

The effects of progressive resistance exercise on running performance among grade 7 and 8 students in Ming Dao High School International Department

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Abstract

Progressive resistance exercise improves cardiovascular endurance which is needed in running. Thus, given the benefits of this exercise, this study aims to determine the effects of progressive resistance exercises on running performance among students in Ming Dao High School. Furthermore, the outcome of this study will recommend the frequent use of progressive resistance exercise at the secondary school level in Taiwan in preparation for the conduct of the yearly Physical Fitness Test to have a better outcome specifically in cardiorespiratory endurance test. This study used a quasi-experimental method of research applying pre-test, mid-test, and post-test to determine the effects of progressive resistance exercise and running of normal weight and overweight students. The participants of this study were the grade 7 and 8 students of Ming Dao High School International Department taking Physical Education subject in academic year 2021-2022. The descriptive statistics used in summing quantitative data includes mean and standard deviation. While to determine whether there is a statistically significant difference between the means of the three sets of scores (pre-test, mid-test, post-test), the researcher used the independent sample t-test. Findings from the study revealed that there's a significant difference between progressive resistance exercise and running performance among overweight and normal weight male and female students. These findings imply that progressive resistance exercise helps in improving students' cardiovascular endurance which is needed in running. The study concludes that progressive resistance exercise helps in improving students' performance in running. This present study thereby recommends to include progressive resistance exercise in implementing programs that would improve the students' performance in taking Physical Fitness Test specifically in cardiovascular endurance test.

Keyword: Progressive Resistance Exercise; running performance; normal weight; overweight

1. Background

According to Novacheckstudy (as cited by The University of British Columbia, 2020) running is a means of terrestrial movement allowing humans and other animals to move speedily on foot. In athletic terms, it merely means a gait in which at consistent points throughout the running cycle both feet are off the ground (Gallahue and Ozmun as cited by The University of Columbia, 2020). The term running can be denoted to any variation of speeds ranging from jogging at the aerobic phase to sprinting which is classically anaerobic. It is considered a gross motor skill as it uses the whole-body and involves stimulation of numerous huge muscle groups (Gibson as cited by The University of Columbia, 2020)). Over the years, running is one of the most reachable sports activities and exercises for individuals seeking to increase their physical activity levels, and

has notably increased in popularity. As a form of aerobic exercising that's easily reachable, it is one of the ways to get the significant benefits of exercise (Loria, 2018).

On the other hand, Waehner (2020) defined progressive resistance exercise as a strength training method in which the load is continuously improved to facilitate adaptation. It is important in building strength, dropping weight, and getting more potent. This is typically a moderate to high intensity two to three-weeks exercise using exercise apparatuses, free weights, or flexible/elastic bands. As compared to any other exercises, progressive resistance exercise is also beneficial to a person's health. It helps burn more calories (and thereby losing weight) as well as strengthening muscles, joints, and even bones for better overall health and fitness.

Progressive resistance exercise also improves cardiovascular endurance which is needed in running. Individual who likes to run frequently don't pay attention more on strength training. In fact, several runners avoid strength training because they don't want to stress up. They think strength training may lessen their flexibility and would undesirably affect their performance. However, this is a misperception, as this can essentially progress running performance (Augustyn, 2020). Thus, given the benefits of this exercise, this study aims to determine the relationship of progressive resistance exercises on running of students in Ming Dao High School. Furthermore, the outcome of this study will recommend the frequent use of progressive resistance exercise at the secondary school level in Taiwan in preparation for the conduct of the yearly Physical Fitness Test to have a better outcome specifically in cardiorespiratory endurance test. This will also help teachers and administrators to implement programs that would improve the students' performance in taking Physical Fitness Test specifically in cardiovascular endurance test.

1.1. Statement of the Problem

In this study, the researcher will determine the effects of progressive resistance exercise in running performance among normal weight and overweight male and female middle school students specifically in Ming Dao High School, International Department. Specifically, the researcher will seek to determine the following:

1. What is the effects of progressive resistance exercise in running of normal weight and overweight male students?
2. What is the effects of progressive resistance exercise in running of normal weight and overweight female students?
3. What is the effects of progressive resistance exercise in running of normal weight and overweight students?
4. How is the implementation of the Progressive Resistance Exercise (PRE) affects students in terms of behavior and engagement.

2. Methodology

This chapter presents the description of the research methods used by the researcher in this study. It consists of (1) research design, (2) respondents of the study, (3) research instrument, and (4) Data Analysis.

2.1 Research Design

This study was made by the means of qualitative and quantitative methods. In addition, this study also used a quasi-experimental method of research applying pre-test, mid-test, and post-test to determine the effects of progressive resistance exercise on running of normal weight and overweight female and male students.

2.2 Population and Sampling

3	340	3	622	3	368	3	620	3	467	3	740	3	475	3	751
4	389	4	499	4	355	4	501	4	501	4	445	4	459	4	732
5	358	5	367	5	301	5	369	5	568	5	447	5	579	5	561
6	317	6	570	6	318	6	565	6	594			6	590		
7	500	7	520	7	468	7	521	7	519			7	590		
8	378	8	352	8	348	8	343								
9	423	9	489	9	392	9	490								
10	527	10	425	10	517	10	425								
11	285	11	527	11	255	11	527								
12	305	12	385	12	271	12	369								
13	360	13	330	13	329	13	325								
14	445	14	372	14	414	14	360								
M	396.14	M	443.93	M	370.71	M	440.57	M	525	M	521	M	533.86	M	747

PACER Test

NORMAL WEIGHT GROUP								OVERWEIGHT GROUP							
Pretest				Post-test				Pretest				Post-test			
EG		CG		EG		CG		EG		CG		EG		CG	
1	16	1	34	1	23	1	34	1	29	1	24	1	32	1	30
2	34	2	52	2	39	2	52	2	19	2	11	2	24	2	18
3	24	3	6	3	29	3	10	3	34	3	20	3	39	3	30
4	50	4	23	4	53	4	26	4	19	4	31	4	22	4	33
5	53	5	41	5	55	5	42	5	38	5	13	5	44	5	22
6	45	6	24	6	47	6	25	6	9			6	15		
7	38	7	32	7	43	7	33	7	15			7	21		
8	43	8	53	8	45	8	53								
9	10	9	30	9	17	9	34								
10	23	10	14	10	25	10	16								
11	29	11	12	11	35	11	14								
12	16	12	32	12	25	12	36								
13	42	13	34	13	41	13	35								
14	26	14	36	14	32	14	38								
M	32.07	M	30.21	M	36.36	M	32	M	23.29	M	19.8	M	28.14	M	26.6

Reflected in table 2 is the pretest and posttest mean scores of the male normal weight and overweight students in 1200m run test and PACER test. The means of experimental group of normal weight male, the group who went through the progressive resistance exercise, shows a lesser time (in seconds) in the 1200m run in their pretest with 396.14 and posttest 370.71 compared to means of the control group in their pretest (443.93) and posttest (440.57) who did not do any exercises during the conduct of the study. While in the overweight male group, control group shows lesser time (in seconds) during the pretest with the mean of 521 compared to the mean of the experimental group which is 525. However, during the posttest, the experimental group garnered a mean score of 533.86 in seconds which is much lesser compared to the mean scores of the control group which is 747. This means that the male students who undergo the progressive resistance exercise for four (4) weeks, in normal weight group, performed well in the 1200m run compared to the students who did not undergo any exercises during the conduct of the study. However, there is no significant decrease in the average (seconds) of overweight group, which indicates that the intervention did not significantly affect overweight male students' running performance in 2000m run.

Meanwhile, the means of experimental group of normal weight male, the group who went through the progressive resistance exercise, during pretest which is 32.07 shows higher laps completed compared to the means of the control group which is 30.21. The same with the posttest, experimental group with a mean of 36.36 completed more laps compared to the mean score of the control group which is 32. Meanwhile in the overweight male group, the experimental group performs better in PACER test with a mean of 23.29 compared to the mean of the control group which is 19.8. The same also in the posttest, experimental group performs better with a mean score of 28.14 compared to the mean of the control group which is 26.6. This means that experimental male students or the students who undergo the progressive resistance exercise for four (4) weeks performed better in the PACER test compared to the students who did not undergo any exercise during the conduct of the study. Most of the male students indicated that progressive resistance exercise improved their running speed and performance. This also helps their body to be active and healthy as what their reflective journals say,

"First, progressive resistance exercise is about training your muscles. your legs have muscles so when you do the progressive resistance exercise it helps your legs to make your muscles have more strength and energy. that makes your legs stronger so you can run faster which makes your running performance better than before."

"...doing progressive resistance exercise training helps our muscles get stronger, making us run with more force, run faster and not let us get tired easily. From my personal experiences from the past-and now, it makes some parts of my body stronger, depending on which part of the muscle I train on. So, since the muscle is stronger, it makes it easier for me to run because the muscle are doing more work. It also makes me run faster because the muscles are more active and they move more effortlessly when they are stronger."

These results support the notion of Wachner (2021) indicating that progressive resistance exercise is crucial in developing muscles and gaining strength. It is a technique where adaptation is facilitated by constantly increasing the workload.

3.3. The effects of progressive resistance exercise in running of normal weight and overweight female students

Table 3. Mean Scores of Pretest and Post-Test of Normal Weight and Overweight Female Students

1200m Run Test															
NORMAL WEIGHT GROUP								OVERWEIGHT GROUP							
Pretest				Post-test				Pretest				Post-test			
EG		CG		EG		CG		EG		CG		EG		CG	
1	641	1	619	1	610	1	632	1	571	1	501	1	581	1	452
2	381	2	510	2	359	2	500	2	489	2	1290	2	535	2	1239
3	534	3	381	3	501	3	380	3	648	3	745	3	655	3	751
4	760	4	510	4	765	4	510	4	587	4	760	4	619	4	732
5	408	5	760	5	385	5	750			5	590			5	561
6	481	6	481	6	461	6	481								

7	541	7	402	7	331	7	400								
8	404	8	444	8	507	8	434								
9	450	9	335	9	420	9	325								
10	390	10	450	10	358	10	451								
11	410	11	434	11	378	11	435								
12	642			12	607										
M	503.50	M	484.18	M	473.50	M	481.64	M	573.75	M	777.2	M	597.5	M	747

PACER Test

NORMAL WEIGHT GROUP								OVERWEIGHT GROUP							
Pretest				Post-test				Pretest				Post-test			
EG		CG		EG		CG		EG		CG		EG		CG	
1	5	1	31	1	13	1	30	1	15	1	37	1	21	1	36
2	80	2	35	2	81	2	36	2	13	2	17	2	14	2	19
3	37	3	43	3	40	3	45	3	24	3	6	3	27	3	9
4	27	4	11	4	27	4	11	4	11	4	14	4	16	4	10
5	59	5	35	5	61	5	30			5	11			5	10
6	68	6	81	6	75	6	81								
7	52	7	56	7	55	7	56								
8	40	8	37	8	40	8	36								
9	26	9	57	9	30	9	60								
10	53	10	26	10	56	10	25								
11	47	11	49	11	50	11	50								
12	40			12	42										
M	44.5	M	41.91	M	47.5	M	41.82	M	15.75	M	17	M	19.5	M	16.8

Depicted in table 3 is the pretest and posttest mean scores of the female normal weight and overweight in 1200m run and PACER test. The means of the control group of normal weight female, the group who did not undergo the progressive resistance exercise, shows a lesser time (in seconds) in the 1200m run in their pretest with 484.18 compared to the mean score of the experimental group, the group who undergo the progressive resistance exercise, which is 503.50. However, during the posttest, the mean score of the experimental group which is 473.50 is much lesser compared to the mean score of the control group which is 481.64. Also, the mean score of the experimental group in the pretest and posttest shows improvement with the difference of 30 seconds after the students undergo progressive resistance exercise. While in the overweight female group, the experimental group's mean score during the pretest which is 573.75 seconds is lesser compared to the mean score of the control group which is 777.2. The same with the posttest, mean score of the experimental group which is 597.5 is much lesser compared to the mean score of the control group which is 747. This means that the female students who undergo the progressive resistance exercise for four (4) weeks, both normal weight and overweight, performed well in the 1200m run compared to the students who did not undergo any exercises during the conduct of the study. One student says that,

"When I was doing the progressive resistance exercise was nice, it feels comfortable, and a little tired to do the exercises during online learning and in school too. It becomes easier over time and I was able to do the exercises quicker and faster... And after doing the exercises, I did improve on the 1200m ..."

Similarly, the study of Silva et al. (2021) revealed that high-intensity resistance training lead to significant increase the ability of the students in sprint at short (10 m) and medium (20 and 30 m). This shows

that regular field-based practice coupled with HIRT may enhance the development of physical fitness.

On the other hand, in the normal weight female group, the experimental group with a mean score of 44.5 in the PACER test pretest performs better compared to the mean score of the control group which is 41.91. The same also in the posttest, experimental group garnered a mean score of 47.5 compared to the mean score of the control group which is 41.82. While in the overweight female group, control group gathered a mean score of 17 which is higher compared to the mean of the experimental group which is 15.75 in the pretest. However, in the posttest, the experimental group's mean score which is 19.5 is higher compared to the mean score of the control group which is 16.8. This means that experimental female students or the students who undergo the progressive resistance exercise for four (4) weeks performed better in the PACER test compared to the students who did not undergo any exercise during the conduct of the study. Most of the female students say that although the exercise is tiring but this makes their body stronger and energetic as stated in their reflective journal,

"I didn't get tired as fast as the first run. I feel more comfortable in the second run."

"It keeps my body energetic and stronger."

Also, one female student also mentioned that keeping a good mentality in a tiring situation would really help her in not giving up finishing the task as cited,

"The progressive resistance exercise make us improve our muscular endurance and our running speed. It also improve our willpower because you will need to go beyond your limits and it will be very tired, so you need to keep a good mentality so you won't give up soo early."

Likewise, Rafton (2023) asserts that the goal of progressive resistance exercise is to continuously challenge the body by systematically increases the volume, intensity, or difficulty of the exercise.

3.4 The effects of progressive resistance exercise in running of normal weight and overweight students

Table 4. Comparison of Pretest and Posttest Scores of Normal Weight and Overweight Male and Female Experimental Group in 1200m Run Test

Gender	MALE				FEMALE			
Test	Pretest		Posttest		Pretest		Posttest	
Groups	NW	OW	NW	OW	NW	OW	NW	OW
N	14	7	14	7	12	4	12	4
Mean	396.1429	525.00	370.7143	533.8571	503.5000	573.7500	473.5000	597.5000
SD	76.31298	59.50070	77.26919	68.38477	122.56241	65.52035	131.43716	51.46844
p-value	.442		.909		.126		.118	
Interpretation	No Significant Difference		No Significant Difference		No Significant Difference		No Significant Difference	

Table 4 shows that the mean scores in pretest of male normal weight ($M = 396.1429$, $SD = 76.31298$) and overweight ($M = 525.00$, $SD = 59.50070$) did not differ significantly with p-value of .442. The same in the posttest, the mean score of male normal weight ($M = 370.7143$, $SD = 77.26919$) and overweight ($M = 533.8571$, $SD = 68.38477$) did not differ significantly with p-value of .909. Additionally, there's a significant decrease of time (in seconds) during the posttest of the male normal weight compared to the pretest. However, there's a significant increase of time in the mean score of male overweight during the posttest. This is because overweight male students feel tired after the intervention and they were not able to perform well during the posttest. In one of the student's reflective journals, a male student state that,

"On the other hand, it is also tiring because I need to use a lot of force, which can use up a lot of energy. Therefore, I often drink some water or some sports drink after exercising. Although it is sometimes tiring, I think it is a very good activity for people to do!"

According to Collins (2022), resistance exercise may have a positive impact on specific correlates of physical activity in inactive and/or obese youth, with strength as a possible underlying mechanism.

On the other hand, that the mean scores in pretest of female normal weight ($M = 396.1429$, $SD = 122.56241$) and overweight ($M = 573.7500$, $SD = 65.52035$) did not differ significantly with p-value of .126. The same in the posttest, the mean score of female normal weight ($M = 473.5000$, $SD = 131.43716$) and overweight ($M = 597.5000$, $SD = 51.46844$) did not differ significantly with p-value of .118. Additionally, there's a significant decrease of time (in seconds) during the posttest of the female normal weight compared to the pretest. This means that the female normal weight students performed better after the conduct of the intervention. However, there's a significant increase of time in the mean score of female overweight during the posttest. This is because overweight female students feel tired after the intervention and they were not able to perform well during the posttest the same with the overweight male students. In one of the student's reflective journals, a female student state that,

"It is actually kind of tired during the training but I'm happy when we saw the result of the tiring training. I'm not sure did I improve or not (I guess I did), I didn't do well at the second time cause I was too high at that time. Me and my friends were listening to our favorite songs and having fun so we were too high. This is why we didn't do well in the running performance."

Table 5. Comparison of Pretest and Posttest Scores of Normal Weight and Overweight Experimental Group in PACER Test

Gender	MALE				FEMALE			
Test	Pretest		Posttest		Pretest		Posttest	
Groups	NW	OW	NW	OW	NW	OW	NW	OW
N	14	7	14	7	12	4	1 2	4
Mean	32.0714	23.2857	36.357 1	28.1429	44.500 0	15.7500	47.5000	19.5000
SD	13.5332 3	10.5942 5	11.672 50	10.5107 7	20.142 67	5.73730	19.66769	5.80230
p-value	.384		.680		.097		.077	
Interpretation	No Significant Difference		No Significant Difference		No Significant Difference		No Significant Difference	

Depicted in table 5, the mean scores in pretest of male normal weight ($M = 32.0714$, $SD = 13.53323$) and overweight ($M = 23.2857$, $SD = 10.59425$) did not differ significantly with p-value of .384. The same in the posttest, the mean score of male normal weight ($M = 36.3571$, $SD = 11.67250$) and overweight ($M = 28.1429$, $SD = 10.51077$) did not differ significantly with p-value of .680. Additionally, there's a significant increase of time (in seconds) during the posttest of the male normal weight and overweight compared to the pretest. This means that the normal weight and overweight male students performed better after the conduct of the progressive resistance exercise. This is stated in the students' journals.

Most of the male students agree that progressive resistance exercise improved their running performance and wrote in their reflective journals that,

"Before I have the progressive resistance exercise I can't run very long, even I didn't use the high speed to run, I am just jogging I still can't run to far, i need to stop and walk for a long time after run. After I have the progressive resistance exercise I felt that running is easier than last time. Although I still need to stop and walk for a long, I still got a big improve I can run faster and farther than last time."

"After doing progressive resistance exercise, we may notice that we are getting stronger and stronger. In addition, we might also feel like we are more healthier. Moreover, we can also improve our energy levels everytime we do the exercise. Therefore, we will have more energy to run faster and further during the tests. To the conclusion of what I have just mentioned, I think progressive resistance exercise is a very important things to do. It can really help enhance our health and also our running performance! I think everyone should take a try in order to make themselves happier and healhier."

The positive effects of physical activity on the health and well-being of youth are well established with recent reviews stating that appropriate levels of physical activity reduce the risk of several diseases (e.g., diabetes and cardiovascular disease) and contributes to the development of healthy musculoskeletal tissues, the cardiovascular system and neuromuscular awareness (Chief Medical Office, 2019).

On the other hand, based on the table the mean scores in pretest of female normal weight ($M = 44.5000$, $SD = 19.66769$) and overweight ($M = 15.7500$, $SD = 5.73730$) did not differ significantly with p-value of .097. The same in the posttest, the mean score of male normal weight ($M = 47.5000$, $SD = 11.67250$) and overweight ($M = 19.5000$, $SD = 5.80230$) did not differ significantly with p-value of .077. Additionally, there's a significant increase of time (in seconds) during the posttest of the male normal weight and overweight compared to the pretest. This means that the normal weight and overweight female students performed better after the conduct of the progressive resistance exercise. This is stated in the students' journals.

Most of the female students claimed that after engaging in the progressive resistance exercise, they performed better in the PACER test. One student state that,

"When I was doing the progressive resistance exercise was nice, it feels comfortable, and a little tired to do the exercises during online learning and in school too. It becomes easier over time and I was able to do the exercises quicker and faster."

"During the second week, the exercises got harder but I was able to handle it because I was use to the exercises during the first week, and the same applies to the third week too. And after doing the exercises, I did improve on the 1200m but got tired after when I was doing the pacers test."

3.5 Effects of Progressive Resistance Exercise (PRE) on Students' Behavior and Engagement

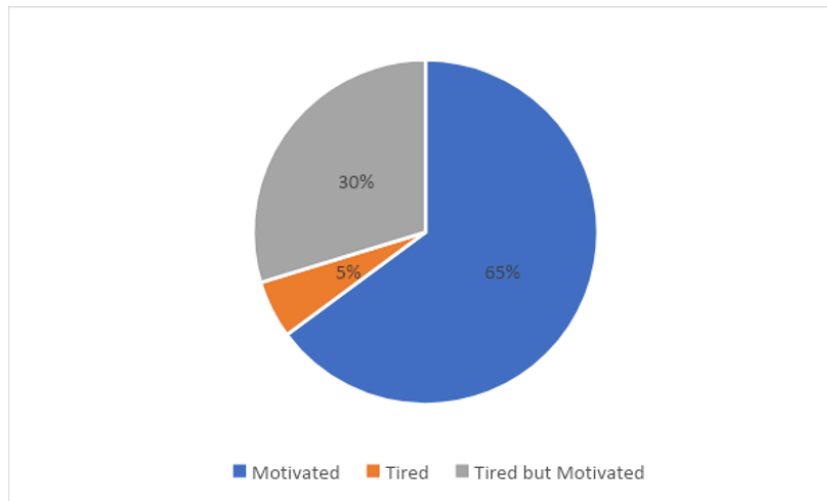


Fig 1. Effects of Progressive Resistance Exercise on Students' Behavior and Engagement

Figure 2 illustrates that 5% of the experimental population mentioned in their reflective journals that the intervention is tiring and makes them feel lazy. Nevertheless, most of the students or 65% of the experimental population were motivated to participate during the conduct of the study because of the benefits progressive resistance exercise could give to their body and in improving their running performance as stated in their reflective journals,

"...Even thought some of the moves that I can't do properly but I try to make it better so that I will not fail. it's really get better when you really try."

"At the beginning of doing the progressive resistance exercise it hard for me, I need to use a lot of energy to push or pull it, but after a while I can push or pull the higher weight, I felt that the weight that I use at beginning of the class is easier for me."

"...When I do progressive resistance, I often feel happy, but also tired. This is because I enjoy doing the progressive resistance exercise because it can help improve my running performance and also make my body stronger..."

Meanwhile, 30% of the experimental population mentioned that even though engaging in progressive resistance exercise is a little bit tiring and want them to give up but the help and encouragement of their classmates and friends want them to finish the task and improve their performance in running as mentioned in their reflective journal,

"... if I am too tired, I might want to giver up doing it. Luckily, my classmates and friends encourages me to keep doing the exercise. At last, I did finish the progressive resistance exercise. In my own opinion, I think it did improve health! I believe that keep doing the progressive resistance can help me improve my running performance!"

"... I did not give up unit the end. During this progress, I got some help from my friends who is better at exercising"

"I think in the beginning it is a little bit harder than others for us to succed the activities that we had choosen before..."

4. Conclusions

Based on the results of the study, it could be concluded that both normal weight and overweight male students who undergo the progressive resistance exercise for four (4) weeks performed well in the 1200m run and PACER tests compared to the students who did not undergo any exercises. After engaging in progressive resistance exercise, they feel their body became stronger and energetic which really helps them in improving their running performance in both 1200m run and PACER tests.

Likewise, both normal weight and overweight female students who undergo the progressive resistance exercise for four (4) weeks performed well in the 1200m run and PACER tests compared to the students who did not undergo any exercises during the conduct of the study. Additionally, although the exercises were tiring at first but because of the health benefits it could give to their body they keep a good mentality and determination to finish the task. Since their body feel better, it was evident in the results that their running performance has improved.

Furthermore, upon comparing the normal and overweight, there's no significant difference. However, results revealed that there's a significant difference between the pretest and posttest of normal weight and overweight experimental group when grouped accordingly. This implies that progressive resistance exercise effectively helps them in improving their running performance in both 1200m run test and PACER test.

Lastly, the implementation of the intervention shows that progressive resistance exercise greatly affects students' behavior and engagement as reflected in students' journals. Most of them were motivated and encouraged by their classmates and peers to finish the task and had improved not only their running performance but also their bodies.

5. Recommendations

In connection with the findings and conclusions of this study, the following recommendations were suggested.

1. Physical Education Teachers, Administrators, and curriculum makers may include progressive resistance exercise in implementing programs that would improve the students' performance in taking Physical Fitness Test specifically in cardiovascular endurance test.

2. Physical Education Teachers may incorporate or include progressive resistance exercise in their lessons not just to improve running performance but also to promote healthy lifestyle.

3. Lastly, for future studies, investigate more on the effects of progressive resistance exercises on running performance of overweight respondents. It is best if the students' BMI were closer for each participant. Use a larger scope of population and equal number of participants each group, and investigate on the other factors that may influence their running performance. Future studies may also separate the activities or exercise program to be executed for the normal weight and overweight participants to see a much more affluent results for both categories.

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