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CHRONIC PAIN (R STAUD, SECTION EDITOR)

Use of Physical Activity Monitors in Rheumatic Populations

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Abstract

Purpose of Review The purpose of this review paper is to provide an overview of the recent research using physical activity monitors in rheumatic populations including those with osteoarthritis, rheumatoid arthritis, systemic lupus erythematosus, and fibromyalgia.

Recent Findings Recent research demonstrates increased use of physical activity monitors in these populations, especially in those with osteoarthritis. Results from cross-sectional, longitudinal, and intervention studies highlight that physical activity levels are below recommended guidelines, yet evidence suggests benefits such as improving pain, fatigue, function, and overall well-being.

Summary While the use of physical activity monitors in rheumatic populations is increasing, more research is needed to better understand physical activity levels in these populations, the effects of activity on relevant clinical outcomes, and how monitors can be used to help more individuals reach physical activity guidelines.

Keywords Physical activity · Technology · Osteoarthritis · Rheumatoid arthritis · Systemic lupus erythematosus · Fibromyalgia

Introduction

Collectively, osteoarthritis, systemic lupus erythematosus (SLE), rheumatoid arthritis, and fibromyalgia are prevalent rheumatologic conditions. Between 2013 and 2015, an estimated 54.4 million (22.7%) adults in the USA were told by a physician they had some form of arthritis, rheumatoid arthritis, SLE, or fibromyalgia [1]. By 2040, this number is projected to rise to 78 million (26%) adults [2]. Osteoarthritis alone affects over 30 million adults [3], being the most prevalent and widely diagnosed of these four conditions. It is also estimated that rheumatoid arthritis affects over 1.3 million adults [4], SLE diagnoses occur within 322,000 adults per year [5], and that approximately 5 million of US adults are affected by fibromyalgia [6].

Many treatment options exist for each of these conditions. While pharmacological options are most common, several behavioral options are also recommended. These include self-management education, physical therapy, occupational therapy, and physical activity [7–11]. According to the 2008 Physical Activity Guidelines, adults, including those with arthritis or other rheumatic conditions, should strive to achieve 150 min/week of moderate intensity physical activity [12]. Physical activity has been found to be an effective treatment option and is associated with positive health outcomes in rheumatic populations (Table 1).

With the proven benefits of engaging in physical activity in rheumatic populations, the use of physical activity monitors to objectively measure physical activity and serve as an inter vention tool to help patients increase activity levels has become

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Table 1 Beneficial effects of physical activity in those with rheumatic conditions

Rheumatic conditions	Benefits of physical activity
Osteoarthritis	Reduce pain and stiffness [8, 13]
	Maintain muscle strength around arthritic joints [8, 13]
	Lessen functional decline [8, 13]
	Improve quality of life [8, 13]
	Decreased inflammation [14]
	Increased self-efficacy [15]
Rheumatoid arthritis	Reduce fatigue [16]
SLE	Increase aerobic and functional capacity [17, 18]
	Improve mental health [17]
Fibromyalgia	Reduce pain [9]
	Improve physical function [19]
	Reduce fatigue [20]

more common. Although physical activity monitors cost more than using subjective, self-report methods, they can provide a more accurate and detailed estimation of physical activity levels [21–23]. Accelerometers have become the standard for objective physical activity measurement and determination of change during an intervention. Research grade accelerometers (i.e., ActiGraph) are the most widely used, however can be costly [23]. Commercially available wearables (i.e., Fitbit, Jawbone) are gaining popularity, as they are often more cost-effective, user-friendly, and less invasive [24, 25]. In addition to measurement, the commercially available wearables are starting to be used as intervention tools. Due to their multi-level functionality, these devices are helpful for self-monitoring, behavioral feedback, reinforcement, and goal setting within behavior change interventions [26–29]. In addition to physical activity, sedentary time is also surfacing as a topic of importance in health behavior research [30]. Excessive sedentary behavior has negative health consequences, including an increased risk of all-cause mortality [31], regardless of one's level of physical activity [32]. Therefore, a focus on both increasing physical activity and reducing sedentary time is important for optimal health and also may provide unique benefits to those with a rheumatic condition [33].

The purpose of this review is to provide an update on the use of physical activity monitors over the past 5 years in populations with rheumatic conditions. In particular, this review focuses on the use of activity monitors to assess or intervene on physical activity levels in those with osteoarthritis, SLE, rheumatoid arthritis, and fibromyalgia. Following a review of the literature, we will provide practical considerations and recommendations for use of physical activity monitors in these rheumatic populations.

Osteoarthritis

Physical activity monitors are frequently used to objectively assess physical activity in osteoarthritis populations, resulting in a plethora of research that has recently been conducted, especially in those with knee osteoarthritis. Physical activity monitors, including pedometers and accelerometers, have been used to quantify physical activity levels by steps and daily minutes of sedentary, light, moderate, and vigorous physical activity (MVPA) [34–42]. Many of these studies [33, 36, 38, 43–45] have been from the publicly available data from the Osteoarthritis Initiative (OAI), which is a multicenter, longitudinal observational study in persons at risk or with symptoms of knee osteoarthritis (see http://www.oai.ucsf.edu/datarelease/About.asp). Accelerometers were added to the OAI as a substudy, which provided the ability to examine longitudinal associations between physical activity and clinical outcomes related to knee osteoarthritis [46]. Consistent across studies is that physical activity levels among individuals with knee osteoarthritis are low with only between 2.0 to 13% meeting recommended physical activity guidelines [35, 38, 42]. Evidence continues to suggest that engaging in physical activity improves mobility [34] and that those engaging in the most sedentary time (> 11 h/day) have poorer physical function outcomes than those engaging in less sedentary time [33]. Sedentary time was associated with functional loss, with every 10% incremental decrease in sedentary time resulting in decreases of − 1.66 ft/min in gait speed and − 0.75 repetitions/min in chair stand rate [43]. Similarly, White et al. [45] found that replacing an hour of daily sedentary time with light-intensity physical activity was linked with a 17% reduced risk of functional limitations 2 years later.

Several interventions to increase physical activity in those with knee osteoarthritis have been conducted, especially as osteoarthritis treatment guidelines recommend activity [47] and evidence suggests proven benefits [33, 34, 43, 45]. Physical activity monitors have been used both as a method to assess change [48–52], as well as an intervention tool to help increase activity levels via self-monitoring and behavioral feedback [53–55]. Interventions among those with knee OA have led to improvements in mobility [55], physical function [49, 50•], and increased physical activity [51, 53, 54].

Technology use has also increased in research involving those with hip osteoarthritis. Some of the physical activity monitors used include pedometers [56], armbands [57, 58], and waist-worn accelerometers [59–62]. In those with hip osteoarthritis, higher levels of physical activity are associated with improved quality of life [56], decreased pain, and improved function [59]. Similar to knee osteoarthritis, individuals with hip osteoarthritis have low levels of physical activity levels [58, 60–62] and spend more than 80% of the day in sedentary behavior [62]. There is less research on hip osteoarthritis physical activity when compared to knee osteoarthritis; however, studies including both hip and knee osteoarthritis are becoming more prevalent.

Systemic Lupus Erythematosus (SLE)

Compared to populations with osteoarthritis, fewer studies using physical activity monitors in SLE populations have recently been conducted. The studies reviewed were all cross-sectional describing an association between objectively measured physical activity and clinical outcomes [63–65] or comparing physical activity levels to other populations [66]. Sample sizes ranged from 20 to 129 patients with SLE [63–66]. Waist-worn, triaxial accelerometers were used in each of the studies to quantify physical activity by minutes per day spent in light and MVPA [63–66] as well as in sedentary behavior [65, 66]. Higher levels of MVPA were associated with less fatigue and pain interference and better function [64•], but not with other clinical outcomes such as arterial stiffness [65]. Patients with SLE were found to engage in less daily MVPA (34.5 ± 22.7 min/day) as compared to healthy controls (64.9 ± 22.4 min/day) [66].

Rheumatoid Arthritis

Physical activity monitors have not been extensively used in individuals with rheumatoid arthritis. The types of studies identified from the past 5 years that used physical activity monitoring in adults with rheumatoid arthritis included validation studies [67, 68], cross-sectional [66, 69] analyses, longitudinal assessments of physical activity patterns [70], and interventions [71, 72•]. Sample sizes ranged from 14 to 150 patients with rheumatoid arthritis. Similar to other rheumatic populations, individuals with rheumatoid arthritis engaged in little MVPA and fell below physical activity recommendations [66, 69, 70]. Compared to healthy controls who engaged in 64.9 ± 22.4 min/day of MVPA, adults with rheumatoid arthritis only engaged in 41.5 ± 21.3 min/day [66]. One behavioral intervention was identified in those with rheumatoid arthritis patients which examined the effect of motivational counseling and text messages on sedentary time [72•]. The intervention resulted in a reduction in sitting time by − 1.61 h/day as compared to the control group that increased sitting time by 0.59 h/day [72•].

Fibromyalgia

Given the strong link between reductions in fatigue with greater levels of physical activity [20], more research has started to explore the effects of physical activity on fatigue and other clinical outcomes in adults with fibromyalgia. Physical activity monitors, including pedometers [73•, 74] and accelerometers [74–77], are more frequently being used to objectively measure the number of steps taken daily, minutes spent in light, moderate and vigorous intensity physical activity, and sedentary time. Among the five studies identified in our review over the past 5 years, the sample sizes ranged from 20 to 176 adults with fibromyalgia. The types of studies conducted varied. One study compared objective (i.e., Actigraph GT1) and subjective (i.e., International Physical Activity Questionnaire) measures of physical activity in adults with fibromyalgia [76], whereas others explored correlates of physical activity or fatigue in this population [75, 77]. Physical activity monitors are also being used within interventions targeting physical activity via a multidisciplinary treatment [73•] or reductions in sedentary time from a primary-care based educational intervention [74]; however, few conclusions can be made due to the limited studies and results available.

Practical Considerations and Recommendations

Physical activity monitors are being used more frequently in rheumatic populations in both research and real-world settings. Although fewer studies have used physical activity monitors in populations with SLE, rheumatoid arthritis, and fibromyalgia compared to osteoarthritis, it is clear that physical activity levels in these populations are low, with very few meeting federal physical activity guidelines [35, 78]. Engaging in regular physical activity not only has substantial general health benefits [79–81], but also has established beneficial effects specific to those with a rheumatic condition [20, 45, 56]. There are several considerations to keep in mind when determining whether to use physical activity monitors, whether examining the association between physical activity and clinical outcomes or intervening to increase physical activity in these populations. Below we have provided several recommendations based on considerations for using physical activity monitors in those with rheumatic conditions.

Identify the Physical Activity Outcome of Interest While physical activity monitors can typically provide a more accurate estimation of physical activity than self-report techniques, physical activity monitors may not always be necessary depending on what aspect of physical activity you are interested in. For example, physical activity monitors can help to quantify how much time is spent in different intensities of activities but are unable to determine what specific behaviors are being completed. Thus, if you were interested in what type of exercises someone is engaging in, a subjective, self-report method of assessment may be more appropriate than a physical activity monitor.

Physical activity monitors are not all alike and often have different strengths and weaknesses. Some physical activity monitors, such as accelerometers developed by Actigraph or ActivPAL, are more commonly used for research and respected to use for outcome assessments, whereas other commercially available monitors are more frequently used as an intervention tool to help modify activity behaviors. Although commercially available monitors can provide a relatively accurate estimate of activity [82], research grade monitors are often preferred for outcome assessments.

Physical activity is a complex behavior and physical activity monitors often quantify physical activity outcomes in varying formats. For example, monitors may provide total daily or activity specific energy expenditure, step counts, and the time spent in various intensity categories (i.e., sedentary, light, moderate, and vigorous intensity). Some monitors are better at estimating different dimensions of physical activity than others. Additionally, some monitors such as the ActivPAL can determine postural allocation, which is helpful in distinguishing between laying, sitting, and standing time. It is critical to determine a priori what aspect of physical activity is most important for your purpose. Once this is determined, it will be easier to choose which physical activity monitor is best for your outcome needs.

Identify the Purpose of Using Physical Activity Monitors It is important to identify whether the purpose of using physical activity monitors is for assessment and/or intervention. Initially, physical activity monitors were primarily used to measure physical activity behaviors at predetermined times to assess change. Research-grade accelerometers are typically worn for 7 days at each assessment period and either do not provide feedback to the individual wearing the device or the feature can be disabled. Self-monitoring activity and receiving feedback on behavior can be viewed as an effective behavior change technique [83]; thus, if strictly measuring activity levels, promoting self-monitoring and providing feedback would not be recommended.

With the continued advancement and increase of commercially available physical activity monitors, including wearables, being used, they become an attractive intervention tool to assist with increasing physical activity. These monitors are typically more user-friendly, provide feedback on behavior, and allow users to set goals on physical activity behaviors. Some monitors also provide opportunities to connect or interact with other users as well as compete in physical activity challenges against yourself or others. Further, many of the commercially available monitors are less burdensome to wear for extended periods of time (> 7 days).

If planning to use physical activity monitors to assess activity levels and serve as an intervention tool, it may be necessary to use two different types of monitors. As mentioned above, it may be possible to turn off physical activity feedback during assessment periods on some of the monitors; however, they do not all provide that option.

Identify Population-Specific Concerns Regarding Wearing a Physical Activity Monitor Some physical activity monitors are easy to use, yet others can be challenging. If your population is not extremely tech savvy, it is important to find a monitor that is easy to use to reduce participant frustration and improve compliance to wearing it, especially over longer periods of time. Some strategies to alleviate frustrations with physical activity monitors are to provide written and visual instructions of how to use the monitor, help the individual set up the monitor, and provide contact information for someone to provide assistance when issues arise.

Some populations may have different preferences or considerations regarding where the monitor is worn or how it is put on. Physical activity monitors come in varying shapes and sizes and can be worn in multiple locations (e.g., wrist, waist, upper arm, thigh). Individuals with sensitive skin may have more challenges with monitors worn on the upper arm or thigh, which are more likely to cause minor skin irritations; whereas others may dislike wearing an activity monitor around their waist or wrist. Some individuals, such as those who are experiencing inflammation or pain in their fingers or wrist could have difficulties putting on a wrist worn device that has a snap rather than a watch clasp. It is recommended that the monitors are tested in the population ahead of time, which can help to identify any unexpected issues that may arise.

Conclusions

Compared to the general population, the use of physical activity monitors in rheumatic populations is in its infancy. Physical activity levels in those with rheumatic conditions are well below recommended physical activity guidelines, yet the benefits of engaging in regular physical activity are vast. Using physical activity monitors is a valuable way to understand more about how physical activity behaviors are related to clinical outcomes in each population. Further, these monitors can serve as a promising motivational behavior change tool aiming to increase physical activity in those who are under recommended physical activity guidelines. Future research is needed to expand the breadth of knowledge and effects of physical activity in rheumatic populations, especially in those with rheumatoid arthritis, systemic lupus erythematosus, and fibromyalgia.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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with systemic lupus erythematosus, engaging in moderate/vigorous physical activity was associated with less fatigue and better physical function.

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