Rheumatoid arthritis

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RHEUMATOID ARTHRITIS:

Sedentary behaviour in RA — a new research agenda

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Standfirst:

Sedentary behaviour is reported to have adverse consequences for metabolic, functional and cardiovascular health — outcomes already prevalent in patients with rheumatoid arthritis (RA). This commentary considers the relevance of sedentary behaviour in the context of RA, highlighting the limitations of past work and offering suggestions for a new research agenda.

Main text:

Sedentary behaviour is defined as "any waking behaviour characterized by an energy expenditure ≤1.5 MET [metabolic equivalent of task] while in a sitting or reclining posture," where 1 MET is the amount of oxygen consumed at rest (that is, 3.5 ml·kg^{-1}·min^{-1})[1]. Common sedentary behaviours include watching television, using a computer and driving. Sedentary behaviour is distinct from physical inactivity, which is defined as insufficient engagement in physical activity with a MET value ≥3 (that is, <150 minutes of moderate-to-vigorous physical activity per week)[1].

A growing body of work conducted in healthy and clinical populations indicates that high levels of sedentary behaviour relate to increased systemic inflammation independent of the anti-inflammatory effect of physical activity[2]. Indeed, experimental studies have reported that the acute and chronic physiological responses to sedentary behaviour are different to those resulting from physical activity. An example of this is the contrast between cellular mechanisms (including

muscle fibre types affected and absence or presence of messenger RNA) underlying the decrease in lipoprotein lipase (LPL) activity that can occur in response to prolonged sitting, and the increase in LPL observed during physical activity[3]. Low levels of LPL are associated with increased circulating triglycerides and decreased high-density lipoprotein cholesterol – precursors to elevated inflammation and possible contributors to accelerated atherosclerosis. So why is this work relevant to rheumatoid arthritis (RA)?

For many clinical populations, functional limitation might result in increased sedentarity, which might, in turn, further affect disease outcomes. Considering that sedentary behaviour is associated with increased inflammation, it is important to examine its role specifically in conditions in which inflammation comprises a substantial component of disease aetiology and outcome, such as RA. High-grade systemic and local inflammation in RA leads to joint pain and stiffness, fatigue, functional disability, adverse psychosocial effects and reduced quality of life, all of which might contribute to increased sedentarity. This sedentarity, in turn, might perpetuate the already elevated inflammatory load and contribute to the continuing presence of such features (Figure 1), as well as important comorbidities, such as cardiovascular disease (CVD) and rheumatoid cachexia.

Research examining the implications of sedentary behaviour for health outcomes in RA is still in its infancy, and it is only since 2013 that sedentary behaviour and physical inactivity have consistently been considered as separate constructs in RA studies. Results of preliminary work link increased sedentary behaviour (as distinct from physical inactivity) to higher disease activity, worse physical function, lower muscle density and bone mass, and increased CVD risk

factor burden in people with RA[4,5]. These studies clearly suggest the need for further observational, mechanistic and even intervention research in this domain.

However, a number of methodological shortcomings with regards to the conceptualisation and measurement of sedentary behaviour in RA need to be addressed if research is to continue to pursue this line of enquiry. First, few studies have employed objective measures (for example, accelerometers and posture sensors) of sedentary behaviour in RA. Instead, researchers have relied heavily on self-report assessments of 'sitting time', which have been shown to underestimate sedentary behaviour in this group of patients[6]. Still, although the application of objective methods would be preferable, the instruments and algorithms currently employed to quantify sedentary behaviour have not been validated for use specifically in RA. This factor is important because people with RA have an elevated basal metabolic rate compared to matched healthy adults[7], and consequently the energy cost of common sitting behaviours (such as watching television) might differ between these populations.

Second, the definition of sedentary behaviour applied across RA studies is inconsistent. Studies to date have not considered concurrently both energy expenditure and posture in their characterisation of 'sedentariness'. As self-report tools typically consider only 'sitting time', they assess behaviour solely on the basis of posture (sitting), and do not afford the ability to directly assess the energy requirements of the behaviours recorded. By contrast, studies employing accelerometers enable the energy cost of activities to be inferred (on the basis of trunk accelerations), but do not qualify the posture at which these activities are undertaken. Adding to this limitation, currently available studies have variably defined the energy cost of sedentary behaviour as 1.0 to 1.5 METS[1]. To be clear, where studies do not

consider the full spectrum of behaviours requiring ≤1.5 METS in their definition of sedentary, conclusions cannot be drawn regarding the health implications of many common sedentary behaviours. For example, in healthy adults, sitting quietly and reading is reported to expend 1.3 METS[8]. Thus, until studies have been conducted which confirm the metabolic costs of 'sitting behaviours' in RA, research should endorse the definition of sedentary as applied consistently among epidemiological and experimental studies conducted among other populations (that is, ≤1.5 METS**)** when seeking to establish the health consequences of prolonged sitting for people living with RA.

Finally, studies are yet to comprehensively examine the multiple constituents of sedentary behaviour proposed to be relevant to RA disease outcomes. These constituents have been defined as 'SITT'[9] and include the following: S — sedentary behaviour frequency (number of sedentary bouts of a certain duration); I — interruptions (frequency of getting up); T — time (duration); and T — type (mode or context) of sedentary behaviour[9]. Indeed, although total sedentary time accrued is adversely related to inflammation, data have also revealed that the number (and duration) of uninterrupted sedentary periods, and the frequency of interruptions or breaks in sedentary time predict variability in systemic inflammation among both healthy and patient populations[2,10]. In addition, certain types of sedentary behaviour (for example, television viewing) are reported to be more closely linked to negative health outcomes than others[10]. Variable relationships between sedentary behaviour type and health outcomes are suggested to be influenced by other context-specific behaviours undertaken whilst sedentary (for example, snacking during television viewing is potentially linked to increased adiposity).

In summary, although research in sedentary behaviour and its consequences in people with RA is desirable, current research priorities must include the use of a uniform definition, validation of the approaches employed to assess sedentariness in this population, and subsequent application of the validated methods to examine the implications of sedentary behaviour (including its individual components) on the outcomes of RA and its comorbidities. The generation of a critical mass of consistently high quality research in this domain will enable identification of the specific constituents of sedentary behaviour that are particularly relevant to the physical and psychosocial health of people living with RA. In turn, these findings might open up new lines of treatment (such as sedentary behaviour change interventions, either as 'self management' or facilitated by trained health professionals) aiming to reduce the burden of RA. In addition, the efficacy and cost-effectiveness of such interventions will also need to be formally assessed.

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Competing interests
The authors declare no competing interests.

Figure 1. Proposed cyclic relationship between sedentary behaviour, inflammation and worsening disease outcomes in rheumatoid arthritis (RA). This figure illustrates the hypothesis that sedentary behaviour perpetuates the chronic high-grade

inflammation already apparent in RA and contributes towards the progression of RA outcomes. MET, metabolic equivalent.