Constant Versus Incremental Cardiopulmonary Exercise Test in Evaluation of Functional Capacity in Normal Young Adults

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ABSTRACT

This study was conducted to compare between the constant (CWR) and the incremental work rate (IWR) cardiopulmonary exercise test (CPET) in measuring the parameters of functional capacity (Maximum oxygen consumption (VO_2 max) and anaerobic threshold) in addition to the maximum work time. ***Subjects:*** *sixty apparently normal subjects (30 males and 30 females) were recruited for this study from Faculties of Physical Therapy [Cairo University and 6th of October University]. Their ages and body mass index (BMI) ranged from 18-24 years old and 25-30 kg/m^2 respectively and non of them was athelitic person.* ***Materials:*** *Cardio pulmonary Exercise test unit; (ZAN; MeBgerate GmbH, Germany) at the faculty of physical therapy laboratory. It consists of breath gas (O_2 and CO_2) analyzer; electronically braked computerized cycle ergometer (SN RAM; Germany). It has been used to evaluate the pulmonary function under resting condition using the built in Spiro meter, and measuring the functional capacity parameters.* ***Procedures:*** *All the subjects were assigned into one study group, every subject performed an incremental cardiopulmonary exercise test, then after one weak, they performed the constant cardiopulmonary exercise test.* ***Results:*** *The statistical analysis of the data had showed that the differences in the parameters of functional capacity indices (VO_2 max, and anaerobic threshold) were higher in constant CPET for all subjects but the values didn't reach a significant difference level. The result also showed significant decrease of the maximum work time during CWR than during IWR for all subjects. It was concluded that there were no significant difference between CWR and IWR cardiopulmonary test protocoles in measuring the functional capacity indices (VO_2 max, and anaerobic threshold) while they are significantlly different in measuring the the maximm work time for adult subjects.*

Key words: *Constant, and Incremental CPET - Functional Capacity.*

INTRODUCTION

Cardiopulmonary exercise test is an integrated type of exercise testing that permits simultaneous evaluation of the ability of the cardiovascular and respiratory system to perform their major function i:e gas exchange[13,23]. Since physical activities constitute a major physiological stress that may pose a greater risk to people with various diagnosis that to people without pathology or impairment, so that the development of more integrated cardiopulmonary exercise test protocoles to evaluate the functional or exercise capacity within a sufficient level of exercise stress without physiological or biomechanical strain become very important[21].

Functional capacity or, the functional limit of cardio vascular and pulmonary system is best measured by the value of $VO_{2\ max}$ or peak VO_2 which is the best index of exercise capacity[22,24]. The Protocols that are widely used to evaluate functional capacity incude the incremental work rate, in which the power increase 5 to 30Watt / min, with especial type, ramp protocol, in which the power is increased continuously, usually every second, and

constant work rate exercise test at standardized submaximal work load[5,16].

Constant or steady state protocol was designed, so that the subject exercise against unchanging work rate so that the subject would be at or near steady state when parameters of exercise capacity are measured, which represent a more physiologically accurate measure[17]. In subjects with moderate to severe limitation of exercise capacity, such protocol may be, unuseful because the patients never reach the steady state and so accurate measurement of exercise capacity is obscured. The statement which give rise to the development of incremental type to alleviate problem[6,7].

The incremental protocol however, introduced new problem, that the patient is never at steady state when physiological parameters of exercise capacity are measured[12,19].

It is therefore useful to compare changes in functional capacity indices as the VO_2 responses for steady state (constant work rate exercise test) protocol and non steady state (incremental work rate exercise test) protocol to reveal the availability of the detection of maximum oxygen consumption during non steady state exercise test protocol.

SUBJECTS, MATERIALS AND METHOD

Subjects

Sixty apparently normal subjects (30 males and 30 females) were recruited for this study from Faculties of Physical Therapy [Cairo University and 6th of October University]. Their ages and body mass index (BMI) ranged from 18-24 years old and 25-30 kg/m^2 respectively and non of them was athelitic person. They were subjected to a preliminary clinical assessement at the National heart instiiute to exclude any health problem that could prevent them from particpating in this study. Subjects were assigned into one study group each subject performed the incremental CPET and one week later performed the constant CPET. Subjects who were smokers,or hading severe anemia or any Cardiovascular, respiratory, and metabolic disorders were excluded from participating in this study. All the subjects had signed a written informed consent before participating in this study.

Materials

- Weight and height scale were used to determine each subject's height and weight as a prerequisites for the exercise test.
- Cardio pulmonary Exercise test unit; (ZAN; MeBgerate GmbH, Germany) at the faculty of physical therapy laboratory. It consists of breath gas (O_2 and CO_2) analyzer; electronically braked computerized cycle ergometer (SN RAM; Germany). It has been used to evaluate the pulmonary function under resting condition using the built in Spiro meter, and performing the cardiopulmonary exercise test to evlauate the functional capacity indices.

Evaluation procedures

I) Pulmonary function test

Pulmonary function test was performed during cardiopulmonary exercise test to measure vital capacity (VC), forced expiratory volume in one second (FEV1), FEV1/FVC, and maximum voluntary volume (MVV) to exclude subjects with restrictive or obstructive lung diseases, and subjects with dyspnea as a cause of failure to complete the test[6].

II) Cadiopulmonary exercise test:

Preparation:

Each subject was instructed to undress to the level of the waist, then to get up on an electronically braked computerized cycle ergometer after being adjusted to the height of

subject[12]. Channel ECG leads had been connected to the subject, then Blood pressure cuff was applied around the left arm in all subjects. Subject was instructed to relax his/her arm during pedaling the ergometer.Clean and sterilized face mask was applied and fitted to the face of the subject and connected to a triple valve sensor. Each subject was asked to relax for three minutes without pedalling to allow the exercise test unit to detect the basal resting measurments[8].

(A) Incremental exercise test:

The test was performed in a continues increased work rate (ramp) type, in which Exercise work test phase begined with increase of the work load at a rate of 25 watt/minute for (8-11) minutes. Subject was instructed to continue cycling till exhaustion. Three minutes of unloading cycling was allowed after exhaustion as a cooling down, then another 7 minutes were allowed for recovery and recording of electrocardiogrph (ECG), blood pressure (BP), heart rate (HR), and to detect any post exercise abnormality[5].

(B) Constant exercise test:

The work load in the constant exercise test was calculated as a percentage of (50-70%) of the maximum load achieved during incremental exercise test. Subjects were instructed to maintain the velocity at 60 rpm in the both two type of exercise testing[23,26].

This study has been done at the cardiopulmonary lab of the faculty of physical therapy , cairo university from the beginning of july to the end of augest 2007.

RESULTS

Results were expressed as mean ± SD. Statistical analysis and comparison was made by student t-test to compare the significance of differences between, the incremental and constant work rate CPET protocols in measuring the parameters of functional capacity (VO_{2max}, anaerobic threshold, and maximum work time), in addition to measuring a selected cardiovascular parameters as maximum heart rate (HR max). maxumum systolic blood pressure (Sys BP), maxumum diastolic blood pressure (Diastolic BP), and oxygen pulse (O_2 pulse). All P-values less than 0.05 were considered statistically significant.

I) Functional capacity indices

(A) Maximum oxygen consumption VO_{2max} (mL / min / kg) Table (1), Fig. (b)

The mean value of $VO_{2\ max}$ for all subjects measured during Incremental work rate test (IWR) was 28.4 ± 5.6 and showed non significant increase (P>0.05) during constant work rate test (CWR), where the mean value of VO_{2max} was 29.3 ± 5.2 with a mean difference of. 0.91 ± 3.7 .The mean value of $VO_{2\ max}$ for male subjects measured by IWR, was (31.18 ± 5.35) and showed non significant increase (P>0.05) during the CWR where its value was (31.97 ± 4.5) with a mean difference of 0.790 ± 4.6. While in female subjects the mean value of VO_{2max} during IWR was 25.85 ± 4.38 and showed significant increase ((P<0.05) during the CWR where the VO_{2max} was 26.6 ± 3.89 with a mean difference of 1.04 ± 2.5.

(B) Anaerobic Threshold (% from predicted $VO_{2\ max}$) Table (1), Fig. (b)

The mean value of AT for all subjects during IWR was 60.2 ± 9.8 and showed non significant increase (P>0.05) during the CWR, where its mean value was (62.4 ± 11.7)with a mean difference of 2.2 ± 13.12. The mean value of AT for male subjects during IWR was 59.58 ± 10.1 and showed non significant increase (P>0.05) during the CWR, where its mean value was (61.6 ± 10.3) with a mean difference of 2.09 ± 11.2. The mean value of AT for female subjects during IWR was 60.9 ±

9.7 and showed non significant increase (P>0.05) during the CWR, as the mean value of AT was (63.2 ± 13.10) with a mean difference of 2.3 ± 14.9.

(C) The mean value of work time: (min) Table (1), Fig. (c)

The mean value of work time for all subjects during IWR was 8.2 ± 1.8 and showed significant decrease (P<0.05) during CWR, where the mean value of work time was 7.14 ± 2.6 with a mean difference of 3.8 ± 2.2. The mean value of work time in male subjects during IWR was 9.2 ± 1.5 and showed significant decrease (P<0.05) in the CWR, where the mean value of work time was 8.36 ± 2.5 with a mean difference of 5.06 ± 1.7. Whereas in female subjects, the mean value of work time during IWR was 7.2 ± 1.3 it also showed significant decrease (P<0.05) during the CWR, where its mean value was 5.90 ± 2.08 with a mean difference of 2.5 ± 1.9.

Table (1): Statistical comparison of the studied variables (VO_2 max, AT, and maximum work time).

Variable	Group	Mean ±S.D.		P-value	Relative change %
		IWR	CWR		
Peak Vo_2 Ml/min/Kg	All subjects	28.4±5.6	23.3±5.2	0.59	3%
	Males	31.18±5.35	31.97±4.56	0.359	2.5%
	Females	25.58±4.38	26.62±3.89	.029*	4%
Anaerobic threshold (VO_2%)	All subjects	60.2±9.8	62.24±11.7	0.198	3.6%
	Males	59.58±10.1	61.6±10.3	0.318	3.4%
	Females	60.9±9.7	63.2±13..10	0.402	3.7%
Maximum work time (min)	All subjects	8.2±1.8	7.14±2.6	.001*	46%
	Males	9.2±1.5	8.36±2.5	.001*	55%
	Females	7.2±1.3	5.90±2.08	.001*	76.4%

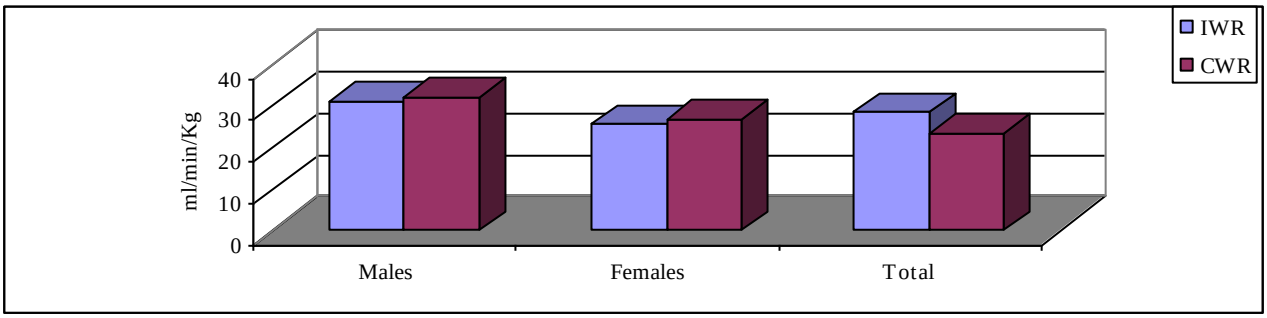

Fig. (a): Mean values of Vo2 max (ml/min/kg) during IWR & CWR of all studied group.

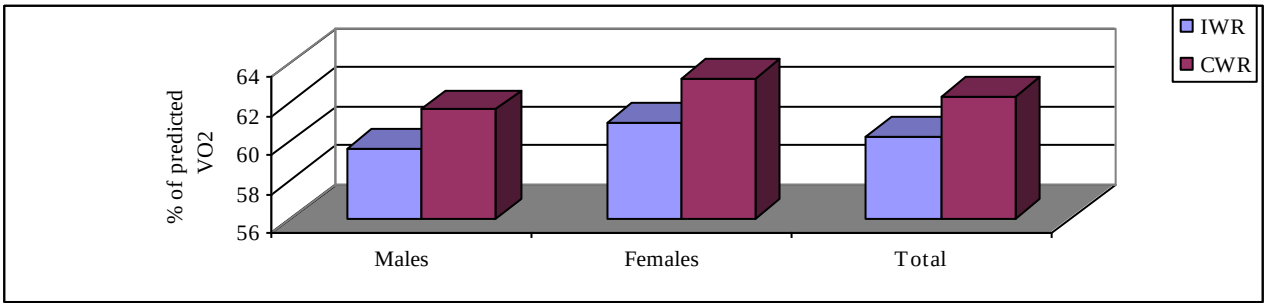

Fig. (b): Mean values of the AT (VO2max) during IWR & CWR of all the studied group.

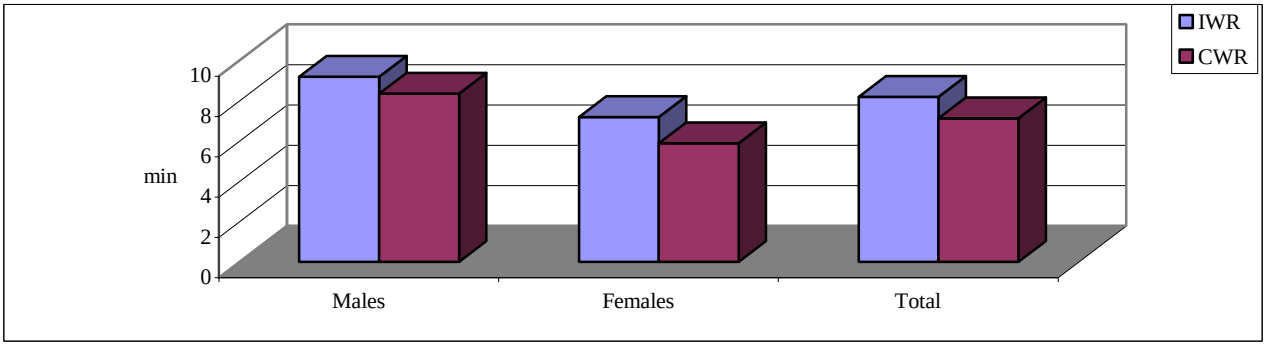

Fig. (c): Mean values of work time (min) for all studied group.

II) Cardiovascular indices

(A) Maximum Heart Rate (HR max) (b/min) Table (2), Fig. (d)

The mean value of HR max, for all subjects during IWR was 167 ± 18.8 it showed significant increase (P<0.05) during CWR, where its mean value was 172 ± 18.1 with a mean difference of 4.2 ± 16.06 .The mean value of HR max for the male subjects during IWR was 165 ± 22.3 and showed non significant increase (P>0.05) during CWR, where its mean value was 169 ± 21.8 with a mean difference of 4.3 ± 21.1. Whereas in female subjects the H R max during IWR was 170 ± 14.4 with significant increase (P<0.05) during CWR, where its mean value was 174 ± 13.3.

(B) Systolic Blood Pressure at maximum CPET (mmHg) Table (2), Fig. (e)

The mean value of Sys. BP. for all subjects at the maximum IWR was 166.9 ± 17.3 with non significant decrease (P>0.05) at the maximum CWR, where the mean value of Sys. BP was 170.8 ± 15.3 with a mean difference of 3.9 ± 17. The mean values of Sys. BP. for male subjects at maximum of IWR was 171 ± 15.8 and showed significant increase (P<0.05) during CWR, where the mean value of Sys BP was 171.6 ± 18.6 with a mean difference of 6.3 ± 16.03. In female subjects, the mean value of Sys. BP at maximum of IWR was 162 ± 19.1 and showed significant increase (P<0.05) during CWR, where its mean value was 170 ± 11.4.

(C) Diastolic Blood pressure at maximum CPET (mmHg) Table (2), Fig. (f)

The mean value of diastolic BP for all subjects at maximum IWR was 88.8 ± 9.1 and showed non significant increase (P>0.05) at maximum CWR, as its mean value was 92.6 ± 18.4 with a mean difference of 3.8 ± 20. The diastolic BP. for male subjects at maximum IWR was 92 ± 8.2 and showed non significant increase (P>0.05) at maximum CWR, where its mean value was 92.6 ± 9.5 with a mean difference of 0.36 ± 10.6. While in female subjects, the mean value of diastolic BP at maximum IWR was 85.3 ± 8.9 and showed non significant increase (P>0.05) at maximum CWR, where the mean value of diastolic BP was 92.6 ± 24.5.

(D) Oxygen pulse at maximum CPET (O_2 pulse) (mL / beat) Table (2), Fig. (g)

The mean value of O_2 pulse for all subjects at maximum IWR was 11.3 ± 2.6 and showed non significant increase (P>0.05) at maximum CWR, where the mean value of O_2 pulse was 11.5 ± 2.6 with a mean difference of 0.22 ± 1.4 The mean value of O_2 pulse for male subjects at maximum IWR was 13.1 ±

2.1 and showed non-significant increase (P>0.05) at maximum CWR, where the mean value of O_2 pulse was 13.2 ± 2.3 with a mean difference of 8.6 ± 1.8 while in female subjects, O_2 pulse at maximum IWR was 9.5 ± 1.8 and showed non significant increase (P>0.05) at maximum CWR, where its mean value was 9.9 ± 1.8.

Table (2): Statistical comparison of the studied variables (HR max, sys & dia BP and O2pulse).

Variable	Group	Mean ±S.D.		P-value	Relative change%
		test IWR	CWR		
Maximum hart rate (beat/min)	All subjects	167±18.8	172±18.1	0.010*	2.9%
	Males	165±22.3	169±21.8	0.304	2.4%
	Females	170±14.4	174±13.3	0.010*	2.3%
Maximum sys. BP (mmHg)	All subjects	166.9±17.3	170.8±15.3	0.091	2.3%
	Males	171±.8	171.6±18.6	0.830	0.03%
	Females	162±19.1	170. ±11.4	0.045*	4.9%
Maximum dia. BP (mmHg)	All subjects	88.8±9.1	92.6±18.4	0.160	4.3%
	Males	92.3±8.2	92.6±9.5	0.852	0.4%
	Females	85.3±8.9	92.6±24.5	0.154	8.5%
Maximum oxygen pulse (mL/min)	All subjects	11.3±2.6	11.5±2.6	0.240	1.7%
	Males	13.1±2.1	13.2±2.3	0.796	0.76%
	Females	9.5±1.8	9.9±1.8	0.062	4.2%

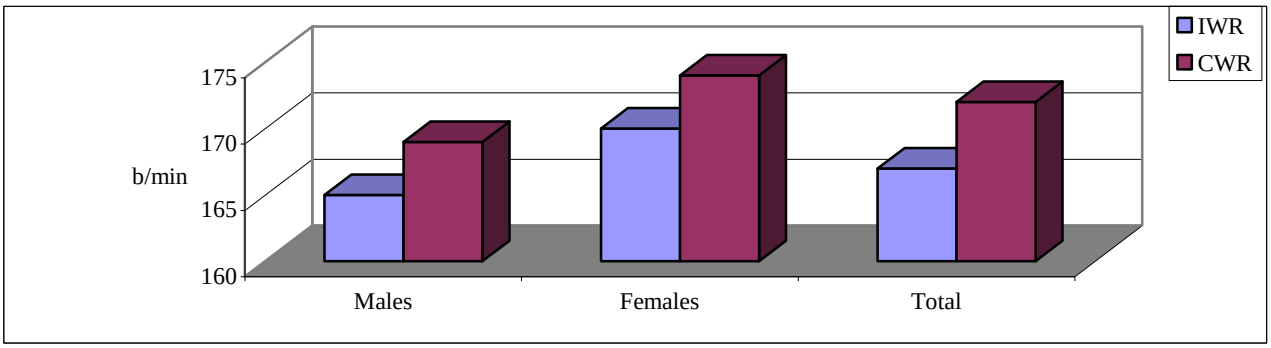

Fig. (d): Mean values of HR max (pulse/min) during IWR & CWR of all studied groups.

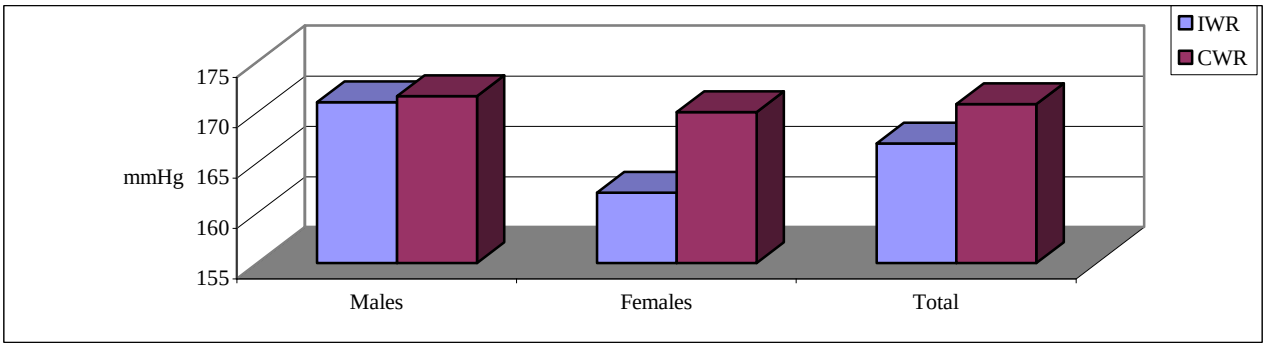

Fig. (e): Mean values of sys BP(mmHg) during IWR & CWR of all studied groups.

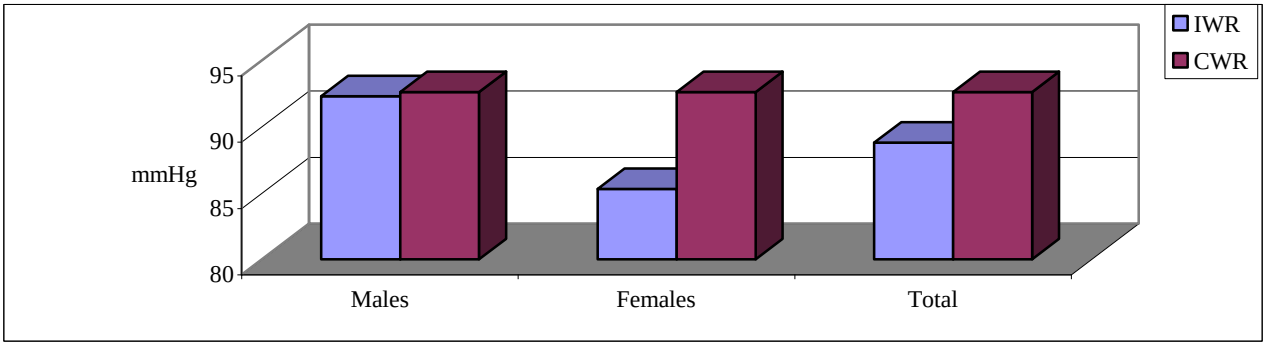

Fig. (f): Mean values of diasys BP (mmHg) during IWR & CWR of all the studied groups.

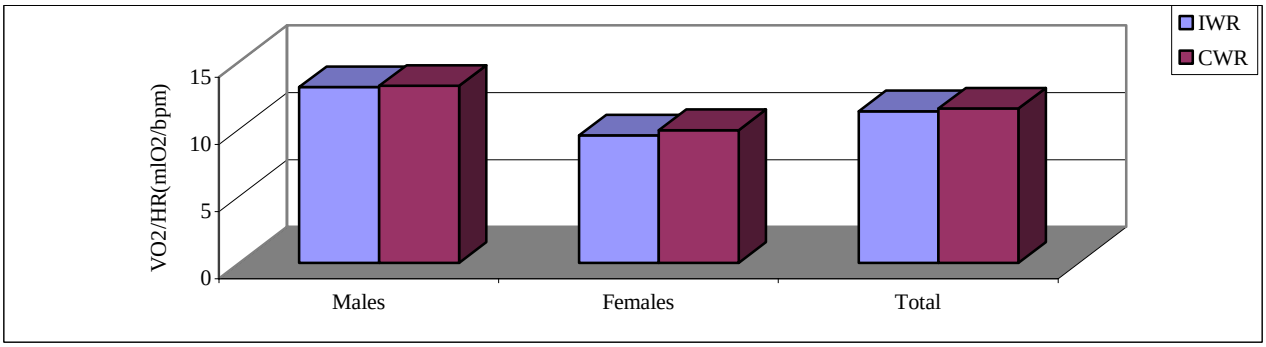

Fig. (g): Mean values of O2 pulse(ml/min) during IWR&CWR of all studied groups.

DISCUSSION

The result of this study showed that the differences in the parameters of functional capacity indices, ($VO_{2\ max}$, and anaerobic threshold) were higher in constant CPET for all subjects but the values didn't reach a significant difference ($P>0.05$). The result also showed significant decrease ($P<0.05$) of the maximum work time during CWR than during work time of IWR in all subjects.

When the studied groups are divided into two groups according to gender the value of VO_{2max} showed significant increase ($P<0.05$) in female subjects during CWR but in male subjects the value of VO_{2max} showed non significant increase ($P>0.05$) during CWR. The value of AT didn't show significant difference in respect to results obtained from female and male subjects.

As regards to the cardio vascular responses, the maximum heart rate obtained during CWR was significantly higher ($P<0.05$) than, those attained during IWR for all subjects. Whereas the value of HR max for female subjects had a significant high ($P<0.05$) difference level during CWR, while in male subjects, the value of HR max obtained from CWR showed non significant difference level ($P>0.05$).

The blood pressure (both systolic and diastolic) didn't showed significant difference between the two protocols of CPET for all subjects except for the systolic BP in female subjects which showed significant increase during CWR.

The value of oxygen /pulse at the peak of exercise test showed non significant difference with for all the subjects and for female and male subjects ($P>0.05$).

The maximal VO_2 represents the highest VO_2 for a given form of exercise, as evidenced by a failure of VO_2 to increase further despite an increase in work rate. Maximal VO_2 is contrasted with the maximum VO_2 (peak VO_2) obtained during a progressively increasing work rate test, it is simply the highest VO_2 achieved for presumed maximal effort[3,14]. It is the fundamental measure of exercise physiology and in combination with the concept of VO_2 plateau, has been described as the single most influential concept in modern exercise physiology. VO_{2max} has been widely recognized as both a representation of the functional limitations of the cardio vascular system as well as a measure of aerobic fitness[24,15].

The result of this study is contrasted to other study, where the validity of concept of VO_{2max} measure with increment work rate test to the volitional exhaustion had been criticized. It has been believed that, the VO_2 plateau is not a measurable phenomena since it cannot be reached in most subjects during non steady state test, consequently, the peak VO_2 attained during an incremental exercise test cannot be assured to be maximal and the interpretation of a cardiovascular limitation to an increasing VO_2 can be questioned[24].

On the other hand, the criteria of VO_{2max} during an incremental work rate test for healthy subjects with different exercise equipment has been studied ,and it has been found that 86.5% of subjects reached or near reached VO_2 plateau regardless, age, sex, and the physical state of subjects. It has been stated also that the large time averaged data on-three minute will under estimate Vo_2max as in case of incremental test with large time interval, so keepig the time averge shorter (30-60s) will yield larger value of VO_2 which is the nearest value to that obtained from constant CPET. Beside that the smaller time averaging interval was associated with less variability in neighboring values at VO_{2max}[20].

Findings of other studies also supported the concept of VO_2 plateau during ramp protocol[1,7].

It has been noted in this study that there was obvious difference in the value of $VO_{2\ max}$ between male and female subjects, as the results showed non significant increase of VO_{2max} for the male subjects during CWR but there was significant increase in $Vo_{2\ max}$ for female subjects during CWR. This is could be attributed to the fact that females have an aerobic power less than males and this is true not only in normal, but also in patient with cardio vascular disease, as a result of the anthropometric differences .This is could also be attributed to the fact that female have a smaller stroke volume compared to males[18,21].

So the girls could not achieve a plateau in the incremental work rate test and there was a marked decrease in the mean value of $VO_{2\ max}$ during IWR (25.58 ± 4.38) while in CWR and owing to the criteria of the steady rate test the value of $VO_{2\ max}$ in females was comparatively greater during CWR (26.62±8.8) but in case of male subjects, the difference between the CWR and IWR was not significant ($P>0.05$) because of the relative high aerobic power in male subjects[4].

The result of this study showed also a non significant increase in the anaerobic threshold for males, females and for all subjects during CWR test, compared to its mean values in the IWR test ($P > 0.05$). This is supported by so many previous studies, as it has been reported that The anaerobic threshold is a measurable phenomena in all subjects, and that the variability between measurement of anaerobic threshold for the same subjects during different test protocols, namely CWR and IWR tests is very low (measured as a

percentage of $VO_{2\ max}$ predicted), but the VO_2 at which lactate start to increase differs[23,25].

The result of the present study showed significant reduction of work time during CWR test, the reduction of work time is of great value considering the economic factor because the decrease of the time of test will increase the total number of tests per day also this type of test will save effort and time for patients, physicians and technicians.However such test is considered very tiring, time and money consuming and can't be tolerated for patients in most cases, it has been reported that three minutes is the minimum time for the variable to attain a steady state therefore the steady state measurement of VO_2 should only begin after 3 minutes in patients with heart, lung diseases or even older and sedentary young[10,16,22].

This study showed also non significant change in the maximum heart rate between CWR and IWR in male subjects, on the other hand the HR_{max} was significantly increased during CWR ($P<0.05$) in female subjects with significant increase in the HR max in total subjects during CWR ($P=0.010$). It has been proved that both the cardiac out put and the heart rate normally increase linearly with VO_2 during increasing work rate. However during the constant work rate test the heart rate increase is more steeper because of rapid change of the work load from resting time to the test i:e sudden increase of work load to 60% of IWR[13]. The higher level of habitual physical activity observed in boys compared with girls has been proposed as a contributor to the difference in heart rate response between males and females to strenuous constant work rate test[9].

The result of this study showed also non significant increase of the systolic blood pressure during CWR test in male subjects whereas the result showed significant increase of the systolic blood pressure in female subjects ($P < 0.05$), on the other hand there were no significance differences of the diastolic blood pressure between the two tests among the studied groups. Such blood pressure response was matched to the heart rate responses for the femal subjects and for all subjects together in this study as noted before, So the increase in heart rate during CWR test in those subjects could contribute to the increase of systolic blood pressure[11,18]. On the other hand the diastolic blood pressure showed non significant change in female subjects despite of the relatively wide range of mean values for the CWR and the IWR respectively, and this is could be related to the large standard division in female subjects that indicated large variability of the diastolic blood pressure measures during test.

It had been noted also in this study the non significant change of oxygen pulse ratio between the two test protocols among the all studied groups, and this is could be explained by a previous suggestion that the both types of test protocols may produce the same amount of changes of stroke volume during exercise testing[2,8].

Conclusion

Within the limitation of the present study it could be concluded that the incremental (ramp) work rate test and the constant work rate test revealed the same values of functional capacity indices (VO_{2max} and anaerobic threshold). Both types of CPET protocoles producethe same amount of cardio vascular stresses for all subjects (except for, HR_{max}).

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الملخص العربي

إختبار التمرين القلبى الرئوى الثابت مقابل التزايدى

فى تقيم القدرة الوظيفية لدى الشباب الطبيعين

لقد اجريت هذه الدراسة للمقارنة بين نوعين مختلفين من بروتوكولات اختبار تمارين القلب الرئوية (اختبار التمارين الثابتة والمتزايدة الشده) في قياس عاملي المقدره الوظائفية (القيمة القصوى لاستهلاك الأوكسجين والعتبة اللاهوائيه) بلاضافة الى زمن الشغل.أجريت هذه الدراسه على ستون طالب من الأصحاء تم اختيارهم من كلية العلاج الطبيعى (ثلاثون من الذكور وثلاثون من الإناث) تتراوح أعمارهم مابين الثامنة عشر والرابعة والعشرون بينما يتراوح مؤشر كتلة اجسامهم ما بين 25-30كجم/م2عام ولقد تم اختيار العينه من الطلبه غير الرياضين . الادوات : استخدمت الدراسة وحدة اختبار التمارين القلب رئوية بكلية العلاج الطبيعى والتى تتكون من محلل الغازات (الاكسجين وثانى اكسيد الكربون) وعجلة ارحومترية ذات فرامل كهربائية تعمل وفق لبرنامج الحاسب الا لي لقياس وظائف الرئة قبل الاختبار واجراء اختبار التمارين القلب رئوية . قام كل شخص بإجراء اختبار التمارين المتزايدة الشده وبعد أسبوع آجري اختبار التمارين الثابتة الشده بحمل قدره ستون بالمائة من الثقل الذي حصل عليه في الاختبار الأول . ولقد أجريت مقارنه لبعض ردود الأفعال للجهاز الدوري والقلب بين نوعى الاختبارات (معدل ضربات القلب القصوى – ضغط الدم الانقباضي – ضغط الدم الانبساطى – نبض الأوكسجين) . أظهرت النتائج عدم وجود اختلافات ذات دلاله احصائيه للقيمه القصوى لاستهلاك الأوكسجين وكذلك بالنسبة للعتبة اللاهوائيه وذلك بالنسبة لمجموعة الذكور أما مجموعة الإناث زادت القيمة القصوى لاستهلاك الأكسجين في الاختبار الثابت الشدة بينما لم تكن هناك اختلافات ذات دلالة للأشخاص مجتمعين . بينما أظهرت النتائج وجود اختلافات ذات دلاله احصائيه بالنسبة لزمن الشغل بين كل من الاختبارين بحيث وجد إن زمن الشغل للاختبار ثابت الشده اقل منه بالنسبة للاختبار متغير الشده ولقد أظهرت النتائج وجود اختلافات ذات دلالة إحصائية بمعدل ضربات القلب القصوى خلال تمارين ثابتة الشدة بينما أظهرت النتائج عدم وجود اختلافات ذات دلاله احصائيه بالنسبة لكل من (ضغط الدم الانقباضي – ضغط الدم الانبساطى – نبض الأوكسجين) بالنسبة للذكور أما للإناث أظهرت النتائج وجود زيادة لكل من معدل ضربات القلب القصوى – وضغط الدم الانقباضي – خلال الاختبار ثابت الشدة بينما لم يوجد هناك أي اختلافات بالنسبة لضغط الدم الانبساطى و نبض الأكسجين بين الاختبارين لمجموعة الإناث.سويستخلص من نتائج هذا البحث عدم وجود اختلافات ذات دلاله بين اختباري معدل الشغل الثابت والمتزايد في تقييم المقدره الوظائفية لعينه من الطلبه في هذه الفئة العمريه . وان تميز معدل اختبار الشغل الثابت بقصر فترة الاختبار وتوفير عامل الوقت والمجهود مقارنة بالاختبار المتزايد الشده .