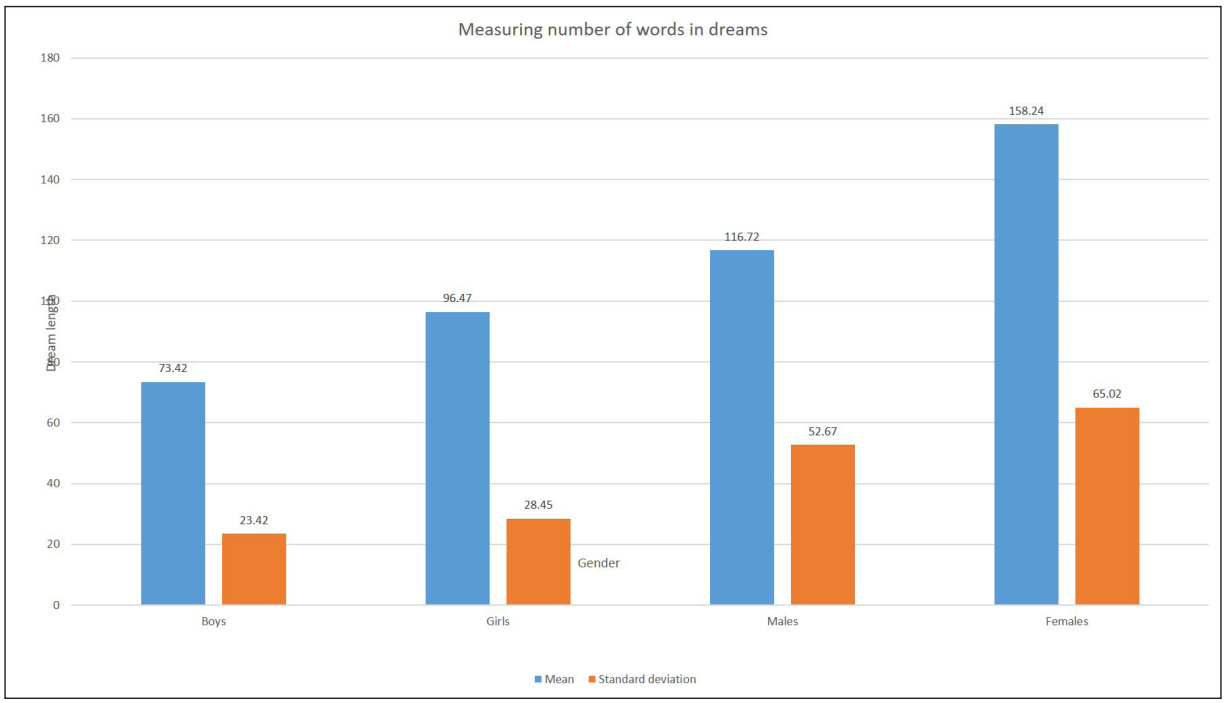
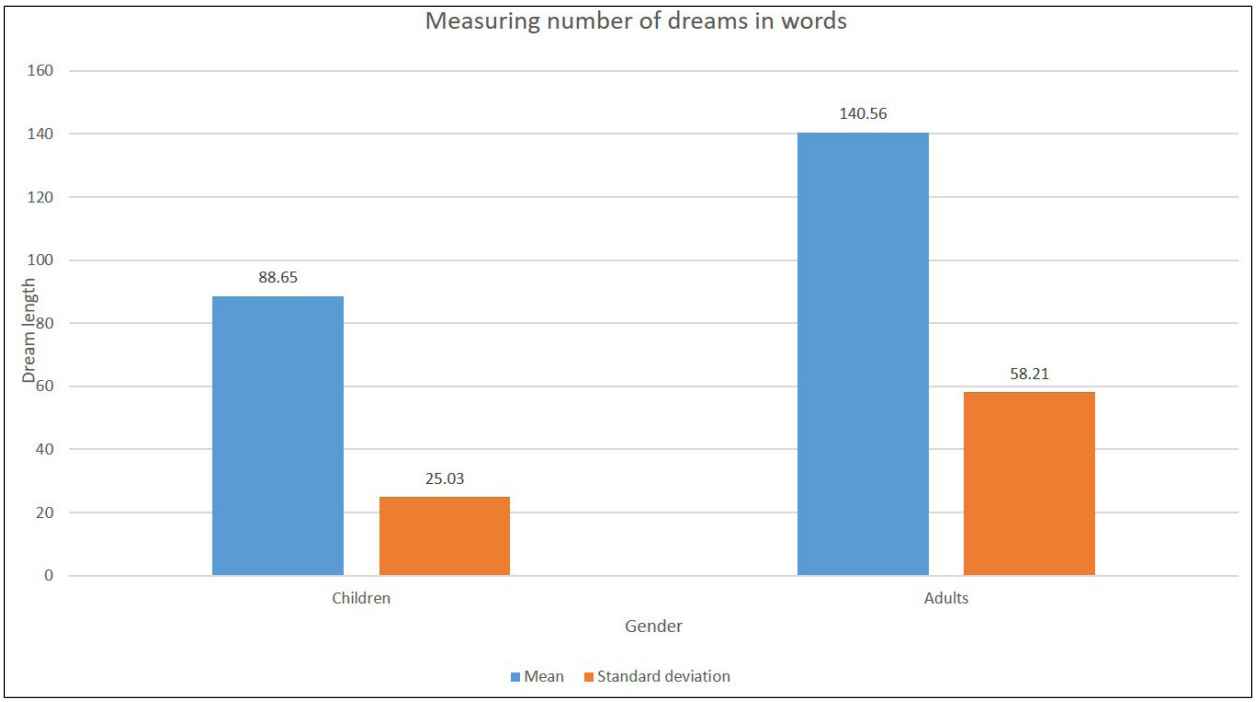


Table 4: Measuring Number of Words in Dreams

Variable	Group	N	Mean	SD	t-value	p-value
Dream Length	Children	60	88.65	25.03	6.346	.0001
	Adults	60	140.56	58.21		



The tables above show that, among children, the mean score for the number of words in dream reports is 73.42 for boys, with a standard deviation of 23.42, and 96.47 for girls, with a standard deviation of 28.45. The t-value calculated for comparing these means is 3.426, and the corresponding p-value is .0001. Since the p-value is less than 0.05 ($p < 0.05$), we conclude that the two means are significantly different. This indicates that boys and girls differ considerably in the number of words in their dream reports. Therefore, we reject the null hypothesis (H_0), which states that there is no significant difference between the number of words in the dream reports of boys and girls. Instead, we accept the alternative hypothesis (H_1), which states that boys and girls differ significantly in the number of words in their dream reports.

In the study of adults, the mean score for assertiveness among males is 116.72, with a standard deviation of 52.67. For females, the mean score is 158.24, with a standard deviation of 65.02. The calculated t-value for comparing these means is 2.718, and the p-value is 0.0087. Since the p-value is less than 0.05 ($p < 0.05$), we conclude that the two means are significantly different. Consequently, we reject the null hypothesis (H0), which states, "Adults, both males and females, do not differ significantly in the number of words in their dream reports." Instead, we accept the alternative hypothesis (H_1), which asserts, "Adults, both males and females, differ significantly in the number of words in their dream reports."

In the final comparison between children and adults, the mean word count in children's dream reports is 88.65, with a standard deviation of 25.03. In contrast, the mean word count for adults is 140.56, with a standard deviation of 58.21. The calculated t-value for comparing these means is 6.346, yielding a p-value of 0.0001. Since the p-value is less than 0.05 ($p < 0.05$), we conclude that the two means are significantly different. Therefore, we reject the null hypothesis (H_0), which states that "Children and adults do not differ significantly in the number of words in their dream reports," and accept the alternative hypothesis (H_1), which asserts that "Children and adults differ significantly in the number of words in their dream reports."

Table 5: Dream Content in Children

Dream Content Index	Specific Indicators	Boys	Girls	z	p
I. Dream Settings	1. Indoor setting percent	42	61	-1.4724	.14156
	2. Familiar setting percent	45	62	-1.3201	.18684
II. Dream Characters	1. Male/female percent	77	42	2.7614	.00578
	2. Familiarity percent	51	76	-2.0112	.04444
	3. Friends percent	22	24	-0.1841	.85716
	4. Family percent	31	57	-2.0286	.04236
	5. Dear&Imaginary percent	6	8	-0.3036	.76418
	6. Animal percent	20	18	0.1974	.84148
III. Social Interactions	1. Aggression/friendliness percent	76	50	2.0857	.03662 p<.05
	2. Befriender percent	43	40	-0.2358	.81034
	3. Aggressor percent	30	18	1.0882	.27572
	4. Physical aggression percent	90	69	2.0147	.0444 p<.05
IV.Social Interaction Ratios	1. A/C Index (Aggression/Character)	.38	.27	No statistical comparisons could be conducted since index values aren't true proportions.	
	2. F/C Index (Friendliness/Character)	.15	.16		
	3. S/C Index Sexuality/Character	.01	.01		
V. Self-concept	1. Self-negativity percent	38	65	-2.0924	.03662 p<.05
	2. Bodily misfortunes percent	37	14	2.0437	.04136 p<.05
	3. Negative emotions percent	56	82	-2.1773	.02926 p<.05
	4. Dreamer-involved success percent	34	68	-2.6342	.00854 p<.05
VI. Dreams with at least one	1. Aggression	52	48	0.3098	.75656
	2. Freindliness	21	28	-0.6304	.5287
	3. Sexuality	2	3	-0.2481	.80258
	4. Misfortune	8	7	0.147	.88076
	5. Good Fortune	5	6	0.1699	.86502
	6. Success	8	6	0.3036	.76418
	7. Failure	7	9	-0.2855	.77182
	8. Striving	10	8	0.2707	.78716

Table 6: Dream Content in Adults

Dream Content Index	Specific Indicators	Male	Female	z	p
I. Dream Settings	1. Indoor setting percent	45	57	-0.9297	.3523
	2. Familiar setting percent	52	62	-0.7823	.4354

Dream Content Index	Specific Indicators	Male	Female	z	p
II. Dream Characters	1. Male/female percent	75	50	2.000	.0455 p<.05
	2. Familiarity percent	49	74	-1.9898	.0466 p<.05
	3. Friends percent	38	40	-0.1588	.8728
	4. Family percent	22	47	-2.0368	.0413 p<.05
	5. Dear&Imaginary percent	7	5	0.3262	.7414
	6. Animal percent	12	10	0.2476	.8025
III. Social Interactions	1. Aggression/friendliness percent	62	43	2.0286	.04236 p<.05
	2. Befriender percent	52	43	0.698	.48392
	3. Aggressor percent	40	17	1.9733	.04884 p<.05
	4. Physical aggression percent	83	60	1.9733	.04884 p<.05
IV. Social Interaction Ratios	1. A/C Index (Aggression/Character)	.34	.27	No statistical comparisons could be conducted since index values aren't true proportions.	
	2. F/C Index (Friendliness/Character)	.16	.15		
	3. S/C Index Sexuality/Character	.05	.05		
V. Self-concept	1. Self-negativity percent	37	69	2.4832	.01314 p<.05
	2. Bodily misfortunes percent	48	21	2.1998	.0278 p<.05
	3. Negative emotions percent	61	82	-1.995	.0466 p<.05
	4. Dreamer-involved success percent	67	38	2.2491	.02444 p<.05
VI. Dreams with at least one	1. Aggression	53	32	1.6453	.09894
	2. Freindliness	25	29	-0.3489	.72634
	3. Sexuality	12	10	0.2476	.80258
	4. Misfortune	10	13	-0.3642	.71884
	5. Good Fortune	6	8	-0.3036	.76418
	6. Success	14	8	0.7427	.4593
	7. Failure	14	8	0.7427	.4593
	8. Striving	22	14	0.8065	.41794

Table 7: Dream Content in Children and Adults

Dream Content Index	Specific Indicators	Children	Adults	z	p
I. Dream Settings	1. Indoor setting percent	58	62	0.4472	.6527
	2. Familiar setting percent	61	68	-0.8012	.4237
II. Dream Characters	1. Male/female percent	59	62	-0.3361	.7278
	2. Familiarity percent	63	61	0.2257	.8181

Dream Content Index	Specific Indicators	Children	Adults	z	p
	3. Friends percent	22	39	-2.0224	.04338 p<0.5
	4. Family percent	48	30	2.0213	.04338 p<05
	5. Dear & Imaginary percent	8	7	0.1681	.8650
	6. Animal percent	19	9	-7.8094	.0000 p<.05
III. Social Interactions	1. Aggression/friendliness percent	75	50	2.000	.0455 p<.05
	2. Befriender percent	55	42	-1.4247	.1556
	3. Aggressor percent	28	32	-0.4781	.63122
	4. Physical aggression percent	74	.56	2.067	.03846 p<0.5
IV. Social Interaction Ratios	1. A/C Index (Aggression/Character)	.36	.25	No statistical comparisons could be conducted since index values aren't true proportions.	
	2. F/C Index (Friendliness/Character)	.15	.15		
	3. S/C Index Sexuality/Character	.01	.05		
V. Self-concept	1. Self-negativity percent	48	55	-0.7672	.4413
	2. Bodily misfortunes percent	25	34	-1.0809	.28014
	3. Negative emotions percent	64	72	-0.9393	.34722
	4. Dreamer-involved success percent	48	51	-0.3286	.7414
VI. Dreams with at least one	1. Aggression	45	42	0.3314	.7414
	2. Freindliness	26	30	-0.488	.62414
	3. Sexuality	3	22	-3.1467	.00164 p<.05
	4. Misfortune	14	12	0.3257	.7414
	5. Good Fortune	10	8	0.3828	.70394
	6. Success	11	10	0.1787	.85716
	7. Failure	8	10	-0.3828	.70394
	8. Striving	14	19	-0.7378	.4593

DISCUSSION AND RESULTS

The tables above reveal significant gender differences in the male-to-female ratio among both children and adults. However, when comparing these differences between children and adults, they are not substantial. It is also noted that the male-to-female ratio increases with age in girls. In other words, as girl children grow into adulthood, they tend to have dreams that reflect a higher male-to-female ratio. These findings align with those of previous studies conducted by Avila-White *et al.* (1999), Domhoff (1996), Oberst *et al.* (2005), Strauch (2005), Strauch & Lederbogen (1999), and Oberst *et al.* (2005).

When it comes to familiar characters in dreams, both children and adults tend to experience dreams featuring more familiar characters than strangers. Notably, girls and women report a higher percentage of familiar characters compared to boys and men. However, there are no significant differences in familiarity percentages between children and adults. This observation aligns with research conducted by Swiss psychologists Strauch (2005) and Strauch and Lederbogen (1999).

Family members frequently appear in dreams. The data indicates that girls and women exhibit higher percentages of family members in their dreams than boys and men in both children and adult groups. Interestingly, the percentage of family members is relatively lower in adults compared to children. The study uncovered several patterns: Firstly, there are significant differences in family percentages between boys and girls, a trend also seen in adults. Secondly, children and adults show significant differences in the percentage of family members appearing in their dreams. Friends play a crucial role in one's personal and social life; thus, it is noteworthy that the percentage of friends appearing in dreams is higher among adults compared to children. These findings are consistent with results from studies conducted by Domhoff (1996), Foulkes (1999), Maggiolini *et al.* (2003), and Strauch (2005).

Regarding the percentage of animals in dreams, there are no significant gender differences between children and adult groups. However, the percentage of animals present in children's dreams is notably higher than in adults. This observation supports the findings of previous studies conducted by Foulkes (1999), Domhoff (1996), Saline (1999), Strauch (2005), and Strauch & Lederbogen (1999).

From the tables presented, it is evident that the percentage of familiar settings in dreams is relatively high compared to unfamiliar or strange settings. Additionally, a trend is observed where more girls in the child group experience familiar and indoor dreams compared to boys. However, the differences between males and females are less pronounced in adults. Notably, adult males showed a significant increase in the percentage of familiar settings. These results are consistent with the research findings of Domhoff (1996), Strauch & Lederbogen (1999), and Strauch (2005).

The data analysis reveals that boys tend to experience more dreams with aggressive elements compared to girls. When examining the aggression/friendliness percentages, it becomes evident that boys and male adults score higher than girls and female adults. Additionally, the aggression and friendliness values of adults are generally lower and more stable than those of children. Statistical analysis indicates significant differences between boys and girls regarding aggression, friendliness, and physical aggression. Similarly, male and female adults also show significant differences in these areas. The data indicates that both children and adults vary considerably in their aggression/friendliness percentages and physical aggression percentages. These findings align with similar research conducted by American psychologists (Avila-White *et al.*, 1999) and Swiss psychologists (Strauch, 2005; Strauch & Lederbogen, 1999). Furthermore, the conclusion drawn from this study— that physical aggression is higher in boys than in girls— is corroborated by studies conducted by Avila-White *et al.* (1999), Oberst *et al.* (2005), and Cristina Riva *et al.* (2008).

In comparison to their counterparts, the percentage of befriending behaviors is relatively high among boys and adult males. Furthermore, it is observed that the befriending percentage score is higher in adults than in children. This study confirms the findings of Robert S. Tartz and Stanley Krippner (2008), who examined cognitive differences in dream content between Argentine males and females. However, the results of the current study do not align with the research conducted by Avila-White *et al.* (1999), which reported a higher befriending percentage among girls.

Regarding the A/C Index, the number of aggressive interactions per dream character is significantly higher for boys and males compared to girls and females. Other social interaction ratios, such as F/C and S/C, are generally similar across genders. However, no statistical comparisons could be made, as the A/C Index values are not true proportions.

Girl children and female adults scored higher self-negativity percentage values compared to boys and male adults. From the above tables, it is inferred that Boys and girls differ significantly with respect to self-negativity percentage, and male and female adults differ significantly with respect to self-negativity percentage. However, the analysis found no significant differences between children and adults concerning self-negativity percentage. The data show that the majority of respondents' emotions are negative. In terms of negative emotion percent, boys and girls differ greatly in children's cases, as do males and females in adults' cases. However, there are no significant differences between children and adults in terms of negative emotions. These findings are in agreement with the findings of the studies conducted by Valli, K., Revonsuo, A., Pälkäs, O., Ismahil, K. H., Jelal Ali, K., & Punamäki, R. L. (2005) on dreams of traumatized children.

CONCLUSION

Regarding the last eight indices under the category of "dreams with at least one…," it was found that, with the exception of sexuality, there are no significant differences between children and adults. Both boys and girls reported a very low occurrence of dreams involving sexual interactions and feelings. In contrast, approximately 22 percent of adult males and females reported experiencing sexual feelings in their dreams. For the other categories—aggression, friendliness, misfortune, good fortune, success, failure, and striving—the differences between children and adults were statistically insignificant.

These findings align with those of several other studies (Avila-White, Schneider, & Domhoff, 1999; Oberst, Charles, & Chamarro, 2005; Saline, 1999; Strauch & Lederbogen, 1999). The scores obtained support the idea that cultural differences influence the dreams of both children and adults. As a result, dream content analysis plays a significant role in understanding the nature of dreams across different age groups.

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Impact of the Psychology of Programming

T.V. Gopal

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Abstract

Human beings are good in ideas and abstractions. Developing Software is a process that expands the documentation with details that are close to the machine. Donald Knuth proposed "Literate Programming" in 1984 which changes the traditional approaches to the design and development of programs. Instead of having the main task as instructing a computer what needs to be done, the focus should be on explaining to human beings what the stakeholders want a computer to do. Instead of writing code containing documentation, the literate programmer writes documentation containing code. The "program" then becomes primarily a document written for humans. Writing a literate program is more intricate than writing a program in a chosen programming language.

With the computers becoming ubiquitous, the inherent essence of computing is so contagious that every human tends to code and even revel in a sequence of codes that work like a program that runs on a computer.

The interplay **"Human X Computer"** with computing as the basis does impact the mental ability as well as the agility of the human coder or programmer. This paper is an overview of certain such impacts.

Keywords: Psychology, Coder, Programmers, Program, Literate Programming, Mental Ability, Mental Agility.

INTRODUCTION

The lack of first principles of software development results in "the software crisis." The North Atlantic Treaty Organization [NATO] Software Engineering Conferences held in 1968[20] and 1969[11] suggested some initial principles given below.

- **Software artifacts are "machines"**
  - ♦ They are primarily characterized as deterministic, in adherence to the principle of cause and effect, describable using appropriate formalism
- **People are potential "machines"**
  - ♦ After initiation with adequate education / training in the understanding of the pertinent formalisms
- With a chosen set of management principles and practices
- **Systems are Cartesian**
- **Model = Machine**

Author's Affiliation: Director, Center for Applied Research in Indic Technologies & Professor, Department of Computer Science and Engineering, College of Engineering, Anna University, Chennai 600025, India.

Corresponding Author: T.V. Gopal, Director, Center for Applied Research in Indic Technologies & Professor, Department of Computer Science and Engineering, College of Engineering, Anna University, Chennai 600025, India.

E-mail: gopal@annauniv.edu

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- Possible to define a formal syntax and grammar capable of Unambiguous description of the implemented machine.

Computers support software models. Software implementations are representations (models) of real-world conceptual systems. The task of development is to represent concepts with technology. Software is developed only once. The cost and effort estimates often have unreliable basis making them go woefully wrong. Software artifacts have many defects resulting in frustrations among all the stakeholders. Software development has programming as an important task. The nature of programming is best expressed as given below.

"I have often felt that programming is an art form, whose real value can only be appreciated by another versed in the same arcane art; there are lovely gems and brilliant coups hidden from human view and admiration, sometimes forever, by the very nature of the process". - Ed Nather (UUCP email address utastro! nather), The Story of Mel, Usenet news group "net.followup" on May 21, 1983.

The process is such that, it is very difficult to read the code scripted by another programmer. Maintaining an existing software is both expensive and cumbersome. The thumb rule is if more than 10% of an existing code needs to be modified, it is better to scrap the entire code and rewrite the program. It takes ten years to learn programming in a chosen language[19]. There are unlimited number of possibilities to solve a problem and there are no strict constraints or nature imposed limits except those stemming from the complexity that is difficult to determine in advance.[10]

Software engineers[3] are highly individualistic and they resist being forced into an organizational structure. The speed of technological advancements hinders both planning and organization of software projects. New and powerful components appear during the project development forcing redesign.

The benefits of tools deployed are difficult to assess in advance.[4] In summary, programming is:

1. Human Performance
2. Social Activity [Peer Support, Mentoring, Professional Societies]
3. Individual Activity
4. Tool - Based

Software began to be understood as a simultaneous crafting of Art, Science, Discipline and Psychology. The aspects of crafting the program amply illustrates the cognitive complexity that is far beyond mere coding skills. Programming highlights the human element as psychological factors on programmers' efficiency, effective creativity, and well-being.

PROGRAMMING AND THE BRIAN

Programming helps one to understand technology, visualize data and enhance problem solving skills. Programming improves the logical thinking skills by allowing the problems to be seen from a new perspective. This can be applied to any scenario both in the personal and professional life.

Algorithmic thinking[7] ideally is to work towards a generic formula for every solution of a given problem. It is eventually an expression of the solution in the form of a series of ordered steps with each step having a clear definition. Algorithm enables the programmers to visualize problems using the abstractions of data flow and the transformation of input into output. An algorithm with a good notation clearly establishes the efficiency, scalability, and maintainability of the coded solutions.

"The Algorithm's coming-of-age as the new language of science promises to be the most disruptive scientific development since quantum mechanics." - Bernard Chazelle, Eugene Higgins Professor of Computer Science, Princeton University, USA.

People tend to underestimate the difficulty of the task. Overconfidence explains most of the poor quality of software being developed. Doing it right is hard work and the adoption of shortcuts is leading to disasters. Software Testing[13] has the following four facets.

1. **Art:** There is individualism in the choice of test cases from within the space of valid inputs.
2. **Science:** The test results are independently verifiable
3. **Discipline:** The test cases must cover a wider space of the mapping from set of well-defined inputs to well defined outputs
4. **Psychology:** No programmer wants to choose test cases that fail / Report too many failure cases.

There is a popular opinion that programming warrants lot of mathematics. It does require some mathematics. The goal of programming has always been to arrive at a formula which is the solution for the given problem and lends itself to a formal proof. However, this is proving to be extremely difficult[14].

One can program in the mind without any need to relate it to the computer. Language is a wonderful thing. It can be used to express thoughts, to conceal thoughts, but more often, to replace thinking. Programming relies more on the language centers in the brain rather than mathematics. Programming language has far limited vocabulary and syntax to learn than natural language. Learning programming in a specific language is not the same a becoming bi-lingual. Other than the programming language, one needs to organize in the mind the moments on the computer screens to interact with the computer. The working memory is the brain's Random Access Memory [RAM]. To understand a line of code, a programmer requires the working set i.e lines of code before and after this line to keep in mind to trace of debug.[15] This working set is imaged in the brain and the logical reasoning within this working set is the mathematical model of the crucial abstraction. The process is replete with abstract symbols and ideas that need to be manipulated to convey higher level concepts[1].

The brain areas involved in this processing at an abstract level are the same as those associated with the verbal semantic processing.[17] Language represents ideas in the brain and a program with limited vocabulary and syntax represents logic.[9] Please see *Fig*. 1.

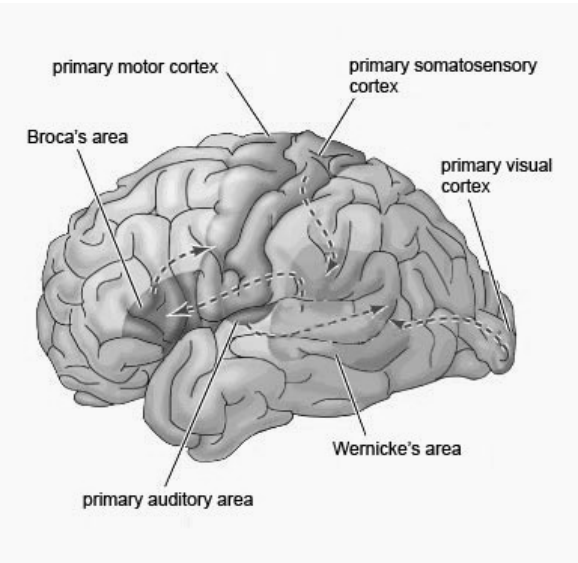

Fig. 1: Language Areas in the Human Brain

The working set needed to model the logical reasoning fits into the "Working Memory" of the human brain seen in *Fig. 2*. "Working memory"[18] is at the core of many real – world functions through a vast set of mnemonic processes and associated brain/neural networks related to the basic intellectual abilities.

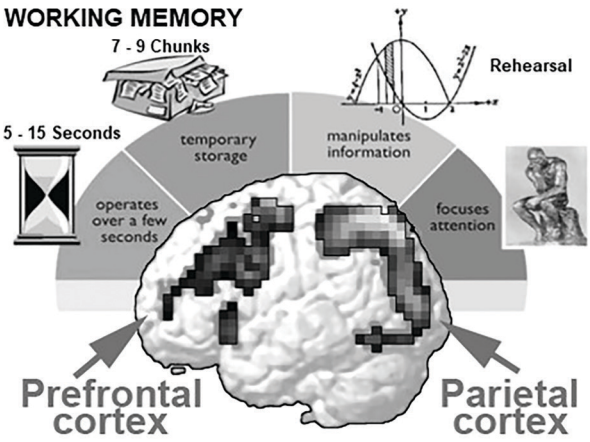

Fig. 2: Working Memory of the Human Brian

The "Working Memory" processes and interactions[2] are seen in *fig. 3*.

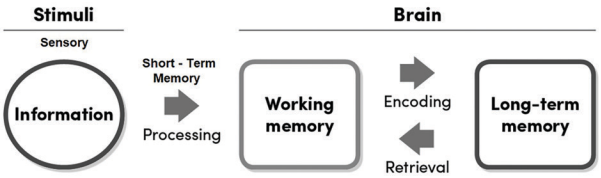

Fig. 3: Working Memory Proceses

PROGRAMMERS ON NOOTROPICS

At least in theory, the brain of a programmer is good at abstraction, language and the Working Memory[12]. Working memory is related to short-term memory, but it is active for slightly longer time and is thus involved in the manipulation of information. Concentrating on the act of programming catches on. The trouble is shaking off this spell. Programming really confirms to the philosophy of "work is its own reward".

However, the nature of programming is such that, the following traits are commonly seen in the best of brains doing computing.

- **Frustration:** Programming the solutions for complex problems often times shakes the programmer out of the comfort zone due to the bugs, and errors. The trial-and-error method for tracing the errors and debugging when there is lack of clarity of the solution may lead to seemingly inevitable frustration and feelings of inadequacy / incompleteness.
- **Burnout:** The demanding nature of programming, coupled with the stiff deadlines often lead to mental fatigue and burnout. The typical symptoms include

exhaustion, cynicism, and significantly reduced professional efficacy that clearly shows on one's quality of life and work.

Nootropic also known as 'cognitive enhancers' are drugs that some people use to hopefully improve memory, increase mental alertness and concentration as well as boost energy levels and wakefulness. There are many different nootropics. Some of them are pharmaceutical drugs that treat conditions such as sleepiness or narcolepsy. Prescribed by a qualified medical practitioner they improve attention span and focus in people with attention disorders. However, some healthy people also tend to use these drugs hoping to improve their cognitive performance and memorizing skills.

Medically, the nootropics may help mask or mitigate fatigue, procrastination or boredom. Usually, these drugs do not make people more intelligent. The effect of these drugs is experienced only when they are chemically within the body. The body needs their replenishment at regular intervals. Such a requirement may cause dependence and can have a wide range of side effects making the young programmers highly vulnerable as they progress in the profession.

Nootropics are also known as Smart Drugs, Brain Boosters, Memory Boosters, Neuroenhancers, Drive Drugs and Study Drugs.

The research is still inconclusive but the early results indicate that they may act on a variety of different systems within the human body and mind simultaneously. Some researchers report that Nootropics can cross the Blood – Brain – Barrier to increase blood flow to the brain and hence more oxygen. Some of the nootropics may raise the adrenalin levels and produce effects like drinking large amounts of caffeine. Use of dopamine tends to result in dependence. Eugeroics are a class of drugs that promote wakefulness and alertness.

BRAIN IMPLANTS

Neurosurgeons all around the world have been implanting electrodes into the human brain for decades to calm down the irregular spikes and spurts in the electrical activity that is responsible for some symptoms. The current brain/neural implants are much more sophisticated and they allow full-duplex or two-way communication between the brain and device or devices,

Machine learning and artificial intelligence are also expected to make the neural implants more sophisticated and intelligent. Integrating neural implants with other technologies, such as virtual and augmented reality promise new possibilities for treating and enhancing human cognitive function. "Brain – as – Computer" metaphor is now much cliched.

"Descartes was impressed by the hydraulic figures in the royal gardens, and developed a hydraulic theory of the action of the brain. We have since had telephone theories, electrical field theories, and now theories based on computing machines… We are more likely to find out how the brain works by studying the brain itself, and the phenomenon of behavior, than by indulging in far-fetched physical analogies." - Karl Lashley, Neuroscientist, 1951.

Psychology of Programming will be vastly improved with Brain Implants as seen in the *fig. 4*.

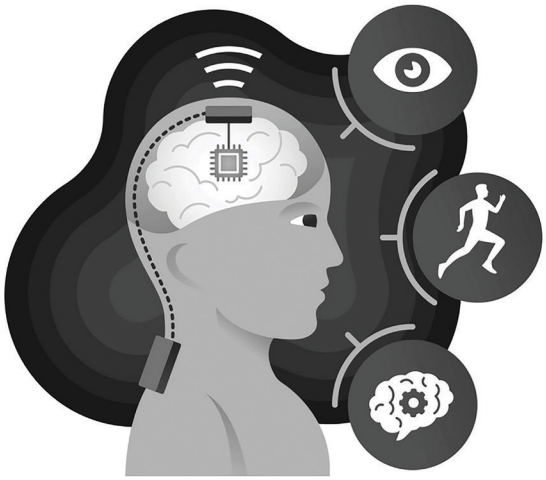

Fig. 4: Brain Implants

There are many technical challenges involving the collection, export, and the interpretation of the signals from the brain. It is a promising science in its infancy. The surgically invasive brain related methods require appropriate rules and ethics that are evolving.

Programming and Formation of Habits

In mastering any profession, the whole man is involved, body and mind, sensation and movement, thought, interest, imagination, will and similar such innumerable known and unknown aspects of our psycho-physical life. Habits emerge because the brain is constantly looking for optimizing effort[5]. The process by which the brain converts a sequence of actions into an automatic routine is known as "chunking". It is at the root of how habits form. Habits form when new behaviours become sub-conscious.

The" Min – Max" is a common sensical habit formed in many good programmers. A programmer most frequently attempts to "Minimize X and Maximize Y". For example: minimise effort and maximize effect or minimize losses and maximize gains.

Diverse changes of activity within and across circuits encode habit formation.[6] Habits are differently processed by striatal output pathways. Key questions concern action sequences, avoidance habits, and habit modulation. Habits may involve components with distinct neural signalling processes.

Habits are actions that are triggered by cues, such as a time of day, an activity, or a location. They culminate in a feel-good reward that when repeated often times will blur the distinction between the cue and the reward.

"If we can find the neural basis of programming and see which other cognitive functions share their neural basis, it provides a hint to what skills are needed to learn to code." - Yun-Fei Liu, John Hopkins University Neuroplasticity and Development Laboratory, USA.

CONCLUSIONS

In computer programming, more emphasis is placed on the mechanization rather than on the human element. A proper study of programming positions the individual in the context of the work and its social conditions. Psychology of Programming is an interdisciplinary area spanning into computer programmers' cognition[16], design and development of tools and methods for programming and related activities such as education and training. This paper is a unique attempt to bring together certain medical aspects that may enable a better understanding of the impact of programming on the brain of the programmer.

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Pathological Laughter as a Manifestation of Left Frontal and Right Pons Stroke

Asmita Mukund Toro[1], Hemendra Singh[2], Lahari R.[3]

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Abstract

Background: Pathological laughter is a disorder of emotional expression characterized by bouts of uncontrollable laughter with no motivating factor. It is seen in various neurological disorders such as Post Traumatic Brain injury, Post stroke, Multiple sclerosis, Amyotrophic lateral sclerosis, etc.

Case Summary: Here, we present a case of a 46 year old male who presented with pathological laughter to the psychiatry outpatient department following acute infarct in the left frontal and right pons area of the brain.

Discussion: Our patient had developed pathological laughter subsequently after right pons and left frontal infarct as pseudobulbar affect. Our case report is unique as both the voluntary and involuntary pathways mediating laughter are involved.

Conclusion: Hence, our case may be indicative of possible role of combination of antipsychotics and antidepressants, which warrants further research.

Keywords: Pathological laughter, Brain Infarct, Pseudobulbar affect.

INTRODUCTION

Pathological laughter is defined as episodes of uncontrollable laughter with no motivating stimulus or inappropriate stimulus under normal conditions.[1] It is a disorder of expression of emotion. Pathological laughter when associated with pathological crying is also known as pseudobulbar affect, emotional incontinence, and emotional lability. Pathological laughter has been described in various neurological disorders such as Alzheimer's disease, Multiple sclerosis, Traumatic Brain injury, Tumors of the Cerebello-pontine region, and Stroke.[2-4] The prevalence following stroke is reported to be about 10 to 20%.[5] Here we present a case of pathological laughter following a stroke in the left frontal and right pons.

CASE SUMMARY

A 46-year-old male presented to the emergency department with complaints of giddiness and episodes of uncontrollable laughter since 4 days. These episodes of laughter arose immediately following a non specific stimulus and were irrespective of the situation. These episodes are

Author's Affiliation: [1]Senior Resident, [2]Associate Professor, [3]Junior Resident, Department of Psychiatry, M.S. Ramaiah Medical College and Hospitals, Bangalore 560054, Karnataka, India.

Corresponding Author: Hemendra Singh, Associate Professor, Department of Psychiatry, M.S. Ramaiah Medical College and Hospitals, Bangalore 560054, Karnataka, India.

E-mail: hemendradoc2010@gmail.com

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uncontrollable, lasted for a few minutes,and persisted throughout the day. The patient's social and personal behaviour was found to be appropriate except for the bouts of inappropriate laughter. Patient was a known case of hypertension. The patient had no past or family history of any psychiatric illness.

On neurological examination,the patient was found to have dysarthria, bradykinesia, reduced arm swing, and brisk deep tendon reflexes. The patient had difficulty in initiation of walking and short steps. Mini mental status examination score of 22/30 was obtained. Cardiovascular, Respiratory, and per Abdominal examinations were within normal limits.

MRI brain showed acute infarct in the left frontal and right pons with chronic lacunar infarct left cerebellar region. (*See fig. 1*)

The patient was treated with Tablet (Tab) Aspirin 150mg/once a day, Tab Atorvastatin 20mg/once a day, Tab Clopidogrel 75mg/once a day, Tab Cilnidipine 5mg/once a day, and Tab Risperidone was given upto 5mg/once a day. However the patient while on Risperidone developed developed tremors and masked like facies. Hence Risperidone was tapered and stopped in view of risk of worsening of extrapyramidal symptoms. Patient was started on Escitalopram which has been titrated to 15mg with 80% improvement of symptoms during follow up.

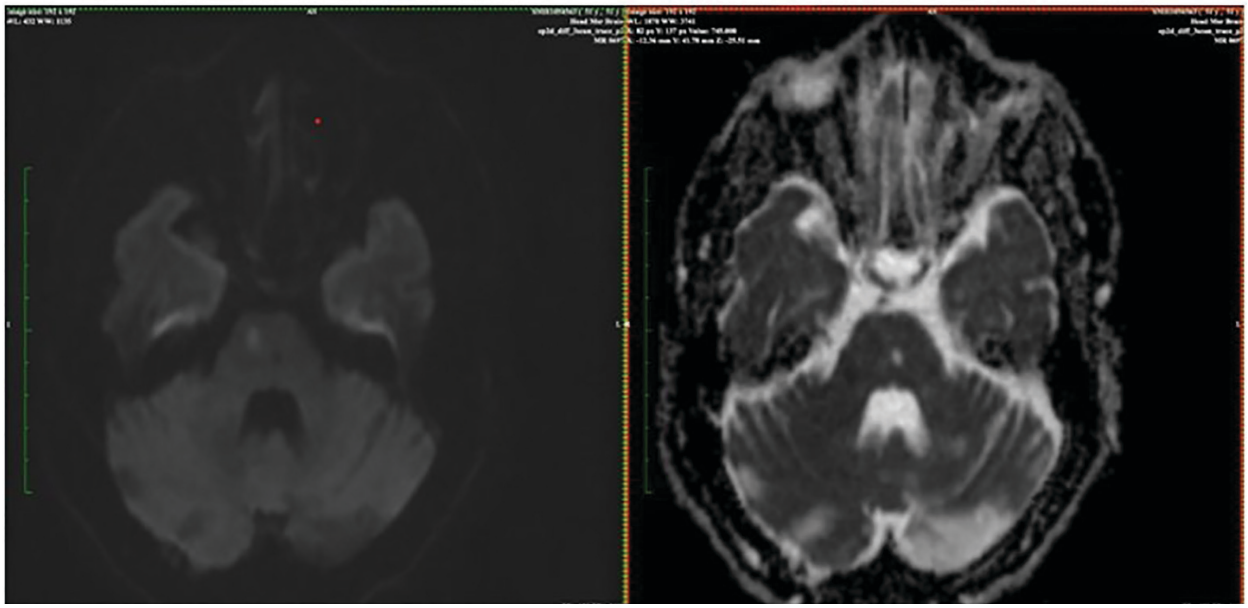

Fig. 1: Right pontine lacunar focus of diffusion restriction with low ADC

DISCUSSION

Pathological laughter is a disorder of emotional expression characterized by episodes of uncontrollable laughter. These bouts may be provoked by stimuli that are congruent to emotion but the response is increased in intensity. Or stimulus may have an emotional valence contrary to the expression.[6] Normally laughter is produced in the presence of stimuli that trigger happiness. The ability to understand that a particular stimulus should be perceived as happiness depends on it being perceived or recollected in a particular social or cognitive context.[7] This function is mediated by the emotion induction sites namely ventromedial prefrontal cortex, anterior cingulate cortex, amygdala, and ventral striatum.[8] The emotion effector sites control facial and respiratory muscles and include motor cortices, hypothalamus, periaqueductal grey matter, cranial nerve nuclei, and premotor cortex.[8] The pathways for emotion induction and effector pass through the cerebellum. Cerebellum plays a modulatory role in controlling the intensity, duration, and whether an emotion should be expressed in a given social context. Pathological laughter is hence produced by the dysfunction of any of these pathways.[1] In our case, the patient had an acute infarct affecting frontal and pontine areas and a chronic cerebellar infact and hence these pathways involvement might be a underlying cause for the pathological laughter.

Serotonergic dysfunction has been implicated in pathological laughter and crying. Serotonin receptors are widespread in the brain and are present on descending pathways to cerebellum. These pathways control emotions.[9] Selective serotonin reuptake inhibitors (SSRI) have been used in the treatment of pathological laughter and crying. For pathological laughter post stroke Citalopram,[10] Sertraline,[11] Fluoxetine,[12] and Amitriptyline[13] have been tried. For patients not responding to SSRIs Venlafaxine[14] and Mirtazapine[15] have been tried. In patients with multiple sclerosis and amyotrophic lateral sclerosis combination therapy of Dextromethorphan/Quinidine has been used.[16] Topiramate an antiepileptic agent has also been used in a case with PLC following cerebral lupus.[17] Recent studies have implicated other neurotransmitters such as dopamine, norepinephrine, and glutamate in the pathogenesis of PLC.[18] A case report of pathological laughter following pontine haemorrhage was treated with Dextromethorphan and no improvement was seen. The patient was treated with a low dose of Quetiapine and a drastic improvement was noted.[19] Our patient was treated with atypical antipsychotic Risperidone and improvement was noted. However, the patient developed extrapyramidal side effects and hence a trial of Escitalopram (SSRI) is being tried. Hence further studies using atypical antipsychotics and SSRI as treatment options are needed.

CONCLUSION

Pathological laughter is not a unusual manifestation of the brain infarct. Our case presented with pathological laughter as a consequence of left frontal and right pons infarct which responded well with SSRI.

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Conflicts of interest: Nil

Financial Interests: Nil

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