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## Brief Report

## Physical activity levels and shoulder pain in wheelchair users during COVID-19 restrictions

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## ABSTRACT

**Background:** Manual wheelchair users are at high risk of developing shoulder pain. However, it is not known if restrictions to limit the spread of the COVID-19 virus affected physical activity, wheelchair use and shoulder pain.

**Objective:** The aim of the study is to determine whether COVID-19 related restrictions caused changes in physical activity levels and the presence of shoulder pain in persons who use a wheelchair.

**Methods:** Manual wheelchair users completed a survey about the presence and severity of shoulder pain in a cross-sectional study design. Participants completed the Leisure Time Physical Activity Questionnaire and were asked about daily wheelchair activity before and during lockdown. A logistic regression examined the relationship between increase in shoulder pain severity and change in activity levels.

**Results:** Sixty respondents were included for analysis. There was no significant change in physical activity during lockdown. There was a significant reduction in number of hours of daily wheelchair use and number of chair transfers during lockdown. Of the respondents, 67% reported having shoulder pain and 22% reported their shoulder pain becoming more severe during lockdown. No significant relationship was observed between the change in activity levels and increasing severity of shoulder pain.

**Conclusion:** Restrictions to reduce the spread of the COVID-19 virus resulted in no changes in physical activity levels in a sample of adult manual wheelchair users; however, there was a reduced time using a wheelchair each day and fewer chair transfers. The changes in wheelchair activities were not related to the worsening of shoulder pain.

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Shoulder pain is common in persons reliant on manual wheelchairs for daily mobility with prevalence reported up to 76%.<sup>1</sup> The cause of shoulder pain has been attributed to the increased demand placed on the shoulder through wheelchair use,<sup>2</sup> where increased wheelchair use and associated activities, such as number of chair transfers, is associated with increased risk of shoulder pain.<sup>3,4</sup> The activities of wheelchair propulsion and weight bearing place the scapula into positions that potentially increase the risk of impingement and reduce sub-acromial space.<sup>5-7</sup> The technique and frequency of chair transfers, in particular, are associated with

shoulder pathology,<sup>7,8</sup> and should be considered to avoid the risk of developing shoulder pain.

Physical activity, defined as activity over and above typical daily wheelchair activities,<sup>9</sup> is essential for wheelchair users to prevent the onset of secondary health conditions such as obesity and cardiovascular disease.<sup>10,11</sup> The global pandemic due to the COVID-19 respiratory virus caused unprecedented restrictions to reduce the spread of the virus. In the United Kingdom (UK), restrictions were first implemented in March 2020 and required people to remain at home and were only permitted to leave their home for essential reasons. Physical activity outside of the home was limited to once per day and led to significant reductions in physical activity levels in children and young adults with disabilities in the UK.<sup>12</sup> However, some individuals reported increasing their physical activity during

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lockdown.<sup>12</sup> In a sample of Spanish adult wheelchair users, there was a significant decrease in time spent on vigorous, moderate, and light intensity physical activity during lockdown.<sup>13</sup> The effects of physical activity on shoulder pain in people who are reliant on a wheelchair is not fully understood. Whilst there is some evidence to suggest that physical activity increases the risk of shoulder pain,<sup>14</sup> other studies have found no effect of physical activity on shoulder pain.<sup>15</sup> Conversely, the study of Fullerton et al.<sup>16</sup> suggests that physical activity reduces the risk of shoulder pain, where non-athletes are twice as likely to develop shoulder pain.

Given the COVID-19 related restrictions imposed, it is not known if the physical activity levels of adults in the UK who use a wheelchair changed and whether there is an association with the onset or worsening of shoulder pain. The restrictions only allowed for essential travel outside of the home; therefore, other typical activities of daily living, such as wheelchair propulsion and chair transfers, might have also been affected. Typical activities of daily living are associated with shoulder pain and changes in the exposure to these activities might influence the presence of shoulder pain. The aim of the study is to investigate physical activity levels, defined as activity over and above typical daily activity, of wheelchair users before and during COVID-19 related restrictions and the presence of shoulder pain.

## Method

### Survey development and deployment

An online survey was developed and distributed in a cross-sectional study design via Microsoft Forms. There are currently 1.2 million wheelchair users in the United Kingdom, where two thirds are regular users (NHS England). The inclusion criteria consisted of wheelchair users over the age of 18 years of age based in the UK who self-propelled using a manual or hybrid wheelchair (manual wheelchair with power assisted wheels). People with a cognitive impairment that limited their ability to complete the survey were excluded from the study. The survey was advertised via social media and on the websites of charities associated with wheelchair use from May 2020. All participants provided electronic informed consent. The study received ethics approval from the University of Southampton Research Ethics Committee in line with the principles of the Declaration of Helsinki.

The survey consisted of the following constructs: chronic shoulder pain, athletic status, physical activity over and above typical wheelchair activities, typical daily wheelchair use and demographics. The chronic pain construct asked whether participants were currently experiencing shoulder pain, the severity of their current pain, whether they had pain before lockdown measures, whether their pain had become more severe during lockdown measures and, if so, the severity of their pain before lockdown. If participants did not have current shoulder pain they were asked if they had shoulder pain in the past. The athletic status construct asked whether they were an international athlete, retired international athlete, national athlete, retired national athlete, recreational sports person or whether they did not take part in any physical activity or sport (i.e. sedentary). Participants completed the Leisure Time Physical Activity Questionnaire for People with spinal cord injury<sup>9</sup> to determine the amount of physical activity participants undertook during their free time over and above typical daily wheelchair activities. Participants completed the Leisure Time Physical Activity Questionnaire twice; firstly, recalling their physical activity level in the week before lockdown measures and then repeating for the seven days prior to the point of completing the survey. Participants were then asked to recall the

number of hours of wheelchair use per day, number of chair transfers per day and number of weight relief per day before and during lockdown. Participants provided details of their disability that requires wheelchair use and demographic details, including employment status.

### Data analysis

Due to non-normal data distributions and missing data a non-parametric statistical analysis approach was utilised. A Wilcoxon test was used to compare leisure time physical activity, for each level of physical activity intensity, and wheelchair activities before to during lockdown. A logistic regression was used to determine if there was a relationship between the onset or worsening of shoulder pain and the change in physical activity levels and typical daily wheelchair activities. Subgroups were formed consisting of employment status (employed and unemployed) and athletic status (athletic and sedentary). Leisure time physical activity at each intensity and wheelchair activities were compared before and during lockdown measures for each sub-group using a Wilcoxon test.

## Results

A total of 65 people responded to the survey between May 2020 and July 2020; however, five were excluded for non-compliance with the inclusion criteria, which consisted of below 18 years of age or not being a resident of the UK. There were 31 males and 28 females (1 non-response) with a mean age of  $49.1 \pm 13.4$  years. Of the respondents, 67% (N = 40) had a neuromuscular related disability and 28% (N = 17) had a musculoskeletal related disability. Of the respondents, 17% (N = 10) were elite athletes, 8% (N = 5) were retired elite athletes, 15% (N = 9) took part in recreational activity and 60% (N = 36) were sedentary.

During lockdown there was a significant ( $P < 0.001$ ) reduction in the number of hours of wheelchair use per day (Table 1). The number of chair transfers per day significantly ( $P = 0.01$ ) reduced during lockdown compared with before lockdown (Table 1). There was no significant ( $P = 0.372$ ) difference in the number of weight relief exercises performed during lockdown compared with before lockdown (Table 1). There was no significant difference in leisure time physical activity at mild ( $P = 0.239$ ), moderate ( $P = 0.439$ ) or heavy ( $P = 0.414$ ) intensities during lockdown compared with before lockdown (Fig. 1).

Of the respondents, 67% (N = 40) reported having current chronic shoulder pain, rated on average as 'severe', and 17% (N = 10) reported having chronic shoulder pain in the past. Thirteen (22%) respondents reported their shoulder pain becoming more severe and two respondents (3%) developed shoulder pain during lockdown. Logistic regression analysis revealed there was no relationship between change in physical activity level or wheelchair activities and the onset or worsening of shoulder pain.

Sub-group analysis demonstrated that the unemployed group (N = 22) significantly reduced the number of hours using a wheelchair and number of chair transfers performed per day during lockdown (Table 1). The employed (N = 31) group also had a significant reduction in number of hours of wheelchair use during lockdown (Table 1). There was no significant difference in physical activity levels when comparing before to during lockdown for either group (Fig. 2). There was a significant between-group difference in physical activity at mild and moderate physical activity levels (Fig. 2).

Sub-group analysis of athletic status demonstrated there was no significant change in physical activity levels before compared with

**Table 1**

Wheelchair activities prior to and during COVID-19 related lockdown measures for the entire sample of respondents and sub-groups within the sample.

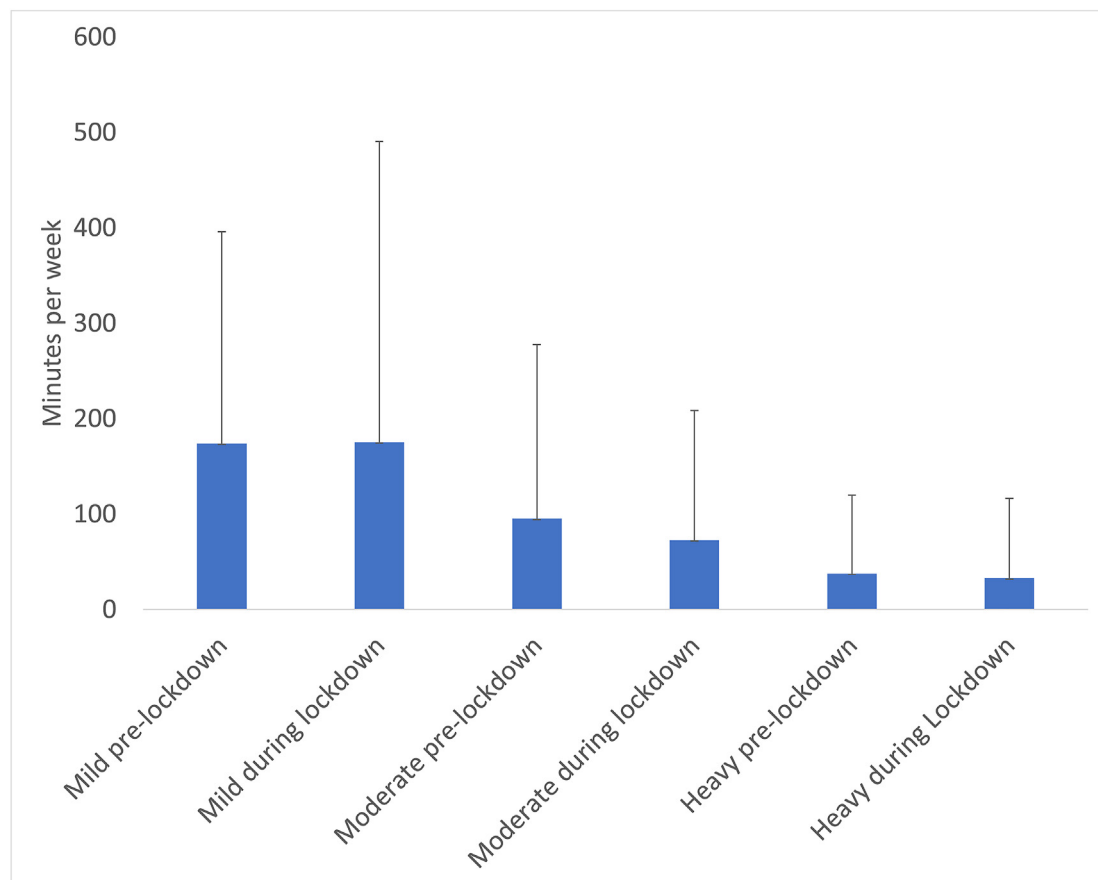
		Wheelchair use (hours per day)		Chair transfers (number per day)		Weight relief (number per day)	
		Prior to lockdown	During lockdown	Prior to lockdown	During lockdown	Prior to lockdown	During lockdown
Entire sample (n = 60)	Median	12*	9*	7*	7*	3	2
	IQR	13	13	9.5	8	10	8
	Range	0–24	0–24	0–28	0–20	0–40	0–40
Sub-groups							
Employed (n = 31)	Median	11*	4*	6	2	2	2
	IQR	11.25	13.5	10	8.5	7.5	6
	Range	0–18	0–18	0–20	0–16	0–30	0–30
Unemployed (n = 22)	Median	14*	12*	6*	5.3*	2.5	2.5
	IQR	11	15	7	7	8.3	9.8
	Range	1–24	0–24	0–25	0–20	0–40	0–40
Non-athletic (n = 50)	Median	11*	5*	6*	4*	1	1.5
	IQR	11.3	14	7.3	9	6	5.1
	Range	0–24	0–24	0–20	0–20	0–40	0–40
Elite athletes (n = 10)	Median	15	11.5	10	8	2	4
	IQR	9.5	11	18.5	17	8	9
	Range	0–18	0–18	0–28	0–20	0–15	0–15

\* denotes significant ( $p < 0.05$ ) difference between prior to lockdown and during lockdown.

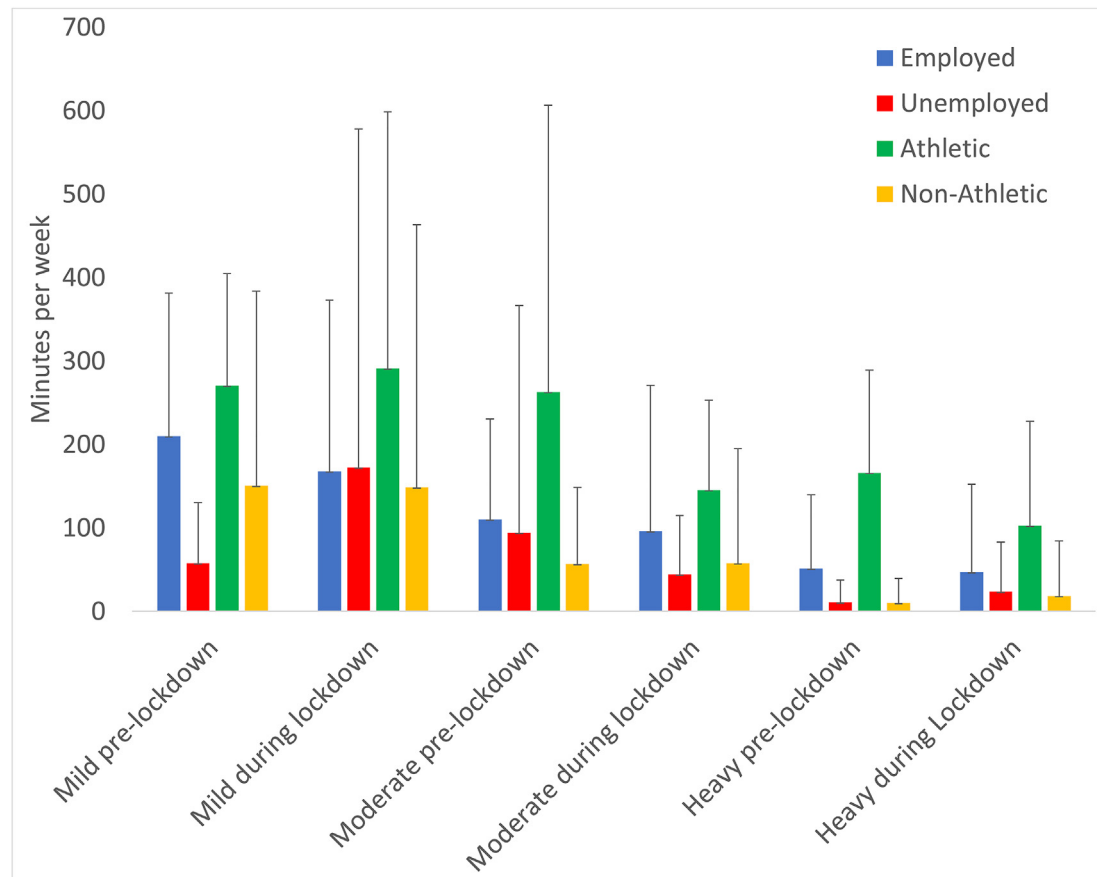
during lockdown for either the athletic ( $N = 10$ ) or sedentary ( $N = 50$ ) groups (Fig. 2). There was a significant difference between the sedentary group and athletic group at each physical activity level, except for mild activity during lockdown (Fig. 2). There was a significant decrease in the number of hours of wheelchair use and the number of chair transfers per day for the sedentary group before to during lockdown (Table 1), but no significant difference in wheelchair activities for the athletic group (Table 1).

## Discussion

The nationwide restrictions in the UK to reduce the spread of the COVID-19 virus led to substantial changes in how people led their lives. The results of this study observed no significant change in physical activity levels in people who are reliant on a wheelchair during lockdown. There were, however, changes to the amount of typical daily wheelchair activities with people spending less time



**Fig. 1.** Physical activity of wheelchair users from the Leisure Time Physical Activity Questionnaire prior to and during COVID-19 lockdown restrictions at mild, moderate, and heavy intensities.



**Fig. 2.** Mild, moderate, and heavy physical activity levels of employed ( $N = 31$ ) unemployed ( $N = 22$ ), athletic ( $N = 10$ ) and non-athletic ( $N = 50$ ) wheelchair users from the Leisure Time Physical Activity Questionnaire prior to and during COVID-19 lockdown restrictions. There were no significant differences in physical activity levels when comparing prior to and during lockdown. Significant differences were observed between employed and unemployed for mild and moderate physical activity. Significant differences were observed between the sedentary group and athletic group at each physical activity level with the exception of mild activity during lockdown.

using their wheelchair and performing fewer chair transfers. The reduction in chair transfers, which was most evident in the employed group, was likely due to a decreased car use. People were not commuting to a place of work and eliminated the need for multiple chair/car/chair transfers.

During lockdown 25% of the respondents reported their shoulder pain becoming more severe or had developed shoulder pain, but there was no relationship between the change in wheelchair related activities and the onset or worsening of shoulder pain. Wheelchair related activities have been suggested as the cause of shoulder pain in wheelchair users with factors such as increased number of chair transfers and duration of wheelchair use increasing the risk of developing shoulder pain.<sup>4</sup> The observed decrease in typical daily wheelchair activities potentially reduces the risks of developing shoulder pain and suggests other factors are responsible for the increase in shoulder pain observed in a quarter of respondents. Weaker shoulder abduction strength and trunk flexion have been associated with increased risk of shoulder pain.<sup>17,18</sup> With a known positive correlation between strength and hand-rim force,<sup>19</sup> it is possible that wheelchair users experienced a decrease in shoulder strength through less wheelchair use during lockdown resulting in an increased risk of shoulder pain. The relationship between shoulder strength and daily wheelchair activities requires further investigation to further elucidate on the possible mechanisms in the development of shoulder pain.

The lack of change in physical activity levels observed in the sample of adult wheelchair users contrasts other studies who

observed reductions in physical activity for children and young adults in the UK with a disability and adults in Spain.<sup>12,13</sup> The average physical activity was generally similar to previous studies,<sup>9,20</sup>; however, 29 respondents performed very little physical activity and did not meet physical activity guidelines for people with a spinal cord injury.<sup>21</sup> Given the low levels of physical activity in half of the sample a measurable decrease in physical activity is not expected. Inactivity in wheelchair users can lead to secondary health conditions, such as obesity and cardiovascular disease, which can have greater impact on wheelchair users compared with the general population.<sup>22</sup> The promotion of physical activity is critical to prevent a secondary consequence of the pandemic of increased risk of cardiovascular disease and obesity.<sup>23</sup> When considering possible explanations of why respondents who undertook physical activity did not reduce their activity levels, the UK's restrictions allowed people to leave the house once per day to undertake physical activity. The lack of ability to undertake typical activities of daily living, such as commuting to work and visiting friends and family, people may have had more time during the day to undertake some form of physical activity. It must also be considered that some respondents were elite athletes, it is likely they continued to train for their sport to maintain fitness levels. It is not known what type of physical activities that were undertaken and whether the type of activity differed during lockdown. Due to sport centres, gyms and other physical activity facilities being closed, it is likely people completed different forms of physical activity to maintain an active lifestyle. The apparent discordance between a reduction in wheelchair use

and the lack of change in physical activity can be attributed to a reduced need to use a wheelchair to undertake activities of daily living, as described above. Although participants may still have been using a wheelchair for physical activity, the overall amount of wheelchair use on a given day reduced. In addition, some physical activity may have been undertaken without the use of a wheelchair (e.g. resistance training).

Several study limitations should be noted, which are predominantly related to the reliance on retrospective reporting of physical activity levels and shoulder pain before lockdown. It is possible that recall bias influenced the data provided for the pre-lockdown related data and caution should be aired when interpreting these results. The incidence of shoulder pain in the sample was 67%, which was 83% when including people who had a history of, but not current, chronic shoulder pain. Although studies have found high incidence of shoulder pain in wheelchair users,<sup>1</sup> a recent meta-analysis of musculoskeletal pain in wheelchair users demonstrated a pooled prevalence of 44% for shoulder pain.<sup>24</sup> Given the high prevalence of shoulder pain observed in the present study, there may have been a bias towards people who have experience of shoulder pain and the sample may not be representative of the wider population. It should also be recognised that the sample of participants included elite athletes, the relative number of which is likely to be higher than found in the general population of wheelchair users. The generalisability of these results to the wider population of manual wheelchair users should be viewed with caution. The respondents completed the survey between May 2020 and July 2020, therefore, the exposure time to lockdown restrictions will have differed across participants. The effect on physical activity and shoulder pain might differ across the participants and should be considered when interpreting these data. Lastly, participants were not asked whether their shoulder pain improved and, therefore, it is not known whether the observed reduction in typical daily wheelchair activities resulted in possible improvements in shoulder pain.

## Conclusion

The restrictions to reduce the spread of the COVID-19 virus resulted in no significant changes in physical activity levels in a small sample of active and inactive adult manual wheelchair users in the United Kingdom. Among this sample, lockdown measures resulted in wheelchair users spending less time per day in their chair and doing fewer wheelchair transfers; however, the study results revealed that these changes were not related to onset or worsening chronic shoulder pain. The relationship between shoulder pain and physical activity and wheelchair use remains unclear.

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## Conflicts of interest

The authors declare no conflict of interest.

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