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Comparison of lung function and self-efficacy between Balinese dancer and non-dancer students in Denpasar, Bali

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ABSTRACT

Background and purpose: Balinese dance is a well-known traditional activity which has been proven to have physiological and psychological benefits. This study aims to compare the differences in lung function and self-efficacy between Balinese dancer and non-dancer students in Denpasar, Bali.

Methods: This was an analytical observational study using a cross-sectional method, which was carried out directly at the Physiology Laboratory of the Faculty of Medicine, Udayana University and Denpasar "X" Institute, from January to September 2023. Participants were students of the Dance and Visual Communication Design Study Programs of Denpasar "X" Institute who met the study criteria accounted for 48 students in each group. The data collection was conducted using a *Chestgraph* HI-101 spirometry for lung function measurement and a self-efficacy scale by I Made Rustika for self-efficacy measurement. The data was analyzed with SPSS 26 using T-independent and Mann-Whitney tests for mean comparison.

Results: The two groups have similar distribution of age, sex, weight, height and smoking status. The respiratory function indicators were higher in dancer group compare to non-dancer group, the mean difference of 0.34 (p=0.02) for FVC(L), 10.14 (p<0.001) for FVC%, 0.3 (p=0.04) for FEV1(L), and 0.77 (p=0.02) for FEV 25%. No significant difference in self-efficacy was observed.

Conclusion: The dancer students have higher lung function compare to non-dancer student. This signify dancing can become one form of physical activities that can be introduced to improve lung function since early age.

Keywords: lung function, self-efficacy, respiratory, dancers, Bali

INTRODUCTION

Dance is one of the inherited cultures available since pre-historic times until now in Indonesia, especially Bali[1], where dance is part of tradition and tourist attraction. Dance has several elements, such as movement, accompaniment, costume, theme and place, which have a physiological impact on the human body. To dance optimally, dancers need good stamina. Balinese dancers have a breathing exercise technique called *Ngunda Bayu* that contains calm and forced breathing. When performing, dancers also need self-confidence to be able to perform the dance well.[2] Therefore, several components may be honed, especially from a physical and psychological point of view.

Physiologically, the lungs have the basic function of facilitating gas exchange.[3] Physical activity has been proven to influence lung function.[4] Studies suggested structured dance, from any genre, has the same or more effective impact than other types of structured exercise, especially aerobic activity, in improving health. It because dance can improve the lung function, so dance is recommended as a safe and effective alternative sport.[5,6] In theory, lung function influenced by several things, such as age, gender, body measurement, smoking status, and activities, especially the aerobic ones.[7,8,9]

Beside physiological aspect, self-efficacy is necessary for a better quality of life. Self-efficacy is a person's belief in determining how well ones can carry out a plan of action in a situation that can be developed with their competencies.[10] Someone with good self-efficacy tend to have a better quality of life.[11] A study shows that dancing is one of the activities that correlates with self-efficacy. To provide optimal performances, dancers need good self-regulation and control influenced by self-efficacy.[12] While dancing, there is traditional theory called *taksu*, ability that can create an appearance of belonging soul, not just a visual appearance, and it is affected by successful experience, verbal persuasion, physiology and mood. [13,14,15]

Therefore, the aim of this study was to determine differences in lung function and self-efficacy between dancers and non-dancers among students in Denpasar, Bali.

METHOD

This analytical observational study with a cross-sectional design was conducted directly at the Physiology Laboratory Faculty of Medicine Udayana University and Denpasar "X" Institute in January-September 2023. The research participants were active students of Denpasar "X" Institute from two groups 1) students of the Dance Study Program at the Faculty of Performance as the dancer group, and 2) students of Visual Communication Design (VCD) Study Program at the Faculty of Fine Arts and Design, which was consider as the non-dancer group. The inclusion criteria were participants have completed at least 1 semester of their study, had no respiratory or psychiatric problems, and did not actively do physical activity for non-dancers. The sample size was calculated with two independent mean estimation with 95% confidence level, 80% power and estimated mean difference of 2 points for self-efficacy, resulted in 48 samples in each group, who were then selected by stratified random sampling.

Lung function was measured using *Chestgraph HI-101* spirometry. First, the participants filled the identity

forms and followed several rules before and during the measurement, so the maneuvers can be optimized. Then, the instructor demonstrated the maneuver, followed by the participants. After that, every participant did the maneuvers, guided by the instructor, at least three until eight maneuvers (deep inspiration and force expiration). It measured force vital capacity (FVC), force expiratory volume (FEV1), and FEV 25% as the lung function parameters.[16] Self-efficacy was measured using the I Made Rustika (2014) self-efficacy scale that contains 20 questions with 10 favorable questions and 10 unfavorable questions. The scoring was done by accumulating every question's score and categorizing the total score into very high, high, middle, low, and very low.[10]

Data analysis was carried out with SPSS 26.0 which include descriptive analysis and mean comparison using the T-independent test for normally distributed data and Mann-Whitney test if the data distribution is not normal for non-parametric test.

This study was approved by the Ethics Committee of The Faculty of Medicine, Udayana University No: 209/UN14.2.2.VII.14/LT/2023. All respondents also signed the informed consent before the examination.

RESULT

Characteristics of respondents

Table 1 presents the distribution of respondent characteristics between the Balinese dancer and non-dancer students in Denpasar, Bali. There was similar distribution of sex between both groups, half were males in each group. The average age was the same between both groups, 19.5±1.09 for dancer group dan 19.5±0.87 years for non-dancer. The height, weight, and BMI were also similar among both groups, with 1.63±0.07 m versus 1.64±1.10m for height, 58.61±3.03 kg versus 58.05±14.61 kg for weight and 21.83±3.03 versus 21.15±3.73 for BMI. Based on smoking status, the dancer group has 14 (29.4%) smokers, with the average of 4±1.71 (Range:1-8) years of smoking and 3±2.14 (Range:1-8) of cigarette sticks daily. Meanwhile, non-dancer group has 15 (31.3%) smokers, with the average of 3.27±1.48 (Range:1-7) years, and 9.33±10.46 (Range:1-40) cigarette sticks per day.

The intensity of dancing of the dancer group

Table 2 presents the intensity of dancing of the dancer group that was described using the FITT pattern (Frequency, Intensity Type, and Time). The average duration of dancing among respondents was 12.98±2.58 (Range: 2-15) years, with a practice frequency of 5.31±1.71 (Range: 2-7) days per week and the duration 4.73±3.42 (Range: 1-12) hours per practice. The average pulse rate during performing the Baris Dance with a 13 minutes duration was 94.75±13.40 (Range:70-120) with the pulse categories according to Christensen's activity intensity criteria[17] are light workload (58.3%) and moderate workload (41.7%).

Table 1. Characteristics of Balinese dancer and non-dancer students

Variable	Dancer Group (n=48)		Non-Dancer Group (n=48)	
	n (%)	Mean ± SD (Min-Max)	n (%)	Mean ± SD (Min-Max)
Age (years)		19.5±1.09 (18-24)		19.5±0.87 (18-22)
Sex				
Male	24 (50)		24 (50)	
Female	24 (50)		24 (50)	
Height (m)		1.63±0.07 (1.48-1.83)		1.64±0.10 (1.45-1.89)
Weight (kg)		58.61±9.62 (44-81)		58.05±14.61 (33.65-100)
BMI (kg/m^2)		21.83±3.03 (16.27-28.26)		21.15±3.73 (13.57-29.58)
<18.5	7 (14.6)		12 (25)	
18.5-25	31 (64.6)		29 (60.4)	
>25	10 (20.8)		7 (14.6)	
Smoking status				
Yes	14 (29.2)		15 (31.3)	
No	34 (70.8)		33 (68.8)	
Only for smokers				
Duration of smoking (years)		4±1.71 (1-8)		3.27±1.48 (1-7)
Number of cigarettes per day (stick)		3±2.14 (1-8)		9.33±10.46 (1-40)

Table 2. The intensity of dancing of dancer group (n=48)

Dancing Activity	n (%)	Mean±SD	Min-Max
History of dancing (years)		12.98±2.58	2-15
Exercise per week		5.31±1.71	2-7
Duration per exercise (hours)		4.73±3.42	1-12
Pulse rate after dancing		94.75±13.40	70-120
Light workload	28 (58.3)		
Moderate workload	20 (41.7)		

The comparison of lung function between Balinese dancer and non-dancer

The comparison and category of lung function between Balinese dancer and non-dancer students can be seen in Table 3. Based on the data, it can be seen that only FCV% is normally distributed, meanwhile, FVC(L), FEV1(L), and FEV25% are not.

The results show that the mean of all lung function indicators were higher among the dancer compare to non-dancer. There were significant differences in all measures, the FVC(L) with a mean difference of 0.34 L with p-value of 0.02, FVC% with a mean difference of 10.14% and p-value < 0.001, the FEV1(L) with a mean

difference of 0.3 L with p-value of 0.04, and a FEV25% with a mean difference of 0.77% with p-value of 0.02. Based on the category of lung function examination results, normal lung function was higher among dancer (27.1%) compare to non-dancer at only 2.1%, while the majority of non-dancer (95.8%) has restrictive lung function compare to 72.9% of dancer participants.

Table 3. The comparison of lung function between Balinese dancer and non-dancer students

Variable	Mean±SD (Min-Max)	Mean Rank	Mean Difference	95%CI		p
FVC (L)				**Lower**	**Upper**	
Dancer Group	2.88±0.65 (2.05-4.21)	55.08	0.34			0.02*
Non-Dancer Group	2.54±0.7 (1.35-3.71)	41.92				
FVC %**						
Dancer Group	71.84±10.78 (50.7-96.9)		10.14	5.91	14.37	0.00*
Non-Dancer Group	61.7±10.09 (40.1-80.1)					
FEV 1 (L)						
Dancer Group	2.8±0.58 (2.02-3.94)	54.41	0.3			0.04*
Non-Dancer Group	2.49±0.7 (1.35-3.65)	42.59				
FEV 25%						
Dancer Group	6.65±2 (4.02-13.23)	55.18	0.77			0.02*
Non-Dancer Group	5.88±2.39 (0.92-12.52)	41.82				
Lung Function Category (n, %)	**Dancer Group**			**Non-Dancer Group**		

*Significant result
**distributed normally with T Independent Test

The comparison of self-efficacy between Balinese dancer and non-dancer groups

Table 4 presents the comparison and category of self-efficacy between Balinese dancer and non-dancer students. There is no significant difference in self-efficacy, with p-value of 0.8. Most of the participants have high self-efficacy for dancers and non-dancers, 29 (60.4%) and 26 (54.2%) respectively.

Table 4. The comparison of self-efficacy between Balinese dancer and non-dancer groups

Variable	Mean ± SD (Min-Max)	Mean Rank	Mean Difference	p
Self-Efficacy				
Dancer Group	59.5±6.12 (45-72)	49.23	0.48	0.8
Non-Dancer Group	59.02 ±8.96 (31-78)	47.77		
Self-Efficacy (n%)	**Dancer Group**		**Non-Dancer Group**	
Very High	9 (18.8)		11 (22.9)	
High	29 (60.4)		26 (54.2)	
Middle	9 (18.8)		7 (14.6)	
Low	1 (2.1)		3 (6.3)	

DISCUSSION

Dancing is one of aerobic activities that can affect physiologically through its mechanism as a physical activity and psychologically through its mechanism as an art activity. In theory, the intensity of physical activity can be measured using the heart rate measured during activity.[18] In our study, dancing was fall into light and moderate physical activity. Aerobic activity moves the body's large muscles rhythmically over a certain period with functions to increase cardiorespiratory fitness.[19] As an activity that can be used as aerobic physical activity, dancing can be carried out with a recommendation of 3 times per week with a one-hour duration per exercise.

We found the dancers have better lung function than non-dancer group, which can be seen in all indicators FVC(L), FVC%, FEV1(L), and FEV25%. This signifies that dancing improves lung capacity and lung function. A previous study shows a significant increase in FVC after 12 weeks dancing intervention.[20] The body's physiological response to dancing depends on the exercise's frequency, intensity, type and time. Dancing should be done adequately so the body start to respond well.[20]

When dancing, the movement, breathing, and coordinated skeletal muscles get trained, especially the respiratory muscles, which will be adapted to perform force breathing. Dancing will also increase cardiac output. In addition, the more joints and tendons are involved in the exercise process, the greater the ventilation that occurs because peripheral proprioception in the muscles, tendons and joint area will be stimulated to send impulses to the respiratory center in the medulla, increasing inspiratory impulses which will affect breathing. Increased ventilation, stimulation of inspiratory impulses, and cardiac circulation will cause an increase in oxygen demand. Therefore, the body begins to compensate by reducing pulmonary circulation resistance due to two mechanisms: capillary recruitment and capillary distension.

Normally, half of the alveolus is closed and not supplied with blood. However, when the capillary recruitment mechanism occurs, the closed capillaries will open, and the area will have increased blood flow. After that, distension or widening of the capillaries will appear, which will help increase blood flow so that vascular resistance can be reduced and more oxygen diffusion can be carried out. Due to this mechanism, there

is an increase in lung volume as a result of dancing practice in a sufficient proportion.[6-21]

Based on the traditional theory, dancing is a form of aerobic physical activity that can affect the vital capacity of the lungs which is also aligned with the basic guidelines for dancing called *tri wi* (three wi- elements that start with 'wi' – *wiraga*, *wirama* and *wirasa.* These elements were then refined by adding two aspects, speech and authority, then become *panca wi (five wi).* Of the five elements, *wiraga* and *wirama* cover the relationship between dancing and physical activity. *Wiraga* is a dance movement and *wirama* is the coordination of movements to the dance tune.

These two elements were supported by a physiological technique called *ngunda bayu*, which is divided into four aspects: breathing, regulating energy intensity, concentrating and placing energy, and regulating the expenditure and return of energy. The breathing exercise performed regularly by the dancer may explain the differences in lung capacity between dancers and non-dancers. Breathing using the basic technique of *ngunda bayu*, with the breathing pattern of continuous inhaling and exhaling called *ngunjar angkihan* helps the dancer to regulate inhalation and exhalation more efficient and effectively. The *ngunda bayu* also help to train concentration and energy processing, which influences the regulation of the energy distribution or power in controlling each dance movement. Due to this mechanism, the respiratory muscles become well trained to influence the higher lung function in the group of dancers.[21,13]

Dancing is also associated with good self-efficacy. Self-efficacy is the quality of confidence in ability to complete responsibilities or goals. We found no significant differences of self-efficacy between the Balinese dancer and non-dancer groups. The average self-efficacy results show that the entire group has a high self-efficacy. These results indicate that all groups of respondents currently undergoing arts education have good confidence in their abilities, namely dancing activities for dancing groups and creating visual communication designs for non-dancing groups.

In theory, several factors can influence self-efficacy: successful experiences, events that are experienced as if they were experienced personally, verbal persuasion, physiological states, and moods.[10,15] In this study, no significant differences in self-efficacy were found because all factors that influence efficacy are included in the art education process of each respondent. First, during the learning process for both groups, the assignments will be presented at a dance performance or art exhibition so that it can be an experience, both failure and success, that can determine an individual's self-efficacy. Successful experiences will increase self-efficacy and vice versa. However, if an individual can interpret the experience of failure well, good self-efficacy will be formed.[10,15]

Second, a model or figure is used during arts education, both dance and visual communication design. This factor can be reinforced when difficulties or failures occur in forming good self-efficacy in each individual according to their competence.[10,15-22] Then third, as artists, all groups have their place and time to exhibit their work, namely the stage and exhibition events. The entire group will receive direct and indirect feedback when this activity occurs. The better the input, the better the individual's self-efficacy.[10,15-23] The fourth factor, physiological state and mood, is also a factor that can influence self-efficacy.

Dancing and designing a visual communication are activities that can be used as coping mechanisms. These two activities will affect the body's physiology, improve mood, and produce positive hormones. These will also affect the increasing serotonin and decreasing cortisol, which will have positive effects on the body, such as a

good mood and reduced level of psychological distress.[24] Besides, a study also explains that the visual art activities included in VCD study program can help relax, freely express all emotions, stimulate thinking, and serve as a means of learning about oneself. Through this mechanism, this activity can reduce cortisol significantly. Based on this study, these two activities can influence hormones physiologically by increasing happy hormones and reducing stress hormones, which cause good mood and physiology so that self-efficacy becomes good.[25]

The good self-efficacy in arts students has various benefits, such as reducing academic procrastination. A study states that self-efficacy has a negative correlation with academic procrastination. The higher or better a person's self-efficacy, the lower the level of academic procrastination. Therefore, good self-efficacy is necessary, for visual communication design students, to carry out the assignments well, reduce academic procrastination, and optimize their abilities.[26] Meanwhile, for the dancer students, good self-efficacy is necessary because research states that self-efficacy influence dancers' self-regulation. Self-regulation in dancers is essential to be able to control themselves while dancing which involve simultaneous integration of rhythm, body movements, emotional turmoil, concentration, appreciation, and cooperation. These components must be controlled by self-regulation to create a *taksu,* a positive aura of dancer. Therefore, to achieve good self-regulation, good self-efficacy is needed in dancers.[12]

Gender can influence lung function because anatomically, men have respiratory structures that are more supportive of having a larger lung capacity compared to women.[27] Beside gender, body posture has a positive correlation because the larger the body size, the greater the lung capacity, and vice versa.[7] In previous research, it was found that BMI had a positive correlation with FVC and FEV1.[28] In our study, age, gender, height, weight, and BMI between groups were similar, so these factors were controlled.

A study shows a significant correlation between smoking and lung function, which is in line with the duration of smoking.[16] Smoking can accelerate the decline in lung function, both inspiratory and expiratory reserve volumes, and students who do not smoke have a higher lung capacity compared to those who smoke.[29-30] However, in this study, the amount of cigarette consumption and the characteristics of smokers in each group tended to be homogeneous, so they did not significantly influence the comparison of lung function and self-efficacy between groups.

Dancer students showed better lung function than non-dancer students, hence dancing should be considered as one option of physical activity that can be introduced as early as possible. Ther limitation of this study, there are no measurement of physical activity and art history as a regular activity for non-dancer group. Therefore, there are no comparison of physical activity and history of art activity that also contribute to lung function and self-efficacy between dancer and non-dancer groups.

CONCLUSION

Our study found a significant difference in lung function between Balinese dancer and non-dancer students in Denpasar, Bali, with the dancer's lung function better than non-dancer group, that is reflected on the higher FVC, FEV1, FEV25% and FVC(L) among dancer group. However, we found no significant difference in self-efficacy between Balinese dancer and non-dancer students which is likely due to similar exposure to factors

that influence self-efficacy in both groups. Dancing can be considered as an alternative of physical activity that can improve the respiratory capacity. Future studies should also explore and control the analysis with other factors such as physical activities other than dancing.

COMPETING INTEREST

We have no conflict of interest in this study

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AUTHOR'S CONTRIBUTION

LP developed the study design, collected and analyzed the data, and drafted the manuscript. MM, SP, and LS provide suggestions from developing the study design until the manuscript is prepared. MM also as the correspondence author.

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