

CHAPTER

6

DETECTION OF CARDIORESPIRATORY EXERCISE INTENSITY USING REGULATED TALK TEST

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6.1 INTRODUCTION

Cardiorespiratory exercise is any activity that trains the body to improve the oxygen and nutrient delivery to tissues for a prolonged time, which is achieved by working the cardiac and respiratory tissues such as the heart, lungs, and nasal. The American College of Sports Medicine (ACSM) reports five components of exercise prescription: 'Frequency', 'intensity', 'time', 'type' (FITT), with 'volume' added to incorporate progression (Ferguson, 2014). Among these components, exercise intensity is an important determinant of physiological responses to exercise training, mainly if the volume of energy expended is satisfied. ACSM recommends that the ideal exercise intensity be set as percentage of aerobic capacity, which is measured by the reserve oxygen consumption (i.e., $\text{VO}_{2\text{R}}$), and should ranging between 50% and 85%, indicating moderate to vigorous exercise intensity. However, measuring oxygen consumption requires expensive laboratory-based equipment and expertise to conduct.

Meanwhile, in the role of safe and effective exercise training, determining reliable exercise intensity is an issue affecting patients in cardiac rehabilitation who may have compromised heart rate responses due to beta-blocker medication effects. The heart rate (HR) method is often used as an alternative because it is objective, convenient and has a linear correlation with both reserve oxygen consumption (VO_2R) (Carvalho et al., 2008) and maximal oxygen consumption (VO_2max) (Lounana et al., 2007), it may not be accurate, especially for cardiac patients with HR irregularities and those who may be on medications that affect HR response to exercise or even healthy individuals who are influenced by the exercise experience and setting (Chu et al., 2010). Thus, simple-use and reliable talk test (TT) methods for exercise intensity assessment can aid in monitoring and prescribing individualised exercise training when the heart rate reserve method may not be feasible or a costly metabolic cart for the oxygen consumption reserve method is unavailable in clinical settings.

Recent evidence indicates that the TT is suitable as an alternative tool for the evaluation of exercise intensity and prescription of exercise in a wide variety of exercising individuals (Foster et al., 2018; Vieira et al., 2022) as it is conceptually a simple process of a ‘speaking while exercising’ test that assesses metabolic stress through speech provocation (Reed & Pipe 2014; Bonafiglia et al. 2018). Researchers have employed various evaluation methods in these tests. For instance, Ambrosetti et al. (2017), Cowan et al. (2012), and Nielsen and Vinther (2016) focused on measuring an individual’s reported speaking comfort upon reciting standard text passages during incremental exercise. Meanwhile, Loose et al. (2012) and Mahmood et al. (2018) utilised the measurement of successful counting phrases, whereas Mahmood et al. (2022) assessed successful syllables uttered in a single breath. General research challenges arise due to the inherent subjectivity and temporal variability of utterance rate in the counting talk test (CTT), particularly as exercise intensity increases. Then this could lead to ineffective exercise training, such as in cardiorespiratory rehabilitation programmes or monitoring the progression of one’s own recreational activities.

This chapter is organised as follows. Section 6.2 presents a review of related literature. Section 6.3 describes the design of the proposed Talk Test approach and its application to healthy participants, while Section 6.4 details the applied study in cardiac patients. Finally, Section 6.5 summarises the conclusions drawn from the study.

6.2 CARDIORESPIRATORY EXERCISE IN CARDIAC REHABILITATION

Cardiac rehabilitation is defined by the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR, 2020) as the provision of comprehensive long-term services that include medical evaluation, prescriptive exercise, cardiovascular risk factor modification, education, counselling, and behavioural interventions.

A Cardiac Rehabilitation Programme (CRP) is a structured set of interventions utilising a multidisciplinary team approach that includes medically supervised exercise and patient education to improve heart health and function. In Malaysian healthcare settings, patients who have experienced cardiac events are typically enrolled in a CRP managed by a comprehensive team comprising cardiologists, physicians, medical officers, pharmacists, physiotherapists, occupational therapists, dietitians, and nurses, in accordance with national guidelines (Ministry of Health Malaysia, 2017). The implementation of CRP may vary across different hospital settings; however, it is traditionally divided into three phases: Inpatient, outpatient, and independent maintenance (Simon et al., 2018).

This study focuses on the second (outpatient) phase of CRP, which involves a comprehensive secondary prevention model in which an individualised treatment plan is introduced, encompassing exercise prescription, education classes, risk modification, and psychosocial counselling. Ogura et al. (2022) categorised patients in this phase into a physically active group (e.g., gardeners) and a non-active group. Their findings demonstrated that the non-active group experienced a significant increase in peak heart rate, along with worsening dyspnoea