

Assessment of muscular strength in oncology: an overview

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Introduction

Cancer is one of the most common chronic diseases in developed countries. In Germany, there were about 470,000 cases of newly diagnosed cancer in 2008 (Robert Koch Institute, 2012).

The medical treatment of a cancer disease mainly depends on the cancer entity, the stage of the disease and the patient's age. The most common treatment methods are surgery, radiation therapy, chemotherapy and hormone therapy. Due to the disease and the medical treatment, cancer patients often suffer from severe psychosocial and physical complications, such as depression, anxiety, cognitive disorders, sleep disorders, fatigue, reduced cardiorespiratory fitness and reduced muscular strength (e.g. Servaes et al., 2002; Mehnert et al., 2006; Jones et al., 2009; Dodson et al., 2011).

Physical exercise has been shown to reduce psychosocial and physical complications and to improve the patients' quality of life (e.g. Stevinson et al., 2004; Galvao et al., 2005; Knols et al., 2005; Spence et al., 2010). In order to examine the effectiveness of an exercise intervention, it is important to objectively assess outcomes such as muscular strength.

To our knowledge, a standard method for assessing muscular strength in oncology does not exist. Therefore, the aim of this paper is to provide an overview on published exercise intervention studies including cancer patients and regarding the assessment methods used by different research groups to assess muscular strength.

Methods

In order to identify relevant studies, a literature search was conducted using the database Scopus. The search combined key words related to

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cancer (cancer, carcinoma, tumor, oncology) and exercise (exercise, training, physical activity, strength, resistance, weight, lifting). Additionally, the reference lists of relevant publications and review articles were screened for possible further relevant studies.

Studies were included if they were published in English or German language and if they reported the assessment of muscular strength as an outcome measure in an exercise intervention study including cancer patients. Design and methodological quality of included studies were not taken into account.

Results

Altogether, more than 70 relevant publications were identified. However, the total number of studies is smaller since results of some studies were presented in several publications. Based on our literature search, we found a wide variety of methods that were used to assess muscular strength in oncology.

To assess maximal strength in cancer patients, many research groups used isometric (e.g. Mello et al., 2003; Schneider et al., 2007; Mustian et al., 2009; Hansen et

al., 2009; Rogers et al., 2009; Weber et al., 2009; Baumann et al., 2010; Culos-Reed et al., 2010; Kampshoff et al., 2010; van Waart et al., 2010; Christensen et al., 2011; Hacker et al., 2011; LaStayo et al., 2011; Wiskemann et al., 2011; Park et al., 2012; Winters-Stone et al., 2012; Potthoff et al., 2013; Schmidt et al., 2013) or isokinetic tests (e.g. Twiss et al., 2009; Weber et al., 2009; Waltman et al., 2010; Fong et al., 2013; Lønbro et al., 2013; Potthoff et al., 2013; Schmidt et al., 2013). Both isometric and isokinetic tests were predominantly performed for lower extremities (knee extensors and flexors) and upper extremities (shoulder rotators). Furthermore, isometric tests were performed to assess handgrip strength in some studies.

In contrast, other research groups used one-repetition maximum tests (e.g. Basaria et al., 2002; Coleman et al., 2003; Schmitz et al., 2005; Galvao et al., 2006; McNeely et al., 2008; Schwartz & Winters-Stone, 2009; Temel et al., 2009; Jones et al., 2010; Katz et al., 2010; Speck et al., 2010; Schmitz et

al., 2010; Brown et al., 2012; Peddle-McIntyre et al., 2012; Thorsen et al., 2012; Winters-Stone et al., 2012; Hanson et al., 2013) or multiple-repetition maximum tests to predict one-repetition maximum (e.g. Adamsen et al., 2003; Lane et al., 2005; Battaglini et al., 2006; Cheema & Gaul, 2006; Quist et al., 2006; Courneya et al., 2007; De Backer et al., 2007; Baumann et al., 2009; Segal et al., 2009; Alberga et al., 2012; Schmidt et al., 2012). One-repetition maximum tests or multiple-repetition maximum tests were predominantly performed using bench press (chest press) and leg press exercises. In order to predict a one-repetition maximum from a multiple-repetition maximum, various prediction equations were used (Lander, 1985; Brzycki, 1993; Kuramoto & Payne, 1995; Gießing, 2003). Strength endurance was assessed in a relatively small number of studies in oncology (e.g. Segal et al., 2003; Cheema & Gaul, 2006; Galvao et al., 2006; Herrero et al., 2006; Schneider et al., 2007; McNeely et al., 2008; Battaglini et al., 2009; Sprod et al., 2010; Peddle-McIntyre et

al., 2012; Hanson et al., 2013; Martin et al., 2013). Strength endurance tests most commonly assessed the number of repetitions of an exercise that could be realized with a defined load. Procedures to determine this particular load varied widely among studies.

In addition, some research groups performed functional tests in order to assess muscular capabilities of lower extremities. Particularly, diverse variations of sit-to-stand tests (e.g. Herrero et al., 2006; Oldervoll et al., 2006; Monga et al., 2007; Kampshoff et al., 2010; van Waart et al., 2010; Park et al., 2012; Winters-Stone et al., 2012) or stair climbing tests (e.g. Hacker et al., 2011; Thorsen et al., 2012) were performed.

Discussion and Conclusion

Based on our data, neither a standard method nor appropriate practice recommendations for assessing muscular strength in oncology can be identified since the variety of used assessment methods was too wide among studies. As a consequence due to this inconsistency, it is difficult to compare the particular results of different studies. To ensure the

comparability of future results of different research groups, future exercise intervention studies in oncology should be more consistent regarding the usage of muscular strength assessment methods.

However, due to the present lack of a standard method or appropriate practice recommendations for assessing muscular strength in cancer patients, our group modified an existing test battery (Schneider et al., 2003) to use it in our current exercise intervention study with prostate cancer patients. At the moment, we are examining the reliability of this modified method.

Key words: oncology, cancer, exercise, resistance training, strength training, assessment, overview

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