

**MOTIVATION AND PHYSICAL ACTIVITY**  
**AMONG RHEUMATOID ARTHRITIS PATIENTS:**  
**A SELF DETERMINATION THEORY APPROACH**

By

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## **ABSTRACT**

Rheumatoid Arthritis (RA) is a chronic inflammatory disease that can negatively impact people both psychologically and physically. Health benefits of regular physical activity (PA) have been demonstrated for RA patients (Cooney et al., 2011), however people living with RA are more likely to be sedentary (Sokka et al., 2008; Yu et al., 2015). To accrue evidence that could facilitate RA patients commencing and maintaining regular PA, a Self-Determination Theory (SDT) based approach was adopted in this thesis. For achieving this broader aim, the validity and reliability of the Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2) was tested (Chapter 2) in the people with RA via a mixed method approach. In a second study (Chapter 3), a SDT-grounded process model of the hypothesised relationships between autonomy support from the important other (s), basic psychological needs, motivation regulations and RA patients' subjective vitality and self-reported PA was tested via structural equation modelling. Presumed mediation effects of basic psychological needs and motivation regulations were also examined. As an incongruence between objective and subjective PA measurement has been found in previous work (Semanik et al., 2011), accelerometry data were collected, and the agreement with self-reported PA and sedentary time (ST) were determined (Chapter 4). Both objective and subjective PA were then related to the 'gold standard' VO<sub>2</sub> max test. Pulling from the three previous studies, the next investigation (Chapter 5) assessed the associations between motivation regulations, objectively measured PA/ST and a key indicator of compromised mental health (i.e., depressive symptoms). Overall findings of this thesis were discussed in Chapter 6, and future research directions, practical implication and limitations proposed.

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## LIST OF PAPERS AND CONFERENCE PRESENTATIONS

The thesis is comprised of the following four papers:

1. **Yu, C.**, Rouse, P.C., Veldhuijzen Van Zanten, J.J.C.S., Ntoumanis, N., Kitas, G.D., Duda, J. L., & Metsios, G.S. (2015). Subjective and objective measured physical activity and their association with cardio-respiratory fitness in rheumatoid arthritis patients. *Arthritis Care and Research*, 17:59, 584-591.
2. **Yu, C.**, Rouse, P.C., Veldhuijzen Van Zanten, J.J.C.S., Metsios, G.S., Ntoumanis, N., Kitas, G.D., & Duda, J. L. (in press). Motivation-related predictors of physical activity engagement and vitality in rheumatoid arthritis patients. *Health Psychology Open*.
3. **Yu, C.**, Rouse, P.C., Kitas, G.D., & Duda, J. L. (under review) The validity and reliability of the behavioural regulation in exercise questionnaire among rheumatoid arthritis patients. *Measurement in Physical Education and Exercise Science*.
4. **Yu, C.**, Fenton, S. A., Kitas, G.D., Duda, J. L. (under review). The relationship of self-determination motivation to objective physical activity, time spent sedentary and depressive symptoms in rheumatoid arthritis patients. *British Journal of Health Psychology*.
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*Musculoskeletal Disorders*, 15, 445-454

7. Rouse, P. C., Duda, J. L., Veldhuijzen Van Zanten, J.J.C.S., Metsios, G.S., Ntoumanis, N., **Yu, C.** & Kitas, G.D. (2013). Feelings of competence and relatedness during physical activity are related to well-being in rheumatoid arthritis patients: Preliminary findings from a randomised control trial. *Annals of the Rheumatic Disease*, 72, S3, 1093.

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## **CHAPTER 1**

### **General Introduction**

## Overview

In terms of the structure of this Introduction Chapter, literature on the prevalence of rheumatoid arthritis (RA) and the implications of RA is first reviewed. The impact of RA on the physical and psychology health of people living with this disease is described next. As illustrated in previous studies, RA patients could accrue a number of positive benefits from PA; e.g., in prescribed exercise programmes that are appropriately tailored and properly supervised. Albeit the obvious advantages of being regularly active for this clinical population, it is noted that RA patients are prone to spending significant time sedentary instead of engaging in and sustaining sufficient levels of PA. With the importance of having PA promotion efforts based on theory, Self-determination Theory (SDT) is then introduced as a conceptual framework which helps explain the “why” and “what” of the reasons behind behaviour engagement.

Within the SDT framework, many key factors need to be realised as they are important for facilitating optimal human behavioural engagement, in this case, participating in PA in the RA population. The process of internalisation and the concepts of basic psychological need theory, and the nature and importance of autonomy supportive social environments are described. Indeed, SDT has been applied in different areas including the promotion of PA engagement, but to date, limited work has been done involving RA patients.

To help us further understand PA patterns among this clinical group, the importance of employing objective measures of PA as well as sedentary time is argued in the next section of this introductory chapter. Relevant measurement issues concerning accelerometry data are reviewed and the recommendations for cleaning and treatment of

accelerometer-derived data are described. As the employment of accelerometers are not a novel research device when applied to clinical populations, studies conducted with other patient groups that have demonstrated the feasibility of this tool are briefly reviewed. Literature is reviewed which highlights the incongruence between self-reported PA and accelerometry-derived PA (and sedentary time). From this work, the case is made for the importance of examining the difference between these two measurements.

Pulling from the research evidence to date on RA and its implications for health and quality of life, the impact of exercise engagement and patterns of PA/ST engagement in this population, and SDT as one framework which provides a framework for examining the determinants of an active lifestyle, the case is made for the overall focus of the present thesis. The introductory chapter concludes with the specific objectives of the four empirical studies comprising this thesis.

### **The prevalence and implications of rheumatoid arthritis**

Rheumatoid arthritis (RA) is a periodical inflammatory musculoskeletal disease affecting one per cent of the general population worldwide (Symmons et al., 2002). According to Symmons and colleagues (2002), 1.16% of men and 1.44 % of women among British adults suffer with this disease. RA is commonly found in the case of the elderly population. For people aged 40 years or older, the risk of developing RA is 5 times higher, particular in women (Brosseau, Wells, & Tugwell, 2004). Women have higher risk to have RA with the gender ratio of incidence being (female to male) 3:1 (Sokka et al., 2009).

RA patients have an increased risk of developing cardiovascular disease (CVD) that is not fully explained by traditional cardiovascular risk factors (Crowson, Liao, et al., 2013). According to a meta analysis study (Avina-Zubieta et al., 2008), there is a 50% increased risk of CVD-related death in RA patients compared with the general population. The exact reason for this heightened risk is still unclear, however it has largely been attributed to atherosclerosis (Metsios et al., 2007). Research by Metsios and colleagues (2009) has shown that low physical activity levels correspond to a worse CVD risk profile among people with RA. Regarding the psychological challenges facing many people living with RA, 20% of RA patients have been found to report anxiety and depression (Evers, Karaaimaat, Geenen, & Bijlsma, 1997). Quality of life (QoL) is significantly lower in the RA population than the general population (Haroon, Aggarwal, Lawrence, Agarwal, & Misra, 2007; Ibn Yacoub, Amine, Laatiris, & Hajjaj-Hassouni, 2012), and functional disability has been pointed out as the most important factor affecting QoL in RA patients.

Physical inactivity is recognized as a risk factor for coronary artery disease (Fletcher et al., 1996) and people with RA tend not to engage in sufficient levels of PA. Lee and colleagues (2012) indicated that 42% of RA patients in their sample were physically inactive, which means that no 10-minute bouts of moderate vigorous PA were discovered during a 7-day monitoring period. Sokka and colleagues' cross-sectional work (2008), reviewed across 21 countries, revealed low percentages of RA patients who regularly engaged in exercise. According to this large-scale survey, the percentage of inactive RA patients was 2-4 times higher than the general population in EU countries. A study involving a Swedish sample (Eurenius, Stenstrom, & The PARA study group, 2005) showed that nearly half of RA patients (47%) did not meet the

recommended physical activity guidelines and that elderly people with RA were less active than their younger adult counterparts. A systematic review of levels of PA in RA (Tierney, Fraser, & Kennedy, 2012) found individuals with RA to be less active than the general population.

### **Benefits of PA in RA patients**

In order to overcome the negative physical and psychological implications associated with being inactive among RA patients, exercise programmes have been introduced to this patient group. Past research has revealed different types of exercise programmes to bring benefits to RA patients depending on the format of the exercise. For example, a review article completed by Cooney and colleagues (2011) indicated that RA patients could improve their cardiovascular health by engaging in aerobic exercise such as cycling, walking, swimming and dance. Other aerobic exercise interventions have resulted in positive effects in RA patients such as decreased fatigue score and pain level, and improvements in aerobic fitness, hand grip strength and walking time (Neuberger et al., 1997). The effects of combining aerobic and flexibility stretch exercise were examined and findings indicated cardiac autonomic function was improved in females with RA (Janse van Rensburg, Ker, Grant, & Fletcher, 2012).

Research has found that a 24 week progressive resistance training programme reduced fat mass, but also increased lean body mass and improved the muscle strength and physical function in RA patients (Lemmey et al., 2009). Progressive resistance training has also been found to benefit RA patients by improving their coordination and balance (Cooney et al., 2011). Indeed, Cooney and colleagues (2011) report that the combining of aerobic and strength exercise results in more optimum effects. Two thirds of RA

patients (Lemmey et al., 2009) also suffer from “rheumatoid cachexia”, which is an accelerated loss of muscle mass resulting in low quality of life (Roubenoff et al., 2002). Inactive RA patients also have the risk of bone density loss and worse joint health, such as evidenced in stiffer tendons, less range of motion or weaker support from the ligament and cartilage, which could be strengthened by engagement in regular PA without exacerbating the disease activity. Thus, promoting PA in an appropriate and consistent fashion is very important for this population.

Past research has demonstrated that engagement in aerobic exercise and weight resistance could help RA patients not only improve cardiorespiratory fitness but also reduce their cardiovascular risk (Stavropoulos-Kalinoglou et al., 2012) and increase endothelial function (Metsios et al., 2013). CVD risk factors, such as blood pressure, blood lipids and body composition, have been found to be improved after the exercise intervention (Stavropoulos-Kalinoglou et al., 2012). Other study also demonstrated the improvement of the microvascular and macrovascular function (Metsios et al., 2013). These results from the empirical study evidence the physical benefit of exercise intervention on people with RA.

### **Sustaining PA is the challenge**

Supported by the above research evidence, it is clear RA patients could gain benefits from regular exercise. However, studies indicate that we are particularly likely to witness insufficient PA levels in this clinical population (Eurenius et al., 2005; Tierney et al., 2012). Thus, we need to investigate the reasons why most patients do not engage in regular physical activity and what contributes to the adoption and maintenance of PA in this population. Hurkmans and colleagues (2010) examined motivation as a

determinant of physical activity in RA patients. Via hierarchical regression analysis, after examining different factors predicting self-report PA among this patient group, the results indicated that lower age and higher autonomous regulation style were the only two predictors of subjective PA. Autonomy support provided by the rheumatologist did not predict higher PA. The Hurkmans et al (2010) study represented important preliminary research on people living with RA based on the self-determination theory framework. In the current thesis, and extending the work of Hurkmans and colleagues (2010), a motivation theory grounded model is adopted for facilitating understanding PA engagement amongst RA patients.

### Self-Determination Theory

Self-determination theory (SDT) is a motivation theory focused on the “what” and “why” of goal pursuits and behaviours (Deci & Ryan, 2000). According to one of the sub theories of SDT, namely orgasmic integration theory (Deci, & Ryan, 2002), people engage in behaviours for less self-determined to more self-determined or autonomous reasons. These behaviour regulations fall on a continuum, which distinguishes external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation (Deci & Ryan, 1985).

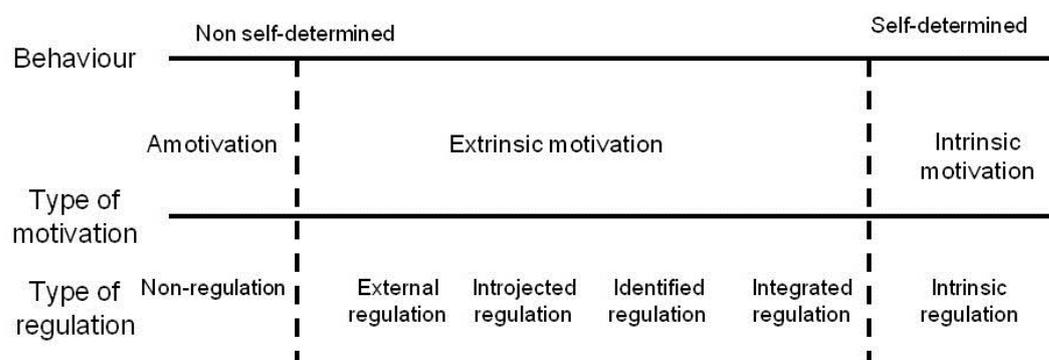


Figure 1.1 The self-determination continuum (Deci & Ryan, 2000)

External regulated behaviour is driven by external rewards or punishment avoidance. It is considered controlling, and externally regulated behaviours tend to result in poor maintenance and transfer once contingencies are withdrawn (Deci, 1985b). Introjected regulation is exhibited when individuals feel they have to engage in the behaviour and/or they want to avoid feeling guilty. In other words, the contingent consequences of the behaviour are administered by the individuals to themselves (Deci & Ryan, 2000).

External regulation is the most controlled form of extrinsic motivation, and introjected regulation is still relatively controlled even it is manifested within the person. Identified regulation is realised when people personally value the benefits of the behaviour. When identified, people recognize and accept the underlying value of the behaviour (Deci & Ryan, 2000). By identifying the personal value of the activity, people will experience greater ownership over the behaviour and feel less controlled when engaged. Identified behaviours would be more self-determined compared to the previous two regulations, but still be instrumental, rather than in the case of engagement for the sake of enjoyment or personal satisfaction. When one's behaviour is integrated, different identifications are organized and brought into congruence with personal experience as a whole. Intrinsic regulation is when people engage in a behaviour out of their curiosity, and/or they are keen to experience or enjoy for its own sake. This is the most autonomous regulation in the SDT continuum.

It was theorised (Deci & Ryan, 2000) that the two most self-determined extrinsic regulations and intrinsic motivation could be considered to be autonomous (intrinsic, integrated, and identified regulation) while controlled regulations are comprised of introjected, and external regulations (Deci & Ryan, 2008). Within each combined or

composite regulation, the individual regulations which are theoretically closest on the self-determined continuum are included and expected to be highly inter-correlated. Controlled motivation and amotivation are postulated to be associated with maladaptive both physical outcomes (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011) and psychological outcomes (Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Ng et al., 2012). On the contrary, autonomous motivation is associated with adaptive outcomes such as positive affect, well-being and the exhibiting of more active lifestyles (Edmunds, Ntoumanis, & Duda, 2007; Williams, Virginia, Zachary, Richard, & Edward, 1996; Wilson, Rodgers, Blanchard, & Gessell, 2003).

### **Internalisation**

From the less self-determined (more controlled) motivation regulations, it is assumed that one could increase the degree of self-determination via the process of internalisation. Internalization is an active, natural process in which individuals attempt to transform socially sanctioned norms or requests into personally endorsed values and self-regulation (Deci & Ryan, 1985). Integrated regulation is the most complete reflection of the internalization of extrinsic motivation in the SDT continuum (Deci & Ryan, 2000). SDT proposes that people will tend naturally to internalize the values and regulations of their social groups (Deci & Ryan, 2000), which is facilitated by feelings of relatedness with the socializing others, as well as the feelings of competence and the feelings of autonomy in terms of the regulation being internalized. These three 'feelings' or perceptions have been proposed to constitute the three psychological needs (Deci & Ryan, 2000).

## **Basic psychological needs**

Psychological needs are defined in SDT as “*innate psychological nutriments that are essential for ongoing psychological growth, integrity and well-being*” (Deci & Ryan, 2000, p. 229). They have been proposed (within SDT) as psychologically fundamental for human beings to pursue optimal functioning and psychological well-being. The term autonomy, means regulation by the self (Ryan & Deci, 2006) or self-governance, or rule by the self. It is not equivalent to independence, however, as people are more prone to depend upon others who support their autonomy (Ryan, 2005). By having many options does not mean people necessarily have more autonomy, unless the options are wholeheartedly endorsed (Ryan & Deci, 2006). Also it is not only the existence of choice itself which constitute autonomy but also the feeling of choice conveying a sense of volition. The need for competence is “fulfilled by the experience that one can effectively bring about desired effects and outcomes” (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000, p. 420). Lastly, the need for relatedness is defined as “feeling connected to others, to caring for and being cared for by those others, to having a sense of belongingness both with other individuals and with one’s communities” (Deci & Ryan, 2000, p. 231), SDT assumed that the fulfilment of all three basic psychological needs contribute to greater autonomous motivation and optimal human functioning (Deci & Ryan, 2000), resulting in a greater realisation of psychological health such as subjective vitality and well-being.

## **Impact of the social environment**

Another important facet in the SDT framework is the nature and assumed implications of the external social environment. The provision of autonomy support has received the

most attention in SDT (Vallerand, 1999) as a key facet of the social environment which has motivational implications. It is assumed that the autonomy support from important others in the environment facilitates satisfaction of the basic psychological needs (Deci & Ryan, 1985; Williams et al., 2006). Research in the physical domain based on the SDT framework demonstrate the importance of degree of the autonomy support realised in the social environment to basic need satisfaction in a variety of populations (Álvarez, Balaguer, Castillo, & Duda, 2009; Hagger et al., 2009; Rouse, Ntoumanis, Duda, Jolly, & Williams, 2011; Standage, Gillison, Ntoumanis, & Treasure, 2012). In health care settings, previous research has indicated that, autonomy support from the health care practitioner and by important others, predicts tobacco cessation (Williams et al., 2006).

### **SDT & engagement in PA**

There is now a considerable literature focused on the application of SDT to the study of PA and exercise (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). The general SDT process model has been proposed and evaluated in previous studies, which considers the relationship of the social environment antecedents, i.e. the need support from the important other, to need satisfaction and motivation regulations leading to the outcome variables such as psychological well-being and/or exercise behavior.

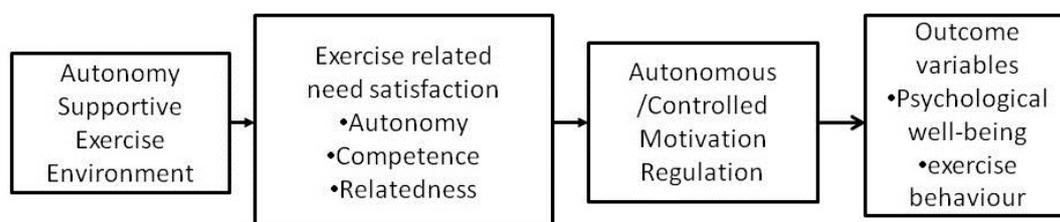


Figure 1.2 General SDT process model in the exercise domain

According to the result of a review on the SDT-based work in PA promotion (Teixeira et al., 2012) relationships have been found between autonomous behavioural regulations and exercise behaviours, though the results regarding controlling forms of regulation were mixed. In addition, identified and integrated regulations were found to be particularly important for initial adoption, whereas an emphasis on intrinsic motivation was found to be more important for longer-term exercise participation.

Following the proposed theoretical structure in figure 1.2, the hypothesized mediational roles of basic psychological needs and motivation regulations should be considered in the SDT framework. This hypothesized mediation has already been tested in other studies e.g. in the sport context (Aadahl & Jorgensen, 2003; Dipietro, Caspersen, Ostfeld, & Nadel, 1992; Quested & Duda, 2010; Quested, Duda, Ntoumanis, & Maxwell, 2013), the current thesis will test this theoretical model in the third chapter of the series of presented studies amongst the RA patients group. The process model emanating from SDT will be examined via Structural Equation Modeling (SEM) analysis.

### **SDT based PA interventions**

Behavioural change techniques are widely used in many areas of public health as well as in terms of physical activity and exercise promotion. Michie and Abraham (2004) have made the point that it is important for interventions involving the implementation of behavioural change techniques to be theory based. According to Michie and her colleagues' review (2004), a theory-based intervention describes and considers the psychological processes accounting for the initiation, re-direction or cessation of behaviour achieved by the intervention. On the other hand, if the theoretically assumed

processes were supported by the empirical data, accounting for intervention effects, this would increase support for the credibility and applicability of the intervention.

Numerous studies have shown that SDT based interventions are effective in numerous domains in health promotion such as tobacco cessation (Williams et al., 2006), weight loss and weight loss maintenance (Silva et al., 2010; Williams et al., 1996) as well as the exercise setting (Duda et al., 2014; Edmunds et al., 2007). In exercise and PA settings, SDT-consistent results were found by Edmunds and colleagues (2007). They reported that the relationship between autonomy support from the employee advisor to the autonomous exercise motivation regulation were mediated by psychological need satisfaction. Based on their findings, the second empirical study of the current thesis involving RA patients will also examine the relationship of autonomy support to motivational regulations through the fulfilment of basic psychological needs. This study also further tests the potential mediation effects of the regulations in relation to the prediction of psychological well-being and self-reported PA.

In the work of Duda and colleagues (Duda et al., 2014; Jolly et al., 2009), an exercise referral intervention was designed and developed based on the SDT. Participants were individuals who exhibited at least one risk factor for CVD and referred to the exercise referral service by their general practitioner (GP) or practice nurse. In order to enhance the adherence to the programme, the health and fitness advisors in the scheme were trained to be autonomy supportive during the consultations. The primary outcome for this project was self-reported PA through follow up; the secondary outcomes included physical health outcomes, mental/emotional outcomes and motivation and processes of change. Testing between arm effects of a SDT grounded model when contrasted with the standard provision exercise on referral service, no significant differences between

exercise behaviours were observed in the 6 month follow up. In both arms, self-reported PA increased from baseline, as well as the feelings of vitality and HADS depression scores. The perceived autonomy support from the health and fitness advisor was found associated with more autonomous reasons for being physically active and intentions to be physically active. This autonomous motivations was linked to the improvement of mental/emotional health outcomes, while controlled motivation was associated with depressive symptoms when individuals were about to commence the exercise referral scheme.

Another review included the above mentioned work and other exercise interventions conducted in different countries (Teixeira et al., 2012), which were all based on SDT with a focus on whether such theory informed PA promotions are effective. The PAC trial (Physical Activity Counselling) was conducted in a primary health care setting and involved a sample of Canadian patients who were referred to an exercise scheme (Fortier, Sweet, O'Sullivan, & Williams, 2007). The 7As model (Fortier, Tulloch, & Hogg, 2006) was developed to guide the intervention within this setting. Such a model provides a shared-care collaborative approach to implementing the intervention which was delivered in an autonomy supportive manner. The participants received autonomy supportive counselling by the family physician with a written PA prescription before the intervention, and the PA counsellor implemented a 3 month PA promotion intervention. For the control arm, there was no such support during the 3 month period. The counsellors were all trained based on the principles of SDT to be autonomy supportive, either in the telephone sessions or the in person sessions. The findings from the PAC trial indicated that the trained PA counsellor, by fostering both quantity and quality (i.e., autonomous) of motivation, facilitated the observed positive changes in PA behaviour.

In the sample of Portuguese mildly obese women (Silva et al., 2010), a one year behaviour change intervention was implemented and 2 year follow-up conducted in the 'PESO' trial (Promotion of Health and Exercise in Obesity). The intervention group was provided with 30 group sessions (120 minutes per session) focused on various topics based on SDT, mainly focused on developing the competence and autonomous motivation towards exercise and weight control. Similarly, the intervention instructors received training based on SDT in order to help them to create a more autonomy supportive environment for the participants and encourage choice and self-initiation. On the other hand, the control group only received the normal curriculum within a similar total contact time. The findings indicated that the intervention was particularly effective in increasing intrinsic motivation and moderate-to-vigorous physical activity (MVPA) at year 2. Long term weight control was also predicted by autonomous exercise motivation.

All the above-mentioned empirical interventions provide the evidence for the effect of SDT based PA intervention in different populations. Noteworthy, among most of the studies which measure PA, a pencil-paper self-report questionnaire was often used. However, it has been acknowledged that social desire may bias reporting of actual PA as such phenomenon has been supported in the case of reported energy intake (Johansson, Solvoll, Bjorneboe, & Derevon, 1997). Also numerous studies have revealed the discrepancy between the self-report and objectively measure PA (Troiano et al., 2007; Tucker, Welk, & Beyler, 2011). Therefore, in terms of understanding PA patterns and their determinants in RA patients, a measure of objective PA (the accelerometer) was adopted in this thesis. As such, we next review accelerometry as a means of assessing PA.

## **Accelerometry**

Accelerometers are small, light, easy to wear motion assessment devices used to record activities or movements. These devices can be worn attached to the body (at the hip via an elastic band worn around the waist) or limb (wrist-worn models). Accelerometers capture the acceleration and deceleration of the body, which is recorded and reported in the unit of counts per minute (CPM), which are then used to estimate parameters such as frequency, duration and intensity of activities. The use of such type of devices in research has increased dramatically in recent years (Strath et al., 2013), and includes testing and validation studies both in the field (Hendelman, Miller, Baggett, Debold, & Freedson, 2000) and lab environment, as well as assessments of movement/level of activity incurred between different types of activities such as walking or running (Brage, Wedderkopp, Franks, Andersen, & Froberg, 2003; Carr & Mahar, 2012). For example, a laboratory based study (Freedson, Melanson, & Sirard, 1998) calibrated the count range by PA level during treadmill walking and running. After testing 50 participants, the cut points were set according to the oxygen consumption in order to categorize the different intensity levels of PA. In addition to validation studies of intensity, the accuracy of assessing energy expenditure has been compared while wearing accelerometers on either the hip (i.e., around the waist) or the wrist (Swartz et al., 2000), and using Cosmed K4b2 portable indirect calorimetry system as the gold standard criterion for energy expenditure. The Swartz et al study (2000) found that while the wrist-worn model was more accurate in estimating energy expenditure, the variability in metabolic equivalent of task (MET) explained by the wrist is less than 5% whereas the hips counts explained 31.7% of the variance. Moreover, this accuracy is offset by the extra time needed to analyse the data and the additional cost of the wrist-

worn accelerometer. The results reported by Swartz and colleagues (2000) was similar to the findings from other studies (Thiem, Keeley, Al-Janabi, Lorgelly, & Coast, 2013; Yu et al., 2015).

Although accelerometers have been validated in different environments, and while being worn on different positions on the body and during various activity types of differing intensities and durations, there are still a number of parameters where consensus has not been reached. Of particular importance to this thesis are the issues of wear time (including both number of days and hours worn within each day needed to provide valid data), and determining the appropriate cut points for intensity within and between groups of varying ages and health status.

Recommendations have been made regarding number of days that should be recorded when using accelerometry (Troost, McIver, & Pate, 2005; Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005). In their review, Trost and colleagues (2005) suggested that for adult populations, 3-5 wearing days are required to reliably estimate the outcome variables typically reported in an accelerometry study. In contrast, Mathews and colleagues (Mathews, Ainsworth, Thompson, & Bassett, 2002) indicated that 3-4 wearing days could result in intraclass correlation coefficients (ICC) up to 0.8, whereas at least a 7-day protocol could result in an ICC to 0.9 and is required to assess patterns of inactivity. Therefore, a 7 day protocol is suggested and at least 4 valid wearing days is required for the representative of the daily activity pattern. With regard to the optimal number of hours per day, Semanik and colleagues (2010) discovered that in terms of patient populations (such as people living with RA), recording a minimum of 10 hours a day will not only provide reliable data, it will also maximize the sample size. This finding has been confirmed in a study of patients with osteoarthritis (Song et al., 2010).

Another variable for which consensus has not yet been reached is the time cut-points for wear and non-wear time. Non-wear time is defined as the length of continuous zeros (i.e. no movement is detected by the accelerometer), which is assumed to reflect the inactivity of the participant. In older adult populations (Hutto et al., 2013), the continuous zero cut-point has been suggested to be 120 minutes, whereas in the RA population, 60-90 minutes has been suggested as the sensible length for detecting the lack of movement while still retaining enough valid data for analyses (Semanik et al., 2010).

The cut-points for differentiating the different PA levels were developed by different formula based on the METs level; i.e., 1 MET is  $3.5 \text{ ml } \times \text{O}_2 \times \text{KG}^{-1} \times \text{min}^{-1}$ , representing the ratio of the metabolic rate for one activity divided by resting metabolic rate. Resting /light PA level is defined as <3 METs, moderate PA is equivalent to 3-6 METs and vigorous PA is equated to >6 METs. The data collected in the CPM, then the different algorithms, have been used to transfer the counts into the time spent in different PA levels, in order to classify the behaviour (Freedson et al., 1998; Hendelman et al., 2000; Strath, Bassett, & Swartz, 2003; Swartz et al., 2000). Strath and colleagues (2003) examined the difference between various sets of cut-points and indicated that there were large individual errors. As a result, they indicated it is difficult to come to a consensus regarding cut-points set and provide firm recommendations.

Strath and associates (2013) had suggested several parameters for consideration in the future studies. Few studies had reviewed the current cut-points for intensity, however the current available cut-points are age specific and not considered to be particularly appropriate for the elderly population. For instance, previous research (Kahn et al., 2002) has demonstrated the GT3X accelerometer model, which will be used in the

current thesis, to be overall an accurate tool to assess objective PA. The energy expenditure (EE) estimation was defined in their study for all age groups, however it was suggested that more accurate energy expenditure estimation is needed in the case of older people.

Through their large-scale investigation, Troiano and colleagues (2007) collected accelerometry data from over 7176 participants across US between 2003-2004. Based on this research, Troiano and associates proposed that for the moderate intensity PA threshold (equivalent to 3 METs), the suggested counts is 2020 per minutes, and 5999 CPM for vigorous intensity threshold (6 METs). As this set of cut-points was developed from a large sample of healthy general population, it is important to note that there are no specific cut-points developed for patient groups. With this consideration in mind, the Troiano cut-off points were used in the current thesis to assess the intensity levels of PA in patients with RA.

### **Accelerometry-based studies conducted with clinical patients**

Although there are a number of validation and calibration studies conducted within the general population that provide support for using accelerometers to measure objective PA, there are relatively few studies that have been conducted within RA patients and other similar clinical populations such as people living with osteoarthritis (OA). For instance, Dunlop and colleagues (2011) used accelerometers to examine whether OA patients met the aerobic component of the 2008 Physical Activity Guidelines for Americans (more than 150 minutes moderate –to-vigorous-intensity activity a week and for at least 10 minutes duration each time). Among the 1233 participants measured, only 12.9% of men and 7.7% of women met the guidelines. These results not only indicated

the feasibility of using accelerometers to assess PA within this clinical population, but also revealed the prevalence of inactivity among patients with OA. Similarly, the utility of accelerometry in patients with RA has also been examined by (Prioreschi, Hodkinson, Avidon, Tikly, & McVeigh, 2013; Semanik et al., 2010). The study conducted by Semanik and colleagues (2010) included 107 RA patients. Findings were drawn from the baseline data of two concurrent RA studies. The authors provided suggestions relating to the settings of the accelerometer within the RA population: 1) A maximum of 90 minutes of zero activity may be more appropriate than 60 minutes to reflect non-wear time. Although this change in the cut-point for non-wear time did not change the final results for mean PA, the authors state that it did increase the number of valid measurement days that could be analysed in this population; and 2) The minimum of 10 hours per day wear time to define a valid day, based on the previously mentioned study (Troiano et al., 2007) appears reasonable for this population. It is important to note that increasing the daily minimum wear time as the inclusion criteria from 10 hours to 12 hours resulted in a loss of data, from 11% of the sample having invalid data to 24% of the sample having invalid data (Semanik et al., 2010). The 10-hour per day cut-point has also been shown to work in other patient groups such as people with knee OA (Song et al., 2010), which also supports the findings of Semanik et al, (2010). Prioreschi and colleagues (2013) also examined the use of accelerometry in patients with RA. Compared to the general population, the results stemming from tri-axial accelerometers revealed that the RA group spent more time being sedentary and were significantly less active in the daytime. After adjusting for age and disease duration in the RA patient sample, a negative correlation was found between objectively assessed PA and the Health Assessment Questionnaire Disability Index score. These results indicated that

the lower one's disability index, the higher their objectively assessed PA levels. Such findings provide additional support for the previous reviewed benefits of PA among RA patients.

### **Measurement issues relevant to objective and subjective PA assessment**

Subjective PA measurements (i.e., data obtained primarily via self-report questionnaires) have been used in many studies assessing PA among clinical populations as they are low-cost, easy to administer and highly efficient. However the discrepancy between objective and subjective PA assessments has caught researchers' attention and is cause for concern. Within an on-going large scale survey in the United States (the National Health and Nutrition Examination Survey, or NHANES), the data collection carried out between 2005-2006 (Schuna, Johnson, & Tudor-Locke, 2013) among 3725 US adults included a comparison of the differences between self-reported and accelerometry assessed PA. To capture PA realised during transport and within the household and domestic domain, two questions were asked "Over the past 30 days, have you walked or bicycled as part of getting to and from work, or school, or to do errands?" and, "Over the past 30 days, did you do any tasks in or around your home or yard for at least 10 minutes that required moderate or greater physical effort?". If respondents answered 'yes' to either or both questions, details regarding the frequency and the duration were further queried. Similar questions tapped leisure time sedentary behaviour. Combining the data from the accelerometry, the results indicated that the participants' self-reported significantly more time spent in MVPA than what was objectively measured (Schuna et al., 2013; Troiano et al., 2007). Specifically, self-reported moderate PA was  $324.5 \pm 18.6$  minutes per week, while moderate PA assessed by accelerometry was  $45.1 \pm 4.6$  minutes per week. Similarly, self-reported vigorous PA

was  $73.6 \pm 3.9$  minutes per week, whereas accelerometry data indicated engagement in  $18.6 \pm 6.6$  minutes per week of vigorous PA. Similar findings were reported for a Canadian sample (Colley et al., 2011) of 2832 adult respondents assessed from 2007 to 2009. According to the self-report estimate, 52.5% of Canadian adults are physically active, however the accelerometer data indicated that only 15% of Canadian adults met the current guidelines of accumulating 150 minutes of MVPA per week.

Amongst a New Zealand population, a significant overestimate was found via responses to the International Physical Activity Questionnaire (IPAQ) and New Zealand Physical Activity Questionnaire compared to the data derived from accelerometers (Boon, Hamlin, Steel, & Ross, 2008). The results from the study of Celis-Morales and colleagues (2012) indicated that participants reported significantly less time being sedentary and significantly more time engaged in MVPA than indicated by accelerometry. PA as assessed via the IPAQ was found to systematically overestimate vigorous activity 4 fold (about 56 minutes more per week) as compared to objectively measured data.

Not surprisingly, these differences between self-reported and objectively measured PA have also been found in the case of arthritis populations. Semanik and colleagues (2011) examined the associations between Yale Physical Activity Survey (Dipietro et al., 1992) derived and accelerometry PA data although the differences between these two measurements among this population were not statistically tested. Among South Asian women in UK however (Curry & Thompson, 2014), findings contrary to the previous research were revealed. That is, South Asian women reported less PA than was revealed via accelerometer (GT3X) assessments. This may due to the discrepancy

between the cultural contexts and cultural groups under investigation. In any regard, the inconsistent findings across groups call for the further examination of the congruity between different PA measurement approaches.

Larger discrepancies have been observed when comparing both objective and subjective PA measurements and their relationships with metabolic and vascular risk biomarkers, which include homeostasis model estimated insulin resistance, glucose, and triglyceride cholesterol concentration (Celis-Morales et al., 2012). The apparent effects of PA on these biomarkers are attenuated if relatively imprecise self-report type of PA measurements are employed (Celis-Morales et al., 2012). Building on from these published findings, one chapter of the current thesis extends existent research and examines differences between objective and subjective PA measurements. This study also determined associations between both forms of PA measurement and the gold standard VO<sub>2</sub> max measurement among a sample of RA patients in the UK.

### **Objectives of this thesis**

To examine the SDT based determinants of PA in people living with RA, one key aspect of the thesis was to ensure that the major construct within SDT, which is motivation regulations, is assessed in a manner that is appropriate for this patient group and found to be valid and reliable. Therefore, (see chapter 2) the psychometric properties of the most popular SDT-based assessment of motivation regulations for PA engagement, i.e., the Behavioural Regulation in Exercise Questionnaire (BREQ-2), were tested in a sample of individuals from the RA population. A mixed method approach was adopted which included the conducting of interviews and a focus group (qualitative approach) and also, questionnaire data (quantitative approach) were

collected and analyzed via SEM. Internal consistency reliability was tested and evidence for the content validity, construct validity, factorial validity and convergent validity examined in the second chapter (and first empirical chapter) of this thesis.

In chapter 3, a SEM was conducted on data obtained in a cross sectional design study in order to test a SDT-based process model within RA patients. The perceived autonomy support from the important other was examined as an antecedent to the three basic psychological needs: the need for autonomy, need for competence and the need for relatedness. Satisfaction of the needs then were tested in relation to composite motivation regulations (autonomous and controlled) which were expected to be linked with the targeted outcome variables, the indicator of psychological well-being and PA. The BREQ-2 tested in the previous chapter was used in this second study for measuring the motivation regulations. Two mediation analyses were conducted for testing: 1. The expected mediation effect of the basic psychological needs between autonomy support from important others and the motivational regulation, and 2. The hypothesized mediation effect of the motivation regulations between psychological needs and the outcome variables, i.e. psychological well-being and subjective PA.

Another measurement issue was investigated in chapter 4, which focused on the congruence between objective and subjective PA measurements in the case of people living with RA. The self-report PA data were collected via the IPAQ and the accelerometry data were obtained from the GT3X accelerometer. The degree of agreement between the two assessments was tested and the associations between the objective and subjective measures of PA were further examined with the gold standard VO<sub>2</sub> max test.

In the last empirical chapter in the thesis, the focus is on associations between motivation regulation variables, as now captured via the relative autonomy index, and accelerometry derived PA data and an indicator of psychological ill-being (i.e., depression). The data were obtained from the baseline data of a longitudinal intervention study. Correlation and path analysis were used to ascertain relationships between the variables of interest and fit indices were provided in order to examine the fit of the data to the proposed model.

## **CHAPTER 2**

### **THE VALIDITY AND RELIABILITY OF THE BEHAVIOURAL REGULATION IN EXERCISE QUESTIONNAIRE-2 AMONG RHEUMATOID ARTHRITIS PATIENTS**

This manuscript is 'Under review' at the *Measurement in Physical Education and  
Exercise Science*

## **Abstract**

### **Introduction**

Rheumatoid Arthritis (RA) is a chronic inflammatory disease that causes pain, stiffness and joint swelling. Health benefits of regular physical activity (PA) have been demonstrated for RA patients however their PA uptake is low (Yu et al., 2015). Thus, it is important to examine the motivation for PA in RA patients. Grounded in Self-determination Theory (Deci & Ryan, 2000), the Behavioural Regulation in Exercise Questionnaire (BREQ-2) (Markland & Tobin, 2004) was developed to assess autonomous and controlled regulations for PA (and amotivation) and validated in healthy populations. It is often errantly assumed that questionnaires designed for such populations are appropriate for clinical groups. This study adopted a mixed methods (qualitative and quantitative) approach to examine the validity and reliability of the BREQ-2 in RA patients.

### **Methods**

Study 1: the 'think aloud' procedure and a focus group were employed to examine the content validity of the BREQ-2 (n=6; M age=65 yrs). Study 2: 325 RA patients [96 (m), 229 (f); M age=57 yrs] completed the BREQ-2. The internal reliability of the subscales was assessed and the factorial validity was determined via confirmatory factor analysis (CFA). To examine criterion related validity, bivariate correlations were calculated with scores on the Subjective Vitality Scale and a measure of perceived capability and quality of life (ICECAP-A).

### **Results**

RA patients reported no difficulties comprehending the BREQ-2 items and found the content suitable. Results of the reliability test and CFA suggested two items be removed and the fit of the data to the measurement model was improved (Chi

square=225.05, CFI=.96, RMSEA=.057). Subscales exhibited acceptable internal consistency (alpha =.75~.93). As hypothesised, the more autonomous motivations positively correlated with subjective vitality and reported quality of life (QOL). Controlled regulations and amotivation were either negatively or not correlated with these variables.

## **Discussion**

Findings provide support for the internal reliability and factorial and criterion-related validity of a 17 item BREQ-2 when administered to RA patients. The BREQ-2 could be employed in future studies examining (a) the determinants of and outcomes associated with PA motivation, and (b) the impact of SDT-based PA promotion interventions in this clinical population.

## **Introduction**

Approximately 0.8% of British adults are affected by rheumatoid arthritis (RA) (Symmons et al., 2002). RA is a chronic inflammatory disease marked by periodic and unpredictable flare-ups in disease activity which are caused by a malfunctioning immune system. The typical symptoms of RA include pain, stiffness and swelling of the joints (D. M. Lee & Weinblatt, 2001). Such symptoms, as well as associated feelings of fatigue, could contribute to, as well as be a consequence of, the reported low levels of physical activity (PA) in people living with RA (Belza, Henke, Yelin, Epstein, & Gillis, 1993). The insufficient levels of PA typically exhibited by this patient group are likely to increase the risk of cardiovascular disease (CVD, (Kitas & Erb, 2003; Metsios et al., 2009) and also premature morbidity and mortality (Solomon, 2003). Further, RA patients are likely to experience lower levels of psychological well-being and report increased psychological distress (Treharne, Kitas, Lyons, & Booth, 2005) which may also be related to their insufficient participation in PA and the physical symptoms associated with this disease.

A wealth of evidence indicates that regular PA results in a variety of physical (Neuberger et al., 1997) and psychological benefits for the general (Braith & Stewart, 2006), elder (Ross & Hayes, 1988) and clinical populations (Cooney et al., 2011) in terms of lowering the risk of CVD and healthy weight maintenance. In RA patients specifically, CVD risk has been shown to be reduced via aerobic exercise and weight resistance training (Stavropoulos-Kalinoglou et al., 2012). However, little is known about how to support PA adoption and maintenance. Knowledge of the processes that lead to sustained PA behaviour change is particularly needed in the case of clinical

populations such as RA patients, as they may gain greater benefit from regular PA by reducing their disease specific symptoms (Cooney et al., 2011).

It is strongly suggested that the investigation of the determinants underpinning PA engagement should be theory driven (Michie & Abraham, 2004). Self-determination theory (SDT, (Deci & Ryan, 1985, 2000) has been widely tested as a framework to examine and explain the processes responsible for behaviour adoption and maintenance in the exercise domain (Duda et al., 2014; Edmunds et al., 2007; Teixeira et al., 2012). SDT emphasises the determinants and implications of differences in the 'why' of behaviour. This theory proposes that different types of motivation exist that vary in their degree of self-determination (Deci & Ryan, 1985). The different motivation regulations include intrinsic motivation, which is the most self-determined motivation regulation. Intrinsically motivated people participate in exercise because they enjoy the activity in and of itself. Identified regulation occurs when people engage in PA because they value the benefits that can be achieved. People who are doing PA based on introjected reasons engage in activities because they feel they should, and/or to avoid feelings of guilt. External regulation exists when the behaviour is driven and underpinned by external rewards or to avoid punishment. Finally, amotivation is manifested when people lack the intention or interest to commence and maintain the behaviour. In essence, amotivated individuals do not know why they are doing the behaviour in question. Previous SDT-based research within the exercise domain has found that the more self-determined motivation regulations are positively correlated with psychological need satisfaction, as well as positively associated with engagement in strenuous and total exercise behaviours and well being (Edmunds, Ntoumanis, & Duda, 2006; Rouse et al., 2011).

The Behavioural Regulation in Exercise Questionnaire (BREQ) was the first psychometric instrument developed to measure the motivation regulations of adults participating in exercise classes (Mullan, Markland, & Ingledew, 1997). The exclusion of amotivation from this questionnaire, however, meant that the BREQ failed to fully align with SDT's proposed framework. Consequently, Markland and Tobin (2004) developed the BREQ-2 and included four new items that measured amotivation. Confirmatory factor analysis (CFA) revealed good factorial validity for the 5-factor model. The BREQ-2 has been employed, tested and validated in different countries and within the general population, consistently demonstrating good psychometric properties (Markland, Kaperoni, Vazou, Vlachopoulos, & Moustaka, 2010; Moreno, Cervelló, & Martínez., 2007). Employing the BREQ-2, previous research in the general population has revealed that more self-determined motivations are related to greater levels of PA and aerobic fitness (Sibley, Hancock, & Bergman, 2013) as well as greater subjective well-being (Gunnell, Crocker, Mack, Wilson, & Zumbo, 2014). However, no research that we are aware of has confirmed the validity and reliability of the BREQ-2 for use in clinical populations. It is often erroneously assumed that measures developed for healthy individuals are appropriate for people who are living with disease and disability. In addition, only quantitative methods have been used to validate the psychometric features of the BREQ-2 (Markland & Tobin, 2004; Moreno et al., 2007). Quantitative methods may allow us to examine the validity and reliability of the questionnaire, however such approaches provide limited if any awareness of the thoughts, feelings and interpretations individuals hold when completing the questionnaire. Quantitative approaches are not especially insightful regarding whether directions or questionnaire

items are understood and/or whether the latter are meaningful or sufficiently capture the construct in the case of those responding to the measure.

The “think aloud” method is a qualitative technique that has been used to examine cognitive processes manifested while individuals are engaged in tasks such as problem-solving, decision making and judgment tasks (Johnson, 1993). This methodology has also been employed to understand participants’ thinking while completing questionnaires (French, Cooke, McLean, Williams, & Sutton, 2007). The think aloud technique requests participants to report what they are thinking by verbalizing all thoughts that are normally silent when completing a questionnaire (Ericsson & Simon, 1998). Yan and colleagues (2012) proposed a model that helps to determine and organise participants’ understanding, interpretation and responses to individual scale items. Understanding refers to the language being properly comprehended by the participants. Interpreting refers to participants correctly recognizing what they are being asked to complete. Finally, responding refers to participants’ ability to adequately follow the questionnaire’s format. In initial pilot work, we adopt Yan and colleagues’ (2012) approach to examine how RA patients think during the process of answering the BREQ-2 items. We also ascertained whether RA patients found the item content of the BREQ-2 meaningful and adequate in terms of capturing their reasons for engaging in physical activity.

## **Pilot Work**

### ***Method***

Three interviews and one focus group were conducted with a small sample of RA patients in order to assess their understanding of, and perspectives on, the items comprising the BREQ-2. The ‘think aloud’ method was used during the interviews, and

structured questions were asked afterwards in order to examine the comprehension and understanding of the BREQ-2 items in this population. The focus here was to determine whether any potential modifications in the BREQ-2 were warranted based on the responses of the participants including any additional item content that needs to be included.

Individual interviews were conducted with a small sample of RA patients (n= 3). Participants (all females, M age=67 years) were recruited from a large hospital in the West Midlands, UK. The interviews were conducted by a trained research fellow in a quiet room with the participants' consent. All the conversations were recorded via an Olympus WS-450s digital voice recorder and transcribed verbatim. Standardised instructions were provided to each participant regarding the think aloud process. Participants were instructed to speak out what they were thinking, while reading and responding to the items contained within the BREQ-2, in order to understand if they comprehended the questions and what they were thinking when reading and interpreting the items. Subsequently, participants were asked five structured questions to ascertain whether there were any other items that might need to be added to the instrument. Questions posed were: "Can you tell me about any physical activity you participated in between diagnosis with RA and the exercise intervention?", "Can you remember why you commenced this activity and (a) Why you continued? (b) Did your reasons for participating change? (c) Why did you stop, if you did?" (d) "Do you currently participate in any physical activity?" "If yes, why is it important to you to participate in physical activity?" and (e) "We are trying to make sure we have appropriate measures for our study. Is there anything you would like to say or add?" This 'thinking aloud' procedure took approximately 15 minutes to complete.

The ‘think aloud’ interviews were followed by a focus group that was conducted with three further RA patients. Focus group participants were white British females (M age = 63 years) all having been diagnosed with RA for more than 10 years. The focus group (which lasted 1 hour 27 minutes) examined participants understanding of a number of psychological measures. Approximately 20 minutes of those discussions centred on the appropriateness and thoroughness of the item content of the BREQ-2. Structured questions were asked which provided participants an opportunity to reflect if they thought the questionnaire had adequately and appropriately covered their reasons for PA engagement (e.g. “We are trying to make sure we have appropriate measures for our study. Is there anything you would like to say or add?”). The question “Would you change the wording of any of the items?” was asked in order to make sure they comprehended the meaning of the items.

### ***Measures***

#### *Behavioural Regulation in Exercise Questionnaire (BREQ-2)*

The BREQ-2 (Markland & Tobin, 2004) contains 19 items assessing intrinsic (e.g. “I engage in physical activity because it’s fun”), identified (e.g. “I value the benefits of physical activity”), introjected (e.g. “I feel ashamed when I miss an exercise session/chance to be physically active”), extrinsic (e.g. “I engage in physical activity because other people say I should”) and amotivation (e.g. “I don’t see why I should have to be physically active”). Each subscale contains four items except the introjected subscale which contained three items (see appendix). The BREQ-2 has displayed a good level of internal consistency in studies involving healthy adult populations (Markland & Tobin, 2004) (Cronbach’s  $\alpha$  from .73~.86).

## *Analysis and Results*

Analyses of the transcribed interviews indicated that participants neither reported nor exhibited any difficulty in understanding the items comprising the BREQ-2. Specifically, the interviews revealed no issues relating to the comprehension of items or the identification of additional reasons for participating in PA. For instance, quotes from the participants when they were asked ‘is there anything else you would like to add or say about the item content?’ included: “*No not really, they covered most of things don’t they? So um..can’t think of anything. No, not really.*”, “*No...no I can’t think of anything.*”. Due to no issues being revealed in the interviews, we proceeded with the conduct of the focus group. Similar to the interviews no additional concerns, confusions or responses were raised by the focus group when asked ”Is there anything on this questionnaire that you want to change, any of the wording or anything you would like to add that reflex that rheumatoid arthritis better...?”.

According to the model proposed by Yan (2012), our results indicate that this present sample of RA participants understood the meaning of the items, had no difficulty interpreting the items and responded appropriately in terms of the requested format. The composition of our sample in the interviews and the focus group was similar to the known demographic characteristics associated with RA (elder adults, more prevalent in females than male patients(Sokka et al., 2009)), which increases the representativeness of the findings.

## *Discussion*

The results of the interviews and the focus group conducted in the pilot work indicated that there were no difficulties in terms of comprehending the items comprising the BREQ-2. Support for the content validity was gleaned as the RA patients’

interpretations of the items contained within the BREQ-2 were consonant with what is assumed to be captured within the different regulation subscales. Also, no further item content was proposed. Therefore, it was decided we could appropriately move onto a subsequent quantitative study that would examine the psychometric properties of the questionnaire when administered to people living with RA.

### **Quantitative Study of the BREQ-2**

A mixed method approach (quantitative and qualitative) allows a more thorough assessment of the appropriateness of the BREQ-2 for patients with RA (Migiro & Magangi, 2011). Therefore, following the qualitative approach adopted in the pilot work, the validity and reliability of the BREQ-2 was further examined within a RA patient sample via a quantitative approach. More specifically, the internal reliability of the subscales was examined through the calculation of the Cronbach's  $\alpha$  value. The factorial validity of the BREQ-2 was also assessed via confirmatory factorial analysis (CFA). The convergent validity of the BREQ-2, when completed by people with RA, was tested through the analysis of the intercorrelations between the motivation regulations (and responses to the amotivation subscale). According to previous research validating the BREQ-2 for healthy adults (Markland & Tobin, 2004) positive correlations were expected between the autonomous regulations (intrinsic and identified regulations) and a similar pattern was anticipated between the controlling motivation subscales (introjected and extrinsic motivation). The correlations between the autonomous regulations to the controlling motivation and amotivation subscale scores were expected to be negative.

The construct validity of the BREQ-2 was tested via the correlations between the motivation regulation (and amotivation) subscales and variables we would expect to

be associated with these subscales. In this study, subjective vitality and reported quality of life (QoL) were the targeted variables. In past work conducted in physical education and exercise settings, autonomous regulation subscales were found to be positively associated with reported QoL and vitality among secondary school pupils (Standage et al., 2012), whereas the controlling regulations and amotivation were negatively correlated with QoL and vitality. Positive relationships have also been observed between autonomous motivation and indicators of QoL and self-esteem in a PE context (Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013; Standage & Gillison, 2007), similar findings also posited that in the PA context (Bagoien, Halvari, & Nesheim, 2010) autonomous motivation positively associated with well-being in general and the effort of PA. Therefore, based on this previous research, and theoretical tenets, we hypothesised that positive associations will emerge between autonomous motivations and QoL and subjective vitality while controlling motivations and amotivation would be negatively correlated with these criterion variables.

### ***Participants***

Participants recruited (N=325 male=96, female=229) had an average age of 57 years (SD = 11 years). The skewed gender distribution favouring females aligns with the disease incidence distribution typical of RA (3:1) (Sokka et al., 2009). The majority of participants were white (93.8%) with a small percentage Asian (2.2 %) and black (1.2 %). Different educational levels were observed as 16.6% of the participants had completed their education to the GCSE/O level while 23.4% received their A level/diploma, 15.4 % an undergraduate Degree, and 9.8% were educated to the postgraduate level (34.8% non-specified). Regarding marital status, 66.8% were

married. The average disease duration in the case of the present sample of RA patients was  $14 \pm 11$  years.

## ***Measures***

### *Subjective Vitality Scale*

The Subjective Vitality Scale (SVS) (Ryan & Frederick, 1997) includes five items which are responded to on a 7-point Likert-type scale, from 1 'not at all true' to 7 'very true'. The instructions requested the participant to consider how he or she was feeling during the last week with an example item being: "In general, over the last week I feel alive and full of vitality". The scale has been validated via structural equation modelling (SEM: (Bostic, Rubio, & Hood, 2000) with the observed data displaying an acceptable fit to the proposed model. The internal reliability of the SVS in past work by Bostic and colleagues' was found to be high, with observed Cronbach's  $\alpha$  of .80 and .89.

### *The ICECAP-A capability wellbeing measure for adults*

The ICECAP-A was employed as an indicator of QoL in the present sample of RA patients as it assesses states of capability well-being. The descriptive system for the measure was developed in two phases (Al-Janabi, Flynn, & Coast, 2011). In a first qualitative phase, five conceptual attributes were developed from interviews with 36 individuals from the general population, aged 18 years of age and older. The five major concepts generated were stability, attachment, autonomy, achievement, and enjoyment. A second qualitative phase was used to check meaningful wording for these attributes. Each attribute is responded to on a 4 level scale with the wording of the items reflecting the degree to which these different capabilities were experienced. For example, the attribute on stability refers to feeling settled and secure has four levels from which the

participant could choose as follows: “I am able to feel settled and secure in **all** areas of my life”, “I am able to feel settled and secure in **many** areas of my life”, “I am able to feel settled and secure in **a few** areas of my life”, and “I am **unable** to feel settled and secure in any areas of my life”. Values on a 0-1 interval scale are available for the measure (Flynn et al., 2015) and these values can be summed as an overall score for different purpose. The construct validity has been tested (Al-Janabi et al., 2013) within adult populations and the content validity of the ICECAP-A has been supported in the health domain (Thiem et al., 2013).

### ***Procedure***

National Health Services (NHS) ethical approval was obtained to collect data from two different samples. Firstly, participants from rheumatology outpatient clinics in a local hospital in the West Midlands, UK were provided with a questionnaire pack along with a stamped addressed envelope. Secondly, questionnaire packs were sent with a stamped addressed envelope to members of the National Rheumatoid Arthritis Society (NRAS). A participant information sheet was included on the front of the questionnaire explaining the purpose of the research. Upon completion, participants returned the questionnaire using the stamped addressed envelope provided. Completing and returning the questionnaire represented informed consent. In the case of the 115 patients recruited at the clinics, all participants provided informed consent after verbal and written information was presented to them about all procedures involved in the project.

### ***Data analyses***

Descriptive analyses were conducted via the SPSS statistical software package (SPSS, 19.0). The factorial validity of the BREQ-2 was tested by CFA using AMOS version 21 (SPSS). Maximum likelihood estimation was used for the CFA with the

following fit indices assessed: Chi-square ( $\chi^2$  square), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and the Non-normed Fit Index (NNFI). CFI and NNFI should be close to 0.95 or above to indicate a good model fit to the data, SRMR should be close or below .08 and the RMSEA should be close or lower than 0.60 (Hu & Bentler, 1998). The internal consistency was examined (Cronbach's alpha) and scores on the different motivational regulation subscales comprising the BREQ-2 were correlated with each other as well as with participants' scores on the SVS and the individual item content assessed in the ICECAP-A. The pairwise deletion approach was adopted in order to gain the maximum sample size.

## **Results**

### ***Descriptive and reliability analyses***

On a 5-point scale, mean scores were intrinsic motivation= 2.50±1.05, identified motivation=2.66± 0.98, introjected motivation =1.30±1.10, extrinsic motivation=0.58±0.82, and amotivation =0.25±0.52. The mean vitality score was 3.76±1.52 on a 7 points scale. For the ICECAP-A the mean level on each dimension was: 2.88±0.8 for stability, 3.43±0.81 for attachment, 3.03±0.80 for autonomy, 2.75±0.74 for achievement and 3.08±0.82 for enjoyment. All descriptive statistics and correlations are provided in Table 2.1.

Table 2.1 Descriptive statistics, internal reliabilities and correlations between variables (adapted 17 item BREQ-2)

Variables	<i>M</i>	<i>SD</i>	<i>Range</i>	<i>α</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)Intrinsic	2.50	1.05	0-4	.91	-										
(2)Identified	2.66	0.98	0-4	.83	.71**	-									
(3)Introjected	1.30	1.10	0-4	.66	.03	.21**	-								
(4)Extrinsic	0.58	0.82	0-4	.76	-.26**	-.09	.42**	-							
(5)Amotivation	0.25	0.52	0-4	.75	-.27**	-.23**	.09	.33**	-						
(6)Vitality	3.76	1.52	1-7	.93	.35**	.19**	-.22**	-.12*	-.15**	-					
(7)Settled and secure	2.88	0.80	1-4		.36**	.24**	-.15**	-.10	-.02	.52**	-				
(8)Love	3.43	0.81	1-4		.43**	.30**	-.04	-.19**	-.16**	.32**	.62**	-			
(9)Independent	3.03	0.80	1-4		.36**	.34**	.05	.03	-.03	.53**	.58**	.46**	-		
(10)Achievement	2.75	0.74	1-4		.46**	.34**	-.01	-.07	-.05	.58**	.62**	.54**	.72**	-	
(11)Enjoyment	3.08	0.82	1-4		.44**	.33**	-.08	-.12*	-.13*	.57**	.68**	.65**	.60**	.69**	-

Note. \* $p < .05$ , \*\* $p < .01$

Notably, the Cronbach's  $\alpha$  value for two of the subscales, introjected and extrinsic regulation, were below the acceptable range (.70~.90)(George & Mallery, 2011). Subsequently, items on these two subscales were examined to determine whether any items should be removed to increase the observed Cronbach  $\alpha$ . Results indicated that, for the introjected subscale, the Cronbach's  $\alpha$  would increase from .51 to .66 if the item "I feel guilty when I don't exercise" was removed. For extrinsic regulation, the value would increase from .41 to .76 if the item "I take part in physical activity because my friends/family/partner/health care provider says I should" was omitted.

### ***Examination of Factorial Validity***

CFAs were conducted on participants' responses to two versions of the BREQ-2. Firstly, the original questionnaire containing all 19 items was tested and the model revealed acceptable fit to the data:  $\chi^2$  square=278.55, CFI=.951, RMSEA=.054, NNFI=.906. Figure 2.1 depicts the original model.

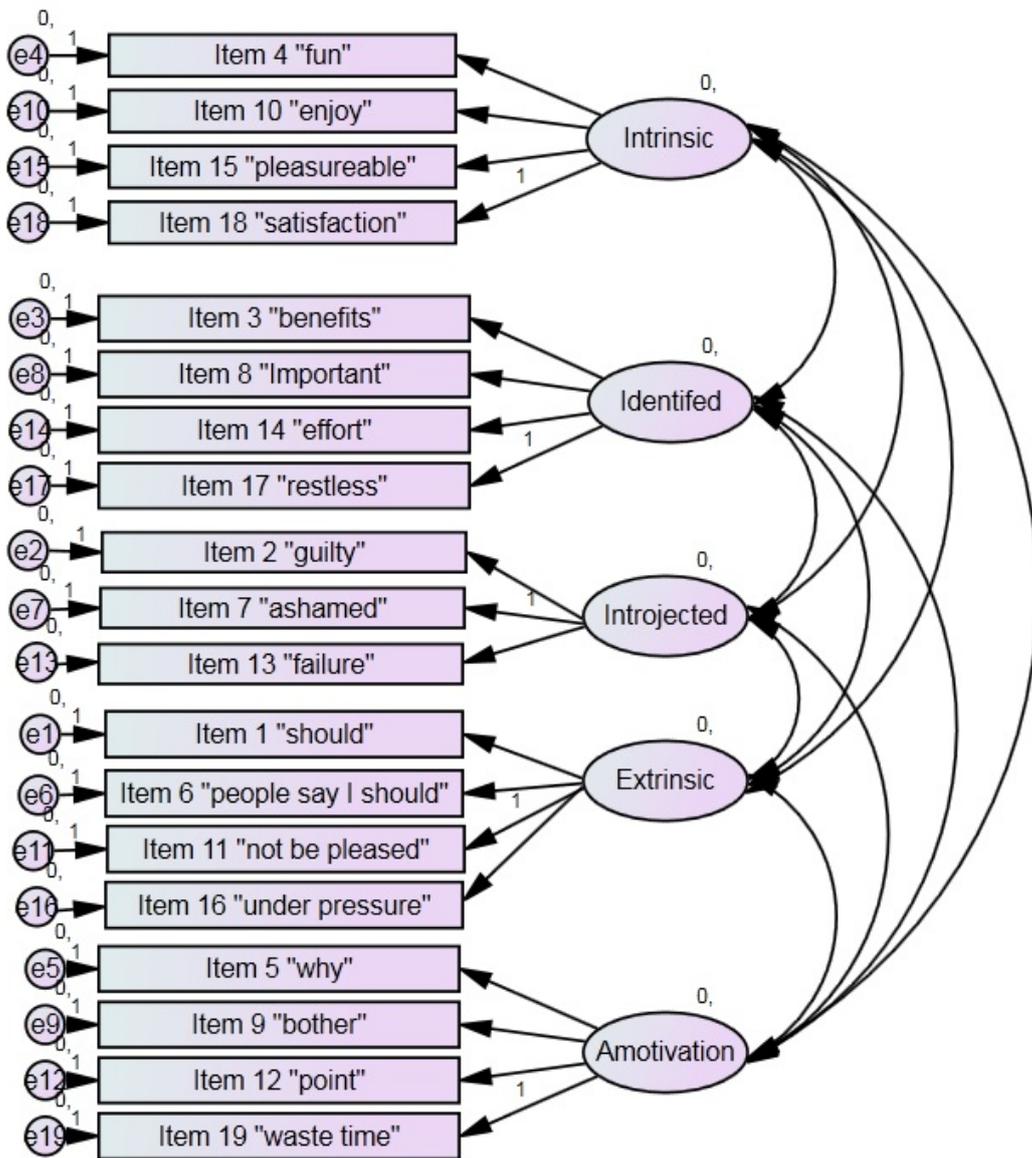


Figure 2.1 The original model of the BREQ-2 questionnaire

Secondly, we examined the factorial validity on a second model containing 17 items (i.e., two items removed based on the results of the examination of internal reliability). The fit of our data to the measurement model for the abbreviated 17 item BREQ-2 improved:  $\chi^2$  square=225.05, CFI=.955, RMSEA=.057, NNFI=.917. See Figure 2.2 for the adapted model.

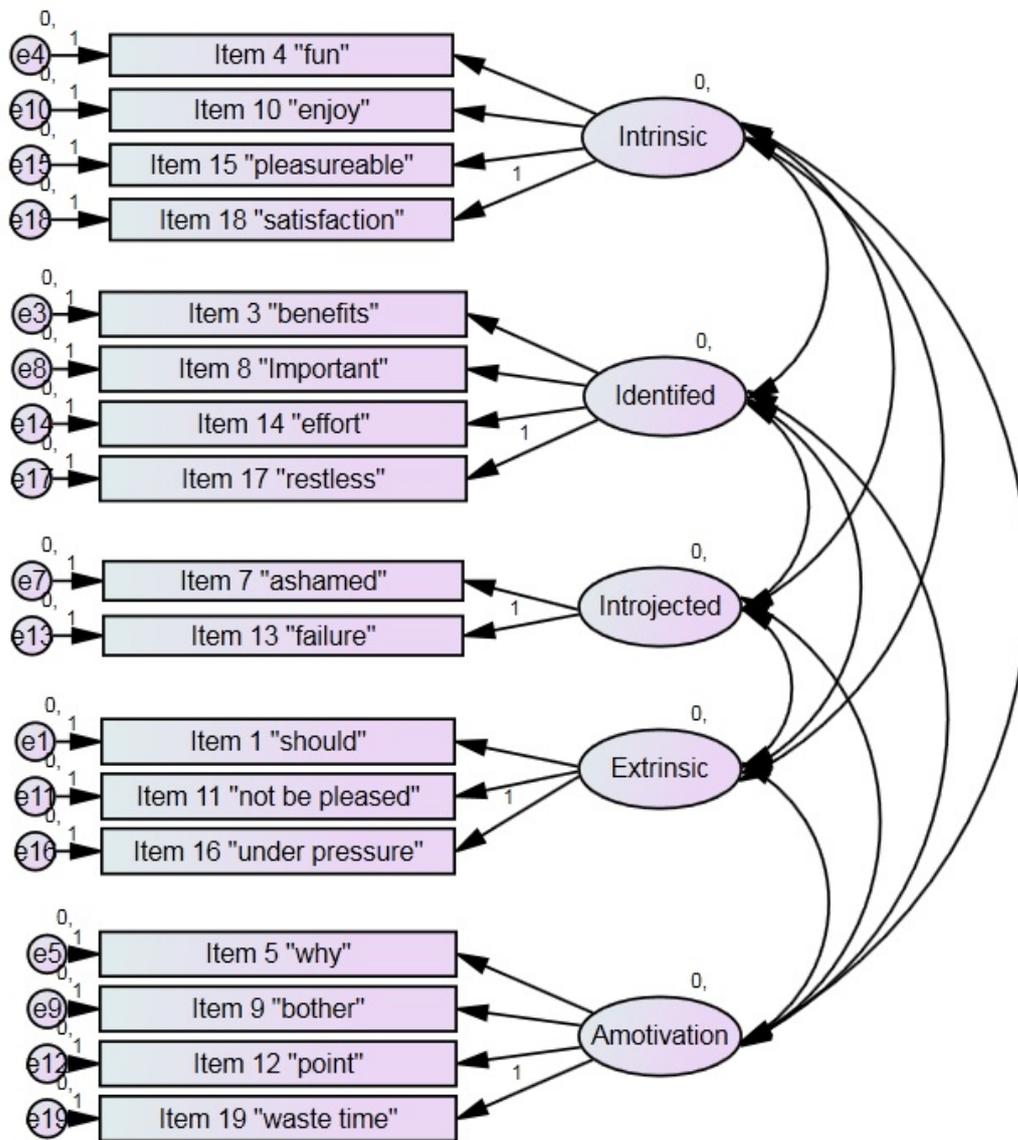


Figure 2.2 The confirmatory analysis model of the BREQ-2 questionnaire in current study

### ***Determination of Convergent- and Criterion-Validity***

With respect to examining the convergent validity of the BREQ-2, the bivariate correlations between the subscales were examined. Autonomous motivation regulations, such as intrinsic motivation and identified regulations, were significantly and positively correlated with each other ( $r = .71$ ,  $p < .01$ ) and intrinsic regulation was negatively correlated to extrinsic motivation ( $r = -.26$ ,  $p < .01$ ). A non-significant relationship was found between the intrinsic regulations and introjected motivation ( $r = .03$ , ns). The intra-correlation between the two controlling correlations ( $r = .42$ ,  $p < .01$ ) was found to be moderate and positive. Amotivation was moderately and negatively correlated with intrinsic motivation ( $r = -.27$ ,  $p < .01$ ) and positively correlated with extrinsic motivation ( $r = .33$ ,  $p < .01$ ). These findings support the convergent validity of BREQ-2.

With respect to evidence of criterion-validity, the observed correlations between the motivation regulations (and amotivation) subscales and the two targeted criterion variables were in line with theoretical predictions (Markland & Tobin, 2004; Ryan & Connell, 1989) and past research (Wilson, Rodgers, Blanchard, & Gessell, 2006). RA patients' reported feelings of vitality positively correlated with the intrinsic regulation and identified regulation, and negatively correlated with introjected regulation and extrinsic regulation as well as amotivation. The five attributes of ICECAP-A were positively correlated to intrinsic regulation and identified regulation. Only the stability attribute was negatively correlated with introjected motivation. Other ICECAP-A attributes demonstrated similar but non-significant correlations with introjected motivation. Regarding the associations with extrinsic regulation, attachment and enjoyment were negatively correlated whereas other attributes of ICECAP-A had no significant associations. Amotivation was negatively correlated with attachment and enjoyment, but no significant correlations emerged with other ICECAP-items.

## Discussion

A quantitative research approach was adopted in order to test the psychometric properties of the BREQ-2 when administered to a RA patient group. The observed mean scores and the standard deviations of all subscales were distributed similar to what has been revealed in previous research involving non-patient groups (Markland & Tobin, 2004). For example, the more autonomous motivation regulations (e.g., intrinsic motivation) had higher scores than the controlling motivation regulations (e.g., extrinsic regulation). Comparing our results with the general population however (Moreno et al., 2007; Moustaka, Vlachopoulos, Kabitsis, & Theodorakis, 2012), the mean scores for each subscale of the BREQ-2 were, in general, lower. For example, in terms of intrinsic regulation, the present sample of RA patients' scores were reduced (mean=2.50) in contrast to what has been revealed in research involving the general population in UK (mean=2.8)(Markland & Tobin, 2004), Spain (mean =4.73, range from 1-5)(Moreno et al., 2007) and Greece (mean=3.00)(Markland et al., 2010) on a 5 point Likert scale. The low observed score for intrinsic motivation in the present sample of RA patients is comparable to what has been reported for other populations such as obese adolescents (Verloigne et al., 2011) and schizophrenia patients (Vancampfort et al., 2013). This suggests that RA patients had lower motivation toward exercise than the general population in regard to all the regulations and exhibited reduced levels of intrinsic motivation for physical activity aligned to what has been observed for other clinical populations. The current findings may be due to the typically high levels of immobility and high reported fatigue in such patient groups (Belza et al., 1993).

The Cronbach's  $\alpha$  scores highlighted that two items compromised the internal consistency of the introjected and external regulation subscales. Once these two items were removed, the internal consistency improved for these two subscales and the internal

consistency of all the sub-scales comprising the BREQ-2 subsequently fell within the acceptable range (George & Mallery, 2011).

Confirmatory factor analyses were conducted on two versions of the questionnaire to examine the fit of the data, namely the original 19 item questionnaire and a 17 item BREQ-2. Findings revealed that, although the fit of the data was acceptable in both cases, fit of the model improved when examining a modified model for the BREQ-2 in which the two problematic items were removed. The acceptable fit revealed for both versions of the BREQ-2 provides support, in the case of RA patients, for the different qualities and types of exercise regulations (and amotivation) as advanced by SDT. Our findings thus echo what has been observed in previous research with non-patient groups (Markland & Tobin, 2004). Despite this, the improved fit for the adapted (slightly shorter) questionnaire suggests that the items needed to measure the motivational regulations may differ slightly for this clinical population compared to the general population and/or the two problematic items need to be revised or two new items generated.

The results of the correlation analyses between autonomous and controlling regulations, as well as amotivation, were consonant with what SDT posits (Deci & Ryan, 2000). Autonomous motivation regulations (intrinsic motivation, identified regulation) strongly and positively related to each other, and negatively correlated with the controlling motivation regulations (introjected motivation, extrinsic regulation) as well as amotivation. Amotivation was positively correlated with extrinsic motivation. Thus, the convergent validity of the BREQ-2 when completed by RA patients was supported.

As would be expected based on the tenets of SDT (Deci & Ryan, 2000), more self-determined motivation regulations have been positively associated with well-being indicators (Gagne, Ryan, & Bargmann, 2003; Standage et al., 2012; Vansteenkiste, Mouratidis, & Lens, 2010). In contrast, more controlled motivation regulations and amotivation have been found

to be negatively related to indicators of optimal functioning (Gonzalez-Cutre & Sicilia, 2011). Similar findings emerged in the case of the present sample of RA patients. In particular, we found that subjective vitality and dimensions of QoL and well being tapped by the ICECAP-A were significantly and positively correlated with autonomous motivation regulations. These findings suggest that participation in physical activity for more autonomous reasons corresponds to a higher quality exercise experience that is more likely to result in heightened well-being capability. The positive correlations also provide support for the criterion-validity of the BREQ-2 when completed by RA patients. In contrast, when RA patients engage in PA for more controlled reasons or do not know why they are participating, their feelings of reported vitality tend to be diminished. The domains of capability well being assessed via the ICECAP-A generally were negatively associated with controlled motivations and amotivation albeit these findings were not as consistent.

### **General Discussion**

This mixed methods study, including the pilot interviews and focus group, provides preliminary evidence that the BREQ-2 could be a reliable and valid tool for use in the case of people living with RA. The qualitative data revealed that the questionnaire was easy to understand and the item content was meaningful for this population. The quantitative results also provide support for the psychometric properties of the BREQ-2 when administered to a patient group living with a condition that causes pain and fatigue and having these patients reflect on their reasons for engaging in physical activity.

Our finding that the removal of items improved the factorial validity of the BREQ-2 is aligned with what has been observed in previous research. Murcia and colleagues (2007) reported that items of the BREQ-2 cross loaded when conducting an EFA in a Spanish sample which led to the removal of one item that measured identified regulation. However, previous research within clinical populations (Vancampfort et al., 2013) indicated that,

although there were some items which cross loaded based on the result of an Exploratory Factorial Analysis (EFA), all items were best retained in the final model. This latter study though, was marked by an insufficient sample size (i.e.,  $n = 168$  which is less than the recommended 10 participants per item; (Gorsuch, 1986). A similar suggestion was made in a study assessing motivation regulations within obese adolescents (Vierling, Standage, & Treasure, 2007). Even though the EFA results identified some items that cross loaded the BREQ-2, the small sample size prevented the authors from removing the items from the scale.

In the present study, the CFA indicated that the factor structure would improve by removing one item from the introjected subscale and one from the extrinsic subscale. Further examination of the introjected item that was identified for deletion revealed a mean score (mean=2.86) that was much higher than the remaining two items on that subscale (mean =1.15, 1.45, respectively). The discrepancy between levels of agreement with the removed item and the rest of the items comprising the assessment of introjected regulation contributed to the low internal consistency of this subscale. The introjected motivation item removed in the present study had also been identified as problematic in a previous study involving obese adolescents (Verloigne et al., 2011). Although the item was retained in the final model in the research of Verloigne and colleagues, it has been suggested that feelings of shame and guilt need to be distinguished given their different antecedents and consequences (Conradt, Dierk, & Schlumberger, 2007), especially in the obese population. It is noteworthy that obesity is also prevalent among RA patients (Stavropoulos-Kalinoglou, Metsios, Koutedakis, & Kitas, 2010) which could indicate that both RA patients and obese populations exercise to avoid feelings of guilt, although further research is needed to support this notion.

The item removed from the extrinsic regulation subscale was “I take part in physical activity because my friends/family/partner/health care provider says I should”. Similar to the

removed introjected item, the extrinsic item observed a relatively high mean score (mean= 2.63) compared to other items in the same subscale (mean=.85, .40, and .61, respectively). It might be the case that RA patients perceive a strong suggestion from their important others that they should exercise more for the health benefits and answered with a higher score as, in matter of fact, they are told to be more active and this health-related reason is salient.

However they might have their own reasons to engage in PA that are separate from such significant other directives. The different score observed for the first item on this scale, “I engage in physical activity because other people say I should”, implies that RA patients do not solely engage in PA because other people advise them to do so. Nevertheless, the support that RA patients receive from these significant others no doubt could be very influential to their motivation to exercise. Future research could investigate the influence that important others have on the reasons why this patient group participates in physical activity.

It could be argued that the mixed methods approach adopted in the present work provided added insight and understanding that might be missed when only a single method is used. Qualitative and quantitative research used together produces more complete knowledge necessary to inform theory and practice (Migiro & Magangi, 2011). In the present study, we would suggest that the mixed methods approach provided greater support for the validity of the BREQ-2. Another strength of the present work is that we secured a larger sample size than has been the case in previous studies tested the factorial validity of the BREQ-2 (Markland & Tobin, 2004) so we know that the statistical power supported the results of the CFA. Future research adopting a longitudinal design would help to establish the BREQ-2's factorial stability across different time points and also allow test-retest reliability to be established. The present study did not measure levels of PA, future research could provide further validation of the associations between the different motivation regulations and self reported as well as objectively assessed PA. Thirdly, disease severity was not included in the

analysis, and this potentially could be a moderator of RA patients' exercise motivation. In subsequent work, it would be interesting to consider other related variables such as fatigue, or tiredness as potential correlates of motivation regulations to exercise.

This study has highlighted that, in its original form, the BREQ-2 appears to be acceptable for administration to people with RA. However, evidence of the validity and reliability for an adapted version has been shown. The authors recommend that the full version of the BREQ-2 be employed and the 17 item version also be tested when examining RA patients' motivations to participate in PA.

### **Acknowledgment**

Thanks to Professor Joanna Coast for the guidance of writing and the use of ICECAP-A questionnaire.

## **CHAPTER 3**

### **MOTIVATION-RELATED PREDICTORS OF PHYSICAL ACTIVITY ENGAGEMENT AND VITALITY IN RHEUMATOID ARTHRITIS PATIENTS**

This manuscript is 'in press' in *Health Psychology Open*

## Abstract

**Objectives.** This study tests the tenets of Self-determination Theory (Deci & Ryan, 2000), in relation to the prediction of physical activity and well-being among rheumatoid arthritis (RA) patients.

**Design.** Cross-sectional

**Methods.** Participants were recruited from rheumatology outpatient clinics and/or the National Rheumatoid Arthritis Society (NRAS) member registry. Following the completion of the consent form, 207 patients (150 females, M age =  $58 \pm 10$  years) completed a questionnaire pack including: The Behavioural Regulation in Exercise Questionnaire-2, The Psychological Need Satisfaction in Exercise Scale, Important Other Climate Questionnaire, Subjective Vitality Scale and The Godin-Shepard Leisure Time Physical Activity Questionnaire.

**Results.** Structural Equation Modeling indicated that the provision of autonomy support regarding exercise engagement is positively linked to RA patients' need satisfaction, physical activity participation levels and reported vitality.

**Conclusions.** The results of this study suggest that the autonomy support provided by important social agents in terms of RA patients' PA engagement fulfills their basic psychological needs for competence, autonomy and relatedness. Satisfaction of these basic needs hold implications for greater autonomous motivation, and can contribute to higher levels of PA and subjective vitality in this patient group.

## **Introduction**

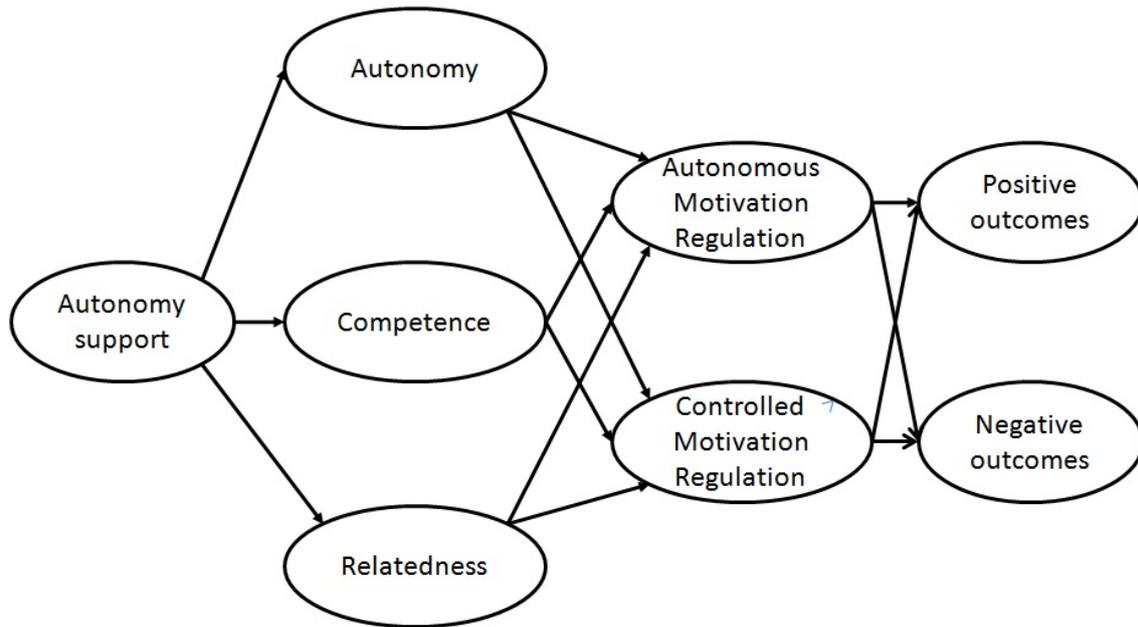
Rheumatoid arthritis (RA) is a chronic autoimmune disorder which causes inflammation leading to symptoms of pain, stiffness, and swelling of the joints (D. M. Lee & Weinblatt, 2001). In addition to these physical and physiological symptoms, patients with RA are also more likely to experience compromised psychological well-being (Treharne et al., 2005). Approximately 0.8% of British adults are affected by RA (Symmons et al., 2002).

Regular physical activity (PA) is associated with physical as well as psychological benefits (Nelson et al., 2007) for both non-clinical and patient groups. In the case of RA patients however, the large majority have been found not to reach the public health recommendations regarding PA participation (Hootman, Macera, Ham, Helmick, & Sniezek, 2003; Metsios et al., 2007). Thus, there is a particular need to understand the determinants of PA in this patient group and it is important for research on such questions to be theoretically based (Michie et al., 2008).

In recent work on PA promotion, Self-determination Theory (SDT) has been widely used to explain the factors impacting behaviour adoption and maintenance in the exercise domain (Deci & Ryan, 2000). SDT focuses on the 'why' of behaviour and assumes that human motivation varies in the extent to which it is autonomous and/or controlled. When participating for autonomous reasons, people feel free to engage in the activity because they personally value the activity and/or because of inherent interest and enjoyment. People engaging for controlled reasons may feel they have been forced to exercise for extrinsic rewards and/or participate out of the feelings of guilt (e.g., to please their partner and/or because their general practitioner told them to be more active).

The tenets of SDT have been examined within different populations and supported by studies conducted in different health care settings (Ng et al., 2012). However, research testing predictions emanating from this theoretical framework in relation to PA behaviour in clinical populations has received limited attention. In a SDT-based study involving RA patients by Hurkmans and colleagues (Hurkmans et al., 2010), higher levels of autonomous motivation significantly predicted higher levels of self-reported PA .

Basic Psychological Need Theory (BPNT) (Ryan, 1995), a sub-theory of SDT, suggests that the origins of autonomous motivation is initiated from individuals' innate propensity to fulfil three basic psychological needs; i.e., the needs for autonomy, competence and relatedness. Past research in the exercise domain has been supportive of the expected positive relationship between basic need satisfaction and participants' autonomous motivation for engaging in PA (Wilson, Rodgers, & Fraser, 2002). It is also assumed (Deci & Ryan, 2000) that when the basic psychological needs have been satisfied, this would negatively predict controlled motivation (Figure 1). Previous work in PA settings has supported this prediction (Gunnell et al., 2014). To our knowledge, however, the implications of basic need satisfaction for autonomous and controlled motivations to participate in PA have not been examined in the case of patient groups, such as people living with RA.



*Figure 3.1* The Basic psychological needs model

According to BPNT, the social environment plays a critical role in the degree to which the needs are satisfied (Deci & Ryan, 2000). BPNT places emphasis on the interpersonal styles of significant others whose behaviours and interactions create that social environment. Two interpersonal styles that have received the most attention are a controlling style, which entails the important other being coercive and acting in a pressuring manner, and an autonomy supportive style (Deci & Ryan, 1987). Autonomy support is evidenced when important others provide opportunities for choice and a meaningful rationale, recognize the feelings and experience of the participants involved and minimize the use of pressures and demands (Williams et al., 1996). Autonomy supportive social environments are also considered to facilitate greater autonomous motivation and internalization of regulatory processes and thus promote effective, long-term behaviour change.

Iversen, Fossel and Daltroy (1999) found RA patients who indicated they had experience engaging in PA to perceive that their rheumatologist provided more social

support for PA. Research by Hurkmans and colleagues (2010), however, indicated that the patients' views of the amount of autonomy support from the rheumatologist were not significantly related to self-reported PA participation. It might be the case that the key source(s) of autonomy support for PA participation in RA patients may not only be their rheumatologist but also other important person/people such as their general practitioner or nurse (Wilcox et al., 2006), their partner, and/ or their children (Rouse et al., 2011). In the present study and extending the research of Hurkmans et al., (2010), the RA patients sampled were able to indicate who might be their 'significant other' in terms of their efforts to be physically active. Ratings of autonomy support were referenced to this individual (e.g., my rheumatologist) or individuals (e.g., my children).

According to BPNT (Ryan, 1995), the fulfilment of the basic needs is not only expected to be relevant to different motivation regulations and levels of participation in the activity in question, but also to the likelihood of experiencing well-being and/or ill-being within and as a result of engagement in the activity. These predictions have been supported within exercise settings where basic need satisfaction was positively predicted a number of well being indicators in non-clinical populations (e.g., (Ferrand, Nasarre, Hautier, & Bonnefoy, 2012), including feelings of vitality (Gunnell et al., 2013). The present study expands on past work by considering whether autonomy support provision by one's important other(s) predicts RA patients' basic need satisfaction, autonomous and controlled motivation for PA, and reported vitality and PA participation.

Within the seminal work of Hurkmans et al. (2010) focused on people living with RA, the associations between SDT-based constructs (and other variables including age, disease duration) to PA levels were examined univariately via hierarchical multiple

regression. A major purpose of the present study was to test, in a sample of RA patients, a BPNT-based hypothesised motivational sequence (autonomy support to basic need satisfaction to motivation regulations to PA/well-being) following the theoretical structure proposed by Vallerand (1999). Structural equation modelling, which controls for measurement error, was employed to test the hypothesised motivational sequence.

Also extending SDT-grounded research on clinical populations, the second aim of the present study was to test the assumed indirect effects within this sequence in the case of RA patients. Specifically, we hypothesised that: 1. Autonomy support provided by an important other(s) will positively predict the three basic psychological needs, 2. The three basic psychological needs will positively predict autonomous motivation regulation, and negatively predict controlled motivation regulation, 3. Autonomous motivation will positively predict subjective vitality and self-reported level of PA, and controlled motivation will negatively predict these variables, and 4. The three basic psychological needs will mediate the relationship between autonomy support provided by the important other(s) and the composite motivation regulations, and the motivation regulations will mediate the relationships between the three basic psychological needs and subjective vitality and self-reported PA.

## **Material and Methods**

***Participants and Procedures.*** After receiving ethical approval from the National Health Services ethics committee, participants were recruited via mail if listed as a member of the National Rheumatoid Arthritis Society (NRAS). Following the completion of the consent form, the participants were requested to respond to a multi-section questionnaire and return by post. A postal survey was mailed to 500 members of the NRAS, 335 questionnaire packs were returned (return rate 67%) and 207 of these

questionnaires were usable in terms of completion of the targeted scales (57 males, 150 females). Missing values were replaced by the mean of each subscale in order to retain the maximum participant number. The observed response rate is similar to what has been reported in previous research on this population (e.g., 62%, (Eurenius et al., 2005) and 64%, (Van Den Berg et al., 2006)). In the Hurkmans et al. study (2010), the response rate to a postal survey was increased from 33% to 42% after telephone contact with the nonresponders.

The mean age of the RA patients in the current sample was 58 years (range 27-82 years;  $SD = 11$ ). Over 99% of the study participants were white British. Within the sample, the educational levels represented were A level (28.5%, equivalent to high school level), degree/undergraduate level (18%) and postgraduate level (12%). The large majority (69.6 %) were married, 4.3% were living with a partner, 6.8% were single, 12.1% were separated /divorced and 7.2% of the patients in the sample were widowed.

### ***Measures***

***Autonomy support for physical activity engagement.*** The autonomy support deemed to be offered for PA engagement from important others, in the view of the RA patients, was assessed through the previously validated Important Other Climate Questionnaire (Williams et al., 2006). Participants were requested to identify one significant other who was particularly influential in their attempt to become physically active. The perceived level of autonomy support provided from the identified significant other(s) was subsequently assessed via six items (e.g., “I feel that my important person provides me with choices and options about physical activity and health”). Each item was responded to using a 7-point Likert-type scale (strongly disagree = 1; strongly agree = 7). In

previous research in the exercise context, this scale has demonstrated good internal reliability with an observed Cronbach's alpha of 0.93 (Rouse et al., 2011).

***Basic Need Satisfaction in Exercise.*** The Psychological Need Satisfaction in Exercise Scale (Wilson, Rogers, Rodgers, & Wild, 2006) was used to assess participants' perceptions of competence, autonomy and relatedness within their PA/exercise programme. Each of the subscales contains six items and responses were provided on a 6-point scale ranging from 1 = false to 6 = true. An example item for the need for autonomy is "I feel free to be physically active in my own way", for relatedness is "I feel attached to those who participate in physical activities with me because they accept me for who I am", and for competence is "I feel that I am able to participate in physical activities that are personally challenging". Previous research in the PA domain has provided support for the internal reliability of the autonomy, ( $\alpha = .91$ ), relatedness ( $\alpha = .90$ ), and competence ( $\alpha = .90$ ) subscales (Wilson, Rogers, et al., 2006).

***Exercise motivation regulations.*** The Behavioural Regulation in Exercise Questionnaire-2 (BREQ -2) (Markland & Tobin, 2004) was used to measure participants' motivational regulations for engagement in PA. The 19-item BREQ-2 assesses external (4 items, such as "I engage in physical activity because other people say I should"), introjected (3 items, such as "I feel guilty when I don't exercise"), identified (4 items, such as "It's important for me to regularly participate in physical activity"), and intrinsic (4 items, such as "I engage in physical activity because it's fun") regulations as well as amotivation (4 items, such as "I don't see why I should have to be physically active"). Responses to each of the items were scored on a scale ranging from 0 (Not at all true) to 4 (Very true). Previous research (Markland & Tobin, 2004) provided support for the internal reliability of the intrinsic regulation ( $\alpha = .86$ ),

identified regulation ( $\alpha = .73$ ), introjected regulation ( $\alpha = .80$ ), external regulation ( $\alpha = .79$ ), and amotivation ( $\alpha = .83$ ) subscales.

***Self-Reported Physical Activity.*** The Godin-Shepard Leisure Time Physical Activity Questionnaire (Godin & Shephard, 1985) was employed to assess leisure-time PA. This self-report questionnaire has been used in previous research on clinical groups, such as diabetes patients (Margaret et al., 2004). Past work has revealed the test-retest reliability of this questionnaire to be 0.64 and its concurrent validity has been supported (Godin, Tobin, & Bouillon, 1986). Participants were asked to report their PA over the past seven days, using a 15 minute bout as the minimum time. Specifically, they indicated the frequencies of the time spent in engaged in PA of strenuous, moderate and mild intensity levels. Weekly overall leisure time physical activity was calculated using the following formula: Physical Activity Index (PA index) =  $(9 \times \text{strenuous}) + (5 \times \text{moderate}) + (3 \times \text{mild})$ . The PA index was used in the current study as the indicator of the RA patients' level of PA.

***Feelings of energy and vitality.*** The 6-item Subjective Vitality Scale (Ryan & Frederick, 1997) was employed to assess participants' state of feeling alive and alert (i.e., having energy available to the self (Bostic et al., 2000)) as an indicator of psychological well-being. An example item is "In general, over the last 2 weeks, I feel alive and full of vitality". Answers were rated on a 7-point scale ranging from 1 (not at all true) to 7 (very true). Good internal consistency had been reported in the exercise context (e.g., Cronbach's  $\alpha = .92$ , (Rouse et al., 2011))

***Data Analysis.*** Following the conducting of descriptive and correlation analyses, the data were analysed through structural equation modelling (AMOS, version 19). The maximum likelihood method was used, and the Satorra-Bentler adjustment for the chi-

square was considered because it provides more accurate standard errors when data are marked by non-normality (Byrne, 2006). The application of the chi-square to assess the adequacy of model fit has been criticized on account of the statistic's sensitivity to sample size. A non-significant Satorra-Bentler  $\chi^2$  value indicates that the data fit the proposed model. The following fit indices were also used to provide additional evidence regarding the adequacy of the proposed model: Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR) and the Non-Normed Fit Index (NNFI). It is recommended that the CFI and NNFI should be close to 0.90 or above to indicate a good model fit to the data (Hu & Bentler, 1995). In terms of the SRMR and RMSEA, it is recommended that SRMR and RMSEA values between 0.05 and 0.10 are considered acceptable, close or lower than 0.08 is optimal (Cole & Maxwell, 1985). The factorial structure of each scale in the current study was tested via confirmatory factor analysis.

In order to reduce non-normality in the data (Little, Cunningham, Shahar, & Widaman, 2002), the number of observed variables was reduced by parcelling. The guide for parcelling was based on the factor loading, the largest of which was paired with the smallest to gain a balance between the parcelled indicators (Little et al., 2002). In line with Deci and Ryan's (2000) theoretical reasoning, an autonomous motivation regulation latent variable was created by combining intrinsic motivation and identified items. A controlled motivation regulation latent variable was formed by combining external regulations and introjected items. The autonomous motivation regulation was indexed by four parcels, and the controlled motivation regulation was indexed by three parcels and one single item.

## **Results**

***Descriptive Statistics, Pearson Correlations and Reliability.*** Descriptive statistics, internal reliability coefficients and bi-variate correlation coefficients for all variables are provided in Table 1. On average, the RA patients reported moderately high autonomy support from their important other. Mean levels of autonomous motivation were moderate while the observed mean for controlled motivation was low. Participants reported moderate levels of subjective vitality and low levels of PA. All of the subscales demonstrated acceptably high internal reliability ( $\alpha=.80\sim.92$ ). The correlations between the three need satisfactions were moderately high and positive. The observed correlation between the need for autonomy and the need for relatedness was lower ( $r=.29$ ) than the other two pairs of associations ( $r=.48$  and  $.46$ , respectively).

**Table 3.1 Descriptive statistics, internal reliabilities and correlations between study variables**

Variables	<i>M</i>	<i>SD</i>	<i>Range</i>	<i>Alpha</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)Important other's autonomy support	5.70	1.38	1-7	.88	-						
(2)Autonomy	4.93	1.37	1-6	.89	.31**	-					
(3)Competence	3.12	1.51	1-6	.90	.27**	.48**	-				
(4)Relatedness	3.54	1.70	1-6	.91	.27**	.29**	.46**	-			
(5)Autonomous motivation regulation	2.62	1.16	0-4	.91	.28**	.46**	.50**	.36**	-		
(6)Controlled motivation regulation	1.03	1.12	0-4	.80	.07	-.21**	-.09	.09	-.13	-	
(7)Subjective Vitality	3.93	1.63	1-7	.92	.22**	.43**	.49**	.13	.34**	-.22**	-
(8)PA index	24.17	18.54	0-89		.08	.27**	.23**	-.01	.29**	-.15*	.31**

\* $p < .05$ , \*\* $p < .01$

**Structural Equation Modelling.** The paths which achieved statistical significance are presented in Figure 2. For ease of viewing, only the latent variables and the significant paths are presented. All hypothesized paths between autonomy support and three basic psychological needs were positive and significant. Competence need satisfaction only positively predicted autonomy motivation regulation. Relatedness was not related to autonomous motivation regulation, and unexpectedly was positively associated with controlled motivation regulation. A positive path between autonomous motivation regulation and each of the outcome variables (i.e., subjective vitality and the PA index) was observed. However, no significant path between controlled motivation regulation and either of the outcome variables emerged.

Based on the modification indices, three co-variances were added between the residual of the three basic psychological needs to improve the model fit. These changes are reasonable as they are theoretically consistent (i.e., we expect the three basic psychological needs to be positively correlated (Deci & Ryan, 2000; Ryan, 1995)) and are aligned with the approach taken in past studies from exercise (Puente & Anshel, 2010) contexts. Adding the three co-variances could help us estimate the model more accurately and indeed improved fit indices.: observed CFI values increased from 0.89 to 0.91, and the NNFI improved from 0.87 to 0.90. These revised fit indices could be considered marginally acceptable. The SRMR decreased from .13 to .09, and RMSEA decreased from .087 to .078. Taken in their totality, these results provided partial support for the hypothesised model (Satorra-Bentler  $\chi^2$  value was decreased from 613.79 (270) to 536.18 (237)).

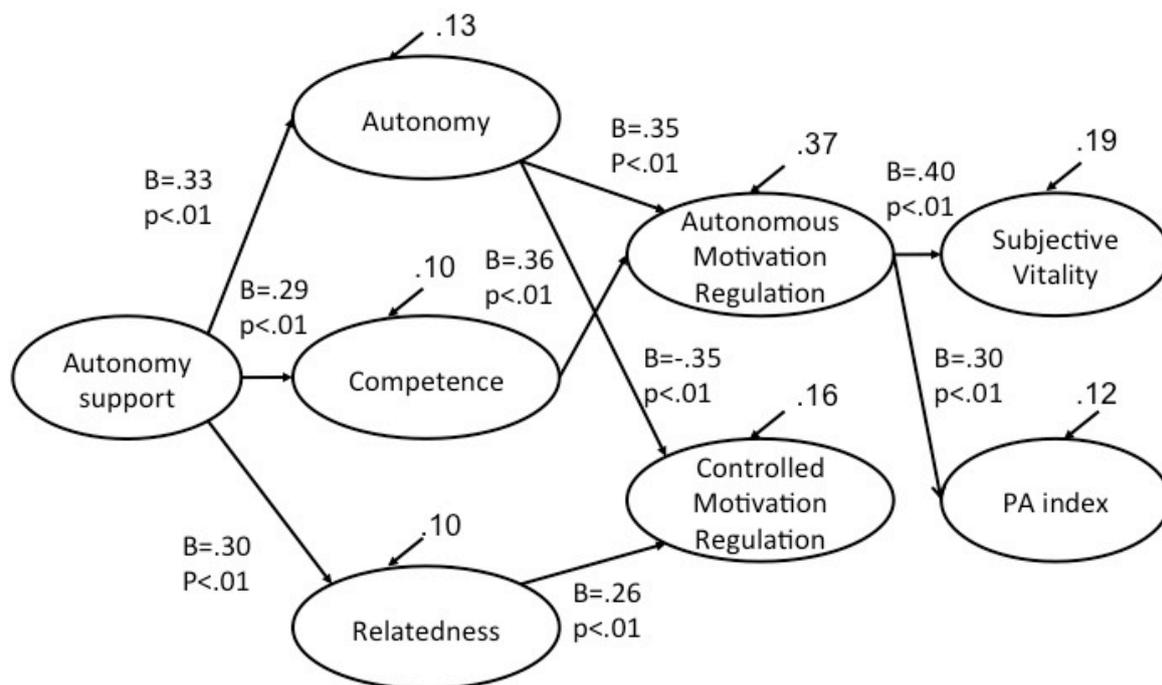


Figure 3.2 The result of structural equation modelling analysis on the proposed model. For simplicity the loading of each item is not presented here (PA index=physical activity index)

**Indirect effects.** To test the theoretically assumed indirect effects, firstly, we examined the indirect effects from autonomy support to the PA index and reported vitality which were both significant but minimal. Secondly, the assumed indirect effects of need satisfaction between autonomy support from important others and the composite motivation regulations, as well as to the targeted outcome variables were tested. The indirect effect from autonomy support to autonomous motivation regulation was significant and from autonomy support to controlled motivation regulation was not statistically significant. These results indicated that the effect of autonomy support from important other(s) to autonomous motivation regulation was mediated by need satisfaction.

Thirdly, the presumed mediational roles of autonomous and controlled regulations in terms of the relationship between need satisfaction to the outcome variables were tested.

Considering the three different needs to the two outcome variables separately, results indicated that the indirect effects from need for competence to vitality ( $\beta=.17$ ;  $p<.05$ ), and the need for autonomy to vitality ( $\beta=.19$ ;  $p<.05$ ) were significant. The need for relatedness to vitality ( $\beta=-.01$ ;  $p=.09$ ) approached significance. The indirect effects of the motivation regulations to vitality were only significant for the need for competence and the need for autonomy and these effects were low. The indirect effects of the need for competence to PA was  $\beta=.14$  ( $p<.05$ ), the need of relatedness to the PA index was  $\beta=.02$  ( $p=.09$ ) and the need for autonomy to the PA index was  $\beta=.14$  ( $p=.09$ ).

**Table 3.2 Mediation tests and indirect effects**

Independent variable (IV)	Mediators (M)	Dependent Variable (DV)	Standardized Indirect effect
Autonomy support	Basic needs and motivational regulation	Vitality	.11*
	Basic needs and motivational regulation	Physical activity index	.09*
Autonomy support	Competence	Autonomous motivation regulation	.24*
	Autonomy		
	Relatedness	Controlled motivation regulation	-.08
	Competence		
Competence	Motivation regulation	Vitality	.17*
	Motivation regulation	Physical activity index	.14*
Autonomy	Motivation regulation	Vitality	.19*
	Motivation regulation	Physical activity index	.14*
Relatedness	Motivation regulation	Vitality	-.01
	Motivation regulation	Physical activity index	.02

\*p&lt;.05

## Discussion

Extending past research, the present study examined a hypothesized motivation sequence which assumed differential relationships from autonomy support to the basic needs, to autonomous and controlled motivation regulation and then to the two targeted outcome variables (reported PA and subjective vitality, as a key marker of well being), in the case of RA patients. In the present study and aligned with previous research (Moustaka et al., 2012), autonomy support provided from a significant other was positively linked to patients' need satisfaction. When RA patients perceived that their significant other provides them with choice, considers their perspective, and encourages input into and decision making in terms of their PA pursuits, they indicated feeling more competent within the PA domain, more close to the people pertinent to their PA participation, and also witnessed a greater sense of autonomy when participating in PA.

Our results revealed differential relationships between the three psychological needs and the RA patients' motivation regulations for PA. Firstly, the observed significant paths from autonomy need satisfaction to both autonomous motivation regulation and controlled motivation regulation were consonant with our hypotheses. These findings suggest that where the need for autonomy had been fulfilled, RA patients are more prone to feel that they engage in PA volitionally. On the contrary, for the RA patients who reported low autonomy need satisfaction, they were more likely to indicate that they are engaging in PA because of more controlling reasons (e.g., free coupon for gym visits; complying with someone who expects them to be more active).

The predicted and observed positive link between competence need satisfaction and autonomous motivation regulation is consonant with past work in exercise (Puente & Anshel, 2010) and physical education (Ntoumanis, 2001) contexts. It is interesting to

note though that in previous research, competence need satisfaction tends to be the strongest predictor of autonomous reasons for engagement. However, in our study, the paths between autonomy and competence need satisfaction to autonomous motivation were more or less equivalent. This is perhaps because the RA patients were not likely to be in an achievement-focused context when engaged in PA and thus, were less likely to centre on demonstrating high levels of ability.

Contrary to our hypotheses, the need for relatedness positively predicted controlled motivation regulation and did not significantly relate to autonomous motivation regulation. These findings may be due to RA patients participating in PA because they did not want to disappoint or 'let down' their important other(s) by not engaging in a behaviour that is beneficial to their overall functioning and disease management. That is, the heightened feelings of relatedness with significant others related to their PA may have led to an exacerbation of more controlled reasons for PA participation in this clinical population; i.e., they felt more like they *have* to be physically active for the people they are close to within the PA setting, because of the overall and disease-specific benefits of regular PA for people with RA. Further research is required to substantiate such speculations. More in-depth information garnered via qualitative methodologies will help us to further understand the nature of RA patients' social interaction and exchanges with fellow exercisers or others (e.g. fitness instructors, their families, friends) pertinent to their reasons for PA engagement (Wilcox et al., 2006) and their motivational implications.

The hypothesized relationships between autonomous motivation regulation and the targeted outcomes were significant and consistent with previous research conducted within the exercise setting (Standage et al., 2012). Results indicated that when the

reasons for RA patients participating in PA were more autonomous or self-determined, it was more likely that they reported greater psychological well-being and higher levels of PA participation. With respect to the observed non-significant relationship between controlled motivation regulation and subjective vitality, it has been suggested that controlled motivation may be less relevant to indicators of positive functioning (Teixeira et al., 2012). In future studies, the potential implications of controlled motivation regulation for negative health related outcomes in RA patients should be considered; e.g., negative affect, depression or persistence (Gonzalez-Cutre & Sicilia, 2011; Pelletier, Fortier, Vallerand, & Briere, 2001). This might be a particularly important line of work with the targeted patient group as RA patients have been found to have higher prevalence of depression than the general population (Evers et al., 1997).

The expected indirect effects of need for autonomy and need for competence, in terms of the relationship between autonomy support from important others and autonomous motivation regulation, were both significant but the indirect effects were quite low. This suggests that there are other variables which may serve as mediators in the relationship in question. For example, according to the expectancy value model (Wigfield & Eccles, 2000), individuals' beliefs regarding their ability and achievement values will be influenced by the larger social context, including partners, children and/or whoever the individual considers as an important person in that particular situation.

Regarding the hypothesised indirect effects of motivation regulations, the relationship between the need for competence and the need for autonomy to subjective vitality were significantly mediated by autonomous motivation, as well as the associations between the need for competence and the need for autonomy to the PA index. These findings extend results from previous work in the sport setting (Reinboth,

Duda, & Ntoumanis, 2004) which have indicated that the effect of need satisfaction would be mediated by motivational regulations instead of having a direct effect on the outcome variables, i.e., subjective well-being and PA engagement.

As the current study adopted a cross-sectional design, it is important that the observed significant relationships between autonomy support, basic needs, motivation regulations and the targeted outcomes are not considered to be causal. Longitudinal work is warranted and, in particular, experimental studies which allow a test of the effects of different levels of autonomy support on PA engagement and associated well-being indicators in people living with RA. The measurement of PA in the present study entailed the use of a valid (e.g., the questionnaire had been successfully used in studies involving other clinical populations such as spinal cord injured patients (Keegan, Chan, Ditchman, & Chiu, 2012) and stroke patients (Cavalcanti, Campos, & Araujo, 2012) albeit self-report questionnaire. In future research, objective measures of PA (such as pedometers or accelerometers) could also be employed to complement the assessment of subjective levels of PA.

In conclusion, our findings indicate that the autonomy support provided by important other(s) in terms of PA engagement can fulfil RA patients' basic psychological needs. Satisfaction of these basic needs may enhance autonomous motivation, and contribute to higher levels of PA and subjective vitality in this patient group. The present results provide valuable insight into how we can foster greater health and functioning in RA patients, as past work has indicated that regular PA results in both psychological and physiological benefits for RA patients (Metsios et al., 2007) and has pointed to the health related costs of insufficient levels of PA in this patient group (Hootman et al., 2003; Metsios et al., 2007).

## **CHAPTER 4**

### **SUBJECTIVE AND OBJECTIVE MEASURED PHYSICAL ACTIVITY AND THEIR ASSOCIATION WITH CARDIO-RESPIRATORY FITNESS IN RHEUMATOID ARTHRITIS PATIENTS**

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## Abstract

**Introduction.** The aims of the present study were: (a) to examine the agreement between subjective (assessed via the International Physical Activity Questionnaire; IPAQ) and objective (accelerometry; GT3X) physical activity (PA) levels in patients with rheumatoid arthritis (RA), and (b) to evaluate the associations of RA patients' subjective and objective PA to their scores on the maximal oxygen uptake test ( $VO_2\text{max}$ ).

**Methods.** The participants wore the GT3X for seven days before completing the IPAQ and  $VO_2\text{max}$  test. The Bland-Altman plot was used to illustrate the agreement between the objective and subjective PA data, and the Wilcoxon test was employed to examine the differences. The association between the PA measurement and  $VO_2\text{max}$  test was examined via the correlations and the magnitude was presented by the Steiger's Z value.

**Results.** 68 RA patients (age= $55\pm 13$  years, body mass index:  $27.8\pm 5.4$   $\text{kg}/\text{m}^2$ , median of disease duration= 5 (2-8) yrs) were recruited. Smaller differences between the subjective and objective measures were found when PA was assessed at the moderate level. Wilcoxon tests revealed that patients reported less time spent engaged in sedentary behaviours ( $Z = -6.80$ ,  $p < 0.01$ ) and light PA ( $Z=-6.89$ ,  $p<0.01$ ) and more moderate PA ( $Z=-6.26$ ,  $p< 0.01$ ) than was objectively indicated. Significant positive correlations were revealed between  $VO_2\text{max}$  with all PA levels derived from accelerometry (light PA  $\rho=.35$ ,  $p<.01$ ; moderate PA  $\rho=.34$ ,  $p=.01$ ; moderate and vigorous PA, (MVPA)  $\rho=.33$ ,  $p=.01$ ), and a negative association to sedentary time (ST) emerged ( $\rho=-.27$ ,  $p=.04$ ). IPAQ-reported moderate PA and MVPA positively correlated with  $\text{maxV}02$  ( $\rho=.25$ ,  $p=.01$ ,  $\rho=.27$ ,  $p=.01$ , respectively). Differences

between the magnitude of correlations between the IPAQ- VO<sub>2</sub> max and GT3X- VO<sub>2</sub> max were only significant for ST ( $Z=3.43$ ,  $p<.01$ ).

**Conclusion.** Via responses to the IPAQ, RA patients reported they were less sedentary and engaged in more higher intensity PA than what was objectively assessed. Accelerometry data correlated with VO<sub>2</sub>max at all PA levels. Only subjective moderate and MPVA correlated with VO<sub>2</sub>max. Findings suggest that self-reported PA and ST should be interpreted with caution in people with RA and complemented with accelerometry when possible.

## **Introduction**

Rheumatoid arthritis (RA), the most common inflammatory musculoskeletal disease, is characterized by joint swelling, pain and bone destruction but also a greater risk of cardiovascular disease (CVD) (Crowson, Liao, et al., 2013; Kitas & Gabriel, 2010). The latter has been partly attributed to an increased prevalence of classical CVD risk factors (Desseing & Joffe, 2006; Gonzalez-Gay et al., 2008; Panoulas et al., 2008) and the effects of high-grade inflammation on the vasculature (Metsios et al., 2013; Sandoo, Veldhuijzen van Zanten, Metsios, Carroll, & Kitas, 2011). Another important factor that may lead to an increased CVD risk in RA is low levels of physical activity (PA) (Metsios et al., 2009; Metsios et al., 2010). RA patients can and should engage in PA, as exercise may slow down disease progression and improve physical ability (de Jong et al., 2004). Nevertheless, it is repeatedly shown that PA levels are significantly lower in RA compared to the general population (J. Lee et al., 2012; Metsios et al., 2007; Prioreshi et al., 2013; Tierney et al., 2012). It seems, therefore, important that accurate methods should be available to both evaluate and monitor PA levels in RA patients.

There are two ways of measuring PA, namely subjective and the objective methods, which are distinguished on how the data are collected. To date, subjective PA is predominantly measured via self-reported means, given that this method is easy to administer, low cost, and more efficient at gathering data from larger samples (Craig et al., 2003). However, self-reported PA is subject to different types of bias (Eurenius et al., 2005) due to lack of understanding and/or differential perceptions of item content when employed in different populations. Due to increased physical disability there may be a risk of RA patients to over-report their PA. Further, it is not clear how self-reported PA corresponds to indicators of physical function in RA patients. On the other

hand, accelerometry is one of the most frequent ways of measuring objective PA, as the device is light to carry and non-invasive (Semanik et al., 2010). Although the accelerometer is not the most accurate assessment of objective PA assessment, data obtained from accelerometry is generated in real time and have been validated (Hendelman et al., 2000) in both field and lab settings (Ried-Larsen et al., 2012). Increased PA is a behaviour that results in physiological adaptations that, in turn, may prevent or improve disease-related factors and CVD risk in RA patients (Metsios et al., 2007; Stavropoulos-Kalinoglou et al., 2012). This beneficial association is strongly supported by a robust inverse relationship of CVD morbidity and mortality with cardiorespiratory fitness, assessed via the “gold standard” method, namely, the maximal oxygen uptake ( $VO_2\text{max}$ ) test (Myers et al., 2002; Sui et al., 2007). Therefore the aims of the present study were to a) examine the agreement between subjective (questionnaire) and objective (accelerometry) levels of PA in RA patients, and b) investigate the associations of these two assessments against  $VO_2\text{max}$ .

## **Methods**

***Participants and procedure.*** Sixty eight RA patients (age= $55\pm 13$  years, body mass index:  $27.8\pm 5.4$   $\text{kg}/\text{m}^2$ , median of disease duration= 5(2-8) yrs) participated in this study. The current medication of all studied participants appears in Table 3.1. The data presented herein are part of a randomised controlled trial study with 100 participants (register number: ISRCTN04121489); in this study we present the baseline data from the participants that provided complete data for objective, subjective PA as well as  $VO_2\text{max}$  data (68 out of 100). All patients fulfilled the revised American College of Rheumatology classification criteria for RA (Arnett et al., 1988) and were recruited

from Russells Hall Hospital (Dudley Group NHS Foundation Trust, UK). The study protocol and the main trial were approved by Birmingham East, North and Solihull Research Ethics Committee. All participants provided informed consent after verbal and written information was presented to them about all procedures involved in the project. Each participant visited the laboratory (Clinical Research Unit) on two separate occasions, seven days apart. During the first visit, participants were provided with a questionnaire pack, including the Health Assessment Questionnaire (HAQ) (Kirwan & Reeback, 1986) to complete at a time convenient for themselves. During the same visit, an accelerometer (GT3X, Actigraph, Pensacola, FL) was provided to the participants to be worn over the subsequent seven consecutive days in order to assess objective PA. In addition, clinical disease activity and physical function were assessed as described below. During the second visit, participants returned the accelerometer and questionnaire pack and completed an assisted long form of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003), in order to evaluate their subjective PA levels. This was then followed by the assessment of cardiorespiratory fitness, with a maximal oxygen uptake test ( $VO_2\text{max}$ ).

***Demographic and anthropometric characteristics.*** Height was measured with a Seca Stadiometer 208 while body mass index and body composition were evaluated via bioelectrical impedance (Tanita BC418-MA, Tokyo, Japan).

***Subjective (self-reported) physical activity.*** Subjective PA was assessed using the long form of the IPAQ (Craig et al., 2003) which has previously been used in the case of RA patients (Ried-Larsen et al., 2012). The IPAQ measures the level of PA across four domains; i.e., leisure time PA, domestic and gardening activities, work-related PA, and

transport-related PA. In each domain, the duration (in minutes) and frequency (days) of PA including sitting, walking, moderate and vigorous PA are self-reported.

**Objective physical activity.** Daily objective PA and sedentary time (ST) were measured using the Actigraph accelerometer (GT3X, Pensacola, FL country). Accelerometry is widely used for assessing individual levels of daily activity/time spent sedentary across different age groups ranging from children (Kwon & Janz, 2012) to elderly people (Hutto et al., 2013), as well as in the case of the general population from different countries (Colley et al., 2011; Troiano et al., 2007). The validity and reliability (Santos-Lozano et al., 2013) of the GT3X has been examined against a previous accelerometer model (Sasaki, John, & Freedson, 2011) and across different testing situations including comparisons between mechanical and real life settings (Ried-Larsen et al., 2012).

Movements recorded by the GT3X are converted into 'counts' within each epoch. These counts are calculated in relation to time spent at different activity intensities according to different cut-off points (Troiano et al., 2007). Daily averages were calculated for different activity levels including ST, light, moderate, vigorous and moderate-to-vigorous physical activity (MVPA). The cut-off points applied in the present study stemmed from Troiano and his colleagues' (2007) research involving more than six thousand participants (Sedentary 0-99 counts per minutes (CPM), Light 100-2019 CPM, moderate 2020-5998 CPM and vigorous 5999 CPM and above, MVPA 2020 CPM and above). In the present study, the accelerometers were initialized in 60 second epochs replicating previous research protocols involving RA patients (Semanik et al., 2010). Data were screened and to be included in the analyses, the participant had to have valid data for a minimum of 10 hours per day (Prioreshi et al., 2013) and for at least 4 days (Troost et al., 2005).

Participants in the current study were advised to wear the accelerometer on their waist at all times during a 7-day period, including their sleeping time if they did not find this uncomfortable. It was recommended to the participants that they should only take the device off during showering, bathing or engaging in any other water activities. If the participants engaged in any other water activity which was not possible to record on the accelerometer, they were requested to report the activity type, intensity and duration when they returned the device to the researchers. However, this was not the case for any of the current study participants.

**Assessment of cardiorespiratory fitness (VO<sub>2</sub>max).** The VO<sub>2</sub>max test was performed using a breath-by-breath system (Metalyzer 3B, Leipzig, Germany) on a HP Cosmos mechanical treadmill (Nussdorf-Traunstein, Germany). After identifying a convenient speed for each individual patient (which was normally 2mph), the speed increased by 0.5mph every minute until it reached 4mph while inclination remain constant at 1%. Thereafter, there were only increases in inclination by 1% every 30sec until volitional exhaustion.

**Data analysis.** Normal distribution of the variables was assessed via the Kolmogorov-Smirnov normality test. To test our first hypothesis, Bland-Altman plots (Bland & Altman, 1986) were used to evaluate the agreement between the different methods of assessing PA (i.e., subjective vs. objective). Furthermore, given the non-normal distribution of both the subjective (IPAQ) and objective (GT3X) PA data, the Wilcoxon signed-rank test was used to test differences between these two methods for ST, light, moderate and MVPA levels.

To test our second hypothesis, correlations between VO<sub>2</sub>max with subjective and objective PA at different levels were examined via Spearman correlations. Furthermore,

Steiger's Z test (Steiger, 1980) was used for analysing the differences between the correlations of subjective PA vs. VO<sub>2</sub>max, and objective PA vs. VO<sub>2</sub>max at ST, light, moderate, vigorous and MVPA levels. All statistical analyses were conducted using SPSS version 21 for windows package (SPSS, Chicago, IL) with the level of significance set at p<.05.

## **Results**

Patient characteristics are reported in Table 4.1.

<b>Table 4.1 Demographic characteristics and medication of RA patients</b>	
Age, mean $\pm$ SD years	55 $\pm$ 13
Women	42 (62)
Height, mean $\pm$ SD	168.2 $\pm$ 9.3
BMI, mean $\pm$ SD	27.8 $\pm$ 5.4
Disease duration, mean $\pm$ SD years	7.2 $\pm$ 8.7
Medication No (%)	
Methotrexate	50 (74)
Other DMARDs	35 (52)
Anti-TNF Therapy	8 (12)
Other Biologics	2 (3)
Prednisolone	11 (16)
NSAIDs	24 (35)
Analgesics	25 (37)
Cholesterol-reducing	18 (27)
Anti-Hypertensives	16 (24)
BMI = body mass index DMARDs= disease-modifying anti-rheumatic drugs, NSAIDs = non-steroidal anti-inflammatory drugs	

***Research Hypothesis 1: Agreement between objective and subjective PA***

***The Bland-Altman Plots***

Separate Bland-Altman plots were produced for ST, light PA, and moderate PA (Figure 4.1). Results indicated that the degree of agreement between the different methods of assessment vary depending on the level of PA targeted. Smaller differences between the subjective and objective measures emerged when PA was assessed at the moderate level.

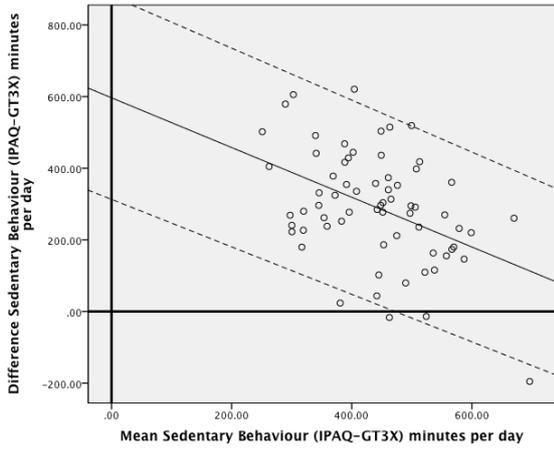


Figure 4.1-1 Sedentary level PA

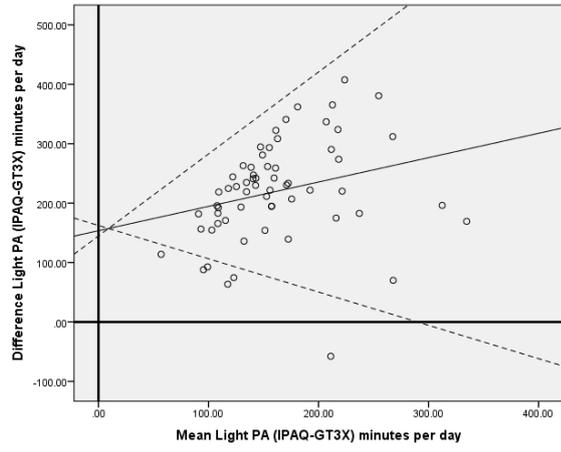


Figure 4.1-2 Light level PA

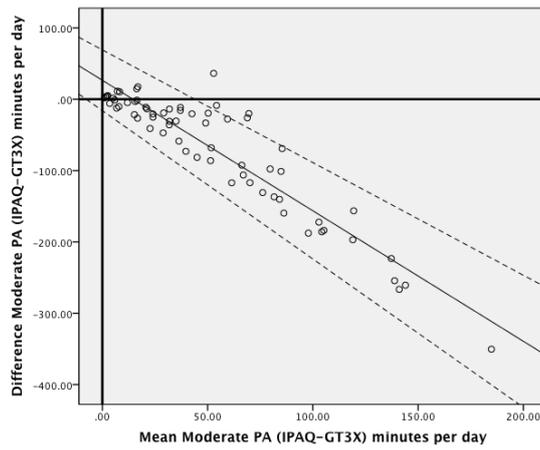


Figure 4.1-3 Moderate level PA

Figure 4.1 Bland-Altman plots for minutes per day reported for different level of PA from the GT3X and IPAQ

Figures 4.1-1 and 4.1-2 demonstrated that the mean differences between subjective and objective data for sedentary behaviour time and light PA were spread evenly in the graph. Assessment of the Bland-Altman plots for moderate PA in Figure 4.1-3, however, revealed that at higher levels of PA, the difference between subjective and objective PA becomes greater. In these cases, the subjectively-reported levels were greater than what was revealed via objective GT3X data. Due to the limited observations from the GT3X at the vigorous level, it was not possible to ascertain the pattern of differences between the two measurements from the Bland-Altman plots for this level of activity.

***Differences between subjective (IPAQ) and objective (GT3X) PA.***

The results of the Wilcoxon tests between subjective and objective PA data at different PA levels and the interquartile range are shown in Table 4.2. Self-reported sitting [median (interquartile range)=337(225-451) min] was significantly less than objectively measured ST [median=596(510-651) min;  $Z = -6.80, p < 0.01$ ]. In addition, self-reported light PA [median=30(11-66) min] was also significantly less compared to objective light PA time [median=267(221-321) min;  $Z=-6.89, p<0.01$ ]. In contrast, participants self-reported significantly more moderate PA behaviour on IPAQ [median=55(19-129) min] than was recorded on GT3X [median=14(5-25) min;  $Z=-6.26, p< 0.01$ ), and more vigorous PA [median =0(0-0) min]\* compared to GT3X [median =0(0-0) min,  $Z=-2.83, p=0.01$ ]. Subjective participation in MVPA [median =59(22-148) min] was also significantly elevated compared to MVPA objectively measured via GT3X [median=14(6-26) min;  $Z=-6.28, p<0.01$ ].

\* The data show very low values for vigorous PA, which are so small the rounding process means the data is reported as zero.

**Table 4.2 Comparisons between IPAQ and accelerometry data at different physical activity levels and median, interquartile information.**

	Accelerometry	IPAQ (range 0-1440)	Z
Sedentary time (minutes per day)	569 (124 – 765)	337 (82-592)	-6.80*
Light PA (minutes per day)	267 (144-390)	30 (0-87)	-6.89*
Moderate PA (minutes per day)	14 (0-34)	55 (0-158)	-6.26*
MVPA (minutes per day)	14 (0-34)	59 (0-181)	-6.28*

PA = physical activity, MVPA = moderate to vigorous physical activity  
 Data reported as Median ± interquartile range  
 \* $p < .05$

***Research Hypothesis 2: Associations between subjective (IPAQ) and objective (GT3X)***

***PA with VO<sub>2</sub>max***

The average VO<sub>2</sub>max was 20.17±4.60 ml/min/kg, which is indicative of poor fitness levels (Metsios et al., 2007). Overall, weak associations emerged between VO<sub>2</sub>max and subjectively reported ST levels, while the correlations between VO<sub>2</sub>max and objective PA levels were stronger (Table 4.3). VO<sub>2</sub>max correlated significantly only with subjective moderate PA (rho=.25, p=.01) and MVPA (rho=.27, p=.01) levels. On the other hand, VO<sub>2</sub>max correlated significantly with all objective GT3X PA measurements (light PA rho=.35, p <.01; moderate PA rho =.34, p=.01; MVPA rho=.33, p=.01), whereas objective ST was negatively associated with VO<sub>2</sub>max fitness (rho=-.27, p=.04).

**Table 4.3 The mean, standard deviation, interquartile range for and Spearman's correlations between the study variables**

Variables	M	SD	IQR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)GT3X sedentary (minutes per day)	583	98	142	-									
(2)GT3X light PA (minutes per day)	275	79	123	-.78**	-								
(3) GT3X moderate PA (minutes per day)	19	17	20	-.44**	.37**	-							
(4) GT3X MVPA (minutes per day)	19	17	20	-.44**	.37**	1**	-						
(5)Step counts	5378	2708	3716	-.64**	.59**	.78**	.78**	-					
(6)IPAQ sitting (minutes per day)	290	159	255	.32*	-.37*	-.15	-.15	-.33**	-				
(7) IPAQ walking (minutes per day)	616	653	57	-.18	.19	.30*	.29*	.21	-.24*	-			
(8) IPAQ moderate PA (minutes per day)	85	275	103	-.22	.25*	.28*	.27*	.28*	-.25*	.42**	-		
(9) IPAQ vigorous PA (minutes per day)	701	785	0	-.09	.08	.01	.01	.08	-.00	.16	.34**	-	
(10) IPAQ MVPA (minutes per day)	510	731	122	-.24	.27*	.28*	.27*	.29*	-.24*	.43**	.98**	.45**	-
(11) VO <sub>2</sub> max (ml/min/kg)	20.17	4.60	7.17	-.27*	.35**	.34**	.33*	.48**	-.02	.11	.25*	.19	.27**

PA = physical activity, MVPA = moderate to vigorous physical activity ,\*p<.05, \*\*p<.01

The tests of the magnitude of the differences between correlations were examined according to the results of the Steiger's Z value. Results indicated that only the differences between the correlations for ST ( $Z=3.43$ ,  $p < .001$ ) were significant, whereas at all other levels of PA, no significant differences emerged; i.e. light PA ( $Z=-1.03$ ,  $p=0.31$ ), moderate PA ( $Z=-.04$ ,  $p=.67$ ), vigorous PA ( $Z=-1.10$ ,  $p=0.27$ ) and MVPA ( $Z=-0.43$ ,  $p=.67$ ).

## **Discussion**

The present study examined in RA patients: a) the agreement between subjective/self-reported (IPAQ) and objective (GT3X) PA, and b) the associations between both of these assessments with  $VO_2\text{max}$ , the gold standard assessment of cardiorespiratory fitness. Our results show that, when compared to accelerometry-derived values, RA patients under-reported ST while in contrast, they over-reported moderate PA, vigorous PA and MVPA when these behaviours are assessed using a self-report questionnaire. In addition, we found  $VO_2\text{max}$  to associate more with objective in contrast to subjective PA.

Based on the data obtained from the GT3X, the present findings indicated that this sample of RA patients had both lower PA compared to relevant guidelines of 150 minutes of moderate intensity PA or 75 minutes of vigorous PA per week (or an equivalent mix of both) (Haskell et al., 2007). Our results echo past work (Sokka et al., 2008) that assessed PA (via the QUEST-RA) in people with RA conducted from different countries, which revealed only a minority of RA patients (13.8%) exercise more than three times a week. Other research has revealed that even if RA patients are aware of the guidelines for PA (Law, Markland, Jones, Maddison, & Thom, 2013), they

generally do not reach recommended levels of PA. As such, identifying barriers and facilitators of PA amongst RA patients is certainly an area warranting future research.

Examination of the agreement between both subjective and objective PA measurements indicated that the two measurements varied in their degree of discrepancy at the different PA levels. The Bland-Altman plots for sedentary and light PA levels revealed lower agreement between these two measurements when RA patients were less active. Similar patterns have been identified in past work in the general population (Hagstromer, Ainsworth, Oja, & Sjostrom, 2010) however the lack of agreement was even larger in the current study as well as when compared to research on another patient group, i.e., hip osteoarthritis (OA) patients (Svege, Kolle, & Risberg, 2012). Even more pronounced than what was the case for hip OA patients, PA was over reported in our sample of RA patients when contrasted to what was observed via objective PA measurement. The accelerometry-derived data in the current study were found to have higher agreement with the gold standard ( $VO_2\text{max}$ ) compared to previous research on RA patients involving objective assessments of PA (Backhouse et al., 2013). In the study by Backhouse and colleagues (2013), however, objective PA was assessed during the completion of a walking task. Participants in the current study were requested to wear the accelerometer over a 7-day period and, thus, were likely to be engaging in a variety of activities including sedentary behaviours.

In regards to comparing self-reported levels of PA with the gold standard measure of fitness ( $VO_2\text{max}$ ), only moderate PA and MVPA were significantly correlated with  $VO_2\text{max}$ . In contrast, all objectively assessed PA levels as well as time spent sedentary were significantly associated with cardiorespiratory fitness in the expected directions. These results suggest that increased engagement in objectively

assessed MVPA may lead to increased cardiorespiratory fitness in the RA population. Increased cardiorespiratory fitness is important to enhanced cardiovascular health in RA patients (Metsios et al., 2013; Stavropoulos-Kalinoglou et al., 2012), as has also been shown in research on coronary artery disease patients (Ekelund et al., 2002).

Despite the implications of our findings, it is equally important to acknowledge some of the limitations of the current study. The sample size was not calculated using standardized techniques and was limited to a certain geographical area within the UK. Also, previous research (Slootmaker, Schuit, Chinapaw, Seidell, & van Mechelen, 2009) has indicated that the over-reporting of PA is usually found in certain groups such as overweight people, which was indeed the case for our participants (BMI of >28). However, it is important to point out that overweight or obese states are highly prevalent in the RA population (Crowson, Matteson, Davis, & Gabriel, 2013; Stavropoulos-Kalinoglou et al., 2010; Summers, Metsios, Stavropoulos-Kalinoglou, & Kitas, 2010).

## **Conclusion**

Overall, our findings suggest that the observed associations highlighted a discrepancy between RA patients' perceptions of their participation in PA and ST (as determined via responses to the IPAQ) and what was the case objectively. Patients with RA self-reported significantly less engagement in sedentary pursuits and significantly more moderate and vigorous PA than what were indicated via accelerometer assessments. Moreover, the associations between IPAQ-assessed sitting time and PA levels and the gold standard assessment of PA indicated that only self reported moderate and MPVA were correlated with VO<sub>2</sub>max in the expected manner. The present findings suggest that

results from existing studies of RA patients' PA and sedentary behaviour patterns that are based solely on subjective measures of PA and sedentary behaviour (such as the IPAQ) should be interpreted with caution.

## CHAPTER 5

# **RELATIONSHIP OF SELF DETERMINATION MOTIVATION TOWARDS PHYSICAL ACTIVITY, TIME SPENT SEDENTARY AND DEPRESSIVE SYMPTOMS IN RHEUMATOID ARTHRITIS PATIENTS**

This manuscript is ‘under review’ in the the *British Journal of Health Psychology*.

## **Abstract**

### **Introduction**

Rheumatoid arthritis patients has been associated with a heightened risk of cardiovascular disease (Metsios et al., 2009) but also indicators of compromised mental health such as high anxiety and depression (Treharne et al., 2005). Participation in moderate-to-vigorous physical activity (MVPA) has been found to accrue health benefits in this clinical population, and research evidence suggest that less time spent sedentary (ST) may also help RA patients enhance their well being. People with RA, however, tend to not engage in sufficient levels of PA. Thus, it is important to better understand the motivational determinants of PA in this clinical population. Pulling from Self-Determination Theory (SDT), this study examined the associations between self determination toward exercise, objectively measured PA and ST, and depressive symptoms in RA patients.

### **Method**

Valid data were obtained from 55 out of 115 patients with RA (age=55±13, 37 females) from the baseline assessment of a RCT. The accelerometer data were downloaded, reduced and analysed by the Activlife 6.0 software. Descriptive and path analyses were on variables derived from both questionnaire and objectively measured physical activity (PA) and sedentary time (ST). The Relative Autonomy Index (RAI) was employed as the indicator of the RA patients degree of self determination regarding their exercise behaviour.

### **Results**

The results revealed RA patients to spend more time in sedentary ( $499.11 \pm 68.71$ , minutes per day) than the general population and do not meet the recommended level of MVPA ( $17.24 \pm 15.80$ ) during the 7 day assessment protocol. RAI positively correlated with moderate PA ( $r=.30$ ,  $p<.05$ ) and MVPA ( $r=.30$ ,  $p<.05$ ), and negatively correlated with depression ( $r=-.38$ ,  $p<.01$ ). Path analysis indicated that an amended model demonstrated acceptable fit to the data.

## **Discussion**

RA patients spend more time sedentary and engage in less MVPA than recommended which echoes previous research findings (Yu et al., 2015). Findings revealed more self determination to be positively related to daily MVPA and negatively linked to depression among patients with RA. The unexpected associations between ST and depression symptoms may need to be examined further in the future. Limitations of this study in terms of sampling and the use of a cross-sectional design are addressed.

## **Introduction**

Rheumatoid arthritis (RA) is a systemic inflammatory disease associated with joint swelling, muscle stiffness and fatigue (D. M. Lee & Weinblatt, 2001) affecting 1.16% of women and 0.44% in men around the UK (Symmons et al., 2002). Research has indicated RA is associated with increased risk of mortality and morbidity resulting from heightened incidence of cardiovascular disease (CVD)(Crowson, Liao, et al., 2013; Kitas & Erb, 2003; Metsios et al., 2009; Metsios et al., 2007; Solomon, 2003), and hypertension (Panoulas et al., 2008).

The presence of RA also holds implications for psychological health. For example, RA has been positively linked to the occurrence of anxiety and depression (Treharne et al., 2005), with studies indicating patients with RA are twice as likely to suffer from depression than the general population (Dickens & Creed, 2001). Research involving a sample of over 10,000 RA patients revealed the 13% (roughly 3.5 times higher than general population) of patients with RA present with the comorbidities of CVD and/or depression (Joyce, Smith, Khandker, Melin, & Singh, 2009). Follow up annual health costs were significantly higher for these patients when compared to patients with RA alone. Depression is also associated with higher levels of pain (Dunstan et al., 2012), and increased functional disability in people living with RA (Dickens & Creed, 2001). Therefore, it is important to consider depression as a significant health outcome in this patient group.

Research conducted in healthy adults indicates that regular physical activity (PA) has both physical and psychological benefits (Nelson et al., 2007). More recently, evidence for the positive effects of PA have also been accrued in the case of RA patients

(Cooney et al., 2011; Metsios et al., 2013; Metsios et al., 2007; Stavropoulos-Kalinoglou et al., 2012). However, whilst people living with RA are aware of the benefits of physical activity engagement, most of them lead a largely sedentary lifestyle (Tierney et al., 2012; Yu et al., 2015). According to the guidelines for PA from the American College of Sports Medicine (Haskell et al., 2007), adults should accumulate moderate and/or vigorous levels of PA on at least 5 days a week, for at least 30 minutes per day. These recommendations are supported by the American College of Rheumatology with respect to RA patients (Tierney et al., 2012). A recent review reported almost 50% of RA patients sampled did not meet recommended guidelines for PA (Sokka et al., 2008). In the current study, the total time spent in moderate-to-vigorous PA (MVPA) is considered to be another important outcome in people living with RA.

Currently there is no cure for RA. As such, encouraging regular participation PA may contribute towards improving both physical and psychological health in this patient group. An important type of PA that may contribute towards one's engagement in recommended levels of MVPA, and associated enhanced health and well-being, is exercise. Indeed, previous studies have demonstrated that RA patients can improve their physical fitness, reduce the risk of CVD and attenuate fatigue when undergoing structured aerobic or resistance exercise training (Neuberger et al., 1997; Stavropoulos-Kalinoglou et al., 2012). Therefore, helping people with RA adopt and maintain participation in exercise may enhance their quality of life and physical health. Accordingly, research is necessary which seeks to identify the motivation-related predictors of RA patients' exercise engagement. Particularly relevant is identifying factors related to participation in health enhancing PA (i.e., MVPA).

It is also important to look at the time spent engaged in sedentary behaviours in RA patients as high levels of sedentary time are an independent risk factor for compromised health (Biswas et al., 2015). Being sedentary has been found to be associated with compromised mental health such as the incidence of depression (Teychenne, Ball, & Salmon, 2010) as well as the occurrence of Type II diabetes (Healy, Winkler, Brakenridge, Reeves, & Eakin, 2015) and cardiovascular disease (CVD) (Wilmot et al., 2012) in the general population. Research has also found depressive symptoms to increase the mortality of elderly adults (Rezende, Rey-Lopez, Matsudo, & Luiz, 2014). In the RA population specifically, subjectively measured low level of PA was also associated with cardiovascular risk factors (Metsios et al., 2009). In addition to RA patients not tending to reach the recommended levels of health-conducive PA, studies have reported this patient group to exhibit high levels of sedentary time (ST)(Eurenius et al., 2005; Sokka et al., 2008; Yu et al., 2015). Thus, it is important to examine assess time spent sedentary and determine the motivational determinants of ST in this clinical population.

Self-determination Theory (SDT)(Deci & Ryan, 2000) is a contemporary theory of motivation which seeks to explain why people adopt and maintain their engagement in a behaviour, such as participation in exercise. Central to self-determination theory is the assertion that an individual's reasons for behavioural engagement can vary in the degree to which they are more or less self-determined. Specifically, behaviour can be guided by more autonomous and/or controlled behaviour regulations, with more self determined reasons for engagement linked to more adaptive outcomes. More self determined behaviour regulations are characterised by engagement in an activity because of intrinsic enjoyment, curiosity, eagerness to learn, or that participation allows

the realisation of personal values. Conversely controlled motivation is thought to be operating when individuals' engage in a behaviour (such as PA) due to internalised contingencies (i.e., the avoidance of shame or guilt), or external factors such as fear of punishment or external rewards.

The SDT framework has been successfully applied to the context of PA among different populations and across different health care settings (Ng et al., 2012). In a health care context, more self determined motivation was found to be positively associated with psychological well-being and self-reported PA in a sample of patients at a general practice (Fortier et al., 2007) as well as patients with schizophrenia (Vancampfort et al., 2013). Hurkmans and colleagues (2010) tested the associations between SDT-based motivational variables (and their associations with other demographic variables such as age and disease duration) and self-reported PA specifically among RA patients. Results revealed higher levels of self-determined motivation significantly predicted higher levels of self-reported PA (Hurkmans et al., 2010). Work by Yu and colleagues (In press) also supported a positive association with more autonomous reasons for PA engagement and subjective PA.

It is important to note that all of these previous studies examining the relationship between self determined motivation and participation in PA relied on self-reported assessments of PA and ST. Research with RA patients has demonstrated that there is low congruence between subjective and objective assessment of PA (Semanik et al., 2010; Yu et al., 2015). For example, Yu et al. (2015), revealed RA patients to over-report their levels of participation in light and moderate PA, and under-report their ST engagement. As such, when examining motivation-related predictors of PA and ST in this patient group, there is a need to apply objective tools to more accurately assess

levels of PA engagement and time spent sedentary. Relative to self-report assessment tools, accelerometers have been shown to provide more valid and reliable estimates of PA across the spectrum of PA intensities (i.e., light, moderate, vigorous and MVPA)(Troiano et al., 2007). Thus, one major purpose of the present study was to examine the relationship between the degree to which RA patients are self determined in regard to their exercise behaviour and their objective levels PA (light, moderate, and MVPA). The relationship of self determination for exercise engagement to ST also was examined.

Research indicates that PA engagement is inversely related to depression (Teychenne et al., 2010). In their review, Teychenne et al., (2010) also pointed out that the available evidence suggests there is also an association between ST and risk of depression. In a study by Lee and colleagues (2012), RA patients who were more objectively physically active reported better mental health (as assessed with SF-36). A second aim of the current study was to investigate the association between objectively measured PA levels, ST and the reporting of depressive symptoms.

Deci and Ryan (2008) contend that self determination is fundamental to more optimal functioning and mental health. Among depressed patients, McBride et al (2010) showed that autonomous motivation towards interpersonal treatment was inversely related to post treatment depression. In their study, patients reporting greater self determination towards interpersonal treatment were as twice as likely to achieve remission from depressive symptoms than those who reported average level of autonomous motivation towards interpersonal treatment. To our knowledge, the relationship between self determination for exercise engagement and depression has not been examined among RA patients. A final aim of the present study was therefore to

determine the interrelationships between objective levels of PA and ST, degree of self determination regarding participation in exercise, and depression. More specifically (see Figure 1), it was hypothesised that positive associations will be observed between self determination and PA levels (i.e., light PA moderate and MVPA), with a negative association observed with ST. In turn, we predicted mediating roles for PA and ST where levels of PA would be negatively related, and ST positively related to depression.

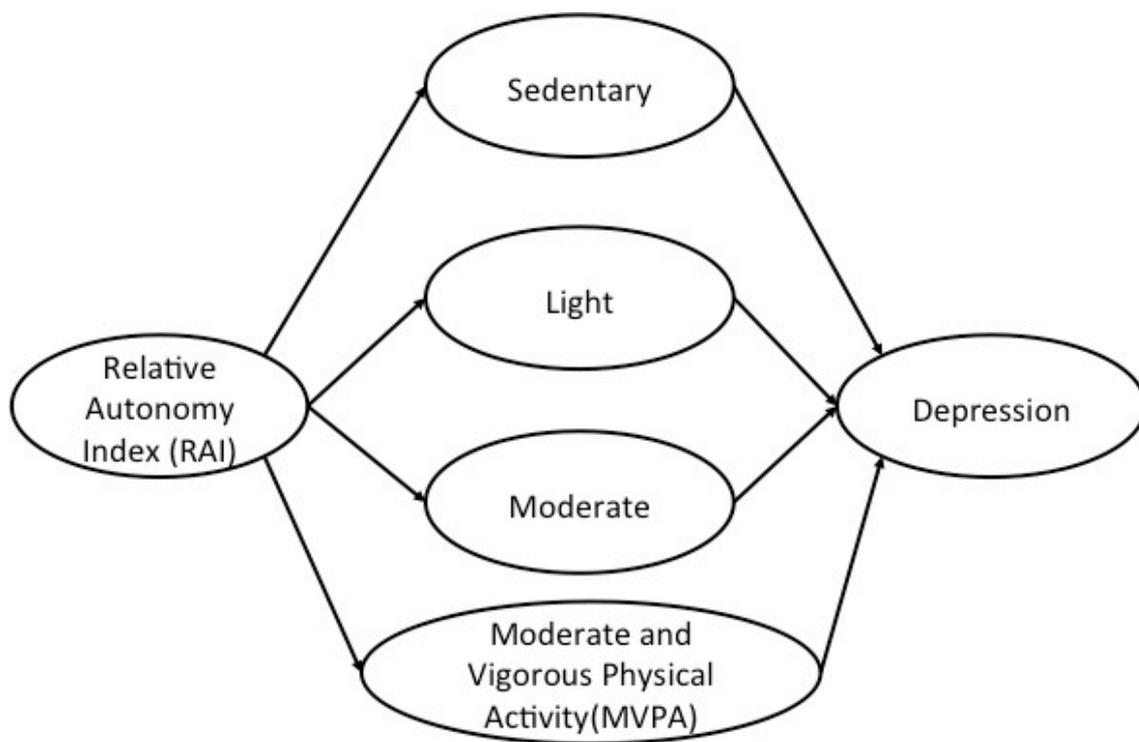


Figure 5.1 The proposed path analysis model

## Method

### *Participants and recruitment*

Participants were recruited from rheumatology clinics within the Dudley Group of Hospitals NHS Foundation Trust (West midlands, UK). The RA patients were involved in a randomised control trial (described in Rouse et al., (2014)) seeking to improve cardiovascular fitness and promote autonomous motivation and PA

engagement among patients with RA. The present study utilises objective PA and ST (accelerometry) and questionnaire data (i.e., motivation regulations for exercise and depression) collected at baseline.

Participants were recruited from the waiting room during rheumatology clinics within the Clinical Research Unit (Russell's Hall Hospital, DGH NHS), or from the hospital gym. They were provided with study information before giving their written consent to participate. A total of N = 115 participants (male=33, female=65, mean age=57) provided their consent and were recruited to the study.

### ***Protocol***

Participants attended the Clinical Research Unit (DGH, NHS) to complete two assessments, seven days apart. During the first assessment, participants were provided with an accelerometer which they were requested to wear for the following seven days. They were also asked to complete a questionnaire pack (taking approximately 30 minutes) which included questions to assess participants' motivations for their exercise participation and depressive symptoms.

### ***Measures***

**Behavioural Regulations in Exercise Questionnaire (BREQ-2).** The BREQ-2 is a 19-item questionnaire used to assess behavioural regulation in the context of exercise. Four items each were used to assess external, intrinsic, identified regulations, and amotivation, and three items were used to measure introjected regulation. Examples of items include 'I exercise because other people say I should' (external), 'I feel guilty when I don't exercise' (introjected), 'I value the benefits of exercise' (identified), 'I exercise because it's fun' (intrinsic), and 'I don't see the point in exercising'

(amotivation). Answers were rated on a 5-point Likert scale ranging from 0 (not true for me) to 4 (very true for me). The Cronbach's alpha reliability for each subscale was greater than .73 (Markland & Tobin, 2004). Mean values for each behavioural regulation were calculated and used to determine a Relative Autonomy Index (RAI) (Ingledeu, Markland, & Sheppard, 2004) for each participant. The RAI is frequently used in research across various contexts (e.g., educational contexts) (Williams & Deci, 1996) for assessing overall levels of self-determination in individuals' motivations for behavioural engagement. Weights are assigned to each subscale measured by the BREQ-2 in order to represent the degree of self-determined motivation reported with a single index, a higher index representing more autonomous motivation. Less autonomous regulations [i.e., controlled regulations (external and introjected)] are given negative weighting and more autonomous regulations (e.g., intrinsic, identified) are assigned positive weightings as follows: external regulation -2, introjected regulation -1, identified regulation +1, intrinsic regulation +2 (Ingledeu et al., 2004). The maximum RAI score when applying this formula to the BREQ-2 is 12 and the minimum is -11.

**Depression** was assessed using the 7-item subscale of the Hospital Anxiety and Depression Status (HADS) questionnaire (Zigmond & Snaith, 1983). Responses are provided on a four point scoring system. In previous research (Covic et al., 2009), results indicated that HADS-D can be used as a gold standard in the absence of clinical diagnostic interviews. Comparisons with psychiatric ratings have shown the depression subscale to possess good discriminant validity (Zigmond & Snaith, 1983). The depression subscale has also been found to be internally consistent ( $\alpha = .79$ ) and demonstrated convergent validity in the case of RA patients (Treharne et al., 2005).

**Objective physical activity.** Objective daily PA and ST were measured using the Actigraph accelerometer (GT3X, Pensacola, FL country). Accelerometers have been validated for the assessment of PA intensity and ST in the elderly (Davis et al., 2011) and patient groups (Semanik et al., 2010). Movements recorded by the GT3X are converted into ‘counts’ within pre-specified time periods called ‘epochs’. In the present study, the accelerometers were initialized in 60 second epochs replicating previous research protocols involving RA patients (Semanik et al., 2010). Counts are used to calculate time spent at different activity intensities by applying validated cut-points (Troiano et al., 2007). The cut-off points applied in the present study stemmed from research conducted by Troiano and colleagues’ (2007), involving more than six thousand participants (ST 0-99 counts per minutes (CPM), Light 100-2019 CPM, moderate 2020-5998 CPM and vigorous 5999 CPM and above, MVPA 2020 CPM and above).

#### ***Accelerometry data reduction***

The accelerometer data were downloaded and analysed by the Actilife 6.0 software. For inclusion in analysis, participants were required to have worn the accelerometer for a minimum of 10 hours per day (Semanik et al., 2010) on at least 4 days, including a weekend day due to the difference between weekday and weekend PA (Trost et al., 2005) during the 7 day protocol. The non-wear time is defined as 60 consecutive minutes of zero count, with allowance of 2 minutes spike tolerance (0-99 CPM)(Matthews et al., 2008). Participants were advised to wear the accelerometer on their waist (Semanik et al., 2010). It was recommended that they should only take the device off during showering, bathing or engaging in any other water activities. If the participants engaged in any other water activity which was not possible to record on the

accelerometer, they were requested to report the activity type, intensity and duration when they returned the device to the researchers by note. However, no participant reported engaging in any water related activity in the present study during the targeted 7 day period. Daily averages (minutes/day) were calculated for different activity levels including ST, light, moderate, vigorous and the sum of MVPA (e.g., total weekly MVPA/number of valid days = average daily MVPA (min/day)). Only 58 participants remained within the data set; 43 were removed due to not complying to the research protocol, or not agreeing to wear the device. 14 participants were removed due to not having sufficient valid wearing days. The overall compliance rate was 50%.

### ***Data analysis***

Data were analysed using SPSS (version 22). Preliminary analysis involved conducting bivariate correlations between PA and ST variables with valid wear time to determine whether variability in participant wear time was related to estimates of time spent in different PA intensities and ST. Bivariate correlations were used to examine the associations between RAI, PA variables and depression. Where preliminary analysis revealed significant correlations between light PA and valid wearing hours, the percentage of the light PA was calculated (average daily light PA/valid wearing hours per day) for the following analysis. Partial correlations adjusted for valid wear time were conducted for variables demonstrating associations with valid wear time.

Path analysis was conducted using AMOS (version 22). A non-significant Satorra-Bentler  $\chi^2$  value indicates a good fit of the data to the proposed model. Following fit indices were used to provide the evidence of the adequacy of the proposed model: Comparative Fit Index (CFI), the Non-Normed Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square

Residual (SRMR). It is recommended that the CFI and NNFI should be close to 0.95 or above to indicate a good model fit to the data (Hu & Bentler, 1998). In terms of the RMSEA and SRMR, it is recommended that the RMSEA should be close or lower than 0.06 and the SRMR should be close or below .08.

## **Results**

### ***Descriptive statistics***

Table 5.1 presents the demographic information for those participants who provided valid data (N = 58). The participants were predominantly white (86%), female (64%) and married (71%).

<b>Table 5.1 Demographic characteristics of the RA patients</b>	
Age, mean $\pm$ SD years	55 $\pm$ 13
Women (No,%)	37 (64)
White/Caucasian	50 (86)
Other	8 (14)
Marital status	
Married	41 (71)
Living with a partner	5 (9)
Single	5 (9)
Divorced/Separated	4 (7)
Widow(er)	3 (5)

<b>Table 5.2 The mean, standard deviation, partial correlations between the Relative Autonomous Index, physical activity variables and depression</b>										
Variables	M	SD	Range	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RAI	1.81	2.96	-11-12	-						
(2) ST	499.11	68.71	0-1440	-.08	-					
(3) Light	267.98	67.93	0-1440	.13	-.90**	-				
(4) Moderate	17.03	15.59	0-1440	.30*	-.43**	.32*	-			
(5) Vigorous	0.21	0.64	0-1440	.01	-.10	.07	.30*	-		
(6) MVPA	17.24	15.80	0-1440	.30*	-.43**	.32*	.99**	.34**	-	
(7)Depression	5.03	3.21	0-21	-.38**	.14	-.25	-.18	-.18	-.18	-

RAI= Relative Autonomous Index, ST=sedentary time, MVPA = moderate to vigorous physical activity \*p<.05, \*\*p<.01 Note: 1.the associations between light PA with other variables were adjusted by the valid hours per day 2. The unit of ST, Light, Moderate, Vigorous and MVPA is minutes/day

Table 5.2 reports the descriptive statistics for participants. The mean RAI was  $1.81 \pm 2.96$ , a relatively low score within the available range (i.e., range = 12 to -11). Accelerometer data indicated that on average, RA patients spent  $499 \pm 68.71$  minutes per day sedentary,  $268 \pm 67.93$  minutes engaged in light PA, and  $17 \pm 15.59$  minutes participating in moderate PA. Analyses also indicated average daily VPA to be below 1 minute per day ( $0.21 \pm 0.64$ ). Accordingly, estimates for time spent in MVPA ( $17 \pm 15.80$ ) were very similar to those reported for moderate PA. The average score for depression in the present sample was  $5.03 \pm 3.21$ . Using a validated cut-off for the HADS-D (i.e., 11), only 3 of the current sample (5%) would be considered to exhibit probable clinical depression (Zigmond & Snaith, 1983).

### ***Correlation analysis***

Preliminary analysis revealed valid wear time to be significantly positively related to light PA ( $r = .42, p < .01$ ). As such, subsequent correlations adjusted for wear time where associations with light PA were examined. Table 5.2 reports the correlations between RAI, PA variables, ST and depression. RAI was positively correlated with moderate PA ( $r = .30, p < .05$ ) and MVPA ( $r = .30, < .05$ ). RAI was not correlated with ST ( $r = -.08, p > .05$ ) or light PA ( $r = .13, p > .05$ ). Light PA, moderate PA, MVPA and ST were not significantly correlated with depression, however, the relationship between ST and depression was in the expected direction. A significant negative association was also observed between RAI and depression ( $r = -.38, p < .01$ ),

### ***Path analysis***

The hypothesised model (Figure 5.1) was tested and demonstrated a poor fit to the data ( $\chi^2 = 1917.77$ ; such high value indicated the data had a very poor fit with the model). As such, the mediating role of the PA and ST can not be tested and the

hypothesised model was revised based on the significant associations observed in the correlation analysis (Figure 5.2). Specifically, as no significant correlation was reported between ST and depression from the correlation analysis, this path was removed from the model. As the significant correlation was found between RAI and depression, we then included a direct path from RAI to reported depressive symptoms, which eliminated the test of mediation effect. Also RAI was found to be positively correlated with MVPA, we tested RAI as a positive predictor of objectively assessed MVPA, and negative predictor of ST in the amended model.

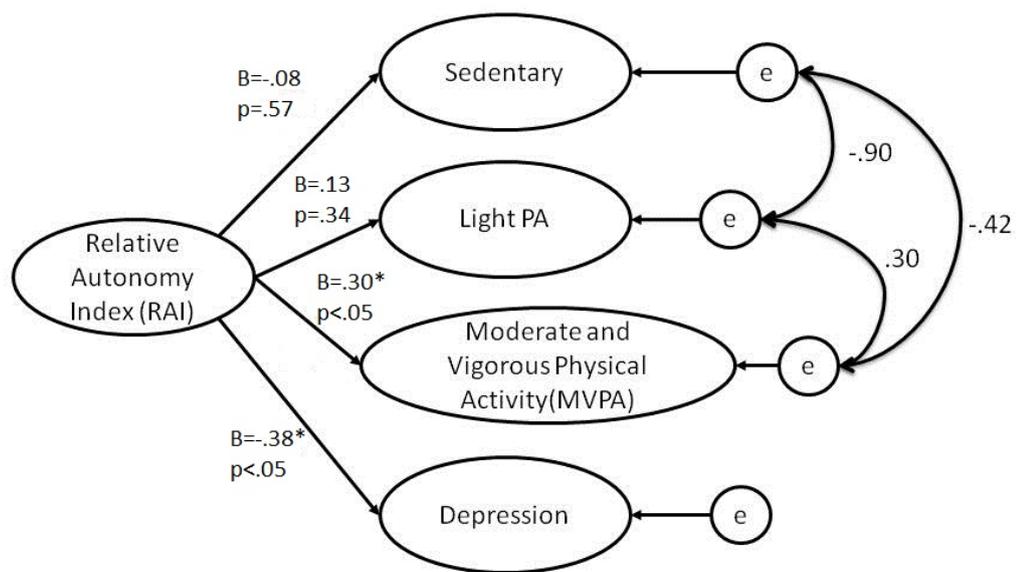


Figure 5.2 The amended path analysis model

The revised model demonstrated an acceptable fit to the data ( $\chi^2 = 5.30$  (3), CFI = .98, SRMR = .06, NNFI = .96). However, the RMSEA was higher than the suggested cut-off value for an acceptable model fit ( $= .12$ , cut-off =  $< .06$ ). Analyses of path

coefficients revealed RAI to positively predict MVPA ( $\beta = .30, p < .05$ ) and negatively predict depression ( $\beta = -.38, p < .01$ ). However RAI did not significantly predict light PA and ST, though the relationships were in the expected directions.

## **Discussion**

The current study examined the relationships between RA patients' degree of self-determination towards their exercise participation, PA and ST engagement, and the reported occurrence of depressive symptoms. Results revealed that level of self-determination towards exercise was positively related to RA patients' engagement in moderate PA and MVPA. In addition, self-determination negatively predicted depression in this patient group.

The observed relationships of self-determination toward exercise engagement and levels of PA partially supported our hypothesis. Only significant associations between RAI and moderate PA and MVPA were observed in the present study. The results of the objective PA measurement indicated that RA patients in the present sample spent on average, more than 8 hours per day engaged in sedentary behaviours, which is more than the average of 7.7 hours from the general population (Matthews et al., 2008). Moreover, patients did not meet recommended guidelines for MVPA (i.e., 150 minutes of moderate PA or 50 minutes vigorous PA per week (Haskell et al., 2007)). This observation echoes findings reported in previous studies (Sokka et al., 2008; Tierney et al., 2012) whereby insufficient levels of health enhancing PA are seen among this patient group. Results therefore indicate the need to encourage higher levels of engagement in PA at a moderate intensity or higher among this patient group if they are to accrue benefits to health.

The data used in the present study constituted baseline assessments taken from a RCT testing the impact of an exercise intervention informed by self-determination theory which aims to promote PA engagement and improve cardiorespiratory fitness in people living with RA (Rouse et al., 2014). Promising then are the present results demonstrating a positive association between more self determined reasons for exercise participation and levels of MVPA engagement. However it should be noted that, compared to previous research in the general population, (Ingledeew et al., 2004), present results indicated that RA patients were more controlled in their motivation toward exercise ( $RAI=1.81 < 8.06$ ). This suggests that interventions, implemented in the case of people living with RA, which could enhance more autonomous motivation for participation in PA are indeed warranted.

Contrary to our hypothesis, the objectively assessed PA variables and ST were not significantly related to symptoms of the depression among this patient group. Our findings are not consistent with past research suggesting that participation in MVPA can potentially reduce the intensity of depressive symptoms (Cooney et al., 2011; Noreau, Martineau, Roy, & Belzile, 1995). Present results are also in contrast to findings from extant studies in which the relationship between inactivity and the depression have been supported among both the general population (Teychenne et al., 2010) and patients living with RA (J. Lee et al., 2012). Differential findings may be related to differences in the way in which sedentary behaviour is operationalized across studies. The present study assessed sedentary time (i.e., behaviour  $\leq 1.5$  METS), whereas other studies (Teychenne et al., 2010) have examined the implications of physical inactivity (i.e., low levels of engagement in health enhancing PA (including PA 1.5 – 3 METS) in relation to depressive symptoms. In addition, we assessed total sedentary time (i.e., the sum of

all sedentary behaviours), rather than engagement in sedentary behaviour(s). Indeed, past work has suggested the type of sedentary behaviour may be important to consider in the association between sedentary time and depression, reporting specific sedentary behaviours (e.g., TV viewing) to be significantly related to depression (Teychenne et al., 2010). A lack of a significant association may also be related to the low score observed within the present sample for depressive symptoms and the small final sample size. Compared to prevalence estimates in the general population [14%~46% (Joyce et al., 2009)], only 5% of the current sample would be considered as having probably clinical depression, which was lower than what has been reported in previous research with RA patients (Covic et al., 2009). Moreover, whilst associations between PA levels and ST did not reach significance, the relationships were in the expected direction, especially the correlation between light PA and depression which was marginal ( $r=-.24$ ,  $p=.058$ ).

The proposed model was amended according to the results of the correlation analysis and a path analysis was conducted. The revised model demonstrated an acceptable fit to the data, with most of the fit indices falling within the acceptable range (Hu & Bentler, 1998). However, in the case of the RMSEA, this was above the accepted cut-off criteria used to indicate good model fit. Still, past research comparing the application of the CFI and RMSEA as model fit indices has indicated that CFI is more appropriate for use in an exploratory context, which is applicable to the present study (Markland & Ingledew, 2007). To our knowledge, this is the first study examining the relationships between SDT based motivation regulations towards exercise behaviour, objectively assessed PA and ST engagement, and depression in patients with RA. As such, results provide an initial insight into the motivational factors contributing towards

participation in MVPA and depression symptoms among this patient group. Future research should aim to further explore these associations in the case of larger samples of RA patients in order to confirm present findings.

Due to the exploratory nature of the current study, there are a few limitations which should be taken into account. First, due to the convenience of the sampling, participants were representative of a relatively small geographical area. In addition, participants were largely white British, older women. This reduces the generalizability of the present findings across the broader spectrum of people living with RA. Second, the cross-sectional study design limits the extent to which we can explore the direction of the hypothesised associations and/or the implications for long-term MVPA engagement and well-being. Finally, a small sample size may account for the lack of significant findings with respect to the associations hypothesised. Future research should aim to increase the number of participants recruited to studies employing objective assessments of PA.

In sum, the revised model tested in the present study revealed more self-determination towards exercise engagement to be positively related to daily MVPA and negatively linked to depression among patients with RA. Enhancing autonomous motivation (and reducing controlled motivation) toward exercise and PA participation in this patient group may therefore hold implications for promoting engagement in health enhancing PA and enhancing mental health in people living with RA.

## **CHAPTER 6**

### **General Discussion**

## Overview

The overall aim of this thesis was to, pulling from the Self-determination Theory (SDT) framework, examine the motivational processes undergirding physical activity (PA) in rheumatoid arthritis (RA) patients. Firstly, a popular, SDT-based assessment of motivation regulations for exercise was tested for its appropriateness in the case of people living with RA, i.e. the Behavioural Regulation in Exercise Questionnaire (BREQ-2). In Chapter 2, the validity and reliability of the BREQ- 2 was examined via a qualitative and quantitative approach. BREQ-2 assessed motivations for exercise was then a key variable in a SDT-grounded process model which was tested with structural equation modelling in chapter 3. The focus here was to determine whether autonomy support for participation in PA from an important other corresponded to basic need satisfaction which was assumed to relate positively and negative respectively to autonomous and controlled motivation to exercise in a large sample of RA patients. The targeted outcomes in this study were self reported PA and vitality. Chapter 4 returned to another important measurement issue that needs to be addressed in this area of work. Specifically, the associations between subjective and objective PA and ST measurements [as captured via the International physical activity questionnaire (IPAQ) and accelerometry via the GT3X)] were determined. The relationships between PA and time spent in sedentary activities, as assessed via these two measures, and the gold standard of Max VO<sub>2</sub> were also examined. Lastly, pulling from but also extending work described in the three previous empirical chapters, Chapter 5 focused on the links between the BREQ-2 assessed motivation regulations, objectively measured physical activity (PA) and ST, and symptoms of depression variables.

In general, the application and relevance of SDT to predicting PA/ST and associated indicators of mental health in RA patients was supported in this thesis. More self-determined regulations tended to correspond with more adaptive outcomes in this clinical population, such as greater subjective vitality, lower depressive symptoms and more PA whether assessed via self-report or objectively. The findings from the different empirical chapters will be summarised in the below section.

### **Summary of the research findings**

In Chapter 2, the BREQ-2 was tested via a mixed method approach. Different psychometric properties of this questionnaire were tested via both qualitative and quantitative methods. In the first qualitative component of this study, there were no difficulties reported in terms of comprehending the items (or feeling that additional item content was needed) based on one on one interviews and a focus group session with RA patients. Extending from such findings, the BREQ-2 was then examined via quantitative techniques and analyses. Internal consistency reliability test was applied on the responses of 335 RA patients, SEM was then used to provide further validation evidence regarding the construct validity and factorial validity of the questionnaire. According to the results of reliability test and emerging model fit indices, 2 items were suggested to be removed from the extrinsic regulation and introjected regulation subscales, respectively. The removal of these two items enhanced the reliability and model fit. In sum, the final 17 item measure displayed a good model fit and as well as psychometric properties. It was suggested, however, that future work involving RA patients should consider using the full scale and discern whether the two items in question remain problematic.

The results from the quantitative part indicated the observed mean score and the standard deviation of each the subscales to be distributed similar to previous studies using the BREQ-2 among the general population (Markland & Tobin, 2004; Moreno et al., 2007). Higher scores were revealed for the more autonomous regulation subscales (i.e., intrinsic regulation and identified regulation), and lower scores observed for the less autonomous/more controlled BREQ-2 subscales (i.e., introjected regulation, extrinsic regulation) as well as amotivation. However, the score on each subscale was generally lower than the findings from previous studies (Markland & Tobin, 2004). These findings suggest lower motivation to engage in PA among this population, regardless of the reason (i.e., more or less autonomous and controlled) behind the behaviour. Similar results were reported in other clinical populations (Vancampfort et al., 2013; Verloigne et al., 2011) suggesting the prevalence of a lower motivation toward exercise when individuals are not as mobile as 'healthy' adults. RA patients tend to experience more fatigue (D. M. Lee & Weinblatt, 2001), and due to the joint swelling, indeed it is understandable that there could be a perceived (as well as real) burden for them to become active. However, we know from other research, that RA patients can safely participate in exercise programmes and gain considerable health benefits from doing so (Lemmey et al., 2009; Stavropoulos-Kalinoglou et al., 2012).

Noteworthy was the findings that the two removed items both scored higher than the other items in the respective subscales (i.e., "I feel guilty when I don't exercise" from the introjected regulation subscale and "I take part in physical activity because my friends/family/partner say I should" from the extrinsic regulation subscale). These heightened scores may be due to the possibility that RA patients receive more

suggestions/encouragement from the people around them, in particular those who are important to their exercise engagement, to be more active.

Other evidence for the validity of the BREQ-2 were also accrued in the study reported in Chapter 2. For instance, the convergent validity was supported according to the result of the correlation analysis, which were consonant to findings from previous studies using the BREQ-2 (Deci & Ryan, 2000; Markland et al., 2010). Autonomous motivation (i.e., intrinsic regulation and identified regulation) regulations were positively correlated to each other, and negatively correlated with the controlling motivation regulations (i.e., introjected regulation and extrinsic regulation) as well as amotivation. Extrinsic regulation was positively correlated to amotivation.

The factorial validity of the BREQ-2 was tested via confirmatory factor analysis (CFA). A good fit of the model to the data emerged, after removing two items from the subscale. The findings also provided support for the construct validity of the BREQ-2, and echoed the results emerging in studies conducted in diverse domains (Gagne et al., 2003; Standage et al., 2012; Vansteenkiste et al., 2010). That is, the more self-determined regulations were positively associated with well-being indicators. In the present study, the well being indicators targeted were subjective vitality and quality of life as measured by the ICECAP-A questionnaire.

Employing the full version of the BREQ-2 as the measure of SDT based motivation regulations, the following chapter (Chapter 3) tested the hypothesized sequence of the relationship from the support of an important other to the three psychological needs, to the composite motivation regulations and then to behavioural and psychological outcomes among RA patients. The associations between the basic psychological needs to the motivation regulations were slightly different to what was

hypothesised. The need for autonomy was positively correlated to the autonomous motivation regulation and negatively correlated to controlled regulation as expected.

However, contrary to our hypothesis was the finding that the need for competence positively related to autonomous motivation regulation but did not significantly relate (negatively) to controlled motivation regulation. The non-significant relationships for competence need satisfaction have emerged in previous research on patients (Fortier et al., 2007). However, in other studies also (Markland et al., 2010), the need for competence was positively associated with the desired outcome such as greater smoking cessation (Williams et al., 2006). This inconsistency in the existing evidence needs to be further examined in patient groups such as people living with RA. Perhaps due to their immobility and overall difficulties experienced especially during the flare up periods, RA patients may not perceive their competence to meet the demands of PA in the same way as those in the general population.

The other unexpected findings were the associations observed for the need of relatedness which was found to be positively associated with controlled motivation and not significantly associated with autonomous motivation. A possible explanation for these results is that RA patients may feel they have to exercise, because they do not want to disappoint their important others. Because of the heightened CVD risks (Desseing & Joffe, 2006; Gonzalez-Gay et al., 2008; Panoulas et al., 2008) associated with their disease, those who are close to these patients (and perhaps contributing to their ratings of relatedness) are aware of how important it is for their health and life expectancy to engage in regular exercise. RA patients, who receive these messages from such significant others, may be thus more likely to feel this extrinsically derived motivation to engage in PA. Thus it is important to further investigate the extent and

nature (in terms of its controlling and autonomy supportive features) of close social relationships RA patients have with their fitness instructors, families, and/or friends, in regard to their reasons for participating in PA (Wilcox et al., 2006).

Although the relationships between the basic psychological needs to motivation regulations were different to our expectations, in general, the results were aligned with hypotheses stemming from the SDT framework (Deci & Ryan, 2000; Fortier, Duda, Guerin, & Teixeira, 2012). For example, as reported in Chapter 3, we found that the three basic psychological needs mediated the relationship between perceived autonomy support from the important other to the motivation regulations.

Regarding the observed relationships between the motivation regulations to the outcome variables in the process model tested in Chapter 3, only autonomous motivation regulation was positively correlated to the outcome variables (i.e., subjective vitality and self reported PA levels). No negative associations between controlled motivation regulation emerged with the outcome variables. These findings partially support our hypothesis and were congruent to the findings reported in the previous chapter and in previous research (Ryan & Deci, 2000; Williams et al., 1996). This work indicates that stronger autonomy regulation is predictive of positive outcomes such as psychological well-being or enhanced PA levels (Bagoien et al., 2010; Ryan & Deci, 2000; Standage et al., 2012).

In testing the hypothesised structural model in Chapter 3, SEM was applied and two mediation effects were tested: Firstly the indirect effects from the antecedent, autonomy support from the important other (s), to outcome variables were both significant but minimal (to PA index  $\beta=.09$ ,  $p<.05$ , to subjective vitality  $\beta=.11$ ,  $p<.05$ ). Then we tested the assumed mediation effects of need satisfaction. The indirect effect of

the autonomy support from the important others to autonomous motivation regulation was significant ( $\beta=.24$ ,  $p<.05$ ) but not to controlled motivation regulation ( $\beta=-.08$ ,  $p=.09$ ). These results demonstrated the mediational role of need satisfaction between the autonomy support from important other (s) to autonomous motivation.

In the third step, the mediation effects of motivation regulation, in terms of the relationships between need satisfaction and outcome variables, were tested. Two outcome variables were examined separately, the need for competence to subjective vitality was  $\beta=.17$ ,  $p<.05$ , the need of relatedness was  $\beta=-.01$ ,  $p=.09$  and the need of autonomy was  $\beta=.19$ ,  $p<.05$ . In terms of the PA index, the indirect effect from the need for competence was  $\beta=.14$ ,  $p<.05$ , from the need of relatedness  $\beta=.02$ ,  $p=.09$ , and from the need of autonomy,  $\beta=.14$ ,  $p=.09$ .

We found, echoing results from previous studies in smoking cessation (Vallerand, 1999) and the exercise domain (Williams, Gagné, Ryan, & Deci, 2002), that the autonomy support from the important other could facilitate the satisfaction of the psychological needs which were relevant to the targeted outcomes. The other mediation effects supported were in regard to the role of autonomous motivation regulation in terms of the observed relationships of the need for competence and need for autonomy to subjective vitality and self reported PA. In the exercise context, previous research (Puente & Anshel, 2010) demonstrated the positive associations between self determination motivation and enjoyment, positive affect and exercise frequency via SEM (and self determination was negatively associated with negative affect). Overall, the findings reported in Chapter 3 were similar to what was found previously (Moustaka et al., 2012) and indicate that both the psychological needs and motivation regulations play a mediational role within the SDT-based process model.

Chapter 3 extended the research of Hurkmans et al., (2010) involving RA patients specifically. They found that a more autonomous regulation was associated with higher PA. We examined this further by considering basic need satisfaction and the potential role of autonomous regulation on PA via the mediation test. A limitation of the study reported in Chapter 3 and past work by Hurkmans et al., (2010) was that PA was assessed via (albeit two different) self-report measures. Measurement issues regarding the assessment of this important outcome variable in the case of RA patients, namely physical activity, were addressed in the following chapter (Chapter 4).

Due to the observed discrepancy between subjective and objective PA measurement observed in previous work in the general population (Troiano et al., 2007), the agreement between the accelerometry data and the self-report PA data were tested within RA population. The results from the objective PA assessment indicated that participants did not meet the weekly PA guidelines for both moderate and vigorous levels (at least 150 minutes moderate PA (Haskell et al., 2007)). Based on their responses to the subjective PA measurement, i.e., the IPAQ, the RA patients over reported their engagement in moderate, vigorous and MVPA and under reported their time spent sedentary.

Bland-Altman plots for demonstrating the agreement between the two PA measurements at different PA levels were generated and examined. At the sedentary PA level and light PA level, less agreement were found between these the objective and self reported measurements. At the moderate PA level, however, there was more consistency in the findings between these two measurements. Regarding the associations with assessed VO<sub>2</sub>max in the RA patients, the objectively measured PA data at light, moderate, vigorous and MVPA level agreed with the gold standard measure of fitness

(VO<sub>2</sub>max). On the other hand, self-reported levels of PA were only significantly correlated with VO<sub>2</sub>max at moderate PA and MVPA levels. The results suggested that increased engagement in objectively measured MVPA corresponds to better cardiovascular fitness in the current clinical population.

Considering the findings of Chapter 4 regarding the incongruence between subjective and objective PA and the over-reporting of moderate and MVPA by RA patients when assessed via the IPAQ, PA (and sedentary time) were objectively assessed in the final empirical chapter comprising the thesis. In Chapter 5, the interrelations were assessed between RA patients' degree of self-determination for PA engagement, different PA levels (i.e., light, moderate and MVPA), as well as the time spent sedentary, and a key mental health indicator in RA patients (namely, depressive symptoms, as assessed via the respective subscale of the HADS). The incidence of depression has been reported to be high in this population (e.g., 14%-46%; (Bagoien et al., 2010). Moreover, research has revealed a number of debilitating symptoms which are associated with depression in RA patients (e.g., pain and functional disability)(Joyce et al., 2009).

In Chapter 5, a proposed model was tested via path analysis which capture hypothesised associations between motivation regulations for exercise engagement, objectively measured PA and ST, and depression were tested. The potential meditational role of PA levels and ST in terms of the relationship between reasons for exercise engagement and depressive symptoms was also of interest in this chapter. The Relative Autonomy Index (RAI) (Ingledeu et al., 2004) was calculated and employed in the analysis as the indicator of the degree to which the RA patients' reasons for exercise engagement were more or less self-determined. The higher the RAI score, the more

autonomous reasons (and less controlled reasons) for engaging in the behaviour. In the current sample, the RAI observed was relatively low ( $1.81 \pm 2.96$ ) compared to the previous result from the general population ( $8.06 \pm 2.58$ ; (Ingledeew et al., 2004).

Regarding the objectively measured PA, RA patients spent average over 8 hours per day engaged in sedentary behaviours ( $499.11 \pm 68.71$  minutes per day) which was higher than the mean objectively measured time spent sedentary of 7.7 hours in the general population (Matthews et al., 2008).

The result of the correlation analyses between RAI and each objectively measured PA level indicated that RAI were positively correlated with moderate PA and MVPA. When the reported depression symptoms were included, they were found to be negatively correlated with the RAI and no significant associations were found between depression and objectively measured PA. The emerging findings did not support the conducting of meditational tests. As the data did not fit well with the proposed path analysis model, the path analysis model was amended based on these findings as well as illuminated by the results of the correlation analyses. In the amended model, a direct path was added between RAI and depression. Vigorous and moderate PA were removed and MVPA was retained as the indicator of engagement in moderate intensity and above PA. The amended model demonstrated a good model fit ( $\chi^2=5.30$  (3), CFI=.98, SRMR=.06, NNFI=.96), except a higher RMSEA ( $=.12$ , cut-off =  $<.06$ ) was observed than what is recommended in the literature (Hu & Bentler, 1998). The predicted paths between RAI and ST and light PA were both non significant. Taken in their totality, the revised model provided preliminary evidence regarding the relevance of self determined motivation to objectively measured PA and ST and the mental health of RA patients. As these data stemmed from a cross sectional study, it was not possible to ascertain

causation. It was suggested that future work should consider examining the interplay between motivation for PA engagement, objectively assessed participation in PA and sedentary behaviours, and the reporting of depressive symptoms over time.

### **Practical implications**

In general, the results from the thesis support SDT tenets and corroborate past findings of studies grounded in the Self Determination theoretical framework (Deci & Ryan, 2000). The new research contained within this holds a number of practical implications. As per the results presented in Chapter 2, the validity and reliability of the BREQ-2 when administered to RA patients was supported. Thus, future studies could employ this questionnaire for investigating the motivation regulations for exercise engagement among the RA population. With a reliable and valid measurement tool, researchers as well as those who work in an exercise setting can assess the SDT based motivation regulations when attempting to examine motivation fluctuations at the start, during or at the end of an exercise programme. A valid and reliable measure of reasons for exercise engagement for RA patients could also be used for investigating the associations with other relevant variables, such as measures of psychological well-being, adherence, and physiological and physical variables relevant to health. Although growing in popularity, to date a limited number of SDT based exercise interventions had been developed and delivered (Duda et al., 2014; Fortier et al., 2012; Rouse et al., 2014). The present results encourage the use of the BREQ-2 as an outcome variable and assessment of key processes in future SDT-grounded interventions designed to promote PA participation in this clinical population. With this point in mind, it is important to note that the scores of the motivation regulations were generally lower than what has

been found in other populations. Thus, findings indicate that RA patients may exhibit lower motivation toward exercise and thus further interventions are needed.

The results of Chapter 3 not only provided support for the SDT model when tested in a RA patient group but also provide insight into the strategies that can be used to foster quality motivation, physical activity and well being in this population. For instance, based on the tenets of SDT and present findings, one can try to facilitate autonomy support provision from the important other(s) who are relevant to RA patients' participation in PA. More specifically, these important others can act and interact in a way that could fulfil the basic psychological needs. For example, strategies could be adapted from what has been proposed for coaches in their exchanges with athletes (Mageau & Vallerand, 2003) such as providing the choice of exercise (intensity, type, duration) for RA patients depending on their preferences and disease severity, providing the opportunity for RA patients to take initiative over their own exercise engagement, providing a meaningful rationale for the selected exercise, asking about and acknowledging patients' feelings, and avoiding overtly controlling behaviours. The effectiveness of such strategies had been tested with middle aged women (Moustaka et al., 2012) and have been found to effectively enhance perseverance regarding exercise, in addition to the motivational and psychological benefits which were observed. Furthermore, PA promotion strategies could be not only autonomy supportive but also relatedness and competence supportive, which could enhance PA engagement in RA patients. For instance, in regard to the former, social support has been found to effectively enhance feelings of care, acceptance and inclusion in youth sport context (Fry & Gano-Overway, 2010). To facilitate relatedness, we could encourage RA

patients to identify an exercise buddy or have the opportunity to exercise in groups with other people afflicted by RA.

In Chapter 4, accelerometry was used in the case of the targeted clinical population for recording their daily life PA without altering their original daily routine, and the agreement with subjectively measured PA was tested. The observed over reporting of moderate PA and MVPA from the self-report PA measurement and the higher associations across the objective measures of PA levels and ST with the gold standard  $VO_2$ max test indicated that accelerometers constitute a more accurate and reliable PA measurement tool for the RA population. Despite the cost difference between the device and the pencil paper test, the accelerometry is a non-invasive and light device which minimizes the alteration the daily routine of the participant, and provides continuous measures of PA and time spent sedentary over a relatively long time period. The use of such devices should be adapted in the future study, based on several issues arising from the results presented in Chapter 4.

Regarding to wear time, which is an important variable for data reduction when employing accelerometers, Two issues should be considered in future studies: 1. The criteria for the inclusion of wear and non-wear hours, and 2. The total valid time/days accrued during the whole assessment period. The decision of selecting inclusion criteria for the valid wear time is a trade-off between securing more valid hours or have the risk of losing data (Semanik et al., 2010). Low wearing hours could decrease the representativeness of the assessed typical daily activity of the participants. Requiring more valid wearing hours per day, however, may result in less valid days and possibly result in a reduction of the sample. Although no clear consensus exists regarding setting this parameter when employing accelerometers, the suggestion has been made for

research (Semanik et al., 2010) on RA patient group to obtain at least 10 valid hours of wear time per valid day. The recommendation of Semanik and colleagues (2010) represents a balance between the valid days likely to be secured and the representativeness of the data. This guideline has been adopted in the current thesis, although no comparisons on the different minimum wearing hours were made. This would constitute an interesting area of future research. Twelve per cent of the participants in the present thesis failed to be complaint and were removed from the data set due to the insufficient wearing hour. Also due to the nature of the water resistance (and not waterproof) design of the GTX3 used in this thesis, the device needs to be taken off during a shower or bath and can not be used to record any water-based physical activity in this patient group. For the former consideration, the device may be forgotten and not put back on (e.g., after taking a shower). Moreover, we could be missing participation in physical activity in this patient group, such as time spent swimming. An easy to carry and user-friendly PA log or diary could be designed and given together with the accelerometer. Further validation may be needed between these more dynamic but still self-recorded PA and objectively measured PA (and ST) in the future. In any regard, reporting on daily activities (what one is doing and when) could help future researchers more easily interpret the PA recorded objectively so there is less likelihood of missing time spent engaged in PA as well as delineating sedentary time.

In terms of enhancing the total wearing time during the testing period, it is important to increase compliance within such studies. 37% of the participant in the study described in Chapter 5 had no accelerometer data. Further investigation is needed for understanding the reasons behind such non-compliance. Why did the RA patients in question decide not to wear the accelerometer? In their study involving South Asian

women group (Curry & Thompson, 2014), the participants reported their concerns that wearing the device around the waist would be seen by their peers, friends or the family member and might cause disruption in their completing daily life activities. In the future, different strategies could be applied to overcome different reasons for not wearing the accelerometer as required within the protocol of the current study. For example, the device should be advised to be worn under one's clothes, or it is possible to disable the flashing light function on the accelerometer. On the other hand, text messages could be used as a reminder after the shower, or sent at the beginning of the day, which are the likely occasions when the participant forgot to put the device back on and lost the whole day's data in some of the cases.

In a previous study, the wearing position of the accelerometer has been investigated in order to enhance the accuracy of measuring the behaviours of the individual. Swartz and colleagues' work (Swartz et al., 2000) compared the different energy expenditures revealed between wearing positions on hips or wrist. The results indicated combining the wearing at both the hip and wrist resulted in the best prediction of energy expenditure in the general population. Another study suggested that (Thaler-Kall, Tusker, Hermsdorfer, Gorzelnik, & Horsch, 2013) wearing the accelerometer on the ankle is the best position for gait analysis. However, it was recommended that an extra device should be worn on the wrist in order to capture the upper limb movement when the calculation of energy expenditure is the main purpose of the use of accelerometry. As for RA patients, the placement of the accelerometer should take into account the functional disability and major disease areas (impacted joints) when tapping limb movements.

In Chapter 5, the associations between an index of self determination regarding exercise engagement, objectively measured PA levels and time spent sedentary, and depression offered further support for the importance of promoting autonomous motivation among RA patients. Extending the practical implications stemming from Chapter 3, not only the creation of an autonomy supportive environment created by important others should facilitate PA behaviour in RA patients, but also working with individual patients and enhancing their self-regulations would be expected to hold implications for ensuing PA pattern levels among RA patients (Knittle, Maes, & de Gucht, 2010). Techniques such as goal setting and planning, self-monitoring, receiving feedback and relapse prevention derived from self-regulation theory (Maes & Karoly, 2005) can enhance the self-efficacy within people living with RA, which could result in increased levels of PA and improvements in health related outcomes such as reduced pain and better physical health status in the future (Smarr et al., 1997). Furthermore, a review study (Knittle et al., 2010) indicated that self regulation techniques could reduce the symptoms of depression and anxiety among recently diagnosed RA patients. In the review (Knittle et al., 2010), the psychological interventions implemented also had a positive impact on self-reported PA in this patient group. The interrelationships between psychological skills/self regulation development, symptoms of psychological ill-being such as anxiety and depression, in addition to objectively measured PA could be investigated in RA patients in the future.

In the study comprising chapter 5, a significant positive association between ST and depression symptoms was predicted. Although no significant association was observed in the present research, a previous study (Thaler-Kall et al., 2013) has pointed to the health risks associated with sedentary behaviours, in particular within the RA

population (Teychenne et al., 2010). Therefore, besides focusing on the promotion of health conducive levels of PA, it is also important to decrease the time RA patients spend sedentary in order to reduce health risk. Recent studies have indicated that the break of time spent sedentary, such as sitting for long periods of time, is beneficial to office workers (J. Lee et al., 2012) by reducing fatigue and musculoskeletal discomfort. Also interruptions in sedentary time lower postprandial glucose and insulin levels in overweight/obese people (Thorp, Kingwell, Owen, & Dunstan, 2014). Due to the immobility and the risk of bone density loss in RA patients one perhaps more readily attainable initial strategy for RA patients to gain health benefit is to have at more breaks during their time spent engaged in sedentary activities.

### **Future directions and limitations**

This thesis was based on and further tested the SDT framework (Deci & Ryan, 2000), extend the existing knowledge into a particular clinical population, i.e. RA patients. The measurements of motivation for exercise and levels of physical activity were examined in depth in regard to people living with RA. Also, the hypothesised associations between motivation regulations, physical activity (and ST, and indicators of mental health were examined across two studies comprising this thesis. The findings have important practical and theoretical implications. However, it is important to acknowledge the findings from the four chapters have limitations and suggested areas of inquiry which could be explored further in future work.

All the studies included in this thesis adopted a cross-sectional design for investigating the associations between the targeted variables. As a result, evidence regarding cause and effect and the direction of the relationships could not be discerned. Longitudinal designs are needed to extend the research comprising this thesis. Further, a

randomized control trial design could be implemented (Dunstan et al., 2012) which is grounded in the SDT framework and entails the manipulation of the social environment. Key effects to be examined include the impact on the basic psychological needs, motivation and behavioural and psychological outcome variables (see Duda et al., 2014; Rouse et al., 2015). For instance, a different PA promotion approach could be implemented with RA patients (perhaps via personal/telephone consultations) to achieve the goal of providing autonomy support. This could be done by acknowledging the barriers for RA patients to begin their exercise and other more autonomous instruction strategies, etc. As part of the data in this thesis were collected from the baseline of a longitudinal exercise intervention study (Rouse et al., 2014), the effect of the long term exercise intervention implemented in that RCT could be examined in the future. With a multi-time point design, the factorial stability over time of the BREQ-2 (see Chapter 2) could be established. The test-retest reliability could be tested in this way as well so that further evidence regarding the psychometric properties of this assessment tool when administered to RA patients will be provided.

For the most part, convenience sampling marked the empirical work comprising this thesis. Participants were representative of a relatively small geographical area (in terms of the data collected for the studies described in Chapters 4-5), and were largely white British, and middle-aged women. This reduces the generalizability of the present findings across the broader spectrum of people living with RA (D. M. Lee & Weinblatt, 2001). However, in the quantitative data described in Chapters 2 and 3 which is based on a sample size of over 300 RA patients from around the country, the gender and age distributions were similar to what has been found in epidemiological studies (Symmons

et al., 2002). A larger sample size was also important for the sophisticated statistical analyses (SEM, CFA) conducted in those studies.

In study 5, one of the reasons it was necessary to use the RAI in the model (rather than the individual motivation regulations or composite autonomous and controlling motivation variables) is due to the low sample size. The number of variables needed to be decreased. Therefore in future studies, appropriate indicators of motivation regulation should be chosen according to the sample size and, albeit very challenging, efforts should be made to maximise that sample size. Indeed, a wider and more extensive sampling approach should be considered in order to include the greatest variety of participants from different demographic backgrounds and ensure the representativeness of the sample in terms of gender and age.

The benefits of exercise has been supported in previous research in terms of both physical (Cramp, Berry, Gardiner, Smith, & Stephens, 2013; Michie & Abraham, 2004) and psychological (Neuberger et al., 1997) outcomes. The benefit of structured aerobic and resistance training has been shown to improve the cardiorespiratory fitness and reduce the cardiovascular risk of RA patients (Cooney et al., 2011). Though short term intensive exercise had been found to improve RA patients' fitness (Stavropoulos-Kalinoglou et al., 2012), it is important that future interventions are designed and delivered under the supervision of a trained physiologist who prescribes the workout sessions based on individual fitness level (van den Ende, Breedveld, Dijkmans, de Mug, & Hazes, 2000). Besides the implementation of a tailored exercise programme, as suggested in the previous section based on previous research findings (Knittle et al., 2010), combining a psychological intervention with the structure exercise could be considered for RA patients. A positive attitude toward the chronic disease and the self-

belief of the patients is key for enhancing the QoL and psychological well-being among RA patients group. If possible, the development of self-regulation skills (Maes & Karoly, 2005) could even be transferred to other life domains.

## **Conclusion**

In this final chapter, the results of four empirical chapters in this thesis have been reviewed and discussed. In sum, the findings have supported the application of a SDT based model in the case of RA patients. Measurement issues pertinent to the testing of this model and future intervention work also have been addressed. Based on the results reported here, an autonomy supportive social environment is expected to fulfil the basic psychological needs of people with RA. This holds implications for their reasons for engagement in exercise as well as in enhancing the psychological well-being and increasing PA among this clinical population. Based on the findings from this thesis, the assessment of objectively measured PA and sedentary time is advocated in future work with RA patients. Future research should consider investigating the effect of tailored exercise interventions coupled with interventions focused on creating more need supportive PA promotion consultations in the case of people living with RA who currently are not accruing sufficient levels of PA.

## **APPENDICES**

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## APPENDIX 1: Material used in Chapter 2

### Demographic information

Identification Number:.....

To complete this questionnaire pack, please **shade** in the circle that corresponds to your answer for each question. For example :



1. Age:                      Years \_\_\_\_\_

2. Gender:                 Male            —                 Female —

3. First diagnosed with rheumatoid arthritis? : \_\_\_\_\_(mm/yyyy)

4. Are you:

- Married.....
- Living with a partner.....
- Single .....
- Divorced/Separated.....
- Widow(er).....

5. What is the highest educational qualification you have obtained?

- None.....
- GCSE/ O level.....
- A level/diploma/vocational qualification...

- Degree.....☐
- Post graduate level.....☐
- Other.....☐ Please specify \_\_\_\_\_

6. What is your ethnicity?

- White .....☐
- Asian .....☐ Please specify\_\_\_\_\_
- Black .....☐
- Other .....☐ Please specify\_\_\_\_\_

For the following questionnaires, we would like to know how you personally feel about yourself and your participation in leisure time physical activity. There are no right or wrong answers and no trick questions. Your responses will be held in confidence and only used for research purposes. Please answer how you truly feel.

**Think aloud Instruction**

In this investigation we are interested in what you think about when you are completing the questionnaires I am about to give you. In order to do this, I am going to ask you to **think aloud** as you work through each questionnaire.

What I mean by ‘think aloud’ is that I would like you to tell me **everything** you are thinking from the time you first see the questionnaire until the time you have completed all the items. If there is something that you do not understand please verbalise these thoughts. I would like you to talk aloud **constantly** for the whole duration of time it takes to complete the questionnaire.

I don’t want you to plan out what you say or to try to explain to me what you are saying. Just act as if you are alone in the room talking to yourself. There is no right or wrong way to think. What is important is that you honestly indicate what goes on in your mind as you read through the questionnaires instructions and particular items. For example, what is the questionnaire trying to capture about

you? What do you understand by each item? In terms of your sporting experience, what are the words (or item content) referring to?

It is important that you keep talking. If you are silent for any long period of time, I will ask you to talk. Please try to speak as clearly as possible, as I shall be recording you as you speak.

Do you understand what I am asking you to do? While you complete each questionnaire I will not say or ask you anything, however, at the end of each questionnaire I will ask if you would like to add anything else and ask a couple of other questions.

Here is a practice so that you can have a go.

### **Interview sheet**

#### **BREQ**

1. Can you tell me about any physical activity you participated in between diagnosis with RA and the exercise intervention?

Can you remember why you commenced this activity?

Did your reasons for participating change?

What did you classify PA as when completing this questionnaire? Definition.

3. Why is it important to you to participate in physical activity?


ng

**The Behavioural Regulation in Exercise Questionnaire, BREQ-2**

We are interested in the reasons underlying people’s decisions to engage or not engage in any current physical activity. Using the scale below and thinking about the activities you identified in PART 3 of this questionnaire pack, please indicate to what extent each of the following items are true for you in terms of why YOU PERSONALLY PARTICIPATE IN PHYSICAL ACTIVITY. Shade only one (1) number for each item.

	Not at all true	1	2	3	4	Somewhat true	5	Very true
1. I engage in physical activity because other people say I should	<input type="checkbox"/>	(	)	}	(	)	}	
2. I feel guilty when I don’t exercise	<input type="checkbox"/>	(	)	}	(	)	}	
3. I value the benefits of physical activity	<input type="checkbox"/>	(	)	}	(	)	}	
4. I engage in physical activity because it’s fun	<input type="checkbox"/>	(	)	}	(	)	}	
5. I don’t see why I should have to be physically active	<input type="checkbox"/>	(	)	}	(	)	}	

6.	I take part in physical activity because my friends/family/partner/health care provider say I should	<input type="checkbox"/>				
7.	I feel ashamed when I miss an exercise session/chance to be physically active	<input type="checkbox"/>				
8.	It's important for me to regularly participate in physical activity	<input type="checkbox"/>				
9.	I can't see why I should bother being physically active	<input type="checkbox"/>				
10.	I enjoy my exercise sessions/participation in physical activity	<input type="checkbox"/>				
11.	I engage in physical activity because others will not be pleased with me if I don't	<input type="checkbox"/>				
12.	I don't see the point in being physically active	<input type="checkbox"/>				
13.	I feel like a failure when I haven't been physically active in a while	<input type="checkbox"/>				
14.	I think it is important to make the effort to regularly participate in physical activity	<input type="checkbox"/>				
15.	I find physical activity pleasurable	<input type="checkbox"/>				
16.	I feel under pressure from my friends/family/partner/health care provider to participate in physical activity	<input type="checkbox"/>				
17.	I get restless if I don't regularly participate in physical activity	<input type="checkbox"/>				
18.	I get pleasure and satisfaction from participating in physical activity	<input type="checkbox"/>				

19. I think engaging in physical activity

is a waste of time

**The ICECAP-A capability wellbeing measure for adults**

Please indicate which statements best describe your overall quality of life at the moment by shading **ONE** circle for each of the five groups below.

<b>1. Feeling settled and secure</b>	
I am able to feel settled and secure in <b>all</b> areas of my life	<input type="checkbox"/> 4
I am able to feel settled and secure in <b>many</b> areas of my life	<input type="checkbox"/> 3
I am able to feel settled and secure in <b>a few</b> areas of my life	<input type="checkbox"/> 2
I am <b>unable</b> to feel settled and secure in <b>any</b> areas of my life	<input type="checkbox"/> 1
<b>2. Love, friendship and support</b>	
I can have <b>a lot</b> of love, friendship and support	<input type="checkbox"/> 4
I can have <b>quite a lot</b> of love, friendship and support	<input type="checkbox"/> 3
I can have <b>a little</b> love, friendship and support	<input type="checkbox"/> 2
I <b>cannot</b> have <b>any</b> love, friendship and support	<input type="checkbox"/> 1
<b>3. Being independent</b>	
I am able to be <b>completely</b> independent	<input type="checkbox"/> 4
I am able to be independent in <b>many</b> things	<input type="checkbox"/> 3
I am able to be independent in <b>a few</b> things	<input type="checkbox"/> 2
I am <b>unable</b> to be at all independent	<input type="checkbox"/> 1
<b>4. Achievement and progress</b>	
I can achieve and progress in <b>all</b> aspects of my life	<input type="checkbox"/> 4
I can achieve and progress in <b>many</b> aspects of my life	<input type="checkbox"/> 3
I can achieve and progress in <b>a few</b> aspects of my life	<input type="checkbox"/> 2
I <b>cannot</b> achieve and progress in <b>any</b> aspects of my life	<input type="checkbox"/> 1
<b>5. Enjoyment and pleasure</b>	
I can have <b>a lot</b> of enjoyment and pleasure	<input type="checkbox"/> 4
I can have <b>quite a lot</b> of enjoyment and pleasure	<input type="checkbox"/> 3

I can have <b>a little</b> enjoyment and pleasure	<input type="checkbox"/>	2
I <b>cannot</b> have <b>any</b> enjoyment and pleasure	<input type="checkbox"/>	1

Please ensure you have only shaded **ONE** circle for each of the five groups.

**Subjective Vitality Scale**

Please respond to each of the following statements by indicating the degree to which the statement is true for you in overall over the last two weeks.

In general, over the last 2 weeks...	Not at all		Somewhat		Very	
	True		True		True	
1. I feel alive and full of vitality	<input type="checkbox"/>					
2. I have energy and spirit	<input type="checkbox"/>					
3. I look forward to each day	<input type="checkbox"/>					
4. I nearly always feel alert and awake	<input type="checkbox"/>					
5. I feel I have a lot of energy	<input type="checkbox"/>					

**APPENDIX 2: Material used in Chapter 3**

**Important Other Climate Questionnaire**

Who are the *most important people* in your effort to becoming healthier through regular physical activity? Examples of people who may support you are your partner, best friend, GP, consultant, brother/sister, son/daughter etc. Please select the *two* most important people to you (and indicate their relationship to you; e.g., partner, GP) in the blanks below and then answer the questions with respect to each individual.

My <u>two</u> important persons are:	1. ....	2. ....
	Strongly disagree Disagree Slightly disagree Neither Slightly agree Agree Strongly agree	Strongly disagree Disagree Slightly disagree Neither Slightly agree Agree Strongly agree
1. I feel that my important person provides me with choices and options about physical activity and health	(    }         □    )    }	(    }         □    )    }
2. I feel my important person understands how I see things with respect to my physical activity and health	(    }         □    )    }	(    }         □    )    }
3. My important person conveys confidence in my ability to make changes regarding my physical activity and health	(    }         □    )    }	(    }         □    )    }
4. My important person listens to how I would like to do things regarding my physical activity and health	(    }         □    )    }	(    }         □    )    }
5. My important person encourages me to ask questions	(    }         □    )    }	(    }         □    )    }

about my physical activity to improve my health

6. My important person tries to understand how I see my health-related physical activity before suggesting changes



**The Psychological Need Satisfaction in Exercise Scale**

**The following statements represent different experiences people have when they exercise or engage in physical activity. Please answer the following questions by considering how you TYPICALLY feel while you are engaging in leisure time physical activity you identified in PART 3 of this questionnaire pack.**

	False	Mostly False	More false than true	More true than false	Mostly True	True
1. I feel that I am able to participate in physical activities that are personally challenging	(	}			□	)
2. I feel attached to those who participate in physical activities with me because they accept me for who I am	(	}			□	)
3. I feel like I share a common bond with people who are important to me when we participate in physical activities	(	}			□	)
4. I feel confident I can do even the most challenging exercises/physical activities	(	}			□	)
5. I feel a sense of camaraderie with those people I am active with because we engage in physical activity for the same reasons	(	}			□	)
6. I feel confident in my ability to perform exercises/physical activities that personally challenge me	(	}			□	)
7. I feel close to those I am physically active with as they appreciate how difficult regular engagement in physical activity can be	(	}			□	)
8. I feel free to be physically active in my own way	(	}			□	)
9. I feel free to make my own decisions regarding my participation in physical activity	(	}			□	)
10. I feel capable of doing physical activities that are challenging to me	(	}			□	)
11. I feel like I am in charge of my exercise program decisions	(	}			□	)
12. I feel like I am capable of doing even the most challenging physical activities	(	}			□	)
13. I feel like I have a say in choosing the exercises/physical activities that I do	(	}			□	)
14. I feel connected to the people who I interact with while we participate in physical activity together	(	}			□	)
15. I feel good about the way I am able to complete challenging exercises/physical activities	(	}			□	)
16. I feel like I get along well with other people who I interact with while we are physically active together	(	}			□	)

17. I feel free to choose which exercises/physical activities I participate in



18. I feel like I am the one who decides what exercises I do/physical activities I engage in



**The Godin-Shepard Leisure Time Physical Activity Questionnaire**

Considering a 7-Day period (a week), how many times on the average do you do the following kinds of physical activity or exercise for more that 15 minutes during your free time (write on each line the appropriate number).

**Times Per Week**

**a) Strenuous Physical Activity (Heart Beats Rapidly)**

(i.e. running, jogging, hockey, football, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

\_\_\_\_\_

**b) Moderate Physical Activity (Not Exhausting)**

(i.e. fast walking, gardening, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, popular and folk dancing)

\_\_\_\_\_

**c) Mild Physical Activity (Minimal Effort)**

(i.e. yoga, archery, fishing from river bank, bowling, horseshoes, golf, easy walking)

\_\_\_\_\_

2. Considering a 7-Day period (a week), during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

**Often** (5-7x week)

1.

**Sometimes** (2-4x week)

2.

**Rarely** (1x week)

3.

**Never**

4.

## APPENDIX 3: Material used in Chapter 4

### Demographic information

ID NO.

--	--	--	--	--	--

### Baseline Questionnaire

To complete this questionnaire pack, please **shade** in the circle that corresponds to your answer for each question. For example:



### Background Information

1. Date of Birth: \_\_\_\_\_

2. Age (Years) \_\_\_\_\_

3. Gender:            Male                        Female           

4. Postcode: \_\_\_\_\_

5. First diagnosed with rheumatoid arthritis: \_\_\_\_\_ (mm/yyyy)

6. Are you:

- Married
- Living with a partner
- Single
- Divorced/Separated
- Widow(er)

7. What is the highest educational qualification you have obtained?

- None
- GCSE / O level
- A level/diploma/vocational qualification
- Degree
- Post graduate level
- Other

Please specify \_\_\_\_\_

8. What is your ethnicity?

- White
- Asian or Asian British
- Black or Black British
- Mixed
- Other

Please specify \_\_\_\_\_

### **The International Physical Activity Questionnaire, IPAQ**

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make

you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

**PART 1: JOB-RELATED PHYSICAL ACTIVITY**

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

Yes

No →

***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

\_\_\_\_\_ **days per week**

No vigorous job-related physical activity



***Skip to question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

\_\_\_\_\_ **days per week**

No moderate job-related physical activity



***Skip to question 6***

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

\_\_\_\_\_ **days per week**

No job-related walking



***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

## **PART 2: TRANSPORTATION PHYSICAL ACTIVITY**

**These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.**

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

\_\_\_\_\_ **days per week**

No traveling in a motor vehicle



**Skip to question 10**

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

\_\_\_\_\_ **days per week**

No bicycling from place to place



**Skip to question 12**

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

\_\_\_\_\_ **days per week**

No walking from place to place



**Skip to PART 3:  
HOUSEWORK, HOUSE  
MAINTENANCE, AND  
CARING FOR FAMILY**

13. *How much time did you usually spend on one of those days walking from place to place?*

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

**PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY**

**This section is about some of the physical activities you might have done in the last 7 days in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.**

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

\_\_\_\_\_ **days per week**

No vigorous activity in garden or yard



**Skip to question 16**

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

\_\_\_\_\_ **days per week**

No moderate activity in garden or yard



**Skip to question 18**

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

\_\_\_\_\_ **days per week**

No moderate activity inside home



**Skip to PART 4:  
RECREATION, SPORT  
AND LEISURE-TIME  
PHYSICAL ACTIVITY**

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

#### ***PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY***

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

\_\_\_\_\_ **days per week**

No walking in leisure time



**Skip to question 22**

21. How much time did you usually spend on one of those days **walking** in your leisure time?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

\_\_\_\_\_ **days per week**

No vigorous activity in leisure time



**Skip to question 24**

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

\_\_\_\_\_ **hours per day**

\_\_\_\_\_ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

\_\_\_\_\_ **days per week**

No moderate activity in leisure time      **→ Skip to PART 5: TIME SPENT SITTING**

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

\_\_\_\_\_            **hours per day**  
\_\_\_\_\_            **minutes per day**

***PART 5: TIME SPENT SITTING***

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

\_\_\_\_\_            **hours per day**  
\_\_\_\_\_            **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

\_\_\_\_\_            **hours per day**  
\_\_\_\_\_            **minutes per day**

**This is the end of the questionnaire, thank you for participating.**

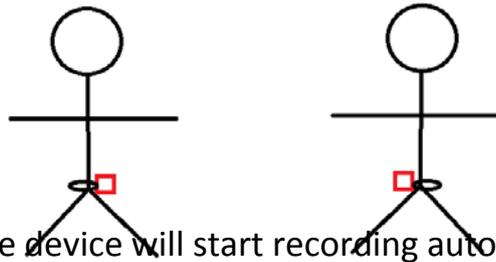
**Accelerometer instruction:**

# Movement Monitor Instructions

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**How to wear the Movement Monitor:**

1. Please, adjust the band to fit your waist size
2. Be sure to wear it firmly on your waist in a comfortable position



3. The device will start recording automatically, you do not need to turn the device on/off
4. Please continue to wear the device for the total recording time (7 days)
5. If possible, please continue to wear when you are asleep
6. If you experience itching or swelling, please remove the device and record the time, and put the device back on once the symptoms have gone.

**Please:**

1. Do not try to open, shake or hit the red box
2. Note that this device is NOT waterproof, therefore please remove it when showering, bathing or swimming
3. Do not wear it on any other part of your body
4. When you take off the device, please be careful not to move or knock it
5. Remember to take care of your movement device.

❖ Thank you for wearing this motion device, and taking into account these instructions. Measuring your movement accurately is important to this research study.

If you have any questions or concerns about this device, please contact:



## APPENDIX 4: Material used in Chapter 5

### Hospital Anxiety and Depression Scale

Please read each item and shade in the circle opposite the reply which comes closest to how you have been feeling **over the last TWO weeks**. Don't take too long thinking about your replies: your immediate reaction to each item will probably be more accurate than a long thought-out response.

**Please shade only ONE circle in each section**

#### **I feel tense or 'wound up':**

Most of the time

A lot of the time

Time to time, occasionally

Not at all

#### **I still enjoy the things I used to enjoy:**

Definitely as much

Not quite as much

Only a little

Hardly at all

#### **I get a sort of frightened feeling as if something awful is about to happen:**

Very definitely and quite badly

Yes, but not too badly

A little, but it doesn't worry me

Not at all

#### **I can laugh and see the funny side of things:**

As much as I always could

Not quite so much now

Definitely not so much now

Not at all

#### **Worrying thoughts go through my mind:**

A great deal of the time

A lot of the time

From time to time but not too often

Only occasionally

#### **I feel cheerful:**

Not at all

Not often

#### **I feel as if I am slowed down:**

Nearly all the time

Very often

Sometimes

Not at all

#### **I get a sort of frightened feeling like 'butterflies' in the stomach**

Not at all

Occasionally

Quite often

Very often

#### **I have lost interest in my appearance:**

Definitely

I don't take so much care as I should

I may not take quite as much care

I take just as much care as ever

#### **I feel restless as if I have to be on the move:**

Very much indeed

Quite a lot

Not very much

Not at all

#### **I look forward with enjoyment to things:**

As much as I ever did

Rather less than I used to

Definitely less than I used to

Hardly at all

#### **I get sudden feelings of panic:**

Very often indeed

Quite often



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