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Quantify the Effect of Repeat Periodic Running Exercise Teenagers - A Case Study in Hong Kong

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Authors' contributions

This work was carried out in collaboration between all authors. Author KLM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors WKL and YTC managed the analyses of the study. Author WKL managed the literature searches. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

In this study, we intend to explore the relationship between running training as a form of exercise and pulmonary functions by conducting a case-control study. A total of 329 subjects coming from five schools were sampled, 149 boys and 180 girls, with age between 14 and 21. Subjects were then assigned to two groups (experimental and controls) using a system of random number tables. Pulmonary function tests and their BMI were measured for all the subjects before exercise with the help of a digital spirometer. The experimental group is required to perform repeat periodic running exercise for 20 minutes, three days per week, for eight consecutive weeks. The running exercise was supervised by trained staff. The control group continued with the routine and performs no specific exercise. Pulmonary function tests were repeated after eight weeks for both experimental and controls groups.

Keywords: Pulmonary function test; repeat periodic running exercise.

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1. INTRODUCTION

The Hong Kong Government launched campaign of the "Healthy Exercise for All Campaign" in 2000. The campaign aimed to raise the public's interest in performing regular exercise and also understand the relationship between exercising and health. The corresponding campaign has entered its fifteenth year, running was being very popular in Hong Kong. Running training was used for physical activity rehabilitation in patients with pulmonary diseases.However, the effect of regular running was not quantified. Many researches showed non-significant change in pulmonary function as effect of running in early 1990's. Kuppu, and Vijayan [1], Hamilton and Andrew [2], Doherty and Dimitrous [3]. However, reverse findings were found by Chandran et al. [4] and Cedric et al. [5] and significant improvement in pulmonary functions as a result of the effect of running exercise. Khanam et al. [6] found that forced expiratory volume in first second was significantly low in runners than controls and this is contrast to other studies from Prakash et al. [7] and Makwana et al. [8]. Therefore, further study on FEV1 about the effect of running exercise was needed in order to have a clear picture.

In our study, we intended to explore the relationship between running training as a form of exercise and pulmonary functions by conducting a case-control study. Subjects were required to fill in a questionnaire about their household condition and living style, such as smoking habit, living condition, etc. Subjects were then assigned to two groups (experimental and controls) using a system of random number tables. Pulmonary function tests and their BMI were measured for all the subjects before exercise with the help of a digital spirometer. The experimental group was required to perform repeat periodic running exercise for 20 minutes, three days per week, for eight consecutive weeks. The running exercise was be supervised by trained staff. The control group will continue with the routine and perform no specific exercise. Pulmonary function tests were repeated after eight weeks for both experimental and controls groups.

2. METHODOLOGY

2.1 Preparation

A questionnaire relating to subjects' living style and household condition was developed for this study. A letter was written to each subject to explain the purpose of the study. A meeting was arranged with responsible student assistants to discuss the practical aspects of research. A briefing was carried out in order to explain to the chosen subjects the questionnaire design and provide some instructions for filling in the questionnaire and information about the case-control study.

A pilot study was then being carried out before the main survey starts. It aimed to test the use of questionnaires and also the acceptability of the methods in the case-control running exercise study.

2.2 Pulmonary Function Tests Sampling

In our study, pulmonary function tests were conducted among surveyed samples to assess their lung functions with reference to suggestions. Spirometers with Model: MIR spirobank G was used for conducting the pulmonary function tests. Accordingly to the American Thoracic Society recommendations, each participant was required to perform at least three satisfactory blows and forced expiratory time exceeding 6s. Pulmonary function tests were performed with two identical spirometers by fully trained technicians. Height and weight were also measured for each participant, and were further used for finding the BMI.

2.3 Data Collection

Pulmonary function tests and their Body Mass Index (BMI) will measure all the subjects before exercise training. Lung function test will perform at least twice for each subject for each measurement, and the best result will be taken. Pulmonary-function data were obtained by trained student assistants, who will also measure each subject's height and weight for the BMI to avoid weight bias on pulmonary function.

Subjects will then be assigned to two groups (experimental and controls) using a system of random number tables. The experimental group will perform running exercise for 30 minutes, three days per week, for eight weeks under supervision of trained student assistants. The control group will continue with the routine and perform no specific exercise. Pulmonary function tests will be carried out again after eight weeks for both experimental and controls groups.

3. RESULTS

A total of 329 subjects coming from five schools were sampled, 149 boys and 180 girls, with age between 14 and 21. Reliability analysis was

performed, Cronbach's Alpha was equaled to 0.897. The average height was 159.8 cm and weight 51.7 kg.

The average Functional Vital Capacity is 2.93 and Forced Expiratory Volume in 1s is 2.61 respectively. Regarding to the height and weight difference among each sample, the FVC and FEV1 value cannot directly applied for comparison. A common practice of using the percentage between the sampled value and the predicted value (sample / predict) is adopted for comparative analysis, percentage with over 80% were considered as normal person. Mak and Loh [9]; Mak et al. [10]; Beres et al. [11]. The predicted values were estimated taking into account of the weight and height of each sample based on the method of The Global Lung Function Initiative.

3.1 Analysis of Covariance

A statistical analysis of covariance, ANCOVA, was carried out to identify if there were significant differences between the factors for each of the cities. ANCOVA is a general linear model which blends ANOVA and regression. ANCOVA evaluates whether population means of a dependent variable are equal across levels of a categorical independent variable, while statistically controlling for the effects of other continuous variables that are not of primary interest, known as covariates. Therefore, when performing ANCOVA, the dependent variable means are adjusted to what they would be if all groups were equal on the covariates. For performing ANCOVA analysis, we need to define covariates. Principal component analysis was carried out on interested confounding factors and the scores from principal component analysis will apply for covariate.

In previous research, (Mak et al. [10]) the observed lung function is most affected by gender, weight and height. In order to isolate the bias from these three well know factors, these three factors were included for principal factor analysis. Therefore, these three factors were also included for principal factor analysis and then derive results that have been adjusted for all the other factors when examining one factor by ANCOVA.

As mentioned in last paragraph, for performing ANCOVA analysis, we need to define covariates. For performing ANCOVA analysis, we need to define covariates. Principal component analysis was used on three interested confounding factors

a. Gender
b. Weight
c. Height

The scores from principal component analysis were applied for the covariate of ANCOVA.

The principal component analysis was carried out on the data set, and the eigenvalues and percentage of variance represented by corresponding components are shown in Table 1. The result showed that two components had eigenvalues greater than one, so these three components were selected as the principal factors in our data set. Varimax with Kaiser normalization was applied for rotation methods of extracting the principal components. The corresponding components are shown in Table 2.

Table 1. Eigenvalues and percentage of variance represented by corresponding components

Component	Eigenvalues	% of variance
1	1.324	47.936
2	1.017	36.821
3	0.421	15.243

Table 2. Result of principal components analysis

	Component	
	1	**2**
Gender	0.194	0.729*
Weight	0.532*	-0.089
Height	0.963*	0.181

**. Coefficient is significant at the 0.05 level*

After Varimax rotation, two components were extracted by the principal component analysis. The first component had one significant coefficient, which was gender and it can represent 47.936% of the overall variation. The second component had two significant coefficients, which were weight and height. The second component represented 36.821% of the overall variation.

A statistical analysis, ANCOVA, was carried out to identify if there were significant differences among different factors. Before performing ANCOVA, Levene Statistical test was preformed, in order to confirm the equal variance

Table 3. Summary of regression model

Dependent variable	Included variable	Partial regression coefficients
FVC R-square: 0.891	Constant Group (0 for control, 1 for experiment)	1.547 0.384
FEV1 R-square: 0.784	Constant Group (0 for control, 1 for experiment)	1.434 0.367

For both models for FVC and FEV1, relatively high R-square was obtained and positive coefficient for "Group". The positive coefficient representing experiment group has 0.384 and 0.367 improvements in terms of FVC and FEV1, respectively

assumption of ANCOVA. A value of larger than 0.05 for significant value reflects the equal variance assumption is valid.

Significant differences were obtained between the experimental and controls group. The result showed that the experimental group has significant improvement in terms of percentage in pulmonary function than control group.

3.2 Statistical Binary Regression Model

Besides testing the significant difference between factors on pulmonary function, statistical binary regression model was developed for quantify the impact of running training to pulmonary functions by numerical model. Finally a statistical regression model was developed, it is important to quantify the effect of running training.

4. CONCLUSION

In our study, an experimental-case study was carried out. The experimental group is required to perform repeat periodic running exercise for 20 minutes, three days per week, for eight consecutive weeks. The running exercise will be supervised by trained staff. The control group will continue with the routine and perform no specific exercise. Pulmonary function tests were carried out repeated after eight weeks for both experimental and controls groups. By statistical analysis, significant difference was found between experimental and controls. The result showed that the experimental group has significant improvement in terms of percentage in pulmonary function than control group. Regression models were developed successfully. In term of the meaning of coefficient, the experimental group has 0.384 in terms of FVC value improvements after perform repeat periodic running exercise for 20 minutes, three days per week, for eight consecutive weeks.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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