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ORIGINAL REPORT

REDUCED PHYSICAL ACTIVITY LEVEL WAS ASSOCIATED WITH POORER QUALITY OF LIFE DURING THE EARLY PHASE OF THE COVID-19 PANDEMIC: A SUB-STUDY OF THE LAST-LONG TRIAL

Anne HOKSTAD, PhD[1], Bente THOMMESSEN, PhD[2], Håkon IHLE-HANSEN, PhD[3], Bent INDREDAVIK, PhD[1,4,5], Øystein DØHL, PhD[1,6] and Torunn ASKIM, PhD[1]

From the [1]Department of Neuromedicine and Movement Science, Faculty of Medicine and Health Science, NTNU-Norwegian University of Science and Technology, Trondheim, Norway, [2]Department of Neurology, Akershus University Hospital, Lørenskog, Norway, [3]Stroke Unit, Medical Department, Bærum Hospital, Vestre Viken Hospital Trust, Bærum, Norway, [4]Department of Stroke, Clinic of Medicine, St Olavs Hospital, Trondheim University Hospital, [5]Department of Medical Quality Registries, St Olavs Hospital, Trondheim University Hospital and [6]Department of Finance, City of Trondheim, Trondheim, Norway

Objectives: **To assess how physical activity levels changed in a stroke cohort during the COVID-19 (SARS-CoV-2) pandemic, and how these changes were associated with quality of life (QoL).**

Methods: **Between March and July 2021, 150 patients with stroke already included in the Life after Stroke (LAST-long) trial in Norway were invited to participate in this cross-sectional survey. Participants were asked to complete a questionnaire assessing changes in physical activity and self-reported health following the pandemic. Univariate and multivariate logistic regression analyses were used to explore the association between physical activity, loneliness, mental health, social activity and QoL.**

Results: **In all, 118 (79%) participants completed the questionnaire. A total of 80 (68%) reported less physical activity, 46 (39%) felt lonelier, and 43 (37%) reported worse mental health, while 50 (42%) reported reduced QoL compared with before the lockdown. In the univariate analyses less physical activity, feeling lonelier and changes in mental health were associated with reduced QoL. In the multivariate analysis only less physical activity odds ratio (OR) = 4.04 (95% confidence interval (95% CI) 1.44–11.34, $p = 0.008$) was significantly associated with reduced QoL.**

Conclusion: **More than two-thirds of patients with stroke reported reduced physical activity during the COVID-19 pandemic, and less physical activity was strongly associated with reduced QoL.**

Key words: stroke; COVID-19; pandemic; physical activity; health-related quality of life.

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Correspondence address: Anne Hokstad, Department of Neuromedicine and Movement Science, Faculty of Medicine and Health Science, Norwegian University of Science and Technology, Trondheim, Norway. E-mail: anne.hokstad@ntnu.no

LAY ABSTRACT

Stroke survivors were at risk for serious side-effects of the lockdown during the COVID-19 (SARS-CoV-2) pandemic in Norway, such as being isolated with limited access to rehabilitation and training facilities. This study aimed to assess how physical activity changed in a stroke cohort during the pandemic, and how these changes were associated with quality of life (QoL). A total of 118 of the 150 first participants in a larger ongoing trial completed a questionnaire assessing changes in physical activity and QoL following the lockdown. A total of 68% of the subjects reported less physical activity and 42% reported reduced QoL compared with before the lockdown. There was a strong association between less physical activity and reduced QoL. Reasons for being more inactive were concerns about getting infected with COVID-19, physical limitations and lack of access to training facilities. The results indicate that there is a need to reduce barriers to physical activity and facilitate access to training facilities for people after stroke.

On 12 March 2020 a national lockdown was announced by the Norwegian government aiming to stop the spread of the COVID-19 (SARS-CoV-2) virus. Physiotherapy clinics and fitness centres were closed for periods of time, and social distancing was regulated by law. The Norwegian COVID-19 regulations were maintained until February 2022, except for a short period during autumn 2021. The regulations were intended to protect people at risk of severe or even fatal COVID-19 illness, such as older people and those with chronic diseases (1, 2).

People with stroke are defined as a population at risk of severe COVID-19 disease because of the stroke itself, their mean age above 70 years and comorbidities such as hypertension, diabetes, and cardiac disorders (1, 2). Stroke survivors are also at high risk of developing serious side-effects of the COVID-19 regulations, such as being isolated with limited access to rehabilitation and training facilities. It is therefore important to investigate the impact of the pandemic on vulnerable groups, such as the stroke population. More knowledge would also help stakeholders in planning strategies for future pandemics.

The lockdown during the COVID-19 pandemic in Norway has been shown to be associated with less

physical activity in older adults (3, 4) and increased sedentary behaviour in people with cardiovascular diseases (5). Even before the pandemic, people with stroke were less active than their healthy counterparts (6, 7). The most common barriers to physical activity after stroke are lack of motivation, physical or cognitive disability, and fear of another stroke, while social support is reported to be a significant motivator (7, 8). Hence, it is likely that the stroke population is at increased risk of reducing their physical activity levels even more than the general population, due to COVID-19 restrictions.

Furthermore, physical activity levels are important for stroke survivors in maintaining independence in activities of daily living (ADL) and in reducing the risk of adverse outcomes, such as recurrent stroke (9–11), which, again, is associated with quality of life (QoL) (12, 13). Several studies during the COVID-19 pandemic suggest that physical activity levels are linked to individual's psychological and mental health (3, 14, 15). However, to our knowledge, no studies have investigated whether reduced activity levels during the pandemic were also associated with reduced QoL in the stroke population.

The main aims of this study are to assess how self-reported physical activity levels changed in a stroke cohort during the COVID-19 pandemic, and how these changes are associated with QoL. A further aim is to investigate how corresponding changes in mental health, loneliness and social activity are associated with changes in QoL.

METHODS

Study design

This is a cross-sectional study which is a sub-study of the larger ongoing Life after Stroke (LAST-long) trial (16). LAST-long is a pragmatic single-blinded, parallel-group randomized controlled multicentre trial conducted in close collaboration with the respective primary healthcare services in Norway (ClincalTrials.gov Identifier: NCT03859063. Registered 1 March 2019). The study protocol has been published (16). In short, the patients are screened for inclusion and recruited into the trial at the outpatient clinics 3 months post-stroke. Furthermore, there are follow-up assessments at each hospital at 6, 12 and 18 months after inclusion.

The LAST-long intervention consists of monthly meetings with a new established community-based stroke-coordinator in the participating municipalities. In each meeting, the stroke-coordinator performs a risk assessment within the domains of lifestyle and secondary prevention, ADL-function, cognitive function, and social function.

For participants at risk within 1 or more domains, the stroke-coordinator and the participant will agree on an appropriate treatment plan, based on individual goals, aiming to maintain or improve function. The treatment plan is evaluated in the next meeting. The intervention is continued for 18 months. In this study, all participants who were assessed at inclusion or at 1 of the follow-up assessments in LAST-long from March to July 2021 (1 year after the first COVID-19 outbreak in Norway) were invited to participate and to answer a questionnaire designed to measure self-reported changes in physical activity levels and self-perceived health related to the pandemic. The study was conducted in accordance with ethics standards given by the Norwegian National Committee for Medical and Health Research Ethics. It was approved by the Regional Committee of Medical and Health Research Ethics (REC), as an amendment to the main LAST-long trial (REC no. 2018/1809). Inclusion in the LAST-long trial is based on written informed consent , and a new written consent was not required for this sub-study.

Participants and data collection

To be included in the LAST-long trial, the participants must have had a stroke within 2–4 months prior to inclusion, being home-dwelling and revealing symptoms on at least on 1 of the following tests; less than 20 points on Short Physical Performance Battery (17), less than 26 points on Montreal Cognitive Assessment (18), not able to comply with item 3 on Motor Assessment Scale, advanced hand activities (draw 10 lines within 20 s) (19), more than 27 points on the 7-item version of Fatigue Severity Scale (20), more than 7 points on the depression or the anxiety sub-scales of Hospital Anxiety and Depression Scale (HADS) (21).

Patients with life expectancy less than 12 months or with other serious diseases, which made it difficult to comply with the intervention (i.e. serious neurological diseases, dementia or drug abuse) were excluded. In addition, participants with 50% missing items or more on the questionnaire applied in the current study were excluded.

Measures

In the LAST-long trial, physical activity was defined as all activity beyond rest (22). The questionnaire consisted of 5 questions about changes in physical activity, social life, loneliness, mental health, and QoL. The responses to the questions were designed as a Likert scale (23), with 3–5 response categories. The question on physical activity was phrased as follows: (Q1) Has the pandemic had any impact on your activity level? Response categories were: (a) I'm considerably less active, (b) I'm a bit less active, (c) My activity level is

unchanged, (d) I'm more active, (e) I'm considerably more active, (f) I don't know. The question regarding QoL was phrased: (Q2) How has the COVID-19 situation affected your QoL? Response categories were: (a) My QoL has worsened, (b) My QoL is unchanged, (c) My QoL has improved, (d) I do not know. The questions on social life, loneliness and mental health and the corresponding responses were phrased similarly. The questionnaire is available in Appendix S1.

Details about demographic measures, such as age, social status and degree of disability, as measured by the modified Rankin Scale (mRS), which is a clinician-reported measure of global disability after stroke, ranging from 0 to 6, with 0 indicating no disability, and 6 indicating death (24), were collected from the main study.

Data analysis

All data were analysed using SPSS version 29.0 (IBM Co. Ltd, Chicago, IL, USA), and the significance level was set at $p < 0.05$.

Descriptive statistics were used to report mean and standard deviation (SD), median (range) and proportions (%) of the demographic variables and the results from the questionnaire, as appropriate.

Binary logistic regression was used to analyse the association between QoL as the dependent variable, and physical activity level, the independent variable of primary interest, loneliness, mental health and social activity, which were independent variables of secondary interest. The responses for all variables were dichotomized, physical activity and social activity were dichotomized into unchanged or less activity, since no-one reported increased activity, while QoL, loneliness and mental health were dichotomized into unchanged vs poorer outcome, since no-one reported better outcome. Unknown and unsure were classified as unchanged for all variables. Both univariate and multivariate analyses were performed. The univariate analyses were unadjusted. In the multivariate analysis, all independent variables were added to the model at the same time, together with age and sex, because previous literature has shown that age and sex are expected to influence these associations (25). Variance inflation factor (VIF) was calculated to check for multicollinearity.

Missing values were not imputed. Hence, all analyses are complete case analyses, meaning that the number of participants will vary in the different analyses.

RESULTS

Altogether, 118 out of 150 eligible participants (attendance rate 78.7%) completed the survey and were included in this sub-study. Of these, 62 participants answered the questionnaire in-person at the outpatient clinic, 36 answered by phone, and 20 participants returned the questionnaire by post. The reasons for dropout and missing are shown in Fig. 1.

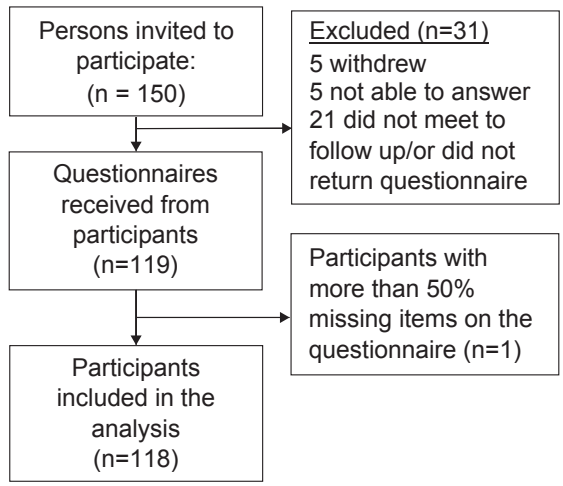

Fig. 1. Flow of participants through the study.

The main reasons for not responding were either because the participants had withdrawn from LAST-long ($n = 5$), were unable to answer due to severe illness ($n = 5$) or did not show up at the outpatient clinic due to COVID-19 restrictions ($n = 21$).

The mean (SD) age was 72.4 (11.8) years, 48 (41%) were female, 82 (70%) were living with someone, and 106 (90%) were independent with an mRS score 0–2. Time from inclusion in the LAST-long trial (which were 2–4 months after the stroke) to inclusion in this sub-study, ranged from 3 to 18 months, with a median time of 6 months (see Table I).

Three participants (2.5%) reported that they had had COVID-19 infection, and 10 (8.5%) reported that they had experienced quarantine.

Table I. Baseline characteristics at inclusion in LAST-long study* ($n = 118$)

Baseline characteristics	
Sex, *n* (%)	
Female	48 (40.7)
Male	70 (59.3)
Age, years	
Mean (SD)	72.4 (11.8)
Median (min–max)	74 (66–80)
Time after inclusion in LAST-long, months	
Mean (SD)	8.9 (6.8)
Median (min–max)	6 (3–18)
mRS, *n* (%)	
0	13 (11.0)
1	47 (39.8)
2	46 (39.0)
3	9 (7.6)
4	3 (2.5)
Social status, *n* (%)	
Live alone	36 (30.5)
Live with someone	82 (69.5)

SD: standard deviation; mRS: modified Rankin Scale.
*Inclusion in LAST-long study was 2–4 months after onset of stroke.

Table II. Distribution of dependent and independent variables, *n* (%), *n* = 118

	Less/poorer outcome	Unchanged	Improved/better outcome	Missing
QoL	50 (42.4)	66 (55.9)	0 (0)	2 (1.7)
PA	80 (67.7)	37 (31.4)	0 (0)	1 (0.8)
Loneliness	38 (32.2)	79 (66.9)	0 (0)	1 (0.8)
Mental health	43 (36.4)	74 (62.7)	0 (0)	1 (0.8)
Social activity	102 (86.4)	12 (10.2)	0 (0)	4 (3.4)

PA: physical activity; QoL: quality of life.

Table III. Reasons for less physical activity (PA) during lockdown (more than 1 response category is possible), *n* = 118

Reason for less PA	*n* (%)
Physical impairments after stroke	37 (31.4)
Worried about getting infected	37 (31.4)
Training facility closed	36 (30.5)
Lack of motivation	21 (17.8)
Mental impairments after stroke	16 (13.6)
Lack of training buddy	10 (8.5)
Other reasons	24 (20.3)

Eighty (68%) participants reported less physical activity, and 37 (31%) reported unchanged physical activity levels compared with before the pandemic (Table II). The most common reasons for less physical activity were impaired function after the stroke, *n* = 37 (31%), worries about getting infected, *n* = 37 (31%), and closed training facilities during the lockdown, *n* = 36 (31%) (see Table III for more details).

Fifty (42.4%) participants reported reduced QoL, 46 (39.0%) reported more loneliness, 43 (36.8%) reported worse mental health and 102 (86.4%) reported less social activity during the lockdown. No participants reported improved self-perceived health nor increased activity levels (Table II).

In the univariate analyses, less physical activity, odds ratio (OR) 4.65 (95% confidence interval (95% CI) 1.82–11.87, $p = 0.001$), and less social activity was associated with poorer QoL, while more loneliness, OR 2.30 (95% CI 1.30–6.45, $p = 0.009$), and poorer mental health OR 2.28 (95% CI 1.06–4.93, $p = 0.035$) were associated with reduced QoL. In the multivariate regression, only physical activity remained significant, OR = 4.04 (95% CI 1.44–11.34, $p = 0.008$) (Table IV). There was no multicollinearity between the covariates.

DISCUSSION

This study found that 68% of participants experienced a reduction in physical activity levels during the first year of the COVID-19 pandemic. In addition, a strong association was found between reduced physical activity and a change toward poorer QoL.

The significant reduction in self-reported physical activity levels and its association with lower QoL is in accordance with findings from similar studies on other groups of patients (26–29). In patients with neurologically related disorders it has been shown that less leisure-time physical activity is associated with more depression and fatigue and lower vitality (29), and in patients with acquired brain injury, maintaining engagement in ADL during the pandemic was associated with better health-related QoL (30)

Reports from The Norwegian Institute of Public Health (NIPH) also showed that the physical activity in the general population in Norway decreased during the pandemic, with 31% of the older population (age >76 years) reporting reduced physical activity levels during the pandemic (31). This is also in line with the findings from Nygård and colleagues in a recently published study among home-dwelling older adults in Norway, reporting 20% reduction in physical activity (3). Similar negative impact of the pandemic on general physical activity is also summed up from current evidence in international studies (4, 5, 32).

The proportion of participants reporting worse mental health and QoL was also substantial in the current study. This is in line with findings from the general population in Norway, showing decline in psychosocial well-being, higher loneliness, and psychological distress in older adults compared with before the pandemic (33).

The most frequently reported reasons for not keeping physical activity at the same levels as before the pandemic among the participants in the current study, were physical impairments after stroke (31.4%), closed training facilities (31.4%) and worries for being infected (30.5%). In addition, worse mental health (13.6%) and lack of motivation (17.8%) were frequently reported as reasons for less activity. These are factors that are known to be barriers to physical activity after

Table IV. Univariate and multivariate regression analysis with quality of life (QoL), dichotomized into unchanged vs less or poorer outcome, as the dependent variable

	Univariate*			Multivariate** *n* = 115		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Physical activity (unchanged vs less), *n* = 115	4.65	1.82–11.87	0.001	4.04	1.44–11.34	0.008
Loneliness (unchanged vs poorer outcome), *n* = 116	2.30	1.30–6.45	0.009	1.92	0.74–5.05	0.181
Mental health (unchanged vs poorer outcome), *n* = 116	2.28	1.06–4.93	0.035	1.30	0.51–3.28	0.582
Social activity (unchanged vs less), *n* = 116	4.35	0.90–20.53	0.069	3.94	0.73–21.22	0.110

OR: odds ratio; 95% CI: 95% confidence interval.
*Unadjusted, **adjusted for age, sex, and physical activity, loneliness, mental health, and social activity, respectively.

stroke. In a systematic review from 2013 the most commonly reported barriers were lack of motivation, environmental factors (e.g. transport), health concerns, and stroke impairments (8). The review conducted by Park et al. (32) also showed that facilitators to more physical activity were nature and green areas, pavements, and living in house with garden, and barriers were higher density dwelling, and lack of places to exercise. It is suggested that providing low threshold places to perform physical activity, such as green areas, and training facilities for maintaining activity levels and social contact in safe environments, should be considered if a similar pandemic situation is continued (26).

Interestingly the large majority, 102 (86.4%) participants, reported less social activity during the lockdown. This finding might be explained by the stroke itself (34), or it could be explained by the fact that the stoke survivors showed very good compliance with the COVID-19 regulations set out by the government, which, again, has resulted in reduced physical activity levels. This hypothesis is in accordance with other studies showing that social distancing during the pandemic was associated with negative impact on physical activity, physical health and psychological distress (35, 36). The importance of social support is also documented in other studies showing that older people participating in social activities, such as community groups and family activities, presented with better physical health compared with those not participating in such activities (8, 36, 37).

Given that the great majority of participants were classified as independent after the stroke, it is interesting to notice that no-one reported increased activity levels, indicating that stroke victims with only minor symptoms also are at high risk of inactivity. It is important to bear this finding in mind, because less physical activity is increasing the risk of accelerating functional decline, which is a barrier to engaging in social activities (38).

Strengths and limitations

The major strength of this study was the good response rate. It is also a strength that the age and sex distribution is comparable to the general Norwegian stroke population (39). Nevertheless, 90% were independent (mRS 0–2) at inclusion, indicating that this sample only is representative to the healthiest part of the population.

The lack of a validated questionnaire for this purpose is a limitation. However, standardized and validated questionnaires assessing the impact of COVID-19 did not exist. While most QoL questionnaires explore multiple dimensions and factors contributing to QoL through a series of questions, it is also possible to gain valuable insight into QoL by asking a single question rated on a Likert scale, as in the current study (40).

The current study questionnaire was developed to ask about changes in activity and experienced changes in QoL. An alternative approach could have been to apply a prospective study design measuring change over time by using a standardized measure, such as the the five-level EuroQol five-dimensional (EQ-5D-5L). However, it was not possible to conduct such a study, as the COVID-19 pandemic occurred very suddenly, which made it impossible to carry out a pre-pandemic assessment. Furthermore, there are limitations of self-report of physical activity, and people often overestimate their activity levels (41, 42). In the original randomized controlled trial (RCT) this weakness was addressed by applying activity monitors as an objective measure of physical activity. However, these data will not be available before the final results from the study are due to be analysed in 2024.

It might have been challenging for the participants to distinguish whether the change in activity level was related to the COVID-19 regulations or to the stroke itself, as both events occurred at approximately the same time. Previous research has shown that some stroke survivors tend to keep their physical activity at the same level as before the stroke while others experience a decline in activity, depending on their age and functional level (43–45). Consequently, the current study cannot preclude that the observed reduction in activity levels partly can be explained by the stroke itself rather than the lack of access to training facilities during the pandemic. However, worries about being infected and closed training facilities were among the top 3 causes of reduced activity levels, showing that the participants were able to distinguish between the 2 events.

Another limitation was the lack of a clear definition of physical activity stated in the questionnaire. However, physical activity was defined as all activity beyond rest (22) in the LAST-long trial, and the participants were familiar with this definition.

Finally, the cross-sectional study design implies that it is not possible to draw causal inference and one must be aware that the relationship might be the other way around (46).

Conclusion

This study showed that stroke survivors reported reduced physical activity following the COVID-19 pandemic, and that physical activity was strongly associated with QoL after stroke. Reasons for being more inactive were concerns for getting infected, physical limitations after the stroke and lack of access to training facilities. These results indicate that preventive measures

and innovative solutions are needed to tear down the barriers to maintain physical activity after stroke. Such solutions should also be possible to implement during the next pandemic with a need for infection control.

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