Physical activity, sleep and quality of life after stroke during the SARS-CoV-2 pandemic.

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ABSTRACT

Background: *Physical activity (PA) involves various aspects of daily life and is beneficial for health, however, after a stroke PA is lower, causing a decreased health related quality of life (HRQOL). In turn, subjects who perform less PA sleep more hours than recommended, being a risk factor for stroke. The effects generated by these variables could be enhanced under the current health context associated with SARS-CoV-2.* ***Objective:*** *To correlate PA, hours of sleep and HRQOL after a stroke.* ***Methods:*** *Descriptive cross-sectional design. PA, sleep and HRQOL were measured using ActivPAL for 7 days, home diary and the ECVI-38 scale, respectively.* ***Results:*** *The sample made up of 3 men and 3 women walked 4,519 steps/day (SD ± 2710), made 37.27 seated-standing transitions per day (SD 16.16), spent 7.63 hours sitting/day (SD ± 3.11), stood 5.18 hours/day (SD ± 3.21), walked 1.17 hours/day (SD ± 0.68), slept 8.5 hours/day (SD ± 1.30). A negative correlation was found between the number of steps per day and ECVI-38. No correlation was found between PA and hours of sleep.* ***Conclusion:*** *Increasing PA is essential for HRQOL as a prevention tool for stroke and CVD. The evidence and findings of this study invite consensus to classify PA and consider the hours of sleep, aspects that are closely related to health after a stroke.*

Key words: *physical activity, quality of life, sleep, stroke.*

Received: 10-02-2022
Accepted: 18-08-2022

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INTRODUCTION

The WHO defines physical activity (PA) as "any bodily movement produced by skeletal muscles that requires energy expenditure". It includes physical exercise and activities during work, transportation, domestic and recreational activities[1]. This means, that the feasibility of integrating PA in daily life is greater than it seems[2]. Nevertheless, people who suffer a stroke, and are able to perform adequate levels of PA, do not do so, mainly due to a lack of knowledge about the benefits of PA for their health condition, difficulty to access resources that support exercise at home or exercise sessions supervised by professionals[3]. This chronic sedentary behavior causes a decrease in cardiorespiratory endurance, functional capacity and health-related life quality (HRQOL) after a stroke[4]. Added to this, confinement and teleworking due to COVID-19, has caused an increase in sedentary behavior, possibly worsening chronic health conditions[5]. Stroke survivors tend to sit more than other groups and spend a greater daily percentage performing sedentary activities as it is difficult for them to achieve recommended levels of exercise[6]. One study concluded that an active life, regardless of regular exercise habit, reduced the risk of a first episode of cardiovascular disease by 27% and all-cause mortality by 30%.[6]

Another important aspect to consider are the hours of sleep. A study carried out in the United States examined the relation between hours of sleep and the stroke incidence, finding that both, myocardial infarction and stroke; were related to a sleep duration equal to or less than 6 hours, and equal to or greater than 9 hours, as opposed to adults who slept 7 to 8 hours, especially in those over 65 years old[7]. An inadequate rest related to stress during confinement or quarantine, can favor fatigue and increase stress, anxiety and depression[8]. Even though accelerometers have been used to objectively measure PA, and can record data continuously for a long time, and recognize the sleep period; there is no consensus regarding the hours of sleep, in subjects who have suffered a stroke[9]. Studies that do consider sleep duration, usually include it to the sedentary period[10], therefore it is not really considered as a variable. A systematic review has shown that gender, date of ACV and fatigue do not affect PA levels after a stroke. However, it does suggest that decreased mood and life quality are negatively linked to daily step counts and PA level[11], pointing out the importance of considering life quality and physical performance as one, since they have a real impact on the way people live and how they perceive their own health. The correlation degree between PA and hours of sleep is unknown when considering them as separate variables; and the correlation degree between PA measured objectively and HRQOL obtained with specific instruments for this variable in stroke after-effects, has not been determined.

Therefore, the purpose of this study is to correlate PA, hours of sleep, and HRQOL after a stroke.

METHODOLOGY

Design

Descriptive Cross Section Study.

Sample

Non-probabilistic, convenience sampling, identifying subjects who met the following inclusion criteria: Between 18 and 80 years old, stroke diagnosis confirmed by a Computed Axial Tomography (CT) or a Magnetic Nuclear Resonance (NMR), ability to walk with/without walking aids, ability to follow instructions (score greater than 14 in abbreviated Mini mental test) and not hospitalized or incapacitated. The exclusion criteria was: other neurological diseases, cerebellar stroke, medical contraindication for PA and recent hospitalization (up to a month ago).

A total of 6 participants (3 men and 3 women) were recruited between the months of March and May 2021.

Procedure

The participants were visited at their homes in order to sign the informed consent, collect the data, apply ECVI-38 and install ActivPAL. A home journal was also provided, which is a document in digital or physical format that aimed to record the time the person woke up and fell asleep. Demographic and clinical data were collected through a registration form. A code was assigned to each participant, thus ensuring the confidentiality of the data. To measure "PA" and "hours of sleep" the "ActivPAL" device was used, which is a valid, reliable and feasible accelerometer to measure PA in both healthy individuals and people with CVA[12]. The variable "hours of sleep" was complemented with the home journal. For the "HRQOL" variable, the ECVI-38 Stroke Quality of Life Scale was used; which is a valid and reliable instrument[13] that includes: physical condition (PC), communication (CO), cognition (CG), emotions (EM), feelings (FE), basic activities of daily living (BADL), common activities of daily living (CADL), socio-family function (FF), sexual activity and work. Wrapped in a nitrile thimble, the ActivPAL was fixed to the unaffected thigh with Tegaderm over a skin protection film (Cavilon 3M)[2]. Tegaderms and extra thimbles were provided. Telephone follow-ups were conducted, and after 7 days the journal and device were recovered. In addition, the acceptability of the use of the accelerometer was explored in a questionnaire that addressed situations that could have been interfered by the use of the device, such as wearing clothes, personal hygiene, skin irritability, discomfort, etc. with a rating that went from 1 (worst rating) to 10 (best rating).

This research was approved on November 10, 2020 by the Scientific Ethics Committee of Universidad La Frontera (No. 085/20, record No. 118_20) and all subjects provided their written informed consent.

Statistic analysis

To manage data, the statistical software SPSS v.25 and the PAL analysis software was usedfor ActivPAL data (PAL Technologies, Glasgow, Scotland). The Shapiro-Wilk test was used to examine the normality of the data. METs, total hours walking, biped, sitting, lying down, step counts, and sitting-to-biped transitions were quantified for PA. The average percentage in one day (24 hours) devoted to the following activities is also shown: walking, standing, sitting, lying down, and sleeping. To quantify the hours of sleep, an average between the home journal and ActivPAL was obtained. For HRQOL, the classification was according to the ECVI-38 score[14]. Due to the sample size, an analysis between the variables PA-Hours of sleep and PA-HRQOL with Spearman's Rho was performed for the correlational analysis[15], with a significance level of 0.05.

RESULTS

All participants completed the registration form and the 7 days with ActivPAL, 83% of the participants filled out the journal. The individual who did not fill it out, was one of the 2 participants who was diagnosed with COVID-19, and required hospitalization one week after finishing their evaluation. 100% of the participants had an ACV with right involvement, 67% was ischemic and was diagnosed more than 2 years ago. The main characteristics of the sample are presented in **Table 1**. Regarding the acceptability of ActivPAL, an average score of 9.2/10 was obtained, and 1 subject reported skin irritation under Tegaderm.

Physical activity

During the recruitment and measurement period, the city of Temuco was in Phase 2 of the Step by Step Plan[16]. This means that from Monday to Friday it was possible carry out activities without any restrictions, but on weekends it was necessary to request a special permit to move through the city. The data extracted from the journals and ActivPAL, showed that the participants carried out similar routines during the week and on weekends, so it was not considered relevant to analyze them separately.

Table 1. Sample characteristics.

Characteristics (n=6)	Average ± DE (Min-Máx.)
Age	53,83 years old ± 12,67 (37-66).
Gender	3 men; 3 women.
Stroke Type	4 ischemic; 2 hemorrhagic.
Location	6 left hemisphere.
Affected side	6 right hemibody.
Access to rehabilitation	**6 yes**
Stroke evolution time (months)	52,67 meses ± 57,64 (2-156).
Place of residence	6 Urban.
BMI	25,217 ± 3,17 (19,5-28,7).
Aid	1 Other; 2 Ankle brace; 3 None.....
Tobacco	2 Smoker; 1 Former smoker; 3 Non-smoker.
Cardiac disease	1 Si; 5 No.
HTA	2 Si; 4 No.
DM	2 Si; 4 No.
Hypercholesterolemia	2 Si; 4 No.
Medications that cause drowsiness	3 Si; 3 No.
COVID+	4 Si; 2 No.
Rehab during 2021?	5 Yes, 1 No.
Modality	1 Not applicable; 3 home; 2 Onsite.
Rehabilitation frequency (days/week)	1.83 days a week ±0.98 (2-3 days).
Rehabilitation Duration	1 hour
Rehabilitation before the pandemic?	5 Yes, 1 Not Applicable.
Modality	1home; 4 Onsite.
Rehabilitation frequency (days/week)	1.83 days a week ±1.17 (1-3 days).
Rehabilitation Duration	1 hour

Standard Deviation (SD).

Table 2. Physical activity parameters per participant according to ActivPAL.

Physical activity	Participant N°						Average ± DE
	1	**2**	**3**	**4**	**5**	**6**	
Steps/Day	25,7	5172	7757	3249,7	4394,6	6514,9	4519,0 ± 2709,65
Seated-biped/day	19	58,1	29,6	56,4	27,6	32,9	37,3 ± 16,16
MET/Hour	31,2	33.3	34,8	32,8	32,2	33,2	32,9 ± 1,20
Hours Lying down/Day	0	1,2	0	0	0	1,5	0,5 ± 0,70
Hours Sitting/Day	11,9	5,8	3,7	6,3	10,7	7,4	7,6 ± 3,11
Hours in an vehicle/Day	0,3	0,1	0,1	3,2	1,9	1,3	1,2 ± 1,24
Hours standing/Day	1	8,2	9,1	5.4	2,1	5,3	5,2 ± 3,21
Hours Walking/Day	0	1,4	2,1	1,1	1,1	1,3	1,2 ± 0,68
Sleep hours ActivPAL	10,6	7,3	9,1	8,5	8,5	7	8,5 ± 1,30
Total sedentary hours	12.2	7,1	3,8	9,5	12,6	10,2	9,2 ± 3,32
Total active hours	1	9,62	11,2	6,5	3,2	6,6	6,4 ± 3,82

Standard Deviation (SD).

The average PA of each participant according to ActivPAL is displayed in **Table 2**. Subjects with more than 2 comorbidities had a higher total sedentary time per day. Regarding BMI, 4 of 6 participants were classified as overweight. The 2 subjects with a healthy weight correspond to those who spent more hours per day standing or walking and, therefore, had a higher total active time.

From the 15.5 hours spent awake, 41.3% (6.4 hours) was active time, this means that time sitting or lying down was subtracted. Despite only spending 2% (0.5 hours) of the day lying down, they spent less time standing and walking (27%) than sitting (36%).

Hours of sleep

The participants slept for an average of 8.5 hours/day. The information recovered from the journals (5 journals out of 6) and from ActivPAL, showed sleep hours averages of 8.7 and 8.5 hours correspondingly. The correlation between the data obtained by both instruments was of 0.94 (p=0.006), therefore the ActivPAL value was used for the analyses. Four out of six participants (66.7%) slept more than 8 hours/day. 3 of them were male. None of the participants slept less than

7 hours/day. Participants spent almost the same percentage of hours sitting (36%) and sleeping (35%), spending more time per day asleep than active (27%).

Life quality related to health

Regarding the degree of general affectation of HRQOL, 33.3% of the participants did not show any affectation. This percentage corresponds to male participants who had the longest stroke evolution time (7 and 13 years). 33.3% suffered a "mild affectation", and were female subjects between 44 and 47 years old. 33.3% suffered a "moderate affectation", corresponding to subjects between 64 and 65 years old with an average of 2.5 years of evolution of the stroke and Broca's Aphasia after-effect. No participant was part of the "serious affectation" group.

The fields with greatest affectation, as can be seen in **Table 3**, were those belonging to PC, CO and BADL, although all of them would be in the "Mildly affected" category. Subjects with Broca's aphasia obtained higher scores in the CO and PC field, and were classified as "moderately affected". Regarding the degree of recovery, no participant considered that they had "Totally" recovered, nor that they had "Not at all" recovered or had "Little" recovery. Most subjects considered they had recovered "Quite a bit" from the stroke, which corresponds to 83.3% and 16.7% felt they had recovered "A lot", regardless of gender and evolution timeline of the stroke.

Table 3. ECVI-38: Results according to category and degree of involvement.

Categroy	Average ± SD (Min-Max.)	Level of affectation
Physical condition (PC)	40,0 ± 17,32 (20,0 – 65,0)	Mild
Communication (CO)	37,5 ± 31,62 (0,0 – 75,0)	Mild
Cognition (CG)	30,6 ± 28,22 (0,0 – 66,7)	Mild
Emotions (EM)	33,3 ± 33,33 (0,0 – 60,0)	Mild
Feelings (FE)	22,5 ± 18,09 (0,0 – 40,0)	No affectation
Basic activities of daily life (BADL)	32,3 ± 25,44 (0,0 – 62,5)	Mild
Common activities of daily life (CADL)	44,8 ± 37,58 (0,0 – 87,5)	Mild
Socio-family function (FF)	33,3 ± 25,06 (3,1 – 62,5)	Mild

Correlations

Correlations between age, BMI, PA (steps, sitting-standing, MET.hr., total sedentary hours, total active hours), sleep hours and HRQOL (ECVI-38) are shown in **Table 4**. No statistically significant correlation was found between PA and hours of sleep. Regarding PA and HRQOL, a statistically significant negative correlation was found between the number of steps per day and ECVI-38, where an increase in the number of steps is related to a decrease in the ECVI-38 score, which means less affectation of HRQOL. A negative correlation was also found between the following variables: steps and age, between total sedentary hours and MET.hr., between total sedentary hours and total active hours, and between total active hours and

Table 4. Correlations between Age, BMI, PA, Sleep Hours and HRQOL.

Variables		Rho Spearman	P
Steps/Day	**Age**	**-0,886***	0,019
	BMI	-0,657	0,156
	Seated-biped/day	0,314	0,544
	MET.Hr/Day	**0,886***	0,019
	Total Sedentary Hours/Day	-0,600	0,208
	Total active hours/Day	**0,886***	0,019
	Hours of sleep	-0,406	0,425
	ECVI-38	**-0,829***	0,042
Seated-biped/day	**Age**	-0,200	0,704
	BMI	-0,257	0,623
	MET.Hr/Day	0,600	0,208
	Total Sedentary Hours/Day	-0,600	0,208
	Total active hours/Day	0,600	0,208
	Hours of sleep	-0,696	0,125
	ECVI-38	0,029	0,957
Total Sedentary Hours/Day	**Age**	0,600	0,208
	BMI	0,429	0,397
	MET.Hr/Day	**-0,886***	0,019
	Total active hours/Day	**-0,886***	0,019
	Hours of sleep	0,058	0,913
	ECVI-38	0,257	0,623
Total active hours/Day	**Age**	**-0,829***	0,042
	BMI	-0,657	0,156
	Hours of sleep	-0,348	0,499
	ECVI-38	-0,600	0,208
Hours of sleep	**Age**	0,203	0,700
	BMI	0,232	0,658
	MET.Hr/Day	-0,348	0,499
	ECVI-38	0,174	0,742
ECVI-38	**Age**	0,714	0,111
	BMI	0,600	0,208
	MET.Hr/Day	-0,600	0,208

(*) The correlation is significant at the level 0.05 (bilateral).

age. A positive correlation was found between the variables steps and MET. hours, as well as between steps and total active hours.

DISCUSSION

This study provides information on PA, hours of sleep, and the HRQOL after a stroke, of subjects living in the community, as well as the relationship between these variables. This assessment arises from the need to delve into the factors that influence PA, and areas that can affect HRQOL in addition to physical and sleep regulation as part of health care and well-being. Evidence suggests that stroke survivors need more time in rehabilitation and a considerable degree of recovery to perform PA and sports[17] However, some participants, despite living with considerable mobility impediments, lead an active life: they work, participate in domestic activities, recreational activities, etc. which suggests that having a stroke does not necessarily imply a decrease in PA.

Physical activity

A systematic review reported that sedentary lifestyle corresponded to 81% (19.5 hours), that subjects spent an average of 7 hours sitting/lying down, and that healthy subjects recorded almost doubled the amount of postural changes (109 v/s 57)[18]. Because sleep hours are included in sedentary time (12.5 hours), the participants in this study spent more hours sitting/lying down (9.2 hours), with fewer changes in posture (37.3 v/s 57), but with a lower percentage of sedentary time in general(73.8% v/s 81%). On the other hand, the average of sleep in the present study is of 8.5 hours; so by discounting the hours of sleep, they obtained 29.2% of sedentary time while awake, versus 38% obtained in this study, thus highlighting the importance of considering sleep and sedentary time separately. Another study reported that regardless of the chronicity of the stroke, the participants spent more than 78% of the time in sedentary activities and took 4,078 daily steps in chronic phases[19], which was similar to what was found in this study. The advantage of using ActivPAL is that if the participant stands up and walks at home or goes to rehab, the device adds[20] to the PA performed. Assessing PA for 7 days provides greater detail about the subject´s real routine in their context[21], and can be a tool to organize habits at home; it is also an appropriate measure to avoid the "Hawthorne Effect", understood as a change in the participant's behavior due to the fact of being included in a study and being observed[22], which was also addressed in the accelerometer use questionnaire , with questions like: "How conscious were you of wearing the device?" and "Did you feel pressured to do more PA than usual because you knew you were being evaluated?", etc.

Hours of sleep

Sleep and ACV have been studied as hours of sleep through self-reports[23], without corroborating it with an objective measurement[18]. The ActivPAL and self-report data showed a high correlation, either considering them together or separately and displayed adequate methods of measurement. The relationship between hours of sleep and stroke deserves more attention. Since healthy sleep has not been thoroughly investigated as a potential stroke prevention strategy, it becomes a relevant fact today where many people´s routine, habits and stress levels have changed due to teleworking and confinement resulting from Covid-19.

Life quality

Despite the fact that no correlation was found between age and ECVI-38, literature suggests that age would influence the perception of HRQOL; specifically that young subjects would have a better perception of it than older ones[14], Most of the subjects rated their degree of recovery as "A lot" despite having to continue rehabilitation indefinitely.

Correlations

Many stroke survivors suffer from after-effects such as decreased mobility, balance and strength, favoring a sedentary lifestyle[24] reducing HRQOL[25], therefore a correlation was found between the number of daily steps and the ECVI-38 score. Due to all the factors associated with PA after stroke[26,27], it is not clear which of them is a bigger influence for PA after a stroke;

and physical function only explains part of it. A comprehensive assessment model that considers physical, cognitive, and psychosocial factors[28] could increase the likelihood that stroke survivors will be more active within the community.[11,29]

Strengths

One of the main strengths of this study is the objective and corroborated measurement of sleep duration, considering it as a different variable from sedentary time. The "Hawthorne Effect" was also considered, measuring PA for 7 days and including it in the ActivPAL user experience questionnaire .

Limitations

The main limitation is the sample size, which prevents the results obtained from being generalized, as well as the influence of the health context due to the COVID-19 pandemic. This situation interrupted access to rehabilitation and restricted possible participants to be part of the study, either due to fear of infection, involvement of more PA or the perception of their HRQOL; which is valid, since people with stroke are part of a vulnerable population, and are therefore limited to performing any PA inside their homes, and are able to access rehabilitation and participate in the community depending on the phase of the "Step by Step Plan"[16]. Another aspect that could be addressed in future studies is depression and PA prior to a stroke, understanding that mood influences PA 11 and the history prior to an event of this kind is important in future performance.

Conclusion

The main therapeutic objectives after a stroke are to improve functional independence, emphasizing on early diagnosis and treatment, and to control modifiable risk factors and comorbidities mainly through pharmacotherapy. Increasing low and high intensity PA, has a very important role and could positively influence health and HRQOL if used as part of the primary and secondary prevention tools for stroke. The available evidence and findings of this study leave an invitation to seek consensus to classify PA and emphasize the need for a broader therapeutic approach; to look into factors related to PA and state the importance of detecting and treating sleep disorders. Finally all aspects are closely related to cardiovascular health and to HRQOL of people before and after a stroke.

Acknowledgments: This study was made possible thanks to the guidance and advice of the PhD. Nicolás Aguilar F.[30]

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