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A Study to Evaluate the Effect of Incentive Spirometry Exercise on Respiratory Status of Postoperative Abdominal Surgeries Patients in the Surgical Ward at PGIMS, Rohtak

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Abstract

Introduction: *Incidence data indicates that 17%–88% of patients may experience decreased lung volume after surgery. Post-operative care aims to manage patients after surgery to prevent complications, such as atelectasis and infection. An incentive spirometer is commonly included in perioperative respiratory therapy strategies to help prevent or address these complications and enhance lung function. Utilizing an incentive spirometer starting on the first postoperative day can effectively address the issue of decreased lung volume.* ***Aim:*** *The main aim of the study was to evaluate the effect of incentive spirometry exercise on respiratory status of postoperative abdominal surgeries patients.* ***Objectives of the study:*** *(1) To assess pre and post respiratory status of postoperative abdominal surgeries patients. (2) To evaluate the effectiveness of spirometry exercise on respiratory status of postoperative abdominal surgeries patients. (3) To assess the relationship between the pre-respiratory status score and the chosen sociodemographic variables of patients. Material and* ***Method:*** *The researcher carried out the study using a quantitative approach and a pre-experimental design with a one-group pretest and posttest format, involving 60 patients selected through convenient sampling. The study was conducted on postoperative patients at PGIMS, Rohtak. Socio demographic variable and observation performance scale were used to evaluate the effect of incentive spirometry exercise on respiratory status of postoperative abdominal surgeries patients.* ***Result:*** *On day 1, only 3% of the patients performed moderately adequately while 84% were inadequate and 13% were not able to perform. On day 5, 50% were moderately adequate, 35% were adequate performance while 15% still had inadequate performance.* ***Conclusion:*** *The study showed that incentive spirometry is effective in enhancing pulmonary function in postoperative patients, which also improves blood circulation and speeds up the recovery of surgical wounds. Nurses in postoperative units should consistently motivate patients to use the spirometer regularly.*

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Keywords: Incentive spirometry, incentive spirometry exercise, respiratory status, postoperative abdominal surgery patients, lung volume

INTRODUCTION

The progress of society in areas, such as education, urbanization, industrialization, innovation, and particularly healthcare, has resulted in a growing population. This expanding demographic should be able to engage fully in all aspects of life. However, this growth has also led to a decline in overall functioning and societal participation. The gradual reduction in physical activity, along with significant life events like

hospitalizations and surgeries, can further impact their functional abilities and daily activities [1–6]. The decline in adaptive capacity can be mitigated by recent medical advancements and may be further reduced, or even prevented, through physical exercise training and consistent physical activity in daily life [4, 7]. Majority of the population is going through the various surgical procedures throughout their life span due to any underlying medical cause. Surgery has become important for better quality of life of patients in health care system. According to World Bank report, 2022, 234 million operations performed yearly and 164 million disability-adjusted life years showing 11% of the entire disease burden [8].

According to World Bank report, 2022, 234 million operations performed yearly and 164 million disability-adjusted life years showing 11% of the entire disease burden. According to definition, postoperative recovery is the process of being in a state of complete well-being, which requires a lot of energy. This can be accomplished by restoring the preoperative level of independence or dependence in daily activities and achieving optimal psychological well-being by regaining control over physical, psychological, social, and habitual functions. Abdominal surgery is commonly performed for both the treatment and diagnosis of various diseases. The choice of incision primarily depends on the area to be exposed, whether the procedure is elective or emergency, and the surgeon's preference. Abdominal access can be achieved through incisions, such as the midline incision, transverse incision, and others. Abdominal surgery refers to any operation on abdominal organs performed for a variety of reasons, including infection, obstruction, or inflammatory bowel disease [9]. Postoperative pulmonary complications (PPCs) are frequent in patients undergoing abdominal surgery and contribute to increased morbidity, mortality, longer hospital stays, and higher healthcare costs. The most common PPCs include atelectasis, pneumonia, acute respiratory failure, tracheobronchitis, wheezing, and prolonged mechanical ventilation. It is well-established that a reduction in lung volumes and capacities, abnormal respiratory patterns, impaired gas exchange, and weakened pulmonary defense mechanisms in patients undergoing open abdominal surgery begin with anesthetic induction and continue in the postoperative period, contributing to the development of these PPCs. An incentive spirometer helps patients breathe slowly and deeply, promoting sustained maximal inspiration. The gauge on the spirometer enables patients to track their progress, offering immediate positive reinforcement. This supports optimal gas exchange, aids in clearing and expectorating secretions, and restores normal breathing and circulation, thus facilitating faster recovery [10–12].

MATERIALS AND METHODS

A pre-experimental study was conducted with 60 postoperative abdominal surgery patients in the surgical ward of a tertiary care hospital in North India, from January 24, 2024, to February 23, 2024. Participants who were able to understand and communicate in Hindi and English without any impairments were included in the study. The study focused on individuals experiencing PPCs following abdominal surgery. Subjects who did not provide consent or were unwilling to participate or follow instructions were excluded from the study.

DATA COLLECTION TOOL

It comprises two sections as follows:

- *Section A: Socio-demographic data:* It is developed by the researcher. It had six questions with multiple options. It consists of structured questions related to age, gender, diagnosis, educational status, smoking status, and body mass index (BMI).
- *Section B: Observation checklist:* In which patients were observed when they were doing Incentive spirometer. It was used to measure lung capacity (Tables 1 and 2).

The data collection involved the systematic, precise gathering of information relevant to the research purpose, questions, and hypothesis of the study. For the present study prior to data collection, ethical permission was taken from biomedical research ethics committee PGIMS, UHS, Rohtak, and

the formal permission was taken from the principal College of nursing, Pandit B.D. Sharma PGIMS, Rohtak, as well. The main study data collection was done from 24 January 2024 to 23 February 2024.

Table 1. Incentive spirometry.

No of Balls	Capacity/Minute	Color
1 ball	600 cc	Red.
2 balls	900 cc	Yellow.
3 balls	1200 cc	Green.

Table 2. The scoring of the patients based on adequacy of each step-in checklist.

Score	Performance
0	Not able to perform.
1	Inadequate.
2	Moderately Adequate.
3	Adequate performance.

Formal permission was obtained from the Head of the Department (HOD) of the surgical ward at PGIMS, Rohtak. The investigator introduced herself to the study participants and built a rapport with them. She explained the purpose of the study and obtained informed consent from the subjects. Participants were assured that their data would remain anonymous, confidential, and securely stored. A total of 60 samples meeting the inclusion criteria were selected using a nonprobability convenient sampling technique. A pre-assessment was carried out using a structured questionnaire interview schedule. Incentive spirometry was administered twice daily for 5 days. A post-assessment was conducted on the 5th day using the same structured questionnaire interview schedule.

STATISTICALANALYSIS

The statistical analysis was performed using IBM's Statistical Package for the Social Sciences (SPSS for Windows version 20.0). A significant level of 0.05 ($p < 0.05$) was applied throughout the study. Continuous variables were reported using mean and standard deviations, while frequency and percentage were used for categorical variables. Pearson's correlation coefficient was employed to assess the relationships between the parameters.

SECTION I

Table 3 presents the frequency and percentage distribution of subjects based on various sociodemographic variables. This table provides a detailed overview of the different characteristics of the subjects, such as age, gender, education, and other demographic factors, offering insights into the sample's composition. The distribution allows for a deeper understanding of how these variables may influence the study outcomes (Figures 1–5).

SECTION II

Table 4 presents the findings related to the assessment of the pre-assessment level of respiratory status among the population who underwent postoperative abdominal surgeries, prior to the administration of incentive spirometry. This table highlights key respiratory indicators, providing a baseline measurement to evaluate the effectiveness of subsequent interventions, such as incentive spirometry (Figure 6).

SECTION III

Table 5 presents the findings related to the post-assessment level of respiratory status among the population who underwent postoperative abdominal surgeries, following the administration of incentive spirometry. This table provides insights into the improvement or changes in respiratory function after the intervention, highlighting the effectiveness of the incentive spirometry in enhancing respiratory status (Figure 7).

Table 3. Frequency and percentage distribution of subjects according to socio-demographical variables.

S.N.	Demographic Variable	Frequency (N = 60)	Percentage (%)
1	*Age*		
	a) 18–30 years	17	28%
	b) 31–40	10	17%
	c) 41–50	7	12%
	d) 51–60	8	13%
	e) Above 60	18	30%
2	*Gender*		
	a) Female	43	72%
	b) Male	17	28%
	c) Transgender	0	0%
3	*Diagnosis*		
	a) Above umbilicus surgery	3	5%
	b) Below umbilicus surgery	0	0%
	c) Complete midline surgery	57	95%
4	*Educational Status*		
	a) Illiterate	12	20%
	b) Primary education	14	23%
	c) Secondary education	15	25%
	d) Senior secondary	10	17%
	e) Undergraduate & above	9	15%
5	*Smoking Status*		
	a) Smoker	44	73%
	b) Chulla smoker	10	17%
	c) Non-Smoker	6	10%
6	*Body Mass Index*		
	a) Underweight <18.5	35	58%
	b) Optimum range 18.5–24.9	18	30%
	c) Overweight 25–29.9	6	10%
	d) Obese 30–34.9	1	2%

Note: n = 60.

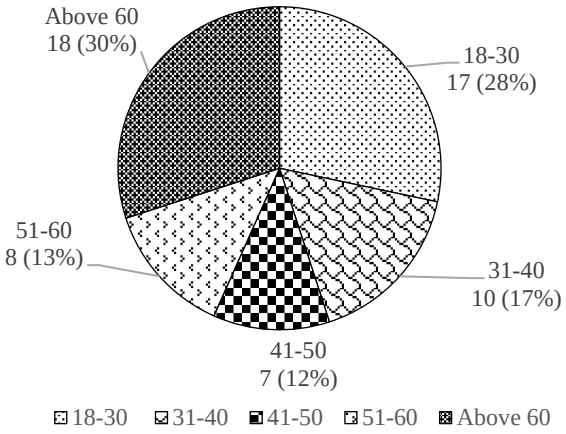

Figure 1. Age in year.

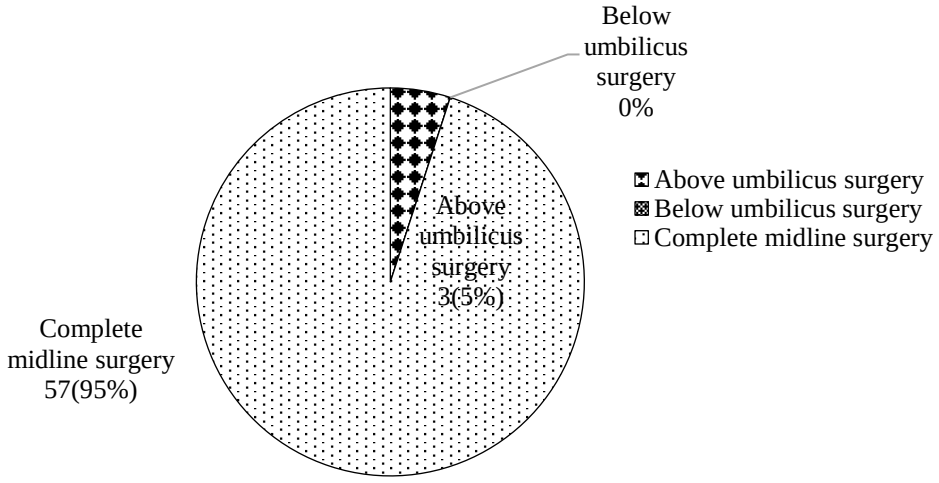

Figure 2. Gender.

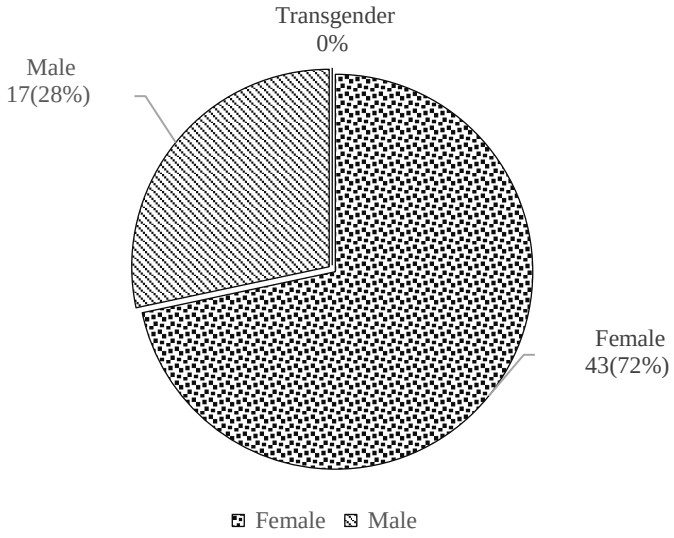

Figure 3. Diagnosis.

Table 4. Findings related to assessing pre-assessment level of respiratory status among the postoperative abdominal surgeries' population before administration of incentive spirometry.

S.N.	Performance Score	Frequency (N = 60)	Percentage (%)
1	Not able to perform	8	13%
2	Inadequate	50	84%
3	Moderately adequate	2	3%
4	Adequate performance	0	0%
	TOTAL	60	100%

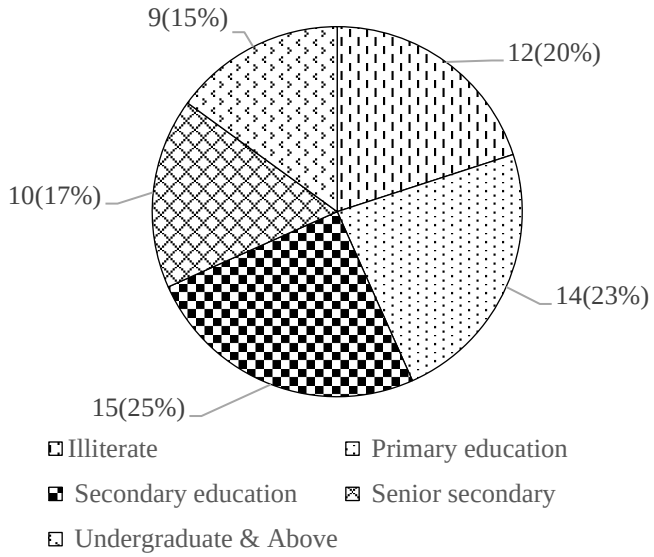

Figure 4. Educational status.

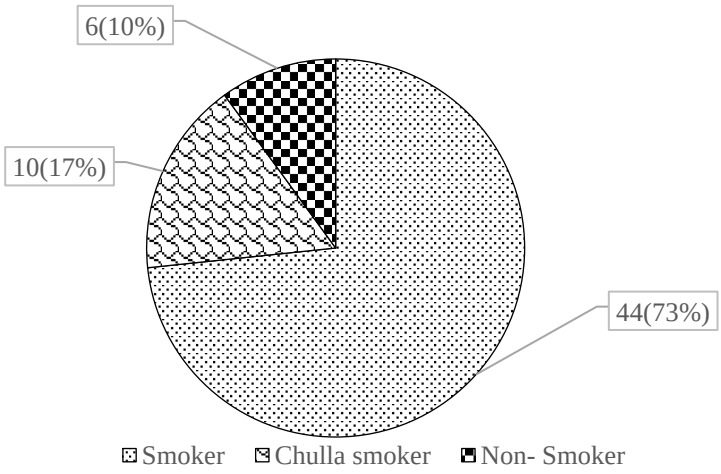

Figure 5. Smoking status.

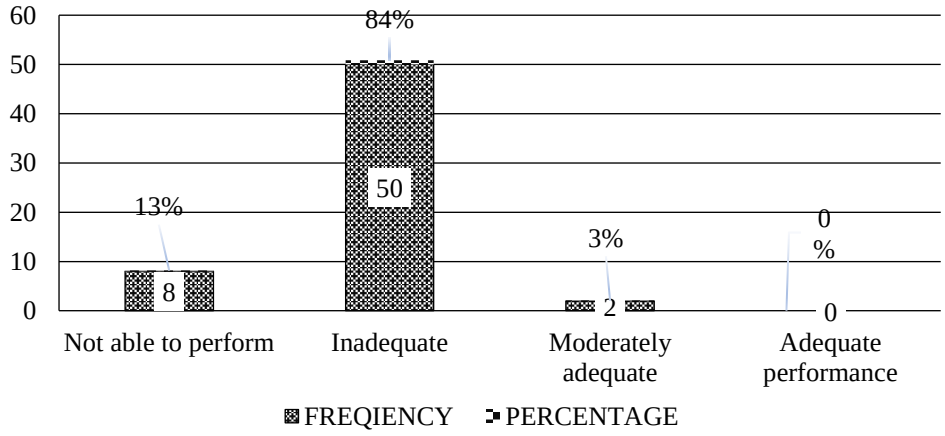

Figure 6. Graph showing pre-assessment level of respiratory status among the postoperative abdominal surgeries' population before administration of incentive spirometry.

Table 5. Findings related to assessing post-assessment level of respiratory status among the postoperative abdominal surgeries' population before administration of incentive spirometry.

S.N.	Performance Score	Frequency (N = 60)	Percentage (%)
1	Not able to perform	0	0%
2	Inadequate	9	15%
3	Moderately adequate	30	50%
4	Adequate performance	21	35%
	TOTAL	60	100%

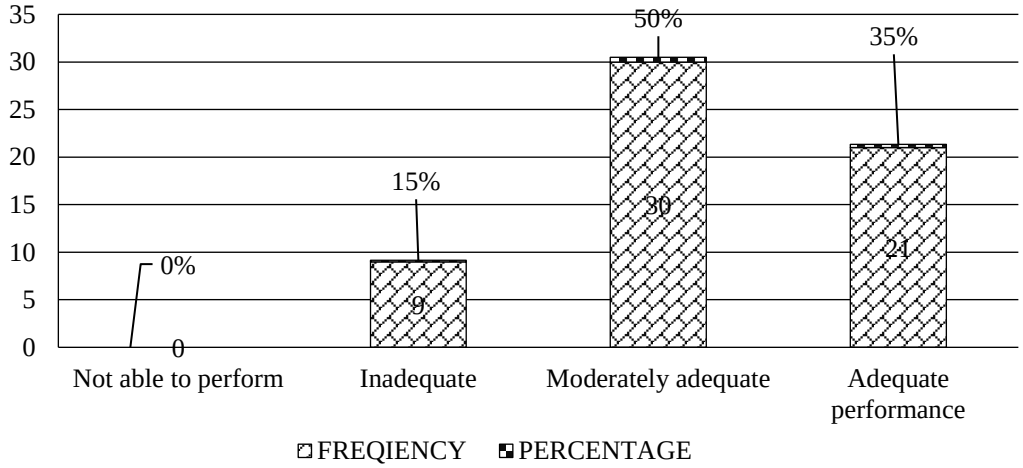

Figure 7. Graph showing post-assessment level of respiratory status among the postoperative abdominal surgeries' population before administration of incentive spirometry.

SECTION IV

Table 6 presents the findings related to determining the effectiveness of incentive spirometry among the postoperative abdominal surgery population. This table evaluates the impact of the intervention on improving respiratory function, providing a clear comparison of pre- and post-assessment results to assess the effectiveness of the spirometry technique (Figure 8).

Table 6. Findings related to determining the effectiveness of incentive spirometry among postoperative abdominal surgeries population.

S.N.	Performance Score	Mean	Standard Deviation	Mean Difference	Paired "t" Test	Df	Table Value
1	Pre-Assessment	0.90	0.399	1.73	27.829 (S*)	59	2.00 at 0.05 level of significance
2	Post-Assessment	2.63	0.486				

SECTION V

Table 7 presents the pre-assessment scores of incentive spirometry among postoperative abdominal surgery patients, categorized by selected socio-demographic variables. This table provides an analysis of how different socio-demographic factors, such as age, gender, and education, influence the baseline respiratory scores before the intervention of incentive spirometry.

RESULTS

Out of 60 subjects, the majority (30%) were in the above 60 years of age group, with 72% being females. According to diagnosis 95% were complete midline surgery. Approximately 25% of them had completed senior secondary school education. The majority (73%) of subjects were smoking status and majority (58%) of underweight. The data presented in table depict that 84% postoperative abdominal surgeries patients had inadequate performance, 13% were not able to perform and 3%

postoperative abdominal surgeries patient had moderately adequate performance. The data presented in table depict that 50% postoperative abdominal surgeries patient had moderately adequate performance, 35% had adequate performance and 15% postoperative abdominal surgeries patient had inadequate performance. Table 4 depicts that mean value of pre-assessment score was 0.90 and SD value of pre-assessment score was 0.479 and post-assessment score of incentive spirometry was 2.63 and SD value of post-assessment score was 0.486. The mean difference between pre- and post-test score was 1.73. The statistical paired "t" test was 27.829, that found to be indicating significantly improvement in respiratory status at 0.05. The calculated chi-square value (20.370) is more than the tabulated chi-square value (15.51) at 80 of freedom and 0.05 level of significance.

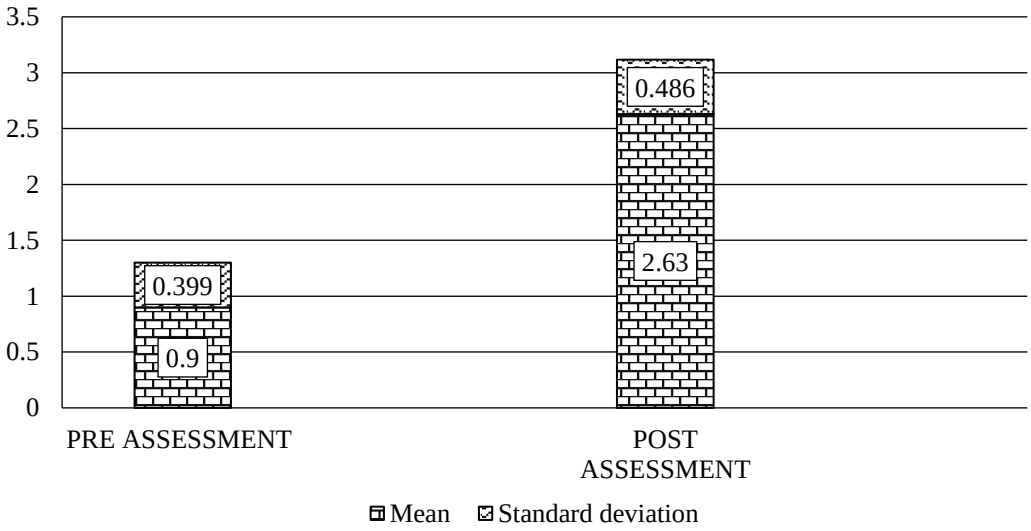

Figure 8. Graph showing the effectiveness of incentive spirometry among postoperative abdominal surgeries population.

This indicates a significant association between the pre-assessment score of incentive spirometry performance and age. The calculated chi-square value (10.250) exceeds the tabulated chi-square value (5.99) with 20 degrees of freedom at a 0.05 significance level. Similarly, there is a significant association between the pre-assessment score of incentive spirometry performance and gender, as the calculated chi-square value (9.053) is greater than the tabulated value (5.99) with 20 degrees of freedom at a 0.05 significance level. However, there is no significant association between the pre-assessment score of incentive spirometry performance and diagnosis, as the calculated chi-square value (11.747) is less than the tabulated chi-square value (15.51) with 80 degrees of freedom at a 0.05 significance level. This shows that there is no significant association between the pre-assessment score of incentive spirometry performance and educational status, as the calculated chi-square value (10.398) is greater than the tabulated chi-square value (9.49) with 40 degrees of freedom at a 0.05 significance level. On the other hand, there is a significant association between the pre-assessment score of incentive spirometry performance and smoking status, since the calculated chi-square value (31.385) exceeds the tabulated value (12.59) with 60 degrees of freedom at a 0.05 significance level. Furthermore, a significant association is observed between the pre-assessment score of incentive spirometry performance and BMI.

DISCUSSION

Section I: Description of the Frequency and Percentage Distribution of Subjects According to Socio Demo-Graphical Variable

In this hospital-based pre-experimental study done among 60 patients, 18(30%) of sample. The age group of 18–30 years represents 17 (28%) of the sample, the age group of 31–40 years represents 10

(17%), the age group of 51–60 years represents 8 (13%) of the sample, while those aged 41–50 years make up only 7 (12%). the gender distribution among participants in the study indicates that the majority, constituting 43 (72%) of the sample, are male. Meanwhile, female account for 17 (28%) of the sample. Majority of participants, 57 (95%) were in complete midline surgery, only 3 (5%) were in below umbilicus surgery. Regarding the educational status, it is revealed that maximum 15 (25%) were senior secondary, followed by 14 (23%) with the primary education, 12 (20%) were having illiterate, 10 (17%) were secondary education, and 9 (15%) were undergraduate or above education. In smoking status, the majority of sample 44 (73%) sample were smokers, 10(17%) were challah smokers and 6 (10%) were nonsmoker. Regarding most participants, 35 (58%) were optimum range, 18 (30%) were in underweight group, 6 (10%) were in overweight group and 1 (2%) belonged to obese group [13].

Table 7. Pre-assessment score of incentive spirometry among postoperative abdominal surgeries with selected socio-demographic variables.

Characteristics		**Total N = 60**	**Level of Performance**			**Association with Pre-Assessment Score of Incentive Spirometry with**			
Variable	**Categories**		**Not Able to Perform**	**Inadequate**	**Moderately Adequate**	**Chi-Square**	**P Value**	**df**	**Table Value**
Age	18–30	17	0	17	0	20.370 **S**	.009	*8*	15.51
	31–40	10	1	8	1				
	41–50	7	0	6	1				
	51–60	8	0	8	0				
	Above 60	19	7	11	0				
Gender	Female	17	6	11	0	10.250 **S**	.006	*2*	*5.99*
	Male	43	2	39	2				
	Transgender	0	0	0	2				
Diagnosis	Above umbilicus surgery	3	0	2	1	9.053 **S**	.011	*2*	*5.99*
	Below umbilicus surgery	0	0	0	1				
	Complete midline surgery	57	8	48	2				
Educational status	Illiterate	12	4	7	4	11.747 NS	*.163*	*8*	15.51
	Primary education	14	0	14	0				
	Secondary education	15	3	11	3				
	Senior secondary	10	0	10	0				
	Undergraduate & above	9	1	8	1				
Smoking status	Smoker	44	6	38	0	10.398 S	*.034*	*4*	*9.49*
	Chulla smoker	10	1	7	2				
	Non-Smoker	6	1	5	0				
BMI	Underweight <18.5	18	1	17	0	31.385 S	.000	*6*	*12.59*
	Optimum range 18.5–24.9	35	6	28	1				
	Overweight 25–29.9	6	1	5	0				
	Obese 30–34.9	1	0	0	1				

Section II: Description of the Pre-Assessment Level of Incentive Spirometry on Respiratory Status

The first objective of the study was to assess pre-respiratory status of postoperative abdominal surgeries patients.

Out of 60 postoperative abdominal surgeries patients, according to assessing respiratory status that majority of them, 50 (84%) of population had inadequate performance, 8 (13%) had not able to perform, and 2 (3%) had moderately adequate performance. The mean value of overall pretest performance score was 0.90 and the standard deviation was 0.399 [14].

Section III: Description of the Post-Assessment Level of Incentive Spirometry on Respiratory Status

The first objective of the study was to assess post-respiratory status of postoperative abdominal surgeries patients.

After administration of incentive spirometry exercise 9 (15%) of population had inadequate performance, 30 (50%) had moderately adequate performance, and 21 (35%) had adequate performance. The mean value of overall post-test performance score was 2.63 and the standard deviation was 0.486. The calculated t-value for respiratory status was 27.829, which exceeds the table value at the 0.05 significance level. The results indicate a significant difference between the pretest and posttest scores, demonstrating a notable improvement in the respiratory status of postoperative abdominal surgery patients [15].

Section IV: Effectiveness of Incentive Spirometry on Respiratory Status Among Postoperative Abdominal Surgeries Patients

The second objective of the study was to evaluate the effectiveness of spirometry exercise on respiratory status of postoperative abdominal surgeries patients.

This was done by calculating the mean and standard deviation for both pre-assessment and post-assessment levels of respiratory status, then comparing the mean difference and standard deviation. A paired t-test was applied at the 0.05 significance level. The results of the current study show that the mean value before using the incentive spirometer was 0.90 ± 0.399, while the post-assessment mean value was 2.63 ± 0.684, with a mean difference of 1.73. The calculated t-value was 27.829, which is higher than the table value (2.00) at 59 degrees of freedom and a 0.05 significance level, confirming the effectiveness of incentive spirometry on the respiratory status of postoperative abdominal surgery patients. This indicates that the research hypothesis (H1) is accepted, while the null hypothesis (H01) is rejected [16].

Section V: Association Between Pre-Assessment Level of Respiratory Status Score with Selected Socio-Demographic Variables of Patients

The third objective of the study was to determine the association between pre-respiratory scores with the selected socio demographic variables.

The chi square test was applied to determine the association between the respiratory score and socio demographic variables. In the pretest the value of chi-square test (x^2) were 20.370 (age), 10.358 (gender), 9.053 (diagnosis), 10.398 (smoking status), and 31.385 (body mass index) which shows that there is significant association between respiratory score and demographic variable because the Calculated value are more (>) than table value which is 15.51 (age), 5.99 (gender), 5.99 (diagnosis), 9.49 (smoking status),12.59 (body mass index) at 0.05 level of significant. In the pretest the value of chi-square test (x^2) was 11.747 (educational status), which shows that there is no significant association between respiratory score and demographic variable because the calculated value are less (<) than table value which is and 15, .51 (educational status) at 0.05 level of significant [17].

Limitations

The study was confined to a small number of subjects and shorter period.

CONCLUSIONS

The focus of this study was a study to evaluate the effect of incentive spirometry exercise on respiratory status of postoperative abdominal surgeries patients in selected ward at PGIMS, Rohtak, Haryana. The study involved pre-experimental one group pre- and post-test design, with nonprobability purposive sampling technique was used. The size of sample was 60 postoperative abdominal surgeries patients receiving incentive spirometry exercise and selection of sample were too done according to inclusion or exclusion criteria. The data was collected by structured demographic questionnaires and Observation performance scale in the pretest followed by implementation of incentive spirometry exercise on 1st day after postoperative abdominal surgery. Posttest was conducted 5 days after the incentive spirometry exercise, I am using structured questionnaires to find out the effectiveness of the intervention. The results were analyzed using both descriptive and inferential statistical methods.

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