Musculoskeletal Science and Practice xxx (2016) 1–4

Contents lists available at ScienceDirect

Musculoskeletal Science and Practice

journal homepage: www.journals.elsevier.com/aquaculture-and-fisheries/

Original article

Astronaut adherence to exercise-based reconditioning: Psychological considerations and future directions

Carly D. McKay*, Martyn Standage

Centre for Motivation and Health Behaviour Change, Department for Health, University of Bath, Claverton Down, Bath, BA2 7AY, United Kingdom

ARTICLE INFO

Article history:
Received 11 August 2016
Received in revised form
13 October 2016
Accepted 1 November 2016

Keywords:
Adherence
Astronauts
Exercise
Motivation

ABSTRACT

Introduction: Exercise-based reconditioning is essential for mitigating the negative physiological and functional effects of spaceflight. Astronaut adherence to prescribed reconditioning programmes is imperative, but there has been limited research in this area.
Purpose: This commentary discusses adherence predictors in analogous terrestrial populations (sport, clinical rehabilitation, general exercise) that may translate to spaceflight environments.
Implications: Reconditioning programmes should foster intrinsic motivation, realistic outcome expectancies, self-regulation skills, and strong therapeutic alliances to promote ongoing exercise adherence. Research is needed to understand spaceflight-specific barriers and facilitators to adherence, and to develop appropriate strategies to promote ongoing exercise behaviours.

1. Introduction

The extant literature is heavily weighted toward understanding and mitigating the physiological effects of space flight. Fewer studies have examined psychological issues in this context, and many of these have focused on clinical psychiatry rather than social psychology (Brady, 2005). Yet, there is significant potential for psychosocial factors to influence engagement with health behaviours, including exercise, which will have a knock-on effect on astronauts' physiological and psychological wellbeing (Brady 2005; Flynn, 2005).

There is a dearth of information about elements of the social and physical environments that might influence astronaut exercise adherence. Therefore, the purpose of this brief commentary is to discuss factors that influence exercise in analogous terrestrial populations. By capitalizing on potential similarities between contexts and identifying likely differences, we aim to provide a foundation to inform future research and make recommendations for best practice in astronaut care.

1.1. Astronaut activity cycles

Preflight exercise ("preconditioning"), inflight training (countermeasures), and postflight reconditioning represent three stages of an integrated intervention programme (Chauvin et al., 2003; Loehr et al., 2015; Lambrecht et al., 2017). Outcome expectations, routines, and relationships with the medical team are developed during preflight and inflight training, providing a foundation to support postflight reconditioning (Bandura, 2004). Therefore, the social and psychological factors affecting reconditioning adherence must be viewed as a progression beginning in the preflight period.

1.2. Adherence

For any intervention to be effective, individuals must adhere to the prescribed treatment. Exercise-based interventions in particular have a dose-response relationship with health whereby the frequency, duration, and quality of exercise completion are directly related to health outcomes (Haskell et al., 2007). As such, these behaviours must be maintained, whether the aim is functional recovery or lifelong wellbeing.

During postflight reconditioning, success is measured by returning to a criterion level of function (Loehr et al., 2015). This is typically achieved within an acute period, but maintaining exercise beyond this timeframe is essential for an astronaut's eligibility for future selection. As mission durations are extended, deleterious health outcomes are likely to be magnified unless astronauts are

* Corresponding author.
E-mail address: c.d.mckay@bath.ac.uk (C.D. McKay).

http://dx.doi.org/10.1016/j.msksp.2016.12.011

able to maintain exercise through changing environmental conditions over time. Understanding the factors that promote self-regulation and exercise adherence is therefore important in the design and implementation of training programmes.

In sport, clinical, and general populations, exercise adherence covers a range from complete non-adherence to over-adherence (Brewer 1998; Jack et al., 2010; Podlog et al., 2013). This is not typically a concern for astronauts during preflight or short duration flights, as there are clear training parameters and individuals are invested in mission success. In the acute post-mission phase, reconditioning is supervised and delimited by return to criterion functioning (Lambrecht et al., 2017), resulting in good adherence (Loehr et al., 2015). For extended duration missions, however, the maintenance period will be variable over months or years, raising concern that exercise behaviours will oscillate over time.

Many factors are implicated in adherence variability, including personal motivational states and perceived barriers or facilitators in the environment. Although these have not been examined in astronauts, terrestrial evidence may generalize to some extent. In the following sections we introduce some of these factors, emphasizing those that are unique to spaceflight and are likely to exert the greatest influence on astronaut behaviour.

2. Motivation

Two primary motives for astronauts to adhere to reconditioning are the recovery/maintenance of functional health and the desire to qualify for future missions (Covertino and Sandler, 1995). These are powerful drivers, but they do not exist in isolation and are unlikely to be sustained long-term. It is therefore important to consider the motivational supports received within the social context that best underpin optimal reconditioning behaviours and outcomes.

Research on astronaut motivation has typically been descriptive, and researchers have called for future work to be couched within theoretical frameworks (Goemaere et al., 2016). A meta-theory of human motivation, personality, and emotion that addresses motivation quality and the conditions that support optimal engagement, growth, and development is *self-determination theory* (SDT; Deci and Ryan, 2000; Ryan and Deci, in press).

SDT assumes that humans are growth-oriented, actively seeking challenges and new learning experiences. This is manifested within SDT by the concept of *intrinsic motivation*; a construct defined as participating for the enjoyment and interest inherent within the activity itself. A large body of empirical evidence supports the manifold benefits of acting through autonomous forms of motivation (e.g., enhanced well-being and health, better performance, improved learning) (Ryan and Deci, in press). Not all activities astronauts engage in can be intrinsically motivated (i.e., operational requirements), but SDT also stresses various types of extrinsic motivation that differ in the degree to which they are autonomous in nature (cf. Ryan and Deci, in press). However, studies show controlled motivation to exhibit positive associations with impoverished adjustment (Ryan and Deci, in press).

SDT specifies three universal psychological needs that provide the essential nutriments for people to experience growth, development, and wellbeing: autonomy, competence, and relatedness. Social environments that support these needs would provide the basis for astronauts to engage more volitionally in reconditioning activities, and experience greater effective functioning and enhanced psychological wellness (Goemaere et al., 2016).

Although there has been little work applying SDT to astronauts, insight can be gleaned from studies in other settings. Indeed, research with firefighters indicates that, although there are policies governing occupational fitness requirements, they value autonomy in choosing elements of their training programmes and view exercise as part of their professional values and identity (Long et al., 2014). Astronaut engagement in exercise will be motivated by similar extrinsic (e.g., policy, performance requirements) and intrinsic (e.g., enjoyment of exercise, identity, challenge) factors (Williams and Davis, 2005). During preflight and inflight phases, fostering supports for competence, relatedness and autonomy will be an important step in promoting more intrinsic motives for adherence. During post-flight reconditioning, however, the balance between autonomy and medically necessitated interventions will change with the transition from acute treatment to long-term health maintenance.

3. Barriers and resources

3.1. Personal factors

For the general population, stress is an inverse determinant of uptake and adherence to exercise programmes (Bauman et al., 2002). Similarly, athletes who have experienced significant negative life stress preceding an injury are at greater risk of low treatment adherence and poor recovery outcomes (Albinson and Petrie, 2003). Astronauts commonly report inflight stressors, including sleep shifting, work overload/underload, limited communications, hardware problems, discomfort, and injury risk associated with use of onboard equipment (Davis and Davis, 2012). Yet, they indicate that exercise counteracts these by maintaining morale and providing a source of enjoyment (Stuster, 1986). The mental health benefits of exercise are well documented (Weinberg and Gould, 2015) and, given the general level of crew satisfaction with inflight training programmes, adherence is likely to remain high. Stressors during postflight reconditioning, however, are poorly understood and could significantly impact adherence.

Symptoms of injury/illness are a strong deterrent to physical activity, and misattributing them to an underlying medical cause magnifies their perceived severity, leading to poorer treatment adherence and longer recovery times (Broshek et al., 2015). In sport, perceived susceptibility to slow recovery is related to non-adherence (Taylor and May, 1996), and athletes facing career termination are at the highest risk of negative outcomes (Broshek et al., 2015). For astronauts, medical complaints are likely to be distinct barriers to both acute and long-term exercise, especially if they are recurrent, slow to recover, or result in permanent functional change (Louw et al., 2012). Those retiring from active service are at particular risk of non-adherence and exercise cessation.

3.2. Knowledge and expectancies

Athletes often identify poor understanding of the rehabilitation process as a key factor in non-adherence (Evans et al., 2012; Marshall et al., 2012). They prefer clear instructions alongside the rationale for each modality, and an explanation of the likely outcomes (Marshall et al., 2012). Realizing anticipated physical and psychological outcomes is also a determinant of ongoing adherence (Bauman et al., 2002; Williams et al., 2005). It is therefore crucial that individuals have accurate expectations for what they can achieve by engaging in exercise, because those with strong beliefs in the efficacy of the proposed treatment demonstrate better adherence (Taylor and May, 1996; te Wierike et al., 2013). Adequate provision of information to astronauts throughout the intervention cycle is therefore likely to be a key predictor of reconditioning success.

Please cite this article in press as: McKay, C.D., Standage, M., Astronaut adherence to exercise-based reconditioning: Psychological considerations and future directions, Musculoskeletal Science and Practice (2016), http://dx.doi.org/10.1016/j.msksp.2016.12.011