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Association of Sleep Quality and Duration on Chest Expansion, BMI and Blood Pressure Among College Going Students - An Observational Study

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ABSTRACT

Background & Objective: Sleep quality is an important concept that many adults struggle with, as they often have trouble falling asleep. A good quality sleep and adequate sleep duration are essential for overall health and well-being. However, several studies have documented that disrupted sleep pattern affect several health factors in young adults due to their lifestyle. The study aims at finding the association of sleep quality, and duration on chest expansion, BMI, and blood pressure among college-going students.
Methodology: The study involved 100 students (50 with each gender) aged between 18-28 years, received detailed information about the study's goals and procedures to ensure transparency. Written informed consent was obtained from all participants. Heights and weights were recorded to calculate BMI. Blood pressure was measured using sphygmomanometer for three sessions in a day. Chest expansion was assessed at three levels in standing.
Results: The study found no significant correlation between PSQI scores and BMI ($r = 0.062$, $p > 0.05$). However, there was a statistically significant weak negative correlation between PSQI scores and systolic blood pressure ($p = 0.011 < 0.05$) as well as diastolic blood pressure ($p = 0.026 < 0.05$). There was no significant correlation between PSQI scores and chest expansion at different levels ($p > 0.05$).
Conclusion: Among college students, inadequate sleep quality and duration (PSQI) didn't significantly impact BMI or chest expansion. Nevertheless, it is associated with lowered systolic and diastolic blood pressure.

Keywords: *Sleep Duration, Sleep Quality, BMI, Chest Expansion, Systolic BP, Diastolic BP.*

INTRODUCTION

Sleep is a vital biological process regulated by the brain, essential for optimal physical functions and overall well-being. Many adults struggle with falling and staying asleep, making "sleep quality" a crucial concept.[1] Studies use diverse methods to assess sleep quality, including large surveys to gather information on common sleep issues. Understanding sleep's importance and the complexities involved helps in addressing sleep-related issues and promoting better health and performance.[2,3] Older individuals often experience more disrupted sleep, negatively affecting their quality of life, mood, and alertness.[4,5] The

National Sleep Foundation suggests a seven to nine hours of sleep for better health. People who regularly sleep less than that are more prone to depression, mental health problems, heart disease, metabolic issues, and high blood pressure.[6] College students and shift workers are more prone to disrupted sleep patterns. Addressing factors like excessive caffeine or alcohol and irregular schedules, artificial light at night and insufficient daylight can help to make a scheduled sleep.[7,8]

During sleep, even healthy individuals may experience mild breathing difficulties due to a slight increase in CO2 levels (2-8 mmHg), which affects gaseous exchange in the body. This happens when the muscles in the throat relax, potentially leading to breathing issues. When asleep, these relaxed muscles in the upper airways are less responsive to negative pressure, which affects the chest movement while breathing. Healthcare professionals use measurements of chest expansion to assess respiratory conditions like COPD or limited chest movement. These evaluations help in planning treatments to improve breathing and enhance quality of life.[9] Understanding sleep's impact on breathing and using chest expansion measurements enables personalized care. Medical providers can target specific breathing issues, addressing factors like throat muscle relaxation and chest movement during sleep. This focus on tailored treatment strategies helps improve patients' respiratory health and overall well-being, supporting better sleep and more effective management of sleep-related breathing problems.[10]

Disturbed sleep can also significantly affect body weight, even when considering factors like age and gender.[11] BMI is commonly used to study obesity trends in groups, aiding in healthcare planning. However, it's less precise when applied to individuals because it doesn't differentiate between muscle, bone, and fat, which can affect its accuracy.[12,13] A disrupted sleep will alter the leptin and ghrelin hormonal cycle which control appetite and glucose levels leading to obesity and metabolic disorders.[14,15]

Age, gender, lifestyle choices and sleep influence BP levels.[16] Recent studies suggest that individuals with "normal" blood pressure are also prone to cardiovascular risks.[17] As inadequate sleep disturbs BP, keeping it low is crucial and addressing sleep problems is essential as it enhances cardiovascular health.[18,19] Previous research has explored how sleep influences health outcomes,[20,21] but its specific effects on chest expansion, BMI, and blood pressure among college students remain unclear. This study aims to address this gap by examining the association of sleep quality and duration on chest expansion, BMI and blood pressure among college going students.

MATERIALS & METHODS

A study was conducted at Tejasvini Hospital Group of Institutions in Mangalore, Karnataka to analyse various health markers in a group of 100 young and healthy volunteers (both men and women of each 50), aged between 18 to 28 years. Participants received clear explanation about the study's procedure and objectives before providing them with written consent. Height, weight, (BMI), blood pressure, and chest expansion were measured. Blood pressure readings were taken three times a day, (morning, afternoon, evening) using a standardized method. This research was conducted adhering to strict ethical guidelines to safeguard participant welfare and ensure reliable data collection. Chest expansion measurements were taken at three specific points on the body (axillary, mammillary, and xiphoid process) in upright position. Specific criteria were set to exclude individuals from the study like those unable to cooperate or follow instructions, individuals taking medications for HTN, pain relief, or decongestion, or those having recent rib fractures, conditions like obstructive sleep apnea or shoulder pain, and individuals who smoked or consumed alcohol regularly. These measures were implemented to ensure the study's accuracy and to focus on a homogeneous group of participants for the study.

OUTCOME MEASURES

Blood Pressure (BP)

The participants were instructed to stay still for at least five minutes, measurements were taken in a supine position. As per the recommendations by the American Heart Association`s, blood pressure of the participants was classified as follows normal (SBP 120 mmHg, DBP 80 mmHg), elevated (SBP 120-129 mmHg DBP 80 mmHg), HTN stage 1 (SBP 130-139 mmHg, DBP 80 - 89 mmHg), and stage 2 (SBP 140 mmHg or higher, DBP 90 mmHg or higher.[22,23]

Body Mass Index (BMI)

The participant's weight was recorded using a weighing scale while they were wearing only light clothing and no shoes. The subjects' height was determined barefoot using a stadiometer with their heels, hips, shoulders, and head in a neutral position. Body mass index (BMI) was determined by dividing weight in kilograms by height in meters squared (Kg/m^2). According to the WHO South East Asia BMI classification there are four categories for BMI: underweight (18.5), normal weight (18.5 - 24.9), overweight (25.0 - 29.9), and obese (>30).[24,25,26]

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PQSI) is used to assess both the quality and quantity of students' sleep.[27] The seven "component" scores that are produced from the 19 independent items include subjective sleep quality, sleep latency, sleep length, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Subjects classified as "good sleepers" had a global Pittsburgh Sleep Quality Inventory (PSQI) score of 5 or less, while those with a score of 5 or more were classified as "poor sleepers". The internal consistency and reliability coefficient for the PSQI is 0.83 (Cronbach's alpha).[28]

Chest Expansion Measurement

The measurement of chest expansion is frequently carried out during a patient's physical examination because it provides a reliable sense of the rib cage's mobility and the capacity of the lungs and thorax to expand.[29] The CE value was measured by subtracting the inspiratory diameter from expiratory diameter using inch tape at three different levels of ribcage i.e., axillary (third intercostal space, the center of the clavicular line, and the fifth thoracic vertebra's spinous process.), mammary, xiphoid. (Xiphoid process and spinous process of the 10th thoracic vertebrae), while resting the arms at the side of the body.[30]

STATISTICAL ANALYSIS

Statistical analysis of the data was done using SPSS 23.0. Descriptive statistics were calculated and summarized as median and IQR. Normality was tested using the Shapiro-Wilk test and it doesn't follow the normal distribution. Inferential statistics were carried out by using Spearman's Rank Correlation test and the level of significance was set at 5%.

RESULT

Table 1: Descriptive statistics were calculated and summarized as median, lower quartile (Q1) and upper quartile (Q3).

Variables	Total Sample (n=100)	Females (n=50)	Males (n=50)
	Mean ± SD		
Age (Years)	19.96 ± 1.56	20.26 ± 3.53	19.66 ± 2.82
Weight (Kg)	55.51 ± 12.7	49.49 ± 12.72	61.52 ± 18.38
Height (cm)	163.61 ± 1.56	156.75 ± 10.39	170.48 ±5.65
BMI (Kg/M^2)	21.18 ± 5.63	20.10 ± 4.01	22.27 ± 6.75
Systolic BP (mmHg)	109.40 ± 8.98	106.06 ± 9.00	112.73 ± 7.69
Diastolic BP (mmHg)	67.39 ± 7.22	66.06 ± 6.65	68.73 ± 7.58
Pittsburgh Sleep Quality Index (PSQI)	4.51 ± 2.53	4.66 ± 2.95	4.36 ± 2.04
CE Axillary (cm)	3.71 ± 1.10	3.24 ± .93	4.19 ± 1.05
CE Mammary (cm)	3.73 ± 1.28	3.00 ± 1.11	4.47 ± .99
CE Xiphoid (cm)	4.14 ± 1.34	3.45 ± 1.18	4.83 ± 1.12

Among 100 individuals (50 males and 50 females) considered for the study, it was observed that the mean and standard deviation of age (in years) of the study participants was 19.96 ± 1.56, the weight (in Kg) of the participants was 55.51 ± 12.17, the height (in cm) of the participants was 163.61 ± 1.56, the BMI (Kg/M^2) of the participants was 21.18 ± 5.63, the Systolic Blood Pressure (mmHg) of the participants was 109.40 ± 8.98, the Diastolic Blood Pressure (mmHg) of the participants was 67.39 ± 7.22, the Pittsburg Sleep Quality Index (PSQI) Score of the participants was 4.51 ± 2.53, and the Chest Expansion (in cm) of the participants at Axillary level was 3.71 ± 1.10, the Mammary Level was 3.73 ± 1.28, and the Xiphoid level was 4.14 ± 1.34.

Table 2: Correlation between PSQI and other variables.

Variables	r-value	p-value
PSQI * BMI	0.062	0.541
PSQI * Systolic BP	-0.252	0.011*
PSQI * Diastolic BP	-0.223	0.026*
PSQI * CE Axillary	0.004	0.969
PSQI * CE Mammary	-0.097	0.339
PSQI * CE Xiphoid	0.017	0.863

- From table 2 it can be seen that PSQI scores and BMI have no correlation with no statistical significance (r = 0.062, p > 0.05)
- The PSQI scores and systolic blood pressure were found to be statistically significant with a weak negative correlation (p = 0.011 < 0.05).
- The PSQI scores and diastolic blood pressure were found to be statistically significant with a weak negative correlation (p = 0.026 < 0.05).
- It can be seen that there is no correlation between PSQI scores and axillary chest expansion and is statistically non-significant (r = 0.004, p >0.05).
- There is no correlation between PSQI scores and mammary chest expansion and is statistically non-significant (r = -0.097, p> 0.05).
- It can be seen that the PSQI scores and xiphoid level chest expansion have no correlation and is statistically non-significant (r= 0.017, p > 0.05).

Fig. 1: Scatter diagram showing the relationship between PSQI and SBP

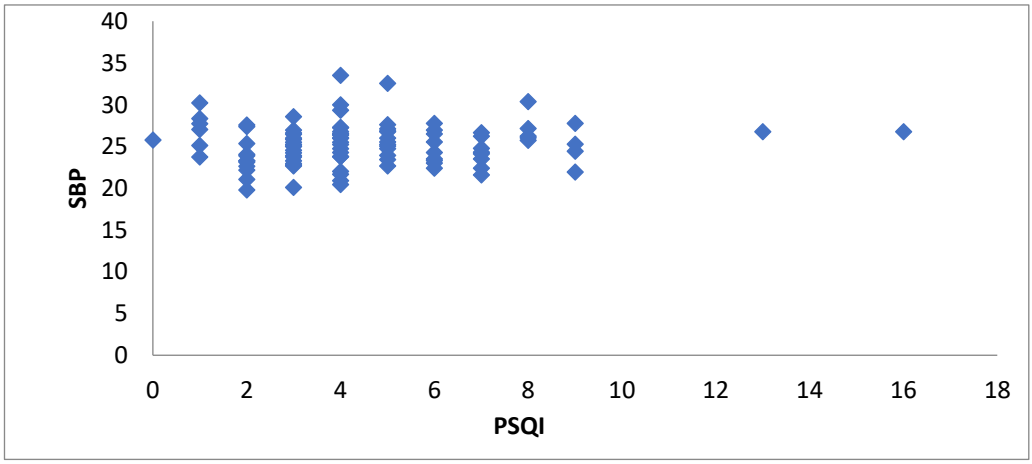


Fig. 2: Scatter diagram showing the relationship between PSQI and DBP

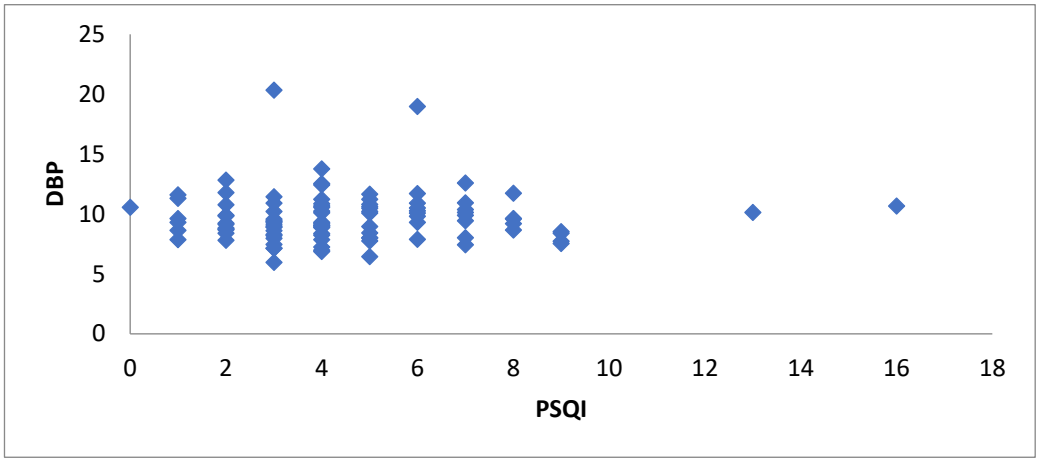


Fig. 3: Scatter diagram showing the relationship between PSQI and CE (Axillary)

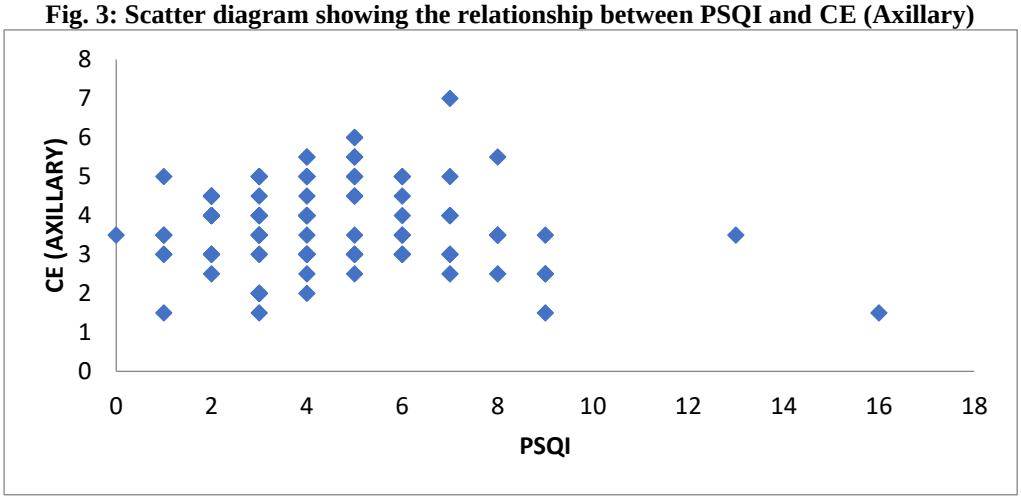


Fig.4: Scatter diagram showing the relationship between PSQI and CE (Mammillary)

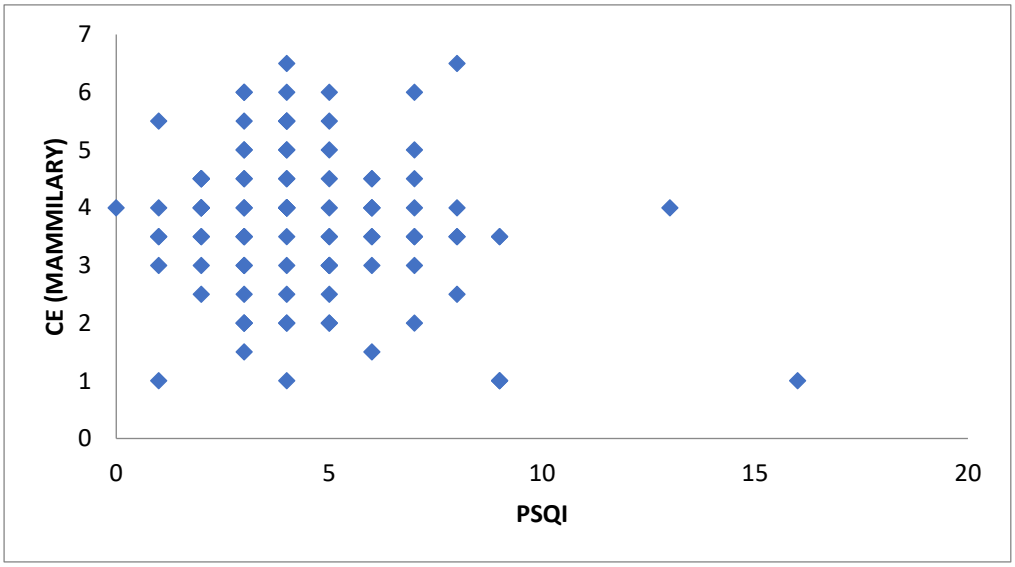


Fig. 5: Scatter diagram showing the relationship between PSQI and CE (Xiphoid process)

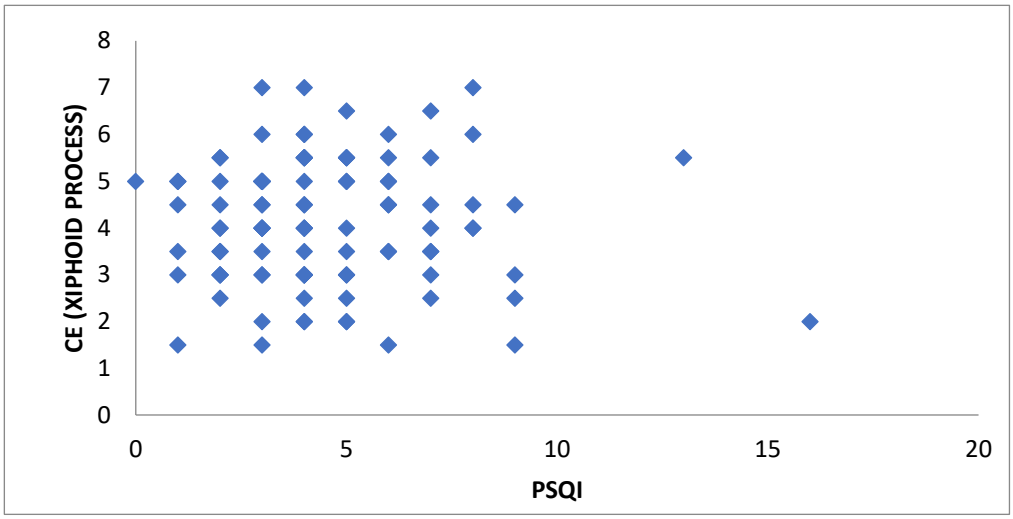
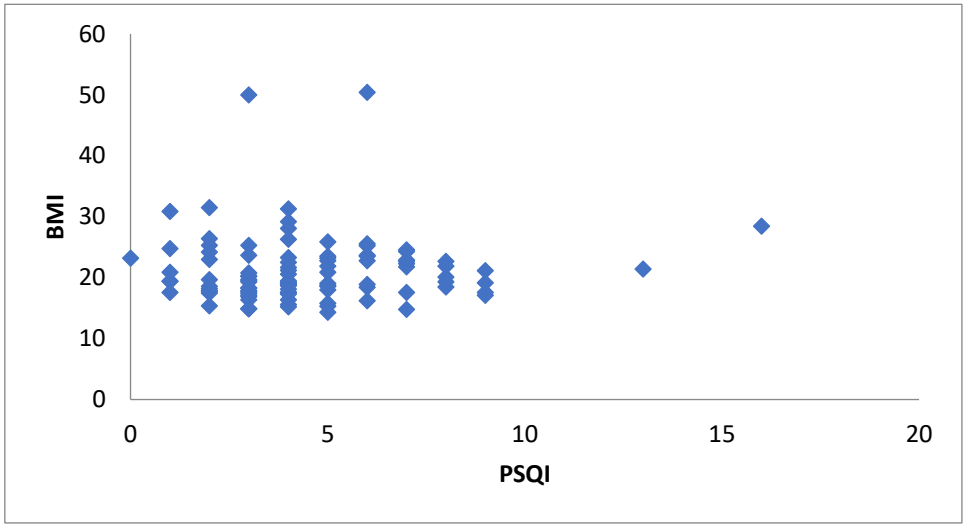


Fig.6 Scatter diagram showing the relationship between PSQI and BMI



DISCUSSION

This study investigated the sleep patterns of young college students, focusing on how sleep duration and quality relate to health indicators like chest expansion, BMI, and blood pressure. The goal was to deepen understanding of the intricate connection between sleep and overall health in this demographic. Even though previous researches have highlighted the effects of disrupted sleep it was crucial to study how it affected and leads to cardiovascular risks in young adults. Thus, the study centered on examining, the length and quality of their sleep, and exploring possible connections to health markers such as chest expansion, BMI, and blood pressure, so that we can help promoting healthy sleep habits among college students for their overall health and well-being.

PSQI & BMI

There are researches which found associations between both sleep quality and duration on BMI highlighting an inadequate amount of sleep has indirect role in weight gain due to fatigue and reduced physical activity.[31] However, this study shows that the quality of sleep does not correlate significantly with BMI in college students. This implies that there are other factors which has a crucial role in determining BMI,[32,33] underscoring the necessity for further studies among college students.

Although the current study did not discover a significant link between sleep quality and BMI in college students, it underscores the fact that other factors such as lifestyle choices, genetics, metabolic differences, and hormonal influences are all probable contributors to BMI variations within this demographic. This emphasizes the importance of comprehending tailored health and wellness strategies for college students regarding this factor.

PSQI & CHEST EXPANSION

The study revealed no statistically significant relationship between PSQI scores and axillary/xiphoid chest expansion in college students, contradicting the hypothesis that sleep quality affects chest expansion in this group.[34] The respiratory muscles have an indirect role in regulating chest expansion.[35] Although inadequate sleep quality can result in fatigue and unhealthy habits, it might not have a direct effect on the strength and functionality of respiratory muscles.[36] Mammillary chest expansion also showed no significant correlation, suggesting limited influence on chest wall movement during sleep.

PSQI & BLOOD PRESSURE

Numerous PSQI factors, including poor sleep quality, extended sleep latency, short sleep duration, and sleep disturbance, have been related to HTN, according to a study in 2016.[37] This study, however, defies other research since it shows a weak negative but statistically significant association between PSQI scores and both systolic and diastolic blood pressure. It implies that lower systolic or diastolic blood pressure levels are correlated with poorer sleep quality, as demonstrated by higher PSQI scores. This suggests that there may be a little trend for blood pressure to drop as PSQI values rise, which indicate worse quality sleep. The poor connection implies that other factors may have a more significant influence on blood pressure regulation in this group, even if the association is statistically significant. Therefore, more thorough investigation is required to fully understand the complicated link between blood pressure and sleep quality, taking into account factors including lifestyle, stress levels, and unique health features.

Limitation of the study: The study relies on self-reported data for sleep quality and duration and limited only to college students. The correlations observed between sleep quality and health outcomes are weak, suggesting that other factors not considered in the study may play significant roles.

CONCLUSION

In accordance with the study, there is a small but statistically significant negative association between systolic and diastolic blood pressure (BP) and PSQI scores. This suggests that there is a minor trend for blood pressure to decline as PSQI values rise, indicating worse quality sleep. Despite being surprising, this result calls for more research to determine its clinical importance. The poor association, however, raises the possibility that other variables may have a bigger influence on this population's ability to regulate blood pressure. As a result, in-depth study is required to examine the intricate connection between blood pressure and sleep quality, taking into account factors including lifestyle, stress levels, and unique health profiles.

Declaration by Authors

Ethical Approval: Approved

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