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ORIGINAL RESEARCH

Comparative study of pulmonary function test between obese and non-obese young adult males

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ABSTRACT

Background:Obesity is linked to a higher risk of insulin resistance, high blood pressure, abnormal cholesterol levels, cardiovascular disease, type 2 diabetes, gallstones and gallbladder inflammation, breathing problems, and certain types of cancer. This was a comparative study of pulmonary function test between obese and non-obese adult males.**Material and methods**: In the present study total 120 subjects were selected which includes 60 normal weight and 60 obese young adultmales who were categorized based on WHO criteria of Body Mass Index. These subjects were selected by a simple random sampling method from the MBBS students of Nalanda Medical College and Hospital, Patna.The selected group of subjects were categorized into normal weight and obese based on the chart provided by WHO for body mass index. Pulmonary Function Tests Between Obese and Non-Obese Young Adult Males were compared.**Results**: Among individuals aged 18-20 years, 43% were of normal weight, while 23% were obese. In the 21-22 years age group, 37% were of normal weight, with a higher percentage, 43%, being obese. For those aged 23-24 years, 20% were of normal weight, and 33% were classified as obese. The overall mean age for the normal weight group was 20.81 ± 1.79 years, compared to 21.78 ± 1.57 years for the obese group. Although the data suggests a trend of increasing obesity with age, the p-value of 0.302 indicates that the age distribution differences between the normal weight and obese groups are not statistically significant.**Conclusion**: The analysis of pulmonary function test parameters revealed notable differences between normal weight and obese young adult males. Obese individuals showed significantly lower Forced Vital Capacity (FVC) and Forced Expiratory Volume in the first second (FEV1) compared to those with normal weight.

Keywords: Pulmonary function tests, Obesity, Body Mass Index

INTRODUCTION

Overweight and obesity have become a global issue. They are now the biggest health concerns in both rich and poor countries. The number of obese children and adults has risen sharply. Obesity happens when too much body fat accumulates, which can harm health, shorten life, and cause more health problems. The term "obesity" comes from the Latin word "abesitas," meaning "stout, fat, or plump." The Greeks were the first to recognize obesity as a medical condition. Before the 20th century, obesity was rare. It began spreading rapidly in wealthy countries during the last 25 years of the 20th century.Obesity is rising at an alarming rate worldwide, reaching epidemic levels. The World Health Organization (WHO) data said that in 2015, at least 10% of the global population were obese.[1]

In 2022, an estimated 37 million children under the age of 5 years were overweight. The prevalence of obesity varies widely across different regions and communities, influenced by factors such as heredity, age, sex, dietary habits, and lifestyle.[2] Obesity is now a common metabolic disorder. It harms the body, worsens health, and lowers the quality of life.[3,4]

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Obesity is linked to a higher risk of insulin resistance, high blood pressure, abnormal cholesterol levels, cardiovascular disease, type 2 diabetes, gallstones and gallbladder inflammation, breathing problems, and certain types of cancer.[5] Obesity is also connected to various respiratory conditions such as chronic obstructive pulmonary disease (COPD), obstructive sleep apnea (OSA), and asthma,although the exact mechanisms are not fully understood.[6] Even without a clear respiratory illness, obese patients are more likely to experience shortness of breath during exercise. This reduced exercise capacity is due to the negative impact of obesity on respiratory function.[7,8] Obesity changes how the lungs, chest wall, and diaphragm interact, raising resistance within the respiratory system. This makes breathing more laborious and affects gas exchange.[9,10]

AIM AND OBJECTIVES: the present study was conducted for comparing pulmonary function test between obese and non-obese young adult males.

MATERIAL AND METHODS

In the present study total 120 subjects were selected which includes 60 normal weight and 60 obese young adults' males who were categorized based on WHO criteria of Body Mass Index. These subjects were selected by a simple random sampling method from the MBBS students of Nalanda Medical College and Hospital, Patna.

Population group

All male students in MBBS course of Nalanda Medical College and Hospital, Patna.

Sample size

Sample size was calculated by using Openepi Sample Size Calculator. Exact numerical value of population group was known for the duration of the study. A confidence interval of 95%, Margin of error of 5% and Response Distribution of 50% was used to calculate the sample size.

Study duration

The total duration of the study was 22 months.

Inclusion Criteria

- Subjects who gave written informed consent.
- Age 18-24 years
- Subjects with BMI of 18.0-24.99 kg/m^2 for normal weight male.
- Subjects with BMI of ≥30kg/m^2.

Exclusion Criteria

- Subjects who don't gave written informed consent.
- Those that have physical deformities of the chest wall.
- Subjects with BMI less than 18.0 kg/m^2.
- Subjects with BMI 25-29.99 kg/m^2.
- Subjects with co morbidities.
- Subjects with present or past (in the last three months) history of upper respiratory tract or lower respiratory tract infections.
- Subjects with history of smoking.

The selected group of subjects were categorized into normal weight and obese based on the chart provided by WHO for body mass index.

Statistical Analysis

All the data were analyzed using SPSS package (Stata, version 26.0 SPSS INC, Chicago, IL, USA) for windows. The data were presented as descriptive statistics for continuous variables and percentage for categorical variables and was subjected Chi-square test, t test &Anova test. Other values were represented in number, proportions (%) and mean ± SD.

Level of significance: - "p" is level of significance.

P> 0.05: No significant

P< 0.05: Significant

P< 0.001: Highly significant

RESULTS

Table 1: Distribution of subjects according to age with Normal weight and obese

Age (in years)	Normal Weight		Obese		P value
	No.	%	No.	%	
18-20	26	43%	14	23%	0.302
21-22	22	37%	26	43%	
23-24	12	20%	20	33%	
Total	60	100%	60	100%	
Mean±SD	20.81±1.79		21.78±1.57		

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The table 1 and figure 1, illustrates the distribution of subjects with normal weight and obesity across various age groups. Among individuals aged 18-20 years, 43% were of normal weight, while 23% were obese. In the 21-22years age group, 37% were of normal weight, with a higher percentage, 43%, being obese. For those aged 23-24 years, 20% were of normal weight, and 33% were classified as obese. The overall mean age for the normal weight group was 20.81 ± 1.79 years, compared to 21.78 ± 1.57 years for the obese group. Although the data suggests a trend of increasing obesity with age, the p-value of 0.302 indicates that the age distribution differences between the normal weight and obese groups are not statistically significant.

Figure 1: Age (in years) wise distribution of the subjects with normal weight and obese

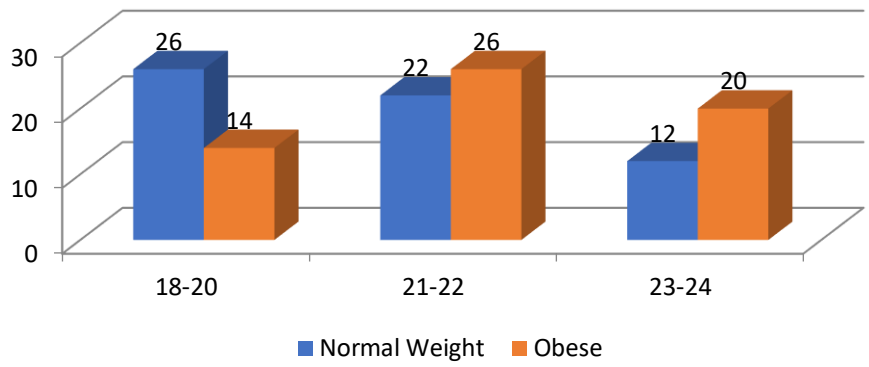
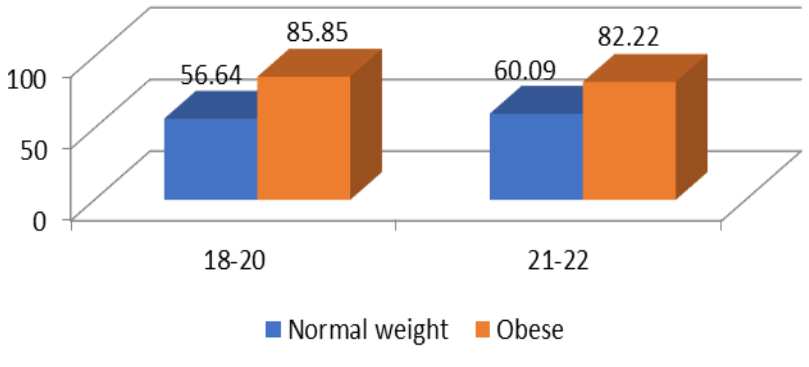


Table 2: Comparison of mean weight according to age of subjects

Age in years	Weight (in kg)		P value
	Normal weight	Obese	
18-20	56.64±8.92	85.85±8.19	<0.001
21-22	60.09±7.73	82.22±9.57	<0.001
23-24	63.58±6.54	79.59±4.60	<0.001

Figure 2: Comparison of mean weight (in kg) according to age of subjects



The table 2 and figure 2, presents a comparison of mean weights among subjects categorized as having normal weight and those categorized as obese, across different age groups. For the 18-20 years age group, the mean weight of individuals with normal weight is 56.64±8.92 kg, while the mean weight of obese individuals is significantly higher at 85.85±8.19 kg. In the 21-22 years age group, the mean weight for those with normal weight increases to 60.09±7.73 kg, while the mean weight for obese individuals is 82.22±9.57 kg. Finally, for the 23-24 years age group, the

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mean weight of those with normal weight further increases to 63.58±6.54 kg, whereas the mean weight for obese individuals decreases slightly to 79.59±4.60 kg. The P-value for all comparisons is <0.001, indicating that the differences in mean weight between normal weight and obese individuals across all age groups are statistically significant.

Table 3: Comparison of mean height according to age of subjects

Age in years	Height (in cm)		P value
	Normal weight	Obese	
18-20	161.60±7.73	162.42±6.11	0.600
21-22	168.27±7.61	159.31±7.29	0.001
23-24	168.25±4.49	157.75±4.26	<0.001

The table 3 and figure 3, compares the mean height of subjects with normal weight and those who are obese across different age groups. In the 18-20 years age group, the mean height for individuals with normal weight is 161.60±7.73 cm, while the mean height for obese individuals is slightly higher at 162.42±6.11 cm. The P-value of 0.600 suggests that this difference is not statistically significant. For the 21-22 years age group, the mean height of normal-weight individuals increases to 168.27±7.61 cm, while the mean height of obese individuals decreases to 159.31±7.29 cm, with a P-value of 0.001, indicating a significant difference. In the 23-24 years age group, the mean height of normal-weight individuals remains almost the same at 168.25±4.49 cm, but the mean height of obese individuals further decreases to 157.75±4.26 cm. The P-value for this age group is <0.001, showing a highly significant difference in height between normal-weight and obese individuals.

Figure 3: Comparison of mean height according to age (in years) of subjects

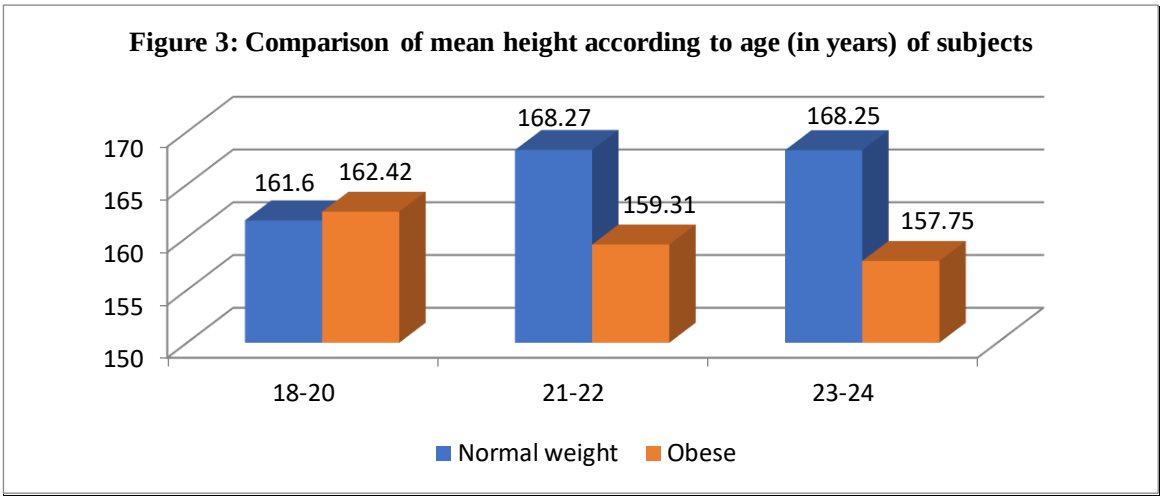

Table 4: Comparison of mean BMI according to age of subjects

Age in years	BMI (kg/m^2)		P value
	Normal weight	Obese	
18-20	21.18±1.61	32.48±1.30	<0.001
21-22	21.34±2.08	32.32±1.53	<0.001
23-24	22.30±1.85	31.95±0.94	<0.001

The table 4 and figure 4,provides a comparison of the mean Body Mass Index (BMI) between subjects with normal weight and those who are obese across different age groups. For the 18-20 years age group, the mean BMI for individuals with normal weight is 21.18±1.61 kg/m², while obese individuals have a significantly higher mean BMI of 32.48±1.30 kg/m². In the 21-22 years age group, the mean BMI for normal-weight individuals slightly increases to 21.34±2.08 kg/m², while the mean BMI for obese individuals is 32.32±1.53 kg/m². For the 23-24 years age group, the mean BMI of normal-weight individuals further increases to 22.30±1.85 kg/m², while the mean BMI for obese individuals decreases slightly to 31.95±0.94 kg/m². The P-

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value for all age groups is <0.001, indicating that the differences in mean BMI between normal-weight and obese individuals are statistically significant across all age groups.

Figure 4: Comparison of mean BMI(Kg/m^2) according to age of the subjects

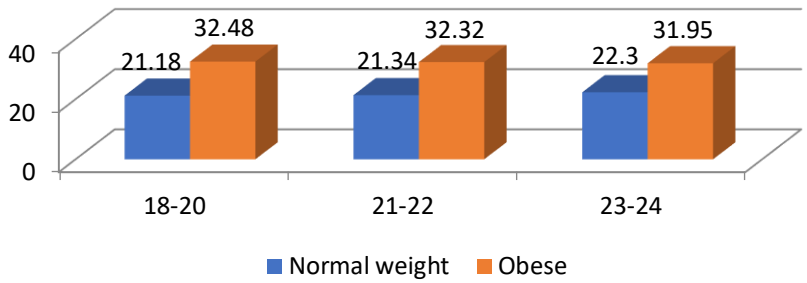

Table 5: Mean and Standard Deviation of PFT variables with Normal weight and Obesein the subjects

Age (in years)	Normal weight	Obese	P value
FVC (lts)	3.54±0.87	3.12±0.60	0.005
FEV1 (lts)	3.62±0.73	3.51±0.71	0.374
FEV1/FVC%	89.48±12.07	89.51±9.98	0.986
PEFR (lts/min)	7.75±1.84	7.22±1.79	0.119

The table 5 and figure 5, compares the mean and standard deviation of Pulmonary Function Test (PFT) variables between subjects with normal weight and those who are obese. The Forced Vital Capacity (FVC) in normal-weight individuals is 3.54±0.87 liters, while it is significantly lower in obese individuals at 3.12±0.60 liters, with a P-value of 0.005, indicating a significant difference. The Forced Expiratory Volume in the first second (FEV1) is slightly higher in normal-weight individuals at 3.62±0.73 liters compared to 3.51±0.71 liters in obese individuals, but this difference is not statistically significant (P-value = 0.374). The FEV1/FVC ratio, expressed as a percentage, is nearly identical between the two groups, with normal-weight individuals having a mean of 89.48±12.07% and obese individuals having 89.51±9.98%, resulting in a non-significant P-value of 0.986. The Peak Expiratory Flow Rate (PEFR) is slightly higher in normal-weight individuals at 7.75±1.84 liters/min compared to 7.22±1.79 liters/min in obese individuals, but this difference is also not statistically significant (P-value = 0.119).

Figure 5: Mean PFT variables with normal weight and obese in the subjects

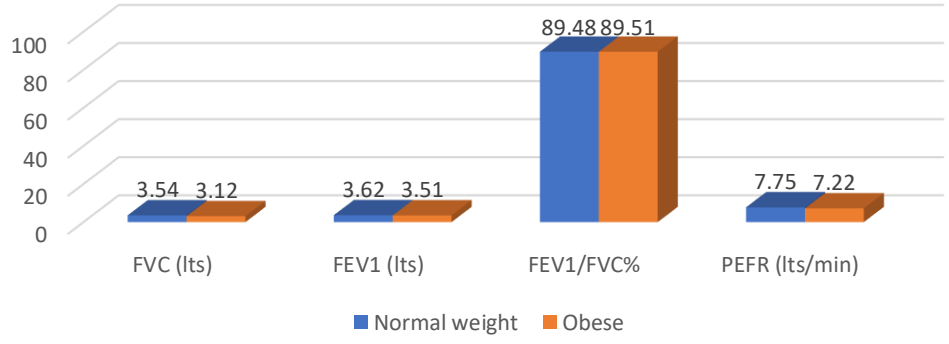

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Table 6: Comparison of FVC in Normal weight and Obese with regard to age in the subjects

Age in years	FVC		P value
	Normal weight	Obese	
<20 years	3.68±0.85	3.06±0.70	0.203
>20 years	3.62±0.92	3.16±0.61	0.012

Table 6 and figure 6, The assessment of Forced Vital Capacity (FVC) across different age groups reveals differences between normal weight and Obeseindividuals. In those under 20 years, normal weight individuals have an average FVC of 3.68±0.85 liters, whereas Obese individuals have an average FVC of 3.06±0.70 liters. For individuals over 20 years, normal weight individuals average 3.62±0.92 liters, compared to 3.16±0.61 liters for Obese individuals. These results suggest that normal weight individuals generally have higher FVC values than Obeseindividuals across both age groups. Although the specific P values for each comparison are not provided, indicating the statistical significance of these differences is not possible. Overall, the data indicate thatObeseindividuals tend to have lower FVC values compared to their normal weight counterparts, irrespective of age.

Figure 6: Comparison of FVC in normal weight and obese with regard to age in the subjects

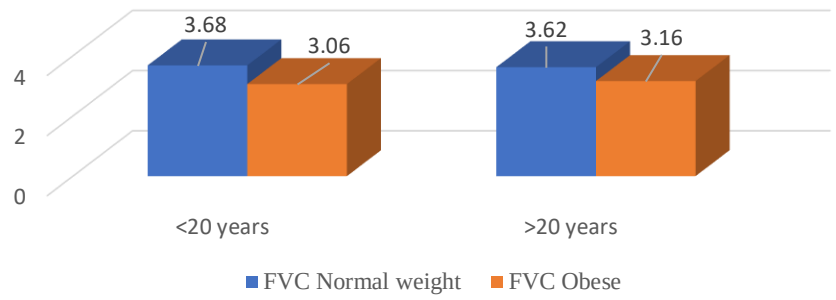

Table 7: Comparison of FEV1 in Normal weight and Obese with regard to age in the subjects

Age in years	FEV1		P value
	Normal weight	Obese	
<20 years	3.49±0.82	3.57±0.31	0.588
>20 years	3.65±0.78	3.58±0.74	0.590

Figure 7: Comparison of FEV1 in normal weight and obese withregard to age(in years)

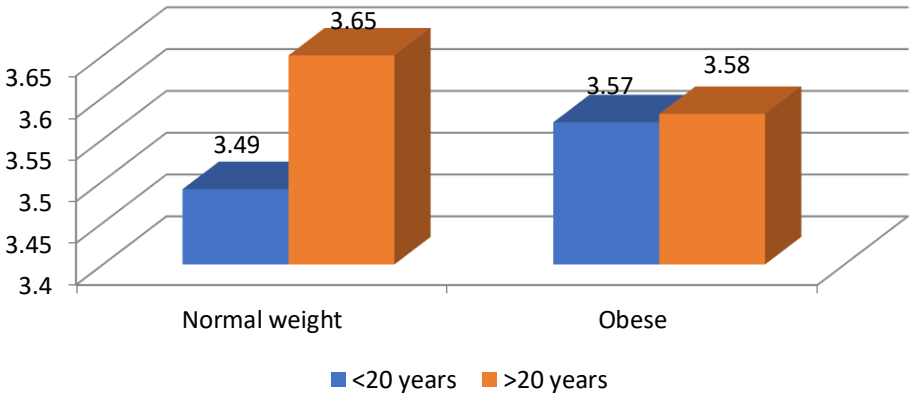

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Table 7 and figure 7, The assessment of Forced Expiratory Volume in one second (FEV1) across different age groups shows some variation between normal weight and Obeseindividuals. For those under 20 years, normal weight individuals have an average FEV1 of 3.49±0.82 liters, while Obese individuals average 3.57±0.31 liters, with a P value of 0.218, indicating no statistically significant difference between the groups. In individuals over 20 years, normal weight individuals average 3.65±0.78 liters, compared to 3.58±0.74 liters for Obese individuals. Although the specific P value for this comparison is not provided, the lack of significant differences in both age groups suggests that FEV1 values are relatively comparable between normal weight and Obeseindividuals, regardless of age.

DISCUSSION

In our study shows the table presents the mean and standard deviation of pulmonary function test (PFT) variables for subjects with normal weight versus those classified as obese. A significant difference was noted in Forced Vital Capacity (FVC), where normal weight individuals had a higher average (3.54 liters) compared to the obese group (3.12 liters), with a p-value of 0.005. However, no significant differences were observed in FEV1, FEV1/FVC%, or Peak Expiratory Flow Rate (PEFR).

The decrease in FVC and FEV1/FVC indicates a restrictive effect on the respiratory system similar findings have been reported by several studies conducted in this field by different investigators.[11-14]

The most frequently reported effect of obesity on lung function has been reported as a decrease in functional residual capacity (FRC).[15]This effect reflects a shift in the balance during inflation and deflation due to an increased load of adipose tissue mass around the rib cage and abdominal cavity.[16]

In our study shows the table compares Forced Vital Capacity (FVC) between normal weight and obese subjects across different age groups. In individuals under 20 years, there was no statistically significant difference in FVC between the two groups, with a p-value of 0.203. In contrast, for those over 20 years, normal weight subjects had a significantly higher FVC (3.62 liters) compared to obese individuals (3.16 liters), with a p-value of 0.012.

Obesity may directly affect through various mechanisms. The accumulation of fat may mechanically affect the expansion of the diaphragm, probably by encroaching in to the chest by the chest wall or diaphragm or by impending the descent of the diaphragm during forced inspiration.[17,18]

In our study shows the table compares Forced Expiratory Volume in 1 second (FEV1) between normal weight and obese subjects across different age groups. In both individuals under 20 years and those over 20 years, there were no statistically significant differences in FEV1 between the two groups, with p-values of 0.588 and 0.590, respectively. FEV1 values were similar across both weight categories in each age group.

Chu et al.[19] to find the relationship between body mass index (BMI) and lung function. This study showed that high BMl in both groups was associated with low FEV1/FVC.

In our study shows the table compares Peak Expiratory Flow Rate (PEFR) between normal weight and obese subjects across different age groups. There were no statistically significant differences in PEFR for either those under 20 years or those over 20 years, with p-values of 0.283 and 0.098, respectively. PEFR values were similar across both weight categories in each age group.

Borse JL et al.[20] carried-out a study among first year medical college student to find the effect of body weight on PEFR (Peak Expiratory Flow Rate). Findings of the study suggested that PER values of overweight student were significantly less compared to normal weight, as observed in the current study.

Study limitations

The small sample size, short study period and study was carried out at one centre were the study's shortcomings.

CONCLUSION

The analysis of pulmonary function test parameters revealed notable differences between normal weight and obese young adult males. Obese individuals showed significantly lower Forced Vital Capacity (FVC) and Forced Expiratory Volume in the first second (FEV1) compared to those with normal weight. This decrease in FVC and FEV1 points to a reduction in lung volume and airflow capacity in obese individuals, likely due to the additional mechanical burden of excess body weight, which impedes lung expansion and overall pulmonary function.

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