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Effectiveness of Nurse Led Intervention on Body Mass Index and Biochemical Parameters in Adolescent Girls with Menstrual Irregularities

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Abstract **Introduction:** Menstrual irregularities are common in adolescent females and are often related to abnormal Body Mass Index (BMI) and changes in biochemical measures. Hormonal imbalance, metabolic disturbances and diseases like polycystic ovary syndrome can have much influence on menstrual health. **Aim:** This study aimed to assess the effect of a nurse-led intervention in relation to body mass index and some biochemical parameters on menstrual irregularities in adolescent girls. **Methods:** A quantitative pre-experimental one group pre-test and post-test design was followed. The study was done in the gynaecology outpatient department of Government Hospital, Thoothukudi. A total of 200 adolescent girls with menstrual irregularities were selected using non-probability purposive sampling. A baseline data collection was done using demographic variables, menstrual assessment checklist, BMI measurement and biochemical investigations. A structured nurse-led intervention comprising health education and lifestyle modification was delivered for 24 weeks, with outcome assessments performed at baseline and at the 8th, 16th and 24th weeks. Data were analysed with descriptive statistic, repeated measures Analysis of Variance and Chi-Square test. **Results:** Significant improvements were found in physiological and biochemical parameters between visits. BMI decreased from 31.99 to 31.08 ($F = 97.003$, $p<0.001$). Random blood sugar, total cholesterol, triglycerides, urea, creatinine, T3, T4 and TSH reduced significantly ($p<0.001$). There was a significant improvement in ultrasound findings with a significant increase in normal findings from 85.5% at visit 1-99.5% at visit 3 (chi-squared = 26.971, $p<0.001$). **Conclusion:** The nurse-led intervention was effective in improving BMI, biochemical parameters and ovarian morphology which indicated the overall improvement in the metabolic and reproductive health of the adolescent girls with menstrual irregularities.

Key Words Menstrual Irregularity, Adolescent Health, BMI and Lifestyle Intervention

INTRODUCTION

Menstrual irregularities are an important reproductive health issue in adolescent girls that is often associated with abnormal Body Mass Index (BMI) and disrupted biochemical parameters [1,2]. Elevated BMI is linked to hormonal disturbances such as insulin resistance, hyperandrogenism and altered levels of leptin, which contribute to menstrual dysfunction [3,4]. Biochemical parameters like fasting glucose, insulin, lipid profile and thyroid hormones are known to affect the ovarian function and the regularity of the menses [5]. Conditions such as Polycystic Ovary Syndrome (PCOS), which is associated with irregularity of periods and disturbance of the metabolism, are becoming more and more common among adolescents [6].

Nurse-led interventions include a wide range of interventions such as health education, lifestyle modification counselling, non-pharmacological strategies for pain management and clinical monitoring of anthropometric and biochemical parameters [7,8]. Lifestyle modification interventions, where nurses are ideally positioned to help, have shown a significant improvement in BMI, regularity of menstruation, hormonal profiles and metabolic parameters in adolescent girls with PCOS and menstrual related disorders.

Exercise based interventions have also shown significant changes in menstrual cycles, LH level and triglyceride level [9].

Non-pharmacological strategies, such as warm compress therapy, has been validated as an effective nurse-facilitated self-care interventions on reduction of primary dysmenorrhea among adolescents where statistically significant pain reduction were reported ($p = 0.000$) [10]. Studies confirm that endocrine abnormalities such as thyroid problems, high prolactin and hyper androgenism are common in adolescents with menstrual disorders, which requires systematic screening by nurses [11].

Biochemical parameters such as fasting insulin, fasting glucose, lipid profiles and insulin resistance indices are important targets of monitoring in adolescent girls with menstrual irregularities. Menstrual irregularity has been significantly correlated with higher BMI, elevated fasting insulin levels and insulin resistance ($p<0.05$) which has been associated with the need for nurse-led metabolic surveillance [12,13].

Despite known links between BMI, biochemical parameters and menstrual irregularities, there is currently a lack of structured and nurse-led intervention studies focusing on adolescents girls in particular. Existing literature focuses mainly on pharmacological or lifestyle modification intervention in adult women, there is lack of evidence concerning nurse led educational and clinical interventions dealing with adolescent specific metabolic and menstrual outcomes.

This study is unique in assessing the efficacy of nurse-led intervention in changing BMI and biochemical parameters of interest in improving menstrual irregularities among adolescent girls to fill a critical gap in adolescent reproductive health nursing research.

Objectives

The main objectives to evaluate the Effectiveness of Nurse Led Intervention on Body Mass Index and Biochemical Parameters in Adolescent Girls with Menstrual Irregularities.

METHODS

Study Design

The current study adopted a quantitative research methodology with one-group pre-test and post-test design where the researcher used a pre-experimental design since the study involved a pre-test and a post-test with a one-group design to establish the effectiveness of a nurse-led intervention to improve Body Mass Index (BMI) and the selected biochemical parameters in adolescent girls with menstrual irregularities.

Participants and Sampling

The research was carried out at the Gynaecology Outpatient Department of Government Hospital, Thoothukudi. The participants were the adolescent girls who were in the OPD at the time of the study. There were 200 participants who were chosen through non-probability purposive sampling method. The inclusion criteria were adolescent girls between the ages of 12 and 18 and had reached their menarche and were willing to take part in the study. Girls who had not yet reached menarche or those who did not want to participate in the study were not included in the study. The total time the research lasted was 1 year.

Intervention

A structured nurse-led intervention was administered to the participants after the baseline assessment. The intervention was primarily based on the education and lifestyle change aimed at enhancing menstrual health. The program featured both the menstrual cycle and the common disorders in the menstrual cycle as well as the need to maintain reproductive health. It was also advised on how to adopt healthy lifestyle habits, including having a balanced diet, having regular integrated exercises at least three or five times a week, meditating to de-stress, avoiding excessive consumption of caffeine and keeping a consistent sleep schedule with a regular bedtime. These actions were supposed to achieve hormonal balance, increase BMI and regular menstruation.

Tools

A structured tool, designed to be used in the study was used in data collection. The first part had demographic data of the participants, age and educational status among other pertinent background information. The second part included a checklist to evaluate menstrual pattern and determine menstrual abnormalities, such as the duration of menstrual cycle, the frequency and associated symptoms. Measurement of Body Mass Index (BMI) was the third component that was obtained through calculating the height and the weight of the participants to ascertain their nutritional status. Besides these tools, a set of necessary biochemical parameters were evaluated by such diagnostic studies as the level of blood sugar, thyroid profile, complete hemogram, lipid profile, coagulation profile, renal function test and ultrasonography of the abdomen and pelvis.

Data Collection Procedure

The data collection was conducted under the permission of the relevant authorities of the chosen hospital. In the gynaecology outpatient department, adolescent girls meeting the inclusion criteria were approached and briefed on the aim of the study. The demographic questionnaire, menstrual assessment checklist, BMI measurement and biochemical investigations were used to collect the baseline data after gaining their consent. The intervention was the nurse-led intervention, which occurred after the pre-test assessment. The participants were then followed up and re-examined at the 8th, 16th and 24th weeks to measure the change in menstrual patterns related to changes in BMI and biochemical parameters.

Statistical Analysis

The data that were collected were coded and an analysis done using the right statistical software. The study variables were

summarized using descriptive statistics like frequency, percentage, mean and standard error. To identify the variations in the physiological and biochemical parameters among the three visits, Repeated Measures Analysis of Variance (RM-ANOVA) was used. The differences between visits regarding the abdomen and pelvic abdomen ultrasound revealed were analyzed using chi-square test. A p-value that was lower than 0.05 was regarded statistically significant.

RESULT

Socio-Demographic and Gynecological Variables

Table 1 shows the socio-demographic characteristics of the girls. Among the 200 participants, the majority 122 (61%) were aged 16-19 years and most 162 (81%) attained menarche at 12-13 years. All participants had school education. Nearly half 96 (48%) had a family income of Rs.10001-20000. Most were Christians 97 (48.5%) and belonged to nuclear families 164 (82%). Almost all 197 (98.5%) followed a non-vegetarian diet and the majority 161 (80.5%) resided in urban areas.

Table 2 presents the gynecological variables of the girls. All girls 200 (100%) reported irregular menstrual cycles. About 105 (52.5%) had a cycle length of 22-35 days. More than half experienced very light menstruation 112 (56%) and scanty bleeding 112 (56%). Most 112 (56%) reported menstrual flow of less than 2 days. Bleeding between periods was reported by 110 (55%) and 108 (54%) experienced pain during menstruation, with mild pain being the most common 108 (54%).

Physiological Parameters

Table 3 shows the physiological parameters of the experimental group across visits. Body Mass Index significantly decreased from visit 1 (31.99±0.439) to visit 3 (31.08±0.448) ($F = 97.003$, $p<0.001$). Respiration rate also showed a significant change across visits ($F = 25.261$, $p<0.001$). Systolic blood pressure ($F = 7.947$, $p<0.001$) and diastolic blood pressure ($F = 5.779$, $p = 0.003$) demonstrated significant variations across visits. However, pulse rate did not show a statistically significant difference ($F = 1.269$, $p = 0.282$).

Table 1: Socio-Demographic of Girls (n = 200)

S. No.	Parameter	Category	Number	Percentage
1	Age (years)	10-12	9	4.5
		13-15	69	34.5
		16-19	122	61.0
2	Age at menarche (years)	12-13	162	81.0
		14-15	38	19.0
3	Education	No formal education	0	0
		School education	200	100
4	Family income (Rs)	<10000	84	42.0
		10001-20000	96	48.0
		>20001	20	10.0
5	Religion	Hindu	75	37.5
		Christian	97	48.5
		Muslim	28	14.0
6	Type of family	Nuclear	164	82.0
		Joint	36	18.0
7	Type of diet	Vegetarian	3	1.5
		Non-vegetarian	197	98.5
8	Residence	Urban	161	80.5
		Rural	39	19.5

Table 2: Gynecological Variables of Girls (n = 200)

S. No.	Parameter	Category	Number	Percentage
1	Type of Menstrual Cycle	Regular	0	0
		Irregular	200	100
2	Average days of the menstrual cycle	<21 days	36	18.0
		22-35 days	105	52.5
		>36 days	59	29.5
3	Experience of very light menstruation	Yes	112	56.0
		No	88	44.0
4	Amount of bleeding	Scanty	112	56.0
		Moderate	44	22.0
		Heavy	44	22.0
5	Average days of menstrual flow	<2 days	112	56.0
		3-7 days	44	22.0
		>8 days	44	22.0
6	Bleeding in between periods	Yes	110	55.0
		No	90	45.0
7	Pain during menstruation	Yes	108	54.0
		No	92	46.0
8	Severity of pain during menstruation	Mild	108	54.0
		Moderate	71	35.5
		Severe	21	10.5

Table 3: Physiological Parameters of the Experimental Group Across Visits (n = 200)

Parameter	Visit	Mean	SE	RM-ANOVA F	p-value
Body Mass Index (kg/m²)	Visit 1	31.994	0.439	97.003	<0.001
	Visit 2	31.638	0.452		
	Visit 3	31.080	0.448		
Pulse (beats/min)	Visit 1	74.850	0.418	1.269	0.282
	Visit 2	74.360	0.332		
	Visit 3	74.353	0.297		
Respiration (breaths/min)	Visit 1	20.060	0.114	25.261	<0.001
	Visit 2	21.302	0.117		
	Visit 3	20.770	0.139		
Systolic Blood Pressure (mmHg)	Visit 1	107.450	0.347	7.947	<0.001
	Visit 2	107.725	0.306		
	Visit 3	109.305	0.416		
Diastolic Blood Pressure (mmHg)	Visit 1	71.350	0.306	5.779	0.003
	Visit 2	72.646	0.420		
	Visit 3	73.369	0.371		

Table 4: Biochemical Parameters of the Experimental Group Across Visits (n = 200)

Parameter	Visit	Mean	SE	RM-ANOVA F	p-value
Random Blood Sugar (mg/dL)	Visit 1	88.670	0.597	150.944	<0.001
	Visit 2	86.037	0.531		
	Visit 3	84.267	0.501		
Total Cholesterol (mg/dL)	Visit 1	176.280	1.079	253.246	<0.001
	Visit 2	173.820	1.093		
	Visit 3	169.267	1.070		
Triglycerides (mg/dL)	Visit 1	130.015	0.640	332.259	<0.001
	Visit 2	126.947	0.630		
	Visit 3	121.717	0.633		
Urea (mg/dL)	Visit 1	17.660	0.345	13.718	<0.001
	Visit 2	17.392	0.341		
	Visit 3	16.701	0.320		
Creatinine (mg/dL)	Visit 1	0.791	0.0106	237.934	<0.001
	Visit 2	0.731	0.0083		
	Visit 3	0.628	0.0077		
T3 (pg/mL)	Visit 1	3.095	0.041	24.314	<0.001
	Visit 2	2.990	0.044		
	Visit 3	2.965	0.045		
T4 (µg/dL)	Visit 1	10.959	0.066	121.092	<0.001
	Visit 2	10.715	0.062		
	Visit 3	10.362	0.071		
TSH (µU/mL)	Visit 1	3.516	0.033	163.371	<0.001
	Visit 2	3.359	0.036		
	Visit 3	3.194	0.034		

Table 5: Ultrasound Analysis of the Abdomen and Pelvic Region of Girls with Menstrual Irregularity

S. No.	Visit	Normal	Small follicle	Polycystic ovaries	Chi-square test
1	Visit 1	171 (85.5)	13 (6.5)	16 (8.0)	$X^2 = 26.971$
2	Visit 2	163 (86.2)	13 (6.9)	13 (6.9)	p<0.001
3	Visit 3	186 (99.5)	0 (0)	1 (0.5)	

Biochemical Parameters

Table 4 presents the biochemical parameters of the experimental group across visits. Random blood sugar, total cholesterol, triglycerides, urea, creatinine, T3, T4 and TSH showed statistically significant changes across visits (p<0.001). Overall, the mean values of these biochemical parameters showed a decreasing trend from visit 1 to visit 3, indicating significant improvement over time.

Ultrasound Analysis

Table 5 presents the ultrasound analysis of the abdomen and pelvic region of girls with menstrual irregularity. At visit 1, the majority 171 (85.5%) had normal findings, while 13 (6.5%) had small follicles and 16 (8.0%) had polycystic ovaries. At visit 2, 163 (86.2%) showed normal findings, whereas 13 (6.9%) each had small follicles and polycystic ovaries. By visit 3, most participants 186 (99.5%) had normal findings, with only 1 (0.5%) showing polycystic ovaries. The difference across visits was statistically significant ($\chi^2 = 26.971$, p<0.001).

DISCUSSION

The present study showed significant improvements of several physiological and biochemical parameters throughout three visits, indicating the possible efficacy of the intervention under investigation. The significant drop in BMI from 31.99-31.08 (p<0.001) is consistent with evidence that a reduction in BMI is associated with favorable

cardiometabolic outcomes. Kristjánsson *et al.* [14] reported that rises in BMI are strongly linked with rises in both systolic and diastolic blood pressure in women and drops in BMI have the potential to be protective cardiovascular factors. Similarly, lifestyle intervention studies have shown that reducing body weight is possible and clinically significant as Xu *et al.* [14] showed significant weight loss after structured lifestyle and dietary interventions ($p<0.05$). These findings support the clinical relevance of the modest weight loss in terms of BMI that was seen in the current study.

The modest but statistically significant improvements in systolic blood pressure (107.45-109.30, $p<0.001$) and diastolic blood pressure (71.35-73.37, $p = 0.003$) should be interpreted with caution because both values remained within the normal physiologic limits. Pozzan *et al.* [16] established that systolic and diastolic blood pressure are positively associated with BMI ($p<0.05$), thus indicating that residual adiposity may affect blood pressure level even when BMI declines. In addition, Sinha et al. reported that blood pressure in normotensive females may be significantly different at different time points due to environmental or seasonal influences ($p<0.001$) and therefore, it is possible that the variations reported are physiological fluctuations rather than clinical abnormalities [17]. The lack of a significant difference in pulse rate ($p = 0.282$) is in accordance with the results by Oliveira *et al.* [18] who showed a lack of significant differences in heart rate during time intervals under different physiological conditions ($p>0.05$).

The positive effect regarding the reduction of random blood sugar from 88.67-84.27 mg/dL ($p<0.001$) is suggestive of an improvement in glycaemic control of the participants and found to be in line with previous evidence that lifestyle interventions were found to be effective in improving glucose metabolism. Xu *et al.* [15] showed that structured lifestyle interventions had a significant effect on reduction of plasma glucose levels and even small weight loss was linked with measurable reductions in blood glucose. The changes seen in the total cholesterol levels (176.28-169.27 mg/dL, $p<0.001$) and triglyceride (130.01-121.72 mg/dL, $p<0.001$) levels of patients further suggested improvements in metabolic status. Earlier research by Kristjánsson *et al.* [14] highlighted that BMI as well as body weight change are independent of lipid profiles, changes and blood pressure trajectories. In addition, Hakala and Tilvis [19] reported that fluctuations in serum cholesterol ($r = 0.207$, $p = 0.002$) and triglycerides ($r = 0.160$, $p = 0.016$) are significantly correlated with changes in blood pressure with the interrelationship among metabolic constituents.

The significant decrease in urea from 17.66-16.70 mg/dL ($p<0.001$) and Cinae from 0.791-0.628 mg/dL ($p<0.001$) appears to indicate the improvement in the renal function at the period of the study. Previous studies have placed emphasis on the fact that biochemical renal markers are strongly linked to cardiovascular and metabolic parameters. Sistani *et al.* [20] demonstrated that systolic blood pressure, microalbuminuria and glomerular filtration rate are significantly associated with renal resistive indices in patients with metabolic disorders. This suggested that monitoring renal function be important when studying metabolic health. Furthermore the remarkable decreases observed in T3, T4 and TSH values ($p<0.001$) suggest the tendency of normalization of thyroid function possibly related to improvement of metabolic parameters.

The ultrasound findings also revealed significant improvement with normal findings rising from 85.5-99.5% with significant improvement in polycystic ovarian morphology. These results indicate the positive impact of the intervention on reproductive health. Previous studies have suggested that improvements in metabolic status and body weight are related to improvement in normal ovarian morphology and endocrine function. Lifestyle interventions leading to weight loss were also associated with a significant improvement in metabolic parameters ($p<0.05$), leading potentially to improvements in reproductive endocrine function [15]. The significant improvement in ultrasound findings ($p<0.001$) found in the present study therefore reflect the multisystem gains associated with the intervention.

CONCLUSIONS

The results of the study indicate a considerable increase in the physiological, biochemical and imaging parameters throughout the time of the study. The decreases in BMI, glucose levels and lipid levels and renal indicators and normalization of thyroid profile and ovarian morphology on ultrasound show general metabolic and reproductive health outcomes. These findings validate the success of the intervention and agree with the evidence available that metabolic, cardiovascular and reproductive health are interconnected.

Recommendation

Based on the findings of the present study, the nurse-led lifestyle interventions targeting weight management and healthy diet and physical activity should be implemented in clinical and community settings for improving the metabolic and reproductive health of women with menstrual irregularities. Regular monitoring of physiological and biochemical parameters such as BMI, blood glucose, lipid profile, thyroid profile and renal markers should be promoted for early detection and control of metabolic abnormalities. In addition, periodic ultrasound evaluation may be considered in order to monitor ovarian morphology. Further research with larger sample sizes and longer follow-up periods is recommended in order to evaluate the long-term effectiveness of such interventions.

Ethical Approval

The study was ethically approved by the Institutional Ethics Committee of Government Thoothukudi Medical College, Thoothukudi. (IEC Ref. No: 02/2024-04, dated 30. 05.2024).

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