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Cycle Ergometer Designed for Elderly People

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Abstract: Introduction. In order to stimulate physical activity, more and more games and ergometers are installed in public parks and areas that are attended by wide population, including children, adults and elderly peoples. These ergometers are generally designed for children or adults, but very seldom for elderly people. The aim of this study was to design and test a cycle ergometer specifically adapted to elderly population.

Methods. The tests were performed on 8 young adults (YA) (age 23 ± 2 years, height 1,80± 0,04 m, weight 71 ± 9 kg) and 7 older persons (OP) (age 64 ± 13 years, height 1,60± 0,07 m, weight 66 ± 16 kg). They were first asked to pedal four times 3 min i) on a reference laboratory ergometer (Monark 868) at 3 different power levels : 46, 76 and 106 Watts and ii) on a specific ergometer designed for elderly people. The heart rate (HR) and the oxygen consumption (VO2) were measured during the last minute of each power level.

Results. As expected the HR and VO2 measured on reference ergometer were linearly related with power level in both YA and OP and there were no difference on absolute values of VO2 between YA and OP. It was then possible to estimate that both YA and OP produced 32 ± 5 Watts on the specific ergometer. This value correspond to a relative intensity of 22% and 32% of maximal theoretical VO2 in respectively YA and OP, and was equivalent of about three time basic metabolic level (3 METS) in both group.

Discussion. According to the relative intensity the specific ergometer was very light and not adapted to YA but was well adapted to OP group, 32% intensity and 3 METS corresponding to light walking and no extra risks for OP population. The specific ergometer was then installed in a public park of the city of Saint Etienne and further questionnaire showed that OP field users were very satisfied of this new ergometer showing that the combination of design, physiological and technological approach could result in optimisation and safety of ergometer proposed in public areas for elderly people.

Keywords: *Aging; Healthy life; Aerobic capacity; Outdoors ergometers*

I. INTRODUCTION

The world population is aging especially in post-industrial countries. For instance the average percentage of the EU population aged 60 and over is increasing from 9.6% in 1960 to 12% in 2015, and it is expected to increase up to 22% by 2050 [1].With aging physiological capacities are declining inexorably [2].Nevertheless it has beenalso largely demonstrated that moderate sustained physical activity could largely slow down this decline[2] andprovide several health benefits such as the decrease in chronic diseases [3]reduced fatigability and improved mood. Moreover, a direct relationship could be established between the duration and regularity of physical activity practiced andthe mortality of older people[4].

In addition, research shows that social isolation and loneliness also impact on quality of life and wellbeing with demonstrable negative health effects [5]and promoting or implementing physical activity in general population remains a serious issue [6]. Ttherefore there is a huge interest to develop the practice of physical activity of the elderly population in daily life through innovative methods.

One possibility to stimulate is to install games and ergometers in public parks and areas that are attended by wide population, including children, adults and elderly peoples.

II. PROBLEM IDENTIFICATION AND BASIC PRINCIPLE

Ergometer and games installed in public parks are generally designed for, and tested on, children or young adults (YO), but very seldom for elderly people (EP).These tests are mainly based on questionnaires that evaluate the satisfaction of the users [9] but the exact physiological and biomechanical stress induced by these ergometers on elderly people are not known, although they could be also largely benefits to this population.

The aim of this study was then to perform accurate physiological and biomechanical evaluation of a cycle ergometer that was specifically adapted to elderly population.

III. METHODOLOGY

The tests were performed on 8 young adults (YA) (age 23 ± 2 years, height 1,80± 0,04 m, weight 71 ± 9 kg, BMI 21.9 ± 1.9 kg/m^2, HR_{rest} 62 ± 14 bpm) and 7 older persons (OP) (age 64 ± 13 years, height 1,60± 0,07 m, weight 66 ± 16 kg, BMI 24.4 ± 4.4 kg/m^2, HR_{rest} 72 ± 18 bpm).

Fig. 1 Oxygen uptake measurements during tests with reference (left) and designed (right) cycle ergometer.

They were asked to pedal four times 3 min i) on a reference laboratory ergometer (Monark 868,) at 3 different increasing power levels (46, 76 and 106 Watts) and ii) on a specific ergometer (PHYSIO-1083SMF-00, PhysioparcHeyrieux, France) designed for elderly people (Fig. 1)

The heart rate (HR) was monitored at rest and during all tests by means of cardio watch (Polar RS800CX). The oxygen consumptions (VO2) were measured during the last minute of each power level (Fig. 1) by means of a gas analyser (Metamax 3B).

Because it was not possible to perform maximal VO2 tests on OP, the theoretical percentage of VO2 for different power levels was estimated from the theoretical maximal oxygen uptake and taking into account that the decline in oxygen uptake is generally agreed to be approximately 1% per year in relatively sedentary people[10]. In addition their metabolic equivalent (MET) was calculated as the amount of oxygen consumed divided by oxygen consumption at rest: 3.5 ml O2 per kg body weight per min [11].

Statistics. A repeated measurement ANOVA and a Newman Keul post hoc test were used to compare HR and VO2 among different power levels performed on reference ergometer and on designed ergometer by YA and OP groups.

IV. RESULTS AND DISCUSSION

As expected the HR and VO2 (see fig 2 and fig 3) measured on reference ergometer were linearly related with power level [12] in both YA and OP and there were no difference on absolute values of VO2 between YA and OP.

It was then possible to estimate the power produced on the specific ergometer from the linear VO2-Power relationship obtained on the reference ergometer. According to that estimation, both YA and OP produced 32 ± 5 Watts on the specific ergometer.

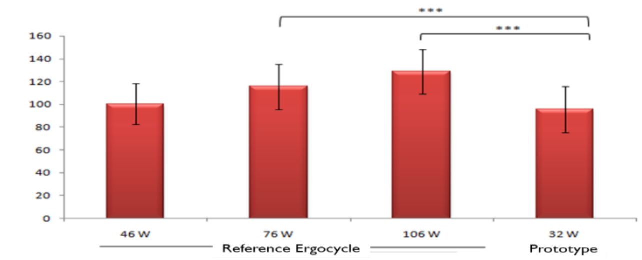

Fig. 2 Results of heart rate measurements during tests with reference (left) and designed (right) cycle ergometer.

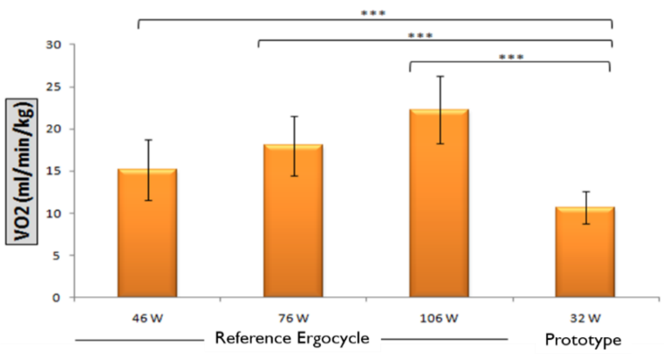

Fig. 3 Results of oxygen uptake measurements during tests with reference (left) and designed (right) cycle ergometer.

This value correspond to a relative intensity of 22% and 32% of maximal theoretical VO2 in respectively YA and OP, and was equivalent of about three time basic metabolic level (3 METS) in both group [11].

CONCLUSION

According to the relative intensity the specific ergometer was very light and not adapted to YA but was well adapted to OP group, 32% intensity and 3 METS corresponding to light walking (Jetté et al.) and no extra risks for OP population.

The specific ergometer could then be installed in a public park of the city of Saint Etienne and further questionnaire showed that OP field users were very satisfied of this new ergometer showing that the combination of design, physiological and technological approach could result in optimisation and safety of ergometer proposed in public areas for elderly people.

Fig. 4Cycling ergometer for elderly people operation in outdoors open condition.

Abbreviations

YA: Young adults group
OP: Older persons group
HR: Heart rate (bpm)
VO2: Oxygen consumption (mlO2/min/kg)
MET: Metabolic equivalent

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