

## Autonomy support, light physical activity and psychological well-being in Rheumatoid Arthritis:

Fenton, Sally; Veldhuijzen van Zanten, Joachimina; Metsios, George S; Rouse, Peter C; Yu, Chen-an; Kitas, George; Duda, Joan

DOI:

[10.1016/j.mhpa.2017.12.002](https://doi.org/10.1016/j.mhpa.2017.12.002)

License:

Creative Commons: Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)

*Document Version*

Peer reviewed version

*Citation for published version (Harvard):*

Fenton, S, Veldhuijzen van Zanten, J, Metsios, GS, Rouse, PC, Yu, C, Kitas, G & Duda, J 2018, 'Autonomy support, light physical activity and psychological well-being in Rheumatoid Arthritis: A cross-sectional study', *Mental Health and Physical Activity*, vol. 14, pp. 11-18. <https://doi.org/10.1016/j.mhpa.2017.12.002>

[Link to publication on Research at Birmingham portal](#)

**Publisher Rights Statement:**

DOI: 10.1016/j.mhpa.2017.12.002

**General rights**

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

**Take down policy**

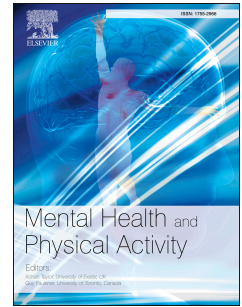
While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact [UBIRA@lists.bham.ac.uk](mailto:UBIRA@lists.bham.ac.uk) providing details and we will remove access to the work immediately and investigate.

# Accepted Manuscript

Autonomy support, light physical activity and psychological well-being in Rheumatoid Arthritis: A cross-sectional study

Sally A.M. Fenton, Jet JCS. Veldhuijzen van Zanten, George S. Metsios, Peter C. Rouse, Chen-an Yu, George D. Kitas, Joan L. Duda



PII: S1755-2966(17)30064-9

DOI: [10.1016/j.mhpa.2017.12.002](https://doi.org/10.1016/j.mhpa.2017.12.002)

Reference: MHPA 236

To appear in: *Mental Health and Physical Activity*

Received Date: 3 July 2017

Revised Date: 6 December 2017

Accepted Date: 9 December 2017

Please cite this article as: Fenton, S.A.M., Veldhuijzen van Zanten, J.J., Metsios, G.S., Rouse, P.C., Yu, C.-a., Kitas, G.D., Duda, J.L., Autonomy support, light physical activity and psychological well-being in Rheumatoid Arthritis: A cross-sectional study, *Mental Health and Physical Activity* (2018), doi: 10.1016/j.mhpa.2017.12.002.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

**Autonomy support, light physical activity and psychological well-being in  
Rheumatoid Arthritis: a cross-sectional study**

**Running title:** Correlates of light-intensity PA in RA

Sally AM Fenton, PhD<sup>1,3</sup>, Jet JCS Veldhuijzen van Zanten, PhD<sup>1,3</sup>, George S  
Metsios, PhD<sup>1,2,3</sup>, Peter C Rouse, PhD<sup>4</sup>, Chen-an Yu, PhD<sup>1</sup>, George D Kitas, PhD<sup>1,3</sup>,  
Joan L Duda, PhD<sup>1</sup>

<sup>1</sup>School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham,  
Birmingham, UK

<sup>2</sup>Faculty of Health Education and Wellbeing, University of Wolverhampton, West  
Midlands, UK

<sup>3</sup>Department of Rheumatology, Russells Hall Hospital, Dudley Group NHS  
Foundation Trust, Dudley, UK

<sup>4</sup>Department for Health, University of Bath

**Corresponding author:** Sally A M Fenton, School of Sport, Exercise and  
Rehabilitation Sciences, University of Birmingham, Edgbaston, Birmingham (UK),  
B15 2TT. Email: [s.a.m.fenton@bham.ac.uk](mailto:s.a.m.fenton@bham.ac.uk). Tel: 0121 4147674

**Tables:** 2

**Figures:** 2

**Conflicts of Interest:** The authors declare no conflict of interest.

**Funding:** The Physical Activity in Rheumatoid Arthritis study (PARA) was funded  
by the Medical Research Council (National Prevention Initiative Phase 3; Trial  
Number: ISRCTN04121489).

**Acknowledgements:** The authors would like to acknowledge all of the participants  
who gave their time to participate in the study. In addition, we would like to thank the  
staff at the Clinical Research Unit and Russells Hall Hospital who provided assistance  
with data collection.

1 **Autonomy support, light physical activity and psychological well-being in Rheumatoid**

2 **Arthritis: a cross-sectional study**

3 **Running title:** Correlates of light-intensity PA in RA

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

## 1 Abstract

2           **Background:** Participation in physical activity may improve psychological well-  
3 being among people with Rheumatoid Arthritis (RA). This study examined the implications  
4 of autonomy support for physical activity, on objectively assessed light physical activity  
5 (*LPA*) engagement, and in turn, psychological well-being in RA. In addition, the role of  
6 lower-limb functional disability in these associations was investigated. **Methods:** RA patients  
7 (N = 50) completed questionnaires assessing 1) autonomy support for physical activity [from  
8 a patient-specified important other], 2) functional disability to 'rise' and 'walk' (functional  
9 disabilityRW), 3) depressive symptoms, and 4) subjective vitality. Levels of LPA [100-2019  
10 counts/minute], were calculated from 7-days of accelerometry. **Results:** Path analysis  
11 supported a model ( $\chi^2(2) = 2.44, p = .304, CFI = .99, SRMR = .05, RMSEA = .07$ ) in which  
12 important other autonomy support for physical activity significantly and positively predicted  
13 LPA engagement. In turn, LPA was significantly and positively associated with subjective  
14 vitality, and significantly and negatively linked to depressive symptoms. These associations  
15 were observed independently of adverse direct relationships between Functional  
16 disabilityRW with depressive symptoms and subjective vitality. **Conclusions:** Important  
17 other autonomy support for physical activity may hold positive consequences for LPA  
18 engagement and related mental health states in RA, independent of the negative effects of  
19 lower-limb functional disability.

20  
21 **Key words:** Functional disability, Autonomy support, Light physical activity, Accelerometer,  
22 Psychological well-being, Rheumatoid Arthritis.

23

24

25

## 1 Introduction

2 Research underlines the benefits of regular participation in physical activity for promoting  
3 more optimal psychological health among both healthy adults and patient cohorts (Bauman,  
4 Merom, Bull, Buchner, & Fiatarone Singh, 2016; Cairns & McVeigh, 2009; Penedo & Dahn,  
5 2005; Windle, Hughes, Linck, Russell, & Woods, 2010). People living with Rheumatoid  
6 Arthritis (RA) frequently report compromised psychological well-being (Gettings, 2010;  
7 Murphy, Sacks, Brady, Hootman, & Chapman, 2012). Thus, participation in physical activity  
8 may prove beneficial for enhancing psychological health in this patient group.

9 To date, the focus of RA studies has been on the psychological health benefits  
10 resulting from participation in physical activity above moderate intensity (i.e.,  $\geq 3$  metabolic  
11 equivalents, METS) (Kelley, Kelley, & Hootman, 2015; Verhoeven et al., 2016; Windle et  
12 al., 2010). However, the reduced functional ability associated with RA, may restrict  
13 individuals' perceived ability to engage and subsequently, overtly participate in moderate  
14 intensity physical activity (Hernandez-Hernandez, Ferraz-Amaro, & Diaz-Gonzalez, 2014;  
15 Sokka et al., 2008; Veldhuijzen van Zanten et al., 2015). Conversely, participation in lower-  
16 intensity physical activities (i.e., light physical activity, 1.6 - 2.9 METS) may be perceived as  
17 relatively more feasible and achievable by people living with RA (Manns, Dunstan, Owen, &  
18 Healy, 2012), and is being increasingly advocated to improve overall health in several other  
19 clinical and ageing populations (Buman et al., 2010; Ekwall, Lindberg, & Magnusson, 2009;  
20 Larsen et al., 2014; Manns et al., 2012; Trinity, 2017). However, studies to date are yet to  
21 investigate the psychological health implications of engagement in light physical activity  
22 (LPA) for people living with RA, as well as factors that may influence engagement in this  
23 behaviour (i.e., determinants).

24 The social environment operating within physical activity settings has been proposed  
25 as a key determinant of physical activity behaviour. For example, Self-determination theory

1 (SDT), suggests where the social environment supports an individual's sense of autonomy  
2 with regards to their physical activity engagement (i.e., it promotes choice and  
3 understanding), this is more likely to encourage the adoption and maintenance of physical  
4 activity behaviour (Chan, Lonsdale, Ho, Yung, & Chan, 2009; Fortier, Duda, Guerin, &  
5 Teixeira, 2012; Milne, Wallman, Guilfoyle, Gordon, & Corneya, 2008). The social  
6 environment is largely created by the interpersonal behaviours of 'significant' or 'important'  
7 others acting within that setting. When considering physical activity in RA, this 'important  
8 other' could be the health care professional (e.g., rheumatology consultant, nurse, or GP) or  
9 other individuals the patient considers relevant to their attempts to be physically active (e.g.,  
10 a spouse, offspring or friend) (Edmunds, 2007; Hardcastle, Blake, & Hagger, 2012; Williams,  
11 2002).

12         Recent research revealed autonomy support for physical activity provided by  
13 'important others', was linked to higher levels of self-reported total physical activity  
14 (comprising light, moderate and vigorous) among people living with RA (Yu et al., 2015).  
15 However, this study did not examine the role of autonomy support for LPA participation  
16 specifically, and a reliance on self-report somewhat limits the validity of these findings. Thus,  
17 research is required to investigate the implications of autonomy support for objectively  
18 assessed LPA engagement in RA, to determine whether the social environment represents a  
19 salient and modifiable determinant of LPA in these patients. In turn, investigating the extent  
20 to which variability in LPA (predicted by autonomy support) is associated with psychological  
21 well-being among people living with RA, will help to establish the potential value of  
22 interventions focused on creating autonomy supportive physical activity environments for  
23 improving psychological well-being among this patient group.

24         Upon investigating these associations, we must still consider the possibility that the  
25 compromised physical function symptomatic of RA may represent a barrier to even low-

1 intensity physical activity engagement for these patients. Of particular relevance is functional  
2 disability related to standing and walking – two common light intensity activities. Indeed,  
3 walking is reported as the most common behaviour undertaken by people living with RA, and  
4 light intensity walking (including standing incidental and sporadic movement) comprises  
5 approximately 90% of ambulatory behaviour (Paul et al., 2014). Accordingly, an individual's  
6 disability related to 'standing' and 'walking' (i.e., lower-limb functional disability) should be  
7 taken into account when seeking to identify modifiable determinants of LPA participation in  
8 RA (e.g., the social environment).

9         The primary aim of this research was therefore to examine the implications of  
10 autonomy support for physical activity *and* lower-limb functional disability, for levels of  
11 objectively assessed LPA engagement, and associated positive and negative indicators of  
12 well-being in RA. Specifically, this study sought to examine the sequential associations  
13 between perceived autonomy support from a participant specified 'important other', lower-  
14 limb functional disability to 'rise' and to 'walk', accelerometer assessed LPA, and in turn,  
15 depressive symptoms and subjective vitality among people living with RA (Figure 1). These  
16 two outcomes are particularly pertinent to psychological functioning in RA. Specifically,  
17 depression represents a highly prevalent co-morbidity in RA (Ang, Choi, Kroenke, & Wolfe,  
18 2005; Margaretten, Julian, Katz, & Yelin, 2011; Treharne et al., 2005), and subjective vitality  
19 provides an indication of an individuals overall optimal psychological functioning (Rouse et  
20 al., 2015; Ryan & Deci, 2001).

21         It was hypothesised that higher lower-limb functional disability (poorer function),  
22 would be negatively associated with LPA engagement. It was also expected that perceived  
23 'important other' autonomy support would be *independently* and positively associated with  
24 LPA, and that LPA would be subsequently positively related to subjective vitality, and  
25 negatively associated with the prevalence of depressive symptoms (Figure 1). That is, we



1 propose that autonomy support for physical activity predicts variability in LPA, to the degree  
2 it will hold positive implications for psychological well-being among people living with RA,  
3 after taking into account lower-limb functional disability.

#### 4 **Methods**

##### 5 **Participants**

6 Patients with RA were recruited as part of the xxxxx study (Trial Number:xxxxx).  
7 The xxxxx study was a randomised controlled trial, with the aim of promoting self-  
8 determined motivation for exercise engagement and improving cardiorespiratory fitness (xxxx  
9 *study reference*). Baseline data were used to answer the current research questions. The study  
10 was granted ethical approved by the local National Health Service Research Ethics  
11 Committee (*reference: xxxxx*).

##### 12 **Recruitment and protocol**

13 Information sheets were distributed to interested participants attending Rheumatology  
14 outpatient clinics at xxxxx Hospital (xxxxx NHS Foundation Trust). In total, 115 participants  
15 ( $\text{Mage} = 53.98 \pm 12.47$  years) were recruited to the xxxxx study and provided informed  
16 consent. Questionnaire data were collected from participants during appointments at xxxxx  
17 Hospital. Following this, accelerometer data were collected over 7 days among a sub-  
18 subsample of willing participants ( $N = 97$ ). The full xxxxx study protocol is detailed  
19 elsewhere (*xxxx study reference*).

##### 20 **Measures**

###### 21 ***Important other Autonomy Support for Physical Activity***

22 Important other support for physical activity (here-on referred to as autonomy  
23 support) was assessed using an adapted version of the Important Other Climate Questionnaire  
24 (IOCQ) (Williams et al., 2006). Participants were first asked to indicate who they consider to  
25 be the 'most important person in their effort to engage in physical activity' (e.g., a spouse,

1 sibling, offspring, friend). Following this, participants responded to 6 statements regarding  
2 the degree of perceived autonomy for physical activity provided by their important other, as  
3 follows; 1) I feel that my important other has provided me with choices and options in  
4 regards to my physical activity, 2) I feel my important other understands how I see things  
5 with respect to my physical activity participation, 3) my important other conveys confidence  
6 in my ability to make changes regarding my physical activity participation, 4) my important  
7 other listens to how I would like to do things regarding physical activity, 5) my important  
8 other encourages me to ask questions about physical activity, 6) my important other tries to  
9 understand how I see my physical activity participation before suggesting any changes.  
10 Responses were given on a 7-point Likert scale ranging from 1 (strongly disagree) to 7  
11 (strongly agree). The IOCQ demonstrated high internal reliability in this sample ( $\alpha = .92$ ).

### 12 ***Functional disability to 'rise' and 'walk'***

13 Participants' functional ability to 'rise' and to 'walk' (functional disabilityRW) was  
14 determined using the 'rising' and 'walking' subscales of the Stanford Health Assessment  
15 Questionnaire (HAQ) (Kirwan & Reeback, 1986) Following the stem, "Are you able to....",  
16 respondents were asked to rate on a scale from 0 (without any difficulty) to 3 (unable to do),  
17 the extent to which they are able to undertake functions related to *rising* (functions; 1) stand  
18 up from an armless straight chair and 2) get in and out of bed) and *walking* (functions; 1)  
19 walk outside on flat ground and 2) climb up five stairs). The score given to each subscale is  
20 the highest score reported across the two questions. Higher scores represent higher functional  
21 disability (i.e., poorer ability to 'rise' and 'walk'). A mean functional disabilityRW score was  
22 derived (to represent lower-limb functional disability), as the average score from the two  
23 subscales. Overall functional disability was also determined from the HAQ and is reported  
24 herein for descriptive purposes.

25

## 1 ***Objectively assessed physical activity behaviours***

2 LPA was assessed using GT3X accelerometers (Actigraph). Participants wore the  
3 accelerometer on the right hip for 7 consecutive days, removing only for water-based  
4 activities (e.g., swimming and bathing) (Semanik et al., 2010; Trost, McIver, & Pate, 2005).  
5 The GT3X detected movements over sixty-second epochs in this study. Movement counts  
6 within each minute-epoch were summed and converted to activity counts that were  
7 interpreted to determine LPA engagement [i.e.,  $\geq 100$  and  $< 2020$  counts per minute, (cpm)]  
8 (Troiano et al., 2008).

### 9 *Accelerometer data reduction*

10 Actilife software (version 6.2) was used to analyse the data. Data pertaining to waking  
11 hours [i.e., 7:00am–10:30pm - identified from visual inspection of graphical data (Tudor-  
12 Locke et al., 2015)], were downloaded and cleaned to check for spurious values and periods  
13 of non-wear. Non-wear time was determined by identifying strings of uninterrupted zero  
14 counts recorded by the accelerometer, for periods of  $> 60$  minutes, allowing for 2 minutes of  
15 counts  $< 100$  (Troiano et al., 2008). Data were retained for subsequent statistical analyses  
16 where participants accumulated  $\geq 10$  waking hours wear, on  $\geq 4$  days, including a weekend  
17 day (Troiano et al., 2008). On this basis,  $N = 36$  participants were excluded from analyses  
18 due to invalid accelerometer data. The outcome variable derived was minutes per day spent in  
19 LPA. To adjust for variability in accelerometer wear time, LPA min/day was converted to  
20 represent a % of daily accelerometer wear spent engaged in LPA (i.e., %LPA per day; [LPA  
21 (min/day)  $\div$  accelerometer wear time (min/day)]  $\times 100$ ).

## 22 ***Psychological well-being***

### 23 *Depressive symptoms*

24 Depression is an independent risk factor for mortality among people living with RA  
25 (Ang et al., 2005; Treharne et al., 2005), and is estimated to affect up to 42% of this patient

1 group (Margaretten et al., 2011). Prevalence of depressive symptoms was assessed using the  
2 depressive symptom subscale of the Hospital Anxiety and Depression Scale (HADS)  
3 (Zigmond & Snaith, 1983). The HADS requires patients to rate the extent to which they agree  
4 with 7 statements representing depressive symptoms (e.g., “I feel cheerful”) via a 4-point  
5 scoring system (ranging from 0 to 3). The HADS has been validated previously in RA  
6 (Treharne, Lyons, Booth, & Kitas, 2007) and internal reliability of the HADS depressive  
7 symptom subscale in this study was acceptable ( $\alpha = .81$ ).

#### 8 *Subjective Vitality*

9 Subjective vitality (e.g., feeling alive, full of energy and spirit) provides an indication  
10 of the extent to which an individual is experiencing optimal psychological functioning –  
11 referred to as *eudaimonic* well-being (Rouse et al., 2015; Ryan & Deci, 2001). Subjective  
12 vitality is considered to have an internal locus of causality, which is influenced by both  
13 physical (e.g., rheumatic pain) and psychological factors. It is an individual’s own perceived  
14 meaning behind these factors that determine the degree of energy, vitality and spirit felt. For  
15 people with RA, an individual’s subjective vitality will therefore provide important  
16 information regarding their overall psychological functioning, within the context of their  
17 rheumatic disease.

18 Participants’ feelings of personal energy were determined using the Subjective  
19 Vitality Scale (SVS) (Ryan & Frederick, 1997). Following the stem... “During the past 3-4  
20 weeks, in my everyday life...”, participants are asked to respond to 5 statements (e.g., “I feel  
21 alive and full of spirit”) on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5  
22 (strongly agree). The SVS demonstrated high internal reliability in this study ( $\alpha = .93$ ) and  
23 has recently been validated for use in RA (Rouse et al., 2015).

24

25

## 1 **Statistical analyses**

2 Kolmogorov-Smirnov tests of normality were conducted and non-normally distributed  
3 data were log-transformed for use in subsequent analyses. Where transformations did not  
4 reduce data skewness (Kolmogorov-Smirnov,  $p < .05$ , Table 1), non-parametric statistical  
5 tests were used in analyses as appropriate.

## 6 ***Preliminary analysis***

7 All preliminary analyses were conducted on participants providing valid  
8 accelerometer data ( $N = 61$ ), using SPSS (version 22). Independent samples t-tests, Mann-  
9 Whitney U Tests and chi-squared tests confirmed that participants excluded on the basis of  
10 missing accelerometer data ( $N = 36$ ) did not differ from those included in terms of age,  
11 gender, self-reported functional disabilityRW, perceptions of autonomy support, subjective  
12 vitality and depressive mood (all  $p$ 's  $> .05$ ).

13 Descriptive statistics were calculated and independent samples t-tests and correlation  
14 analyses conducted to examine whether participant sex and age, were associated with light  
15 physical activity and wellbeing variables. Where significant associations were observed,  
16 variables were adjusted for in path models.

## 17 ***Correlation analysis***

18 Bivariate correlations between autonomy support for physical activity, functional  
19 disabilityRW, light physical activity and positive/negative well-being outcomes were  
20 computed. In order to adjust for inter-participant variability in daily accelerometer wear-time,  
21 LPA was modelled as %LPA per day in both correlation and subsequent path analysis.

## 22 ***Path analyses***

23 Path analysis was employed to examine the associations between autonomy support,  
24 functional disabilityRW, LPA, depressive symptoms and subjective vitality. In brief, this  
25 approach involves stipulating hypothesised associations or 'paths' between variables of

1 interest, in order to specify a causal model (e.g., Figure 1). The relationships specified within  
2 the model are then analysed simultaneously, to investigate the extent to which the current  
3 multivariate set of non-experimental data ‘fits’ with the hypothesised causal model.  
4 Analytically, this approach is an advance over correlation and traditional regression analysis  
5 as it enables exploration of how a set of variables relate to each other, including analysis of  
6 multiple dependent variables. For example, it allows us to examine if a hypothesised  
7 dependent variable (e.g., LPA), is also an independent variable for other dependent variables  
8 (e.g., vitality and depression). In addition, path analysis affords the ability to examine both  
9 direct *and* indirect effects. This means the possible indirect contribution of an independent  
10 variable on a dependent variable (e.g., via LPA) is not discounted where a direct association  
11 is not evident.

12 Path analysis with maximum likelihood estimation was employed in conjunction with  
13 the bootstrapping procedure to test the hypothesised model, as depicted in Figure 1. Previous  
14 research has shown this approach to be superior to alternative tests with respect to Type 1  
15 error rates and power (Preacher & Hayes, 2008; Shrout & Bolger, 2002). Thus, it was  
16 deemed appropriate given the study sample size. Model fit was evaluated using the chi-square  
17 statistic ( $\chi^2$ ), comparative fit index (CFI), root square mean error of approximation (RMSEA,  
18 90% CI and PCLOSE], and standardised root mean square residual (SRMR). A non-  
19 significant  $\chi^2$  ( $p = < .05$ ), a CFI  $> .90$ , and an SRMR and RMSEA of  $< .10$  specify reasonable  
20 fit of the model to the data (Hu, 1999). For the RMSEA, a  $p$  of close fit [PCLOSE] statistic  
21  $> .05$  also indicates a well-fitting model. In the instance where CFI is  $> .95$ , the model is  
22 considered to demonstrate excellent fit to the data. The strength and direction of path  
23 coefficients were also considered in assessing the validity of the models. Standardised path  
24 coefficients corresponding to ( $\beta =$ ) 0.1, 0.3 and 0.5 were interpreted as small, medium and  
25 large effect sizes, respectively. Indirect effects were determined via examination of the

1 bootstrap bias-corrected 95% confidence intervals. Specifically, the indirect effects of  
2 autonomy support and functional disabilityRW, on depressive symptoms and subjective  
3 vitality (via LPA) were examined.

4 All path analysis was conducted using AMOS (version 22). As required for AMOS  
5 path models, only data representing participants who provided complete valid data points for  
6 all targeted variables were retained for inclusion in path analyses (N = 50) (Arbuckle, 1999).  
7 Participants were excluded on the basis of invalid accelerometer data as previously described  
8 (N = 36), and a further N = 11 participants were excluded due to missing questionnaire data  
9 (SVS, N = 1, IOCQ, N = 10). Analyses established that participants excluded from path  
10 models on the basis of missing data (N = 47) did not differ from those included in terms of  
11 age, gender, self-reported functional disabilityRW, perceptions of autonomy support and  
12 depressive mood (all  $p$ 's > .05). Mann-Whitney U Tests indicated levels of subjective vitality  
13 were significantly higher among included compared to excluded participants ( $U = -2.06$ ,  $p$   
14 = .041, effect size ( $r$ ) = -.20).

## 15 **Results**

### 16 *Descriptive statistics*

17 Descriptive statistics for the targeted variables are reported in Table 1. Data are  
18 presented for the full sample recruited to the xxxxx study, and separately for those who  
19 provided valid accelerometer data (N = 61). Participants' providing valid data were largely  
20 female (67.2%) and white Caucasian (85.2%). Of these participants, 73.8% reported being  
21 married and/or living with a partner (9.8% single, 1.6% not living with partner, 6.6%  
22 divorced, 4.9% widowed, missing data = 3.3%), and 49.2% reported being in current  
23 employment (34.4% retired, 4.9% unable to work due to arthritis, 3.3% homemaker, 3.3%  
24 unemployed, missing data = 4.9%).

1 Results revealed a degree of functional disabilityRW of between 0 (without any  
2 difficulty) and 1 (with some difficulty) [*NB*: overall functional disability from eight HAQ  
3 dimensions,  $M \pm SD = .67 \pm .58$ ]. On average, participants engaged in 4.5 hours of LPA per  
4 day and reported moderate to high levels of autonomy support for physical activity from their  
5 identified important other. Average prevalence of depressive mood was below the proposed  
6 clinical cut-off of  $\geq 8$  for probable depression, and subjective vitality was moderate to high  
7 for this sample of RA patients. Independent samples-tests and correlation analysis revealed  
8 participants' sex and age were not associated with LPA or wellbeing outcomes (all  $p$ 's  $>.05$ ,  
9 i.e., no adjustments were made for these variables in path models).

#### 10 ***Correlation analyses***

11 Results of bivariate correlations are displayed in Table 2. Analysis revealed  
12 perceptions of autonomy support were significantly positively related to %LPA engagement  
13 and subjective vitality, but were not significantly associated with depressive symptoms.  
14 Functional disabilityRW was not significantly related to %LPA engagement, but was  
15 significantly negatively related to subjective vitality, and significantly positively linked to  
16 depressive symptoms. Finally, a significant positive association was observed between  
17 %LPA and subjective vitality, and a significant negative relationship revealed between LPA  
18 and depressive symptoms.

#### 20 ***Path analysis***

21 *Hypothesised model*: The hypothesised model demonstrated a poor fit to the data ( $\chi^2$   
22 (5) = 22.29  $p = .000$ , CFI = .73, SRMR = .19, RMSEA = .27 (90% CI .00 to .26, PCLOSE =  
23 .16). Modification indices provided by AMOS (Arbuckle, 1999) were consulted in order to  
24 determine if there were problems with the hypothesised model that could be remedied in the  
25 context of the current data. Specifically, modification indices were used to identify  
26 associations between variables within the data set that were not currently specified within the  
27 hypothesised model. Aligned with recommendations regarding model re-specification,



1 modifications to the hypothesised model were made *only* where relationships identified were  
2 conceptually justifiable based on previous research and theoretical assumptions (i.e., SDT)  
3 (MacCallum, 1995). Evaluation of modification indices demonstrated that re-specification of  
4 the model to stipulate direct paths from; 1) functional disabilityRW to depressive symptoms,  
5 2) functional disabilityRW to subjective vitality, and 3) autonomy support to subjective  
6 vitality, would improve the fit between the model and the data. This is in agreement with  
7 results revealed in bivariate correlation analyses and consequently, the hypothesised model  
8 was revised and re-tested in accordance with these specifications (Figure 2).

9 *Re-specified model:* The revised model demonstrated an excellent fit to the data  
10 (Figure 2,  $\chi^2 (2) = 2.44$   $p = .304$ , CFI = .99, SRMR = .05, RMSEA = .07 (90% CI .00 to .30,  
11 PCLOSE = .34). Results revealed autonomy support for physical activity significantly  
12 positively predicted %LPA engagement, which in turn, was significantly positively related to  
13 subjective vitality, and significantly negatively associated with depressive symptoms.  
14 Functional disability RW was not associated with %LPA engagement. All significant  
15 associations were of a small to moderate effect size ( $\beta = \geq .2$  and  $< .5$ ). Examination of  $R^2$   
16 values indicated autonomy support for physical activity accounted for 15% of the variance in  
17 %LPA ( $R^2 = .15$ ). This subsequently predicted 4% of the variance in both subjective vitality  
18 and depressive symptoms ( $R^2 = .04$ ).

19 *Indirect effects:* Perceptions of autonomy support demonstrated a significant negative  
20 indirect effect on depressive symptoms, ( $\beta = -.12$ , 95% CI:  $-.26$  to  $-.02$ ), and a significant  
21 positive indirect effect on subjective vitality ( $\beta = .10$ , 95% CI:  $.01$  to  $.28$ ) via LPA. No  
22 significant indirect effect of functional disabilityRW on depressive symptoms or subjective  
23 vitality via LPA was observed (depressive symptoms,  $\beta = -.02$ , 95% CI:  $-.13$  to  $.06$ ,  
24 subjective vitality,  $\beta = .02$ , 95% CI:  $-.05$  to  $.13$ ).

1            *Direct effects:* Model re-specification enabled investigation of direct effects;  
2 functional disabilityRW was significantly negatively associated with subjective vitality, and  
3 significantly positively associated with depressive symptoms, accounting for 18% and 23%  
4 of the variability in these outcomes, respectively (subjective vitality,  $R^2 = .18$ ; depressive  
5 symptoms,  $R^2 = .23$ ). Perceptions of autonomy support for physical activity were  
6 significantly positively associated with subjective vitality, predicting 16% of the variability in  
7 this outcome ( $R^2 = .16$ ).

## 8 **Discussion**

9            This cross-sectional study is the first to examine the relationships between autonomy  
10 support for physical activity, lower-limb functional disability, LPA engagement and  
11 indicators of positive and negative psychological well-being in RA. Results revealed that  
12 ‘important other’ autonomy support is beneficially linked to LPA engagement, and in turn,  
13 lower prevalence of depressive symptoms and higher subjective vitality in RA. These  
14 relationships were observed to be independent of the adverse role of self-reported functional  
15 disability to ‘rise’ and to ‘walk’ on psychological well-being states in these patients.

16            Past work has revealed autonomy support for physical activity to be positively  
17 associated with self-reported physical activity engagement among patient groups and the  
18 general population (Duda et al., 2014; Fortier et al., 2012; Milne et al., 2008). Previous  
19 research among older adults, has also demonstrated an association between objectively  
20 assessed LPA with indices of psychological well-being. (Buman et al., 2010; Rennemark,  
21 Lindwall, Halling, & Berglund, 2009). This study extends these findings in three ways. First,  
22 by providing new evidence of an association between autonomy support and objectively  
23 assessed LPA in RA. Second, by highlighting the potential role of LPA for fostering more  
24 optimal psychological well-being in this patient group. Finally, the analytical approach  
25 adopted permitted exploration of a hypothesised causal model, by which autonomy support

1 may influence mental health states among people living with RA, via LPA engagement. That  
2 is, results suggest autonomy support from an ‘important other’ may encourage daily LPA  
3 participation to the extent it may impact positively on psychological health among people  
4 living with RA.

5 Our findings also revealed functional disability to ‘rise’ and ‘walk’, was not  
6 significantly associated with LPA engagement among this group of RA patients. This  
7 supports the contention that LPA (relative to moderate-intensity physical activity) may be  
8 more achievable for people with RA, despite the physical dysfunction symptomatic of this  
9 condition. However, whilst not related to LPA, lower-limb functional disability was observed  
10 to demonstrate direct adverse relationships with both subjective vitality (negatively) and  
11 depressive symptoms (positively). Results therefore substantiate findings from existing  
12 research, which demonstrate the deleterious consequences of functional disability for mental  
13 health in people living with RA (Benka et al., 2014; Wan et al., 2016) (van der Heide et al.,  
14 1994). Still, this study demonstrated autonomy support to be related to both subjective  
15 vitality (directly and via LPA) and depressive symptoms (via LPA), independently of the  
16 potential negative effects of lower-limb physical dysfunction on psychological functioning.

17 Establishing the independence of these associations not only improves our  
18 understanding of these relationships, but also serves to advance the management of RA  
19 outcomes, providing a framework for the development of effective interventions that aim to  
20 facilitate LPA and optimise psychological functioning in Rheumatic disease. Accordingly,  
21 when considering potential targets for interventions, strategies which ensure ‘important  
22 others’ are equipped with the skills to; support an individual’s choices with regards to  
23 physical activity engagement, provide a meaningful rationale (e.g., improved mental health)  
24 to encourage physical activity participation, and demonstrate understanding of an individual’s  
25 feelings/perspectives towards physical activity (Williams et al., 2006), may exhibit enhanced

1 efficacy for encouraging LPA, and in turn, and improving psychological well-being in this  
2 patient group (Fortier et al., 2012; Ng et al., 2012).

3           Nevertheless, it is still important to consider the implications of current findings  
4 within the broader context of the xxxxx study. Participants recruited to this RCT were ready  
5 to engage in physical activity behavioural change – i.e., they were consenting to be  
6 prescribed (and undertake) an exercise programme to improve their cardiovascular health.  
7 Study participants therefore likely represent a cohort of RA patients at the ‘preparation’ stage  
8 of change in regards to their physical activity (Daley & Duda, 2006; Prochaska &  
9 DiClemente, 1983). It is possible that for individuals with RA who are not ready and  
10 preparing to initiate behavioural change (e.g., at the preceding pre-contemplation/  
11 contemplation stages of change), autonomy support for physical activity may represent a less  
12 prominent determinant of LPA behaviour. Exploration of the extent to which an individuals  
13 ‘readiness to change’ may interact with social environmental factors and psychological well-  
14 being states in regards to their physical activity, represents an interesting avenue for future  
15 research.

16           Similarly, xxxxx study participants reported low-to-moderate functional disability,  
17 limiting the generalisability of our findings to RA patients with more severe physical function.  
18 Moreover, we did not undertake clinical assessment of disease activity (i.e., Disease  
19 Assessment Score-28, DAS-28) to characterise the study sample. Studies employing the  
20 DAS-28 are required to confirm the extent to which autonomy support may contribute to  
21 more optimal mental health (via promoting LPA) among RA patients with more ‘active’ vs.  
22 ‘controlled’ disease.

23           Finally, the cross-sectional design of this study and small sample size should also be  
24 considered when interpreting current results. Specifically, compliance with the accelerometer  
25 protocol (63%) restricted the number of participants available for analyses, and the cross-

1 sectional design limits the extent to which inferences can be made regarding causal direction  
2 of the associations examined. For example, it is possible that a patients' mood state (e.g.,  
3 depressive symptoms) could influence their perceptions of autonomy support. However,  
4 results from experimental studies framed by SDT strongly support the directionality of the  
5 associations as investigated herein (Duda et al., 2014; Fortier et al., 2012; Teixeira, Carraca,  
6 Markland, Silva, & Ryan, 2012). In addition, the sample size is comparable with past  
7 research employing accelerometers coupled with questionnaires to investigate links between  
8 physical activity and self-reported health in RA (Khoja, Almeida, Chester Wasko, Terhorst,  
9 & Piva, 2016).

## 10 **Conclusion**

11 Findings suggest that autonomy support for physical activity provided by an  
12 'important other', is positively related to levels of LPA engagement among people living with  
13 RA. In turn, higher engagement in LPA is beneficially linked to lower prevalence of  
14 depressive symptoms and higher vitality in this patient group. These beneficial associations  
15 are observed independently of the adverse consequences of lower-limb functional disability  
16 for psychological well-being in RA. Results underline the importance of determining avenues  
17 through which 'important others' can be encouraged to provide autonomy support for  
18 physical activity among people with RA, in order to enhance mental health in this patient  
19 group.

20

21

22

23

24

25

1

**References**

- 2 Ang, D. C., Choi, H., Kroenke, K., & Wolfe, F. (2005). Comorbid depression is an  
3 independent risk factor for mortality in patients with rheumatoid arthritis. *J*  
4 *Rheumatol*, 32(6), 1013-1019.
- 5 Arbuckle, J. L. W., W. (1999). *AMOS 4.0 user's guide*: SPSS Incorporated.
- 6 Bauman, A., Merom, D., Bull, F. C., Buchner, D. M., & Fiatarone Singh, M. A. (2016).  
7 Updating the Evidence for Physical Activity: Summative Reviews of the  
8 Epidemiological Evidence, Prevalence, and Interventions to Promote "Active Aging".  
9 *Gerontologist*, 56 Suppl 2, S268-280. doi:10.1093/geront/gnw031
- 10 Benka, J., Nagyova, I., Rosenberger, J., Calfova, A., Macejova, Z., Lazurova, I., . . .  
11 Groothoff, J. W. (2014). Social support as a moderator of functional disability's effect  
12 on depressive feelings in early rheumatoid arthritis: a four-year prospective study.  
13 *Rehabil Psychol*, 59(1), 19-26.
- 14 Buman, M. P., Hekler, E. B., Haskell, W. L., Pruitt, L., Conway, T. L., Cain, K. L., . . . King,  
15 A. C. (2010). Objective light-intensity physical activity associations with rated health  
16 in older adults. *Am J Epidemiol*, 172(10), 1155-1165.
- 17 Cairns, A. P., & McVeigh, J. G. (2009). A systematic review of the effects of dynamic  
18 exercise in rheumatoid arthritis. *Rheumatol Int*, 30(2), 147-158.
- 19 Chan, D. K., Lonsdale, C., Ho, P. Y., Yung, P. S., & Chan, K. M. (2009). Patient motivation  
20 and adherence to postsurgery rehabilitation exercise recommendations: the influence  
21 of physiotherapists' autonomy-supportive behaviors. *Arch Phys Med Rehabil*, 90(12),  
22 1977-1982.
- 23 Daley, A., & Duda, J. L. (2006). Self-determination, stage of readiness to change for  
24 exercise, and frequency of physical activity in young people. *European Journal of*  
25 *Sport Science*, 6(4).
- 26 Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *J*  
27 *Pers Soc Psychol*, 53(6), 1024-1037.
- 28 Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY:  
29 University of Rochester Press.
- 30 Duda, J. L., Williams, G. C., Ntoumanis, N., Daley, A., Eves, F. F., Mutrie, N., . . . Jolly, K.  
31 (2014). Effects of a standard provision versus an autonomy supportive exercise  
32 referral programme on physical activity, quality of life and well-being indicators: a  
33 cluster randomised controlled trial. *Int J Behav Nutr Phys Act*, 11, 10.
- 34 Edmunds, J. N., N.; Duda, J.L.;. (2007). Adherence and well-being in overweight and obese  
35 patients referred to an exercise on prescription scheme: A self-determination theory  
36 perspective. *Psychology of Sport and Exercise*, 8, 18.
- 37 Ekwall, A., Lindberg, A., & Magnusson, M. (2009). Dizzy - why not take a walk? Low level  
38 physical activity improves quality of life among elderly with dizziness. *Gerontology*,  
39 55(6), 652-659.
- 40 Fortier, M. S., Duda, J. L., Guerin, E., & Teixeira, P. J. (2012). Promoting physical activity:  
41 development and testing of self-determination theory-based interventions. *Int J Behav*  
42 *Nutr Phys Act*, 9, 20.

- 1 Gettings, L. (2010). Psychological well-being in rheumatoid arthritis: a review of the  
2 literature. *Musculoskeletal Care*, 8(2), 99-106.
- 3 Hardcastle, S., Blake, N., & Hagger, M. S. (2012). The effectiveness of a motivational  
4 interviewing primary-care based intervention on physical activity and predictors of  
5 change in a disadvantaged community. *J Behav Med*, 35(3), 318-333.
- 6 Hernandez-Hernandez, V., Ferraz-Amaro, I., & Diaz-Gonzalez, F. (2014). Influence of  
7 disease activity on the physical activity of rheumatoid arthritis patients. *Rheumatology*  
8 (*Oxford*), 53(4), 722-731.
- 9 Hu, L. B., P.M. (1999). Cut-off criteria for fit indexes in covariance structural equation  
10 analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*,  
11 6, 55.
- 12 Kelley, G. A., Kelley, K. S., & Hootman, J. M. (2015). Effects of exercise on depression in  
13 adults with arthritis: a systematic review with meta-analysis of randomized controlled  
14 trials. *Arthritis Res Ther*, 17, 21.
- 15 Khoja, S. S., Almeida, G. J., Chester Wasko, M., Terhorst, L., & Piva, S. R. (2016).  
16 Association of Light-Intensity Physical Activity With Lower Cardiovascular Disease  
17 Risk Burden in Rheumatoid Arthritis. *Arthritis Care Res (Hoboken)*, 68(4), 424-431.
- 18 Kirwan, J. R., & Reeback, J. S. (1986). Stanford Health Assessment Questionnaire modified  
19 to assess disability in British patients with rheumatoid arthritis. *Br J Rheumatol*,  
20 25(2), 206-209.
- 21 Larsen, R. N., Kingwell, B. A., Sethi, P., Cerin, E., Owen, N., & Dunstan, D. W. (2014).  
22 Breaking up prolonged sitting reduces resting blood pressure in overweight/obese  
23 adults. *Nutr Metab Cardiovasc Dis*, 24(9), 976-982.
- 24 MacCallum, R. C. (1995). Model specification: Procedures, strategies, and related issues. In  
25 R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications*  
26 (pp. 16-36). Newbury Park, CA: Sage.
- 27 Manns, P. J., Dunstan, D. W., Owen, N., & Healy, G. N. (2012). Addressing the nonexercise  
28 part of the activity continuum: a more realistic and achievable approach to activity  
29 programming for adults with mobility disability? *Phys Ther*, 92(4), 614-625.
- 30 Margaretten, M., Julian, L., Katz, P., & Yelin, E. (2011). Depression in patients with  
31 rheumatoid arthritis: description, causes and mechanisms. *Int J Clin Rheumatol*, 6(6),  
32 617-623.
- 33 Milne, H. M., Wallman, K. E., Guilfoyle, A., Gordon, S., & Corneya, K. S. (2008). Self-  
34 determination theory and physical activity among breast cancer survivors. *J Sport*  
35 *Exerc Psychol*, 30(1), 23-38.
- 36 Murphy, L. B., Sacks, J. J., Brady, T. J., Hootman, J. M., & Chapman, D. P. (2012). Anxiety  
37 and depression among US adults with arthritis: prevalence and correlates. *Arthritis*  
38 *Care Res (Hoboken)*, 64(7), 968-976.
- 39 Ng, J. Y., Ntoumanis, N., Thogersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J. L., &  
40 Williams, G. C. (2012). Self-Determination Theory Applied to Health Contexts: A  
41 Meta-Analysis. *Perspect Psychol Sci*, 7(4), 325-340.
- 42 Paul, L., Rafferty, D., Marshall-McKenna, R., Gill, J. M., McInnes, I., Porter, D., &  
43 Woodburn, J. (2014). Oxygen cost of walking, physical activity, and sedentary  
44 behaviours in rheumatoid arthritis. *Scand J Rheumatol*, 43(1), 28-34.

- 1 Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical  
2 health benefits associated with physical activity. *Curr Opin Psychiatry*, *18*(2), 189-  
3 193.
- 4 Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing  
5 and comparing indirect effects in multiple mediator models. *Behav Res Methods*,  
6 *40*(3), 879-891.
- 7 Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of  
8 smoking: toward an integrative model of change. *J Consult Clin Psychol*, *51*(3), 390-  
9 395.
- 10 Rennemark, M., Lindwall, M., Halling, A., & Berglund, J. (2009). Relationships between  
11 physical activity and perceived qualities of life in old age. Results of the SNAC study.  
12 *Aging Ment Health*, *13*(1), 1-8.
- 13 Rouse, P. C., Veldhuijzen Van Zanten, J. J., Ntoumanis, N., Metsios, G. S., Yu, C. A., Kitas,  
14 G. D., & Duda, J. L. (2015). Measuring the positive psychological well-being of  
15 people with rheumatoid arthritis: a cross-sectional validation of the subjective vitality  
16 scale. *Arthritis Res Ther*, *17*, 312.
- 17 Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: subjective vitality  
18 as a dynamic reflection of well-being. *J Pers*, *65*(3), 529-565.
- 19 Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: a review of research  
20 on hedonic and eudaimonic well-being. *Annu Rev Psychol*, *52*, 141-166.
- 21 Semanik, P., Song, J., Chang, R. W., Manheim, L., Ainsworth, B., & Dunlop, D. (2010).  
22 Assessing physical activity in persons with rheumatoid arthritis using accelerometry.  
23 *Med Sci Sports Exerc*, *42*(8), 1493-1501.
- 24 Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies:  
25 new procedures and recommendations. *Psychol Methods*, *7*(4), 422-445.
- 26 Sokka, T., Hakkinen, A., Kautiainen, H., Maillefert, J. F., Toloza, S., Mork Hansen, T., . . .  
27 Group, Q.-R. (2008). Physical inactivity in patients with rheumatoid arthritis: data  
28 from twenty-one countries in a cross-sectional, international study. *Arthritis Rheum*,  
29 *59*(1), 42-50.
- 30 Teixeira, P. J., Carraca, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise,  
31 physical activity, and self-determination theory: a systematic review. *Int J Behav Nutr*  
32 *Phys Act*, *9*, 78. doi:10.1186/1479-5868-9-78
- 33 Treharne, G. J., Hale, E. D., Lyons, A. C., Booth, D. A., Banks, M. J., Erb, N., . . . Kitas, G.  
34 D. (2005). Cardiovascular disease and psychological morbidity among rheumatoid  
35 arthritis patients. *Rheumatology (Oxford)*, *44*(2), 241-246.
- 36 Treharne, G. J., Lyons, A. C., Booth, D. A., & Kitas, G. D. (2007). Psychological well-being  
37 across 1 year with rheumatoid arthritis: coping resources as buffers of perceived  
38 stress. *Br J Health Psychol*, *12*(Pt 3), 323-345.
- 39 Trinity, J. D. (2017). Something is definitely better than nothing: simple strategies to prevent  
40 vascular dysfunction. *Clin Sci (Lond)*, *131*(11), 1055-1058. doi:10.1042/CS20170130
- 41 Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008).  
42 Physical activity in the United States measured by accelerometer. *Med Sci Sports*  
43 *Exerc*, *40*(1), 181-188.



- 1 Trost, S. G., McIver, K. L., & Pate, R. R. (2005). Conducting accelerometer-based activity  
2 assessments in field-based research. *Med Sci Sports Exerc*, 37(11 Suppl), S531-543.
- 3 Tudor-Locke, C., Barreira, T. V., Schuna, J. M., Jr., Mire, E. F., Chaput, J. P., Fogelholm,  
4 M., . . . Group, I. R. (2015). Improving wear time compliance with a 24-hour waist-  
5 worn accelerometer protocol in the International Study of Childhood Obesity,  
6 Lifestyle and the Environment (ISCOLE). *Int J Behav Nutr Phys Act*, 12, 11.
- 7 van der Heide, A., Jacobs, J. W., van Albada-Kuipers, G. A., Kraaimaat, F. W., Geenen, R.,  
8 & Bijlsma, J. W. (1994). Physical disability and psychological well being in recent  
9 onset rheumatoid arthritis. *J Rheumatol*, 21(1), 28-32.
- 10 Veldhuijzen van Zanten, J. J., Rouse, P. C., Hale, E. D., Ntoumanis, N., Metsios, G. S., Duda,  
11 J. L., & Kitas, G. D. (2015). Perceived Barriers, Facilitators and Benefits for Regular  
12 Physical Activity and Exercise in Patients with Rheumatoid Arthritis: A Review of  
13 the Literature. *Sports Med*, 45(10), 1401-1412.
- 14 Verhoeven, F., Tordi, N., Prati, C., Demougeot, C., Mougin, F., & Wendling, D. (2016).  
15 Physical activity in patients with rheumatoid arthritis. *Joint Bone Spine*, 83(3), 265-  
16 270. doi:10.1016/j.jbspin.2015.10.002
- 17 Wan, S. W., He, H. G., Mak, A., Lahiri, M., Luo, N., Cheung, P. P., & Wang, W. (2016).  
18 Health-related quality of life and its predictors among patients with rheumatoid  
19 arthritis. *Appl Nurs Res*, 30, 176-183.
- 20 Williams, G. C. (2002). Improving patients' health through supporting the autonomy of  
21 patients and providers. In E. L. R. Deci, R.M. (Ed.), *Handbook of self-determination*  
22 *research* (pp. 232-254). Rochester, NY: University of Rochester Press.
- 23 Williams, G. C., Lynch, M. F., McGregor, H. A., Sharp, D., Deci, E. L., & Ryan, R. M.  
24 (2006). Validation of the "Important Other" Climate Questionnaire: Assessing  
25 autonomy support for health-related change. *Families, Systems & Health*, 24, 15.
- 26 Windle, G., Hughes, D., Linck, P., Russell, I., & Woods, B. (2010). Is exercise effective in  
27 promoting mental well-being in older age? A systematic review. *Aging Ment Health*,  
28 14(6), 652-669.
- 29 Yu, C. A., Rouse, P. C., Van Zanten, J. V., Metsios, G. S., Ntoumanis, N., Kitas, G. D., &  
30 Duda, J. L. (2015). Motivation-related predictors of physical activity engagement and  
31 vitality in rheumatoid arthritis patients. *Health Psychol Open*, 2(2),  
32 2055102915600359.
- 33 Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta*  
34 *Psychiatr Scand*, 67(6), 361-370

35

36

**Figure Captions**

**Figure 1.** Hypothesised associations between functional disability to ‘rise’ and ‘walk’, LPA engagement, important other autonomy support for physical activity, and indices of psychological well-being.

*Note:* Signs indicate the direction of the hypothesised associations.

**Figure 2.** Data fit of the model

*Note:* \*  $p < .05$ , \*\*  $p < .01$ . Values represent path coefficients ( $\beta$ ).

Bootstrap-generated 95% bias corrected confidence intervals were constructed for 5000 samples on the hypothesised model.

LPA estimates were modelled as minutes of LPA per/hour. This approach was adopted to reduce the number of parameter estimates of the model, resulting in increased statistical power (i.e., relative to modelling accelerometer wear time as an additional observed variable).

Table 1. Descriptive statistics for the total PARA study sample and participants included in statistical analyses

	<b>Total sample</b>	<b>Included participants</b>
	<b>Mean <math>\pm</math> SD (n = 115)</b>	<b>Mean <math>\pm</math> SD (n = 61)</b>
Age (years)	53.98 $\pm$ 12.47 (115)	54.92 $\pm$ 12.39 (61)
Gender (% female)	68.7 (115)	67.2 (61)
Height (m)	1.68 $\pm$ .09 (97)	1.67 $\pm$ .09 (50)
Weight (kg)	79.36 $\pm$ 18.41 (97)	77.23 $\pm$ 16.94 (50)
RA duration (years from diagnosis)	7.40 $\pm$ 8.61 (102)	6.96 $\pm$ 9.01 (55)
<b>Questionnaire data</b>		
<sup>†</sup> Important other autonomy support for PA	5.40 $\pm$ 1.39 (94)	5.30 $\pm$ 1.51 (51)
<sup>¶</sup> Functional disability to ‘rise’ and ‘walk’	.54 $\pm$ .58 (108)	.50 $\pm$ .57 (60)
<sup>†</sup> Depressive symptoms	5.11 $\pm$ 3.52 (108)	5.13 $\pm$ 3.32 (60)
<sup>¶</sup> Subjective vitality	4.05 $\pm$ 1.58 (106)	4.31 $\pm$ 1.52 (59)
<b>Accelerometer data</b>		
Average valid wear time (hours/day)	-----	13.08 $\pm$ .76 (61)
Light PA (min/day)	-----	269.35 $\pm$ 69.35 (61)
Light PA (% accelerometer wear time)	-----	34.22 $\pm$ 8.10 (61)

*Note:* values reported are mean  $\pm$  SD. <sup>†</sup> = log transformed variables. <sup>¶</sup> = non-normally distributed variables requiring non-parametric tests/bootstrapping.

*Included participants;* represent those with valid accelerometer (n = 61). Available data for each specific variable are reported in parentheses (e.g., weight (n = 97), RA duration (n = 102)).

*Questionnaire data;* for important other autonomy support and subjective vitality, higher scores represent ‘better’ outcomes (i.e., higher perceived autonomy support and subjective vitality); for functional disability and depressive symptoms, higher scores represent ‘worse’ outcomes (i.e., higher functional disability (poorer physical function) and higher prevalence of depressive symptoms). Range of scores for questionnaire data (min-max) = autonomy support (1 - 7), functional disability (0 - 2), depressive symptoms (0 - 17), subjective vitality (1 - 7).

PARA = Physical Activity in Rheumatoid Arthritis Study; RA = Rheumatoid Arthritis; PA = physical activity.

Table 2. Bivariate correlations

	1	2	3	4
1. †Important other autonomy support				
2. †Functional disability to 'rise' and 'walk'	-.02			
3. Light physical activity (%)	.37**	-.03		
4. †Depressive symptoms	-.27	.48**	-.29*	
5. †Subjective vitality	.42**	-.41**	.27*	-.74**

Note: \*  $p < .05$ , \*\*  $p < .01$ , <sup>a</sup>  $p = .06$

† = log transformed variables, † bootstrapped variables

For all normally distributed and log-transformed variables, results are presented following Pearson's correlation analysis. Data for non-normally distributed variables are reported following bootstrapping (5000 samples) - a non-parametric resampling procedure that does not impose the assumption of normality on the data. For non-normally distributed variables, correlation coefficients obtained from bootstrapping were identical to those observed following Pearson's correlations with the exception of the association between subjective vitality and LPA (Pearson's  $r = .33^*$  vs  $.27^*$ ).

Figure 1.

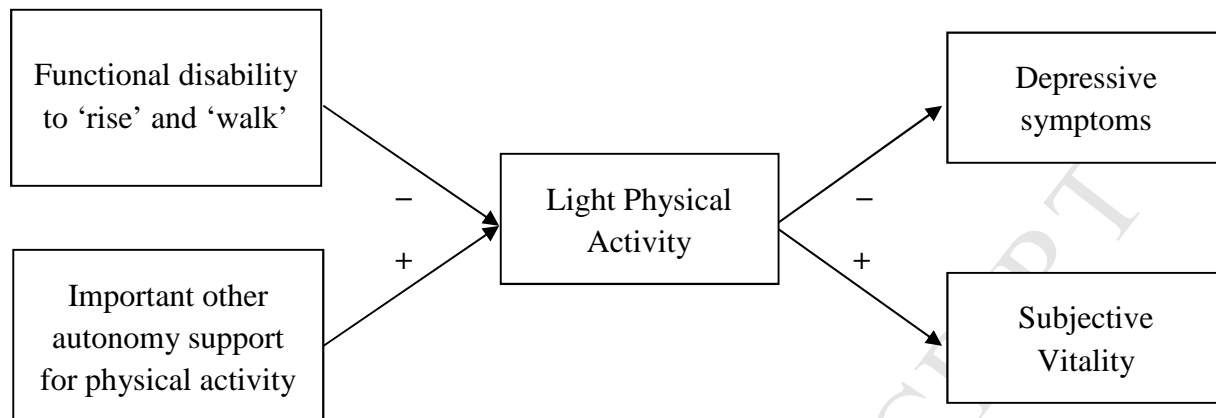
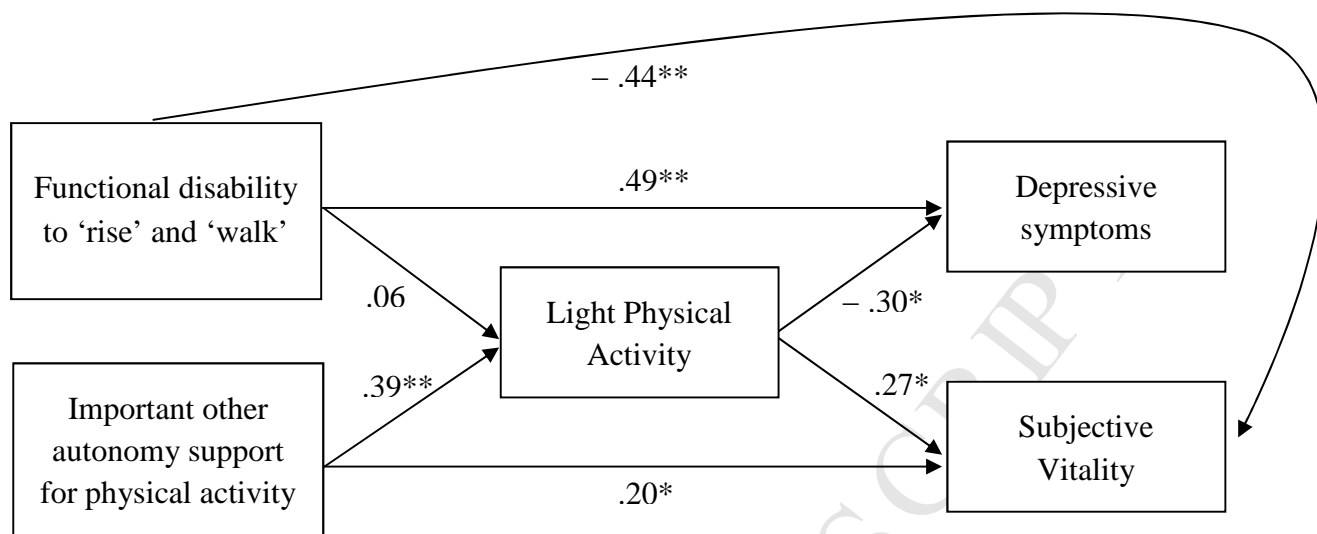


Figure 2.



**Highlights**

- Light physical activity (LPA) may improve mental health in Rheumatoid Arthritis (RA)
- Modifiable correlates of LPA need to be identified prior to intervention
- This study examined associations between autonomy support, (e.g., the promotion of choice and understanding), LPA and mental health in RA.
- *Important other* autonomy support for physical activity was positively linked to LPA
- LPA predicted lower prevalence of depressive symptoms and higher subjective vitality