Original Article

Ann Rehabil Med 2024;48(2):124-134
eISSN: 2234-0653
https://doi.org/10.5535/arm.230030

Annals of Rehabilitation Medicine

Chronic Neck Pain Prevalence Before and After COVID-19 Restrictions and Its Relationship With Digital Device Screen Viewing: A Population Study

Tomas Nakazato, MD, Pablo Quezada, MD, César Gutiérrez, MD, MSc, Franco Romaní, MD, MSc

Facultad de Medicina Humana, Universidad de Piura, Lima, Peru

Objective: To estimate the prevalence of chronic neck pain (CNP) among the adult population in Peru during the post-coronavirus disease 2019 (COVID-19) restriction period compared with that during the pre-pandemic period and evaluate its association with prolonged digital devices connected to the internet (DDCI) screen viewing.
Methods: We conducted a cross-sectional study using a representative sample of adults living in Peru in November 2022. A structured survey was employed to identify CNP, and the exposure variable was set as the duration of DDCI screen viewing. The McNemar test was used to compare CNP prevalence pre- and post-COVID-19 restrictions, and ordinal logistic regression was used to evaluate its association with prolonged screen viewing.
Results: A total of 1,202 individuals participated, with 52.8% females and 79.9% residing in urban areas. Following the restrictions, the prevalence of CNP occurring daily or almost daily and at least once a week was 14.8% and 27.8%, respectively (95% confidence Interval [95% CI], 12.6–17.3 and 24.9–30.9), representing a significant increase (p<0.001) compared with pre-pandemic estimates. Notably, among those viewing DDCI screens for ≥8 hours, the odds ratio for CNP frequency escalation compared with those who did not or rarely view screens was 1.61 (95% CI, 1.04–2.50; p=0.033).
Conclusion: Approximately 4 of 10 adults in Peru experienced CNP following the lifting of COVID-19 social restrictions, more than double the pre-pandemic prevalence. Furthermore, prolonged viewing of DDCI screens increased the risk of having this condition.

Keywords: Neck pain, Chronic pain, Prevalence, Screen time, COVID-19

Received: December 18, 2023
Revised: February 15, 2024
Accepted: March 19, 2024

Correspondence:
Tomas Nakazato
Facultad de Medicina Humana, Universidad de Piura, Martir Jose Olaya Street 162, Miraflores, Lima 15074, Peru.
Tel: +51-01-2139600
E-mail: tomas.nakazato@udep.edu.pe

INTRODUCTION

Neck pain is a multifactorial disease and ranks among the most common musculoskeletal disorders, with an age-standardized prevalence rate of 2.7% globally in 2019 [1]. While many acute episodes resolve spontaneously, approximately one in five individuals affected by neck pain seek treatment within a year [2]. Chronic neck pain (CNP) imposes a substantial personal and socioeconomic burden, causing millions of years of life lost due to disability [3]. Given these adverse impacts on individuals affected by CNP, it is imperative that this condition be formally diagnosed and appropriately treated. Consequently, CNP warrants recognition as a distinct ailment, similar to other musculoskeletal disorders such as chronic low back pain [4].

The association between CNP and postural deviations, particularly forward head posture, in the adult population is well established [5]. Additionally, there has been a recent increase in CNP prevalence attributed to prolonged periods of neck flexion resulting from increased time spent viewing digital devices connected to the internet (DDCI) screens [6-8]. However, the relationship between CNP and DDCI usage is complex. Existing evidence has primarily stemmed from studies involving university students and a younger demographic, with some results showing an association [9-11] and others contradicting it [12-14]. These discrepancies can be attributed to the diversity of study methodologies used to define CNP and the selection of young participants through convenience sampling, contributing to study heterogeneity.

During the lockdown and social distancing measures implemented amidst the coronavirus disease 2019 (COVID-19) pandemic, the utilization of DDCI, such as smartphones, desktop computers, laptops, and tablets, increased due to the popularization of remote work, education, entertainment, and social interaction [15,16]. Particularly, Peru declared a state of emergency in March 2020, leading to the implementation of social distancing measures, including quarantine [17]. A study reported that approximately 76.2% of households in Peru had internet access, and nearly 90% of the population aged 12 and above used smartphones to browse the internet in 2019 [18]. This pre-pandemic landscape may have exacerbated the adverse effects of the COVID-19 lockdown on the population's health and quality of life [19], potentially leading to increased neck problems, especially in Peru, where a survey conducted in 2016 estimated a CNP prevalence of 20.9% among a representative sample of adults [20]. Globally, the extent to which the frequency of CNP has changed following the relaxation of social restrictions remains unknown. With the lifting of restrictions in Peru in October 2022 [21], the absence of such evidence is a cause for concern. We hypothesized that the prevalence of CNP, defined herein as neck pain occurring daily or almost daily or at least once a week within the last 6 months, has increased following the lifting of COVID-19 restrictions compared with its pre-pandemic levels, primarily due to the increased usage of DDCI.

This study aimed to estimate the prevalence of CNP during the transition back to normalcy after COVID-19 restrictions in Peru and compare it with its prevalence during the pre-pandemic period. In addition, we evaluated the association between DDCI screen viewing and the occurrence of CNP.

METHODS

Ethical approval

This study was conducted in accordance with the principles of the Declaration of Helsinki, and the study protocol was approved by an Institutional Committee on Ethics in Research of Universidad de Piura (Act No. 14/2022). All participants were asked for informed consent. Statistical analyses were performed using an anonymized database and reported according to the STROBE guidelines.

Study design

This analytical, cross-sectional study was conducted in the Republic of Peru, a Latin American country divided administratively into 25 territories (grouped into five regions: Lima, North, Center, South, and East). The survey was population-based and conducted between November 24 and 25, 2022. The target population included individuals aged >18 years living in urban and rural areas. According to official data, the population size in 2021 was 24,290,921 individuals (50.2% females), with 79.9% residing in urban areas [22].

Sampling design

The sampling design was computed with a margin of error of 2.83%, a maximum variance of population proportions (p=0.50), and a 95% confidence interval (95% CI), resulting in a calculated sample size of 1,202 individuals. We employed a multistage sampling method. The first stage consisted of a probabilistic sample selection of locations via systematic random sampling, proportional to the number of inhabitants in each location. The second stage involved systematic sampling, with random selection of blocks of houses, where the probability of block selection was proportional to the number of houses. The third stage comprised the selection of houses through systematic sampling, with a random starting point. Finally, in the fourth stage, individuals within each household were selected based on their sex and age, to achieve the required distribution.

To perform the first, second, and third sampling stages, the cartography of the Instituto Nacional de Estadística e Informática del Peru generated during the national census of 2017 was utilized as the sampling frame [23].

Definition of variables

The variable of interest, CNP, was measured using two questions, each targeting different intervals. The first question inquired: "Considering the last 6 months, have you experienced any pain in the neck, nape, or in the tops of your shoulders?" The second question evaluated a similar occurrence preceding the onset of the pandemic: "Did you experience any persistent pain in the neck, nape, or on the tops of your shoulders before March 2020 (prior to the COVID-19 lockdown) persistently, that is, lasting 6 months or more?"

For both questions, respondents were presented with five response options: (1) "Yes, I experienced pain in that area once a month on average;" (2) "Yes, I experienced pain in that area once a week on average;" (3) "Yes, I experienced pain in that area daily or almost daily;" (4) "No, I have not experienced any pain in that area;" and (5) "I could not tell." Participants who responded to categories 2 and 3 were considered CNP cases.

The exposure variable was the number of hours spent viewing DDCI screens, measured through a third question: "On average, how many hours a day do you spend looking at a screen of a device connected to the internet, such as your cellphone (smartphone), laptop, personal computer, or tablet for study, work, or entertainment purposes?" Respondents were provided with the following response categories: (1) "I do not look at any screen, or I barely do it;" (2) "I spend <4 h/day looking at a screen;" (3) "I spend between 4 and 8 h/day looking at a screen;" (4) "I spend ≥8 h/day;" and (5) "I could not tell."

The covariates were demographic characteristics, including age (years), sex, and household socioeconomic level (from "A" indicating higher resources to "E" indicating fewer resources). This socioeconomic variable was derived from the income of the household head, goods and services accessed, household appliances, and access to public services, as previously described. Other covariates included were resident area (urban, rural) and region (Lima, North, Central, South, and East).

Survey

Fieldwork was conducted by IPSOS Opinión y Mercados S.A. organization through face-to-face surveys conducted in the selected households. Data were collected by local resident interviewers who have experience in survey applications. Before administering the survey, the interviewer requested each participant's consent. In instances where the selected participant was not at home, three additional visits were made. However, if the participants could not be reached after these attempts, they were replaced with individuals matching their age and sex characteristics.

Data collection was facilitated through mobile devices using the iField application (IPSOS Group S.A.), an integrated computer-aided personal interview platform. This approach enabled efficient location tracking of interviewers and participants during the survey, real-time quality control of data, reduced errors in data collection, closed card sorting, and ensured adherence to the sample selection process in assigning households.

Statistical analysis

An exploratory analysis confirmed the absence of data loss; thus, we analyzed the complete dataset. Continuous variables are presented using the mean and 95% CI. Categorical variables are expressed as weighted proportions. Additionally, unweighted absolute frequencies were provided, considering that the weights applied enable the expansion of frequencies to estimate the absolute parameter. The weighted proportions provided corrected and valid percentages representative of the population ≥18 years residing in Peru in November 2022.

The prevalence of CNP was estimated along with the corresponding 95% CI for two-time points: before the COVID-19 pandemic and during the return to normalcy (COVID-19 post-restrictions period). For this analysis, the primary outcome was CNP, defined as occurring daily or almost daily (response category 3) or at least once weekly (response category 2) onset. These frequency levels were selected for prevalence estimation, consistent with previous studies [24,25]. Prevalence was calculated by considering the total of participants in the survey as the denominator.

To estimate the dynamics of CNP changes before and after COVID-19 social restrictions, we utilized a contingency table, with CNP categories before restrictions forming the rows and categories for the post-restriction period forming the columns. Changes were depicted as weighted proportions. These prevalences were compared using McNemar's test.

To evaluate the association between CNP and DDCI screen use, we considered CNP occurrence after COVID-19 social restrictions. Pearson's chi-square test with a second-order Rao-Scott correction was used to compare the CNP proportions across strata defined by the study variables. This analysis was conducted among a subpopulation of participants who provided valid responses to the questions, excluding those who responded, "I could not tell." Additionally, factors associated with DDCI screen-viewing were also identified. A subpopulation of participants with valid responses to this question was used for analysis. At this stage, a statistical criterion ($p<0.20$) was applied to define the variables included in the regression model.

Ordinal logistic regression was employed to evaluate the association between DDCI screen-viewing and CNP. This model was chosen because CNP, the dependent variable, was measured using categories that reflected an order of frequency (i.e., no pain, daily or almost daily pain, weekly pain, and monthly pain). Prior to fitting the model, we evaluated whether the included variables met the proportional odds assumption by conducting the Wald test for parallel lines. A significance level >0.05 implied that the odds were proportional. This analysis was conducted independently for each variable and set of model variables. IBM SPSS Statistics version 25.0 (IBM Corp.) was used to verify these assumptions.

In the multivariate analysis, we formulated a complete model with all covariates at $p<0.20$. Additionally, socioeconomic status was included as an epidemiological criterion. Subsequently, a second (reduced) model was constructed, incorporating factors that were significant in the first multivariate model alongside the exposure of interest. Adjusted odds ratios (ORs), their corresponding 95% confidence intervals (95% CIs), and the estimated coefficient were presented for both models. McFadden and Nagelkerke's pseudo-R-squared values were estimated to assess the global goodness-of-fit. Post-hoc statistical power calculations for the regression model were performed, considering factors such as the sample size, the number of predictors included in the models, the observed R-squared value, and a significance level of 5%.

Statistical analysis was performed for a complex survey sample using the svy command in Stata Statistical Software (Release 16; StataCorp LLC). Statistical significance was set at $p<0.05$.

RESULTS

A total of 1,202 participants (52.8% females) were included in this study. The mean age was 39.48 years (range, 18–85 years). Among them, 55.5% were within the age range of 30–60 years, 34.5% lived in Lima, and 79.9% lived in urban areas (Table 1).

Changes in the prevalence of CNP

During the return to normalcy, the prevalence of daily or almost daily CNP was 14.8% (95% CI, 12.6–17.3), while the prev-

Table 1. Sociodemographic characteristics of the sample

Variate	Unweighted count	Weighted proportion	Standard error
Age	1,202	39.48 (38.49–40.47)	0.5
Age group (yr)			
18 to <30	384	31.6 (28.4–34.9)	1.7
30 to <60	660	55.5 (52.0–58.8)	1.7
≥60	158	13.0 (10.9–15.3)	1.1
Sex			
Male	604	47.2 (43.8–50.6)	1.7
Female	598	52.8 (49.4–56.2)	1.7
Area of residence			
Urban	1,001	79.9 (76.5–83.0)	1.7
Rural	201	20.1 (17.0–23.5)	1.7
Region			
Lima	500	34.5 (31.7–37.5)	1.5
North	270	23.8 (20.8–26.9)	1.6
Center	131	12.5 (10.2–15.2)	1.3
South	176	17.1 (14.3–20.3)	1.5
East	125	12.1 (10.1–14.5)	1.1
Socioeconomic level			
A	42	2.1 (1.6–2.9)	0.3
B	236	12.2 (10.2–14.6)	1.1
C	432	31.7 (28.8–34.6)	1.5
D	249	24.3 (21.4–27.4)	1.5
E	243	29.7 (26.4–33.3)	1.8

Values are presented as number only or proportion (95% confidence interval).

alence of CNP occurring at least once a week was 27.8% (95% CI, 24.9–30.9). These findings represented a significant increase compared to the estimates before the restrictions for both outcomes (McNemar's test, p<0.001).

Post-restriction, the prevalence of daily or almost daily CNP was 2.43 times higher than before the COVID-19 pandemic (95% CI, 1.78–3.08). Similarly, the prevalence of CNP occurring at least once a week increased by 2.25 times (95% CI, 1.86–2.64). Additionally, we estimated the difference in the weighted prevalence between the return to normal and before the restrictions for each population stratum (Table 2).

Among participants who did not experience any pain or had pain very rarely before the restrictions, 60.7% remained painless during the return to normal. For those who reported pain once a month before the restrictions, 17.0% and 12.3% reported an increase in frequency to once a week and daily or almost daily pain, respectively, during the return to normalcy. Additionally, among participants who experienced daily or almost daily pain before the restrictions, 45.9% remained at the same frequency of pain during the return to normal (Table 3).

Screen viewing

Among the entire sample (n=1,202), 23.5% (95% CI, 20.7–26.6) of the participants reported that they did not view screens or did so rarely. In contrast, 39.6% (95% CI, 36.4–43.0) reported viewing screens for <4 h/day, while 20.1% (95% CI, 17.7–22.8) reported viewing screens between 4 and <8 h/day and 12.3% (95% CI, 10.1–15.0) declared viewing screens for ≥8 h/day. Only 4.4% of the participants could not specify how much time they spent viewing screens.

Covariates associated with CNP after the COVID-19 restrictions

In bivariate analysis, the proportion of CNP at any frequency was higher among females than males. Age was also significantly associated with CNP, with a higher proportion of daily CNP observed among individuals aged 60 and above. Furthermore, the crude analysis showed an association between CNP and exposure to DDCI screens (Table 4).

Conversely, the number of hours spent viewing screens was associated with age, area of residence, region, and socioeconomic

Table 2. Prevalence of daily chronic neck pain daily or almost daily, and at least once a week on average for the sample and according to strata

Variate	Neck pain daily, or almost daily			Neck pain at least once a week on average		
	Before COVID-19 pandemic	Return to normal	Δ	Before COVID-19 pandemic	Return to normal	Δ
Global	6.1 (4.8–7.8)	14.8 (12.6–17.3)	8.7 (6.5–10.9)	12.4 (10.4–14.6)	27.8 (24.9–30.9)	15.4 (12.8–18.0)
Age group						
18 to <30	5.0 (2.9–8.6)	8.5 (5.8–12.1)	3.5 (1.4–6.7)	12.3 (8.9–16.8)	22.4 (17.9–27.6)	10.1 (5.7–14.5)
30 to <60	6.1 (4.5–8.2)	16.9 (13.7–20.6)	10.8 (7.8–13.8)	11.8 (9.4–14.7)	29.7 (25.7–34.0)	17.9 (14.3–21.4)
≥60	8.6 (4.8–15.0)	21.2 (15.0–29.2)	12.6 (5.8–19.4)	15.0 (9.7–22.5)	32.6 (24.8–41.6)	17.6 (9.6–25.7)
Sex						
Male	5.4 (3.7–7.8)	9.6 (7.3–12.6)	4.2 (1.6–6.8)	11.4 (8.9–14.5)	20.2 (16.9–24.0)	8.8 (5.5–12.1)
Female	6.7 (4.8–9.2)	19.4 (15.9–23.5)	12.7 (9.4–16.1)	13.2 (10.5–16.5)	34.5 (30.0–39.3)	21.3 (17.4–25.2)
Area of residence						
Urban	6.2 (4.9–8.0)	14.4 (12.2–17.0)	8.2 (5.8–10.5)	13.3 (11.2–15.7)	28.1 (25.1–31.4)	14.8 (12.0–17.8)
Rural	5.4 (2.5–11.4)	16.2 (10.3–24.6)	10.8 (5.5–16.0)	8.7 (4.8–15.5)	26.2 (18.8–35.3)	17.5 (11.2–23.9)
Region						
Lima	7.9 (5.8–10.7)	16.1 (13.0–19.7)	8.2 (4.3–12.0)	14.2 (11.3–17.6)	28.4 (24.5–32.6)	14.2 (9.9–18.7)
North	6.0 (3.4–10.6)	17.8 (12.6–24.5)	11.8 (6.9–16.6)	16.1 (11.5–21.9)	33.8 (27.1–41.2)	17.7 (11.9–23.5)
Center	5.1 (2.3–11.0)	14.4 (8.6–23.1)	9.3 (3.5–14.9)	10.9 (6.1–18.8)	31.9 (22.7–42.9)	21.0 (13.2–28.8)
South	2.2 (0.9–5.3)	9.4 (5.3–16.2)	7.3 (2.8–11.7)	6.0 (3.3–10.8)	17.2 (11.5–24.8)	11.1 (5.4–16.9)
East	7.6 (3.7–14.9)	13.2 (7.9–21.3)	5.6 (-0.4–11.7)	10.4 (5.8–17.9)	24.8 (17.4–34.1)	14.4 (7.1–21.8)
Socioeconomic level						
A	2.3 (0.3–14.6)	10.1 (3.8–24.1)	7.8 (-6.4–22.1)	15.0 (6.9–29.7)	19.8 (10.4–34.5)	4.8 (-13.3–22.8)
B	3.5 (1.7–6.9)	9.2 (5.9–14.0)	5.7 (0.8–10.6)	9.8 (6.4–14.6)	21.2 (15.7–27.8)	11.4 (4.3–18.5)
C	7.1 (4.9–10.1)	14.5 (11.3–18.4)	7.4 (3.6–11.2)	15.8 (12.5–19.8)	30.0 (25.6–34.7)	14.2 (9.4–18.9)
D	7.2 (4.6–11.1)	15.8 (11.6–21.1)	8.6 (4.0–13.2)	12.9 (9.1–17.9)	29.7 (23.7–36.5)	16.8 (11.7–21.9)
E	5.5 (3.1–9.6)	16.9 (12.0–23.3)	11.4 (7.2–15.6)	9.1 (5.8–14.1)	27.1 (21.1–34.1)	18.0 (13.0–23.1)

Values are presented as weighted proportion (95% confidence interval).
COVID-19, coronavirus disease 2019; Δ, difference in proportions.

Table 3. Changes in the recurrence of chronic neck pain before COVID-19 pandemic and during the return to normality

Chronic neck pain before COVID-19 pandemic (%)	Neck pain during return to normality (%)				
	No pain	Once a month	Once a week	Daily, or almost daily	I could not tell
No pain	60.7[a)]	17.0[c)]	10.4[c)]	11.5[c)]	0.5
Once a month	12.7[a)]	56.7[b)]	17.0[c)]	12.3[c)]	1.3
Once a week	19.1[a)]	16.2[a)]	31.0[b)]	33.8[c)]	0
Daily, or almost daily	18.3[a)]	14.9[a)]	20.9[a)]	45.9[b)]	0
I could not tell	38.6	38.5	10.6	0	12.3

The cells show the weighted proportions for the rows. The total for the rows is 100%.
COVID-19, coronavirus disease 2019.
a)A positive change respect the frequency of chronic neck pain (CNP) or maintain free of CNP.
b)CNP in the same frequency.
c)A negative change.

Table 4. Crude analysis of associated factors with chronic neck pain during the return to normality in adults of Peru

Variable	N	No pain	Once a month	Once a week	Daily, or almost daily	p-value[a)]
Total	1,188	607 (50.5)	252 (21.6)	161 (13.1)	168 (14.9)	-
Sex						
Male	598	352 (60.4)	120 (19.2)	69 (10.6)	57 (9.7)	<0.001
Female	590	255 (41.5)	132 (23.6)	92 (15.3)	111 (19.6)	
Age (yr)						
18 to <30	381	216 (54.7)	71 (22.8)	59 (14.0)	35 (8.5)	0.039
30 to <60	649	314 (49.3)	147 (20.7)	86 (12.9)	102 (17.0)	
≥60	158	77 (45.3)	34 (22.1)	16 (11.4)	31 (21.2)	
Urban						
Area	992	503 (49.4)	217 (22.3)	133 (13.8)	139 (14.5)	0.532
Rural	196	104 (54.7)	35 (18.8)	28 (10.2)	29 (16.4)	
Region						
Lima	495	242 (48.7)	116 (22.7)	61 (12.5)	76 (16.2)	0.208
North	270	131 (47.2)	49 (19.0)	48 (16.0)	42 (17.8)	
Center	127	55 (42.2)	33 (25.8)	23 (17.6)	16 (14.4)	
South	173	113 (61.2)	29 (21.4)	15 (7.8)	16 (9.5)	
East	123	66 (55.5)	25 (19.2)	14 (11.9)	18 (13.5)	
Socioeconomic level						
A	40	20 (49.8)	11 (29.3)	5 (10.2)	4 (10.7)	0.167
B	233	122 (47.1)	59 (31.6)	30 (12.1)	22 (9.2)	
C	429	204 (47.8)	96 (22.1)	68 (15.5)	61 (14.6)	
D	247	134 (52.7)	38 (17.4)	32 (14.0)	43 (15.9)	
E	239	127 (52.9)	48 (19.8)	26 (10.3)	38 (17.1)	
Exposure to screens (hours/day)[b)]						
0	245	117 (47.6)	48 (16.6)	35 (16.3)	45 (19.5)	0.045
1 to <4	478	257 (53.8)	104 (21.4)	54 (10.4)	63 (14.3)	
4 to <8	269	146 (49.6)	52 (21.9)	43 (16.0)	28 (12.5)	
≥8	167	70 (40.2)	42 (31.2)	25 (12.6)	30 (16.0)	

Values are presented as number (%).
Number, unweighted count; %, weighted proportion.
a)p-value estimated under Pearson chi-square test with the second-order Rao-Scott correction.
b)Estimated for a subpopulation sized=1,159.

status. Among individuals aged 18 to <30 years, 25.9% reported viewing screens for ≥8 h/day, while only 2.9% of those aged ≥60 years engaged in the same activity. By residence area, 40.1% of participants residing in rural areas reported not viewing screens, whereas this proportion was 21.2% among those living in urban areas. Additionally, individuals with higher socioeconomic status exhibited higher screen usage (Supplementary Table S1).

Ordinal logistic regression

In the first model, the number of hours spent viewing DDCI screens was included as an independent variable, while the covariates comprised sex, age (in years), socioeconomic status, and region. The covariates met the proportional odds assumption in the bivariate analysis, except for age, which had a p-value of 0.006 in contrast to parallel lines. Nevertheless, we applied ordinal logistic regression since the global model met the proportional odds assumption.

Both the complete and reduced models revealed that viewing DDCI screens, sex, and age were independently associated with CNP. In the reduced model, those who viewed screens for ≥8 hours had 61% higher odds of increasing the frequency of CNP from one level to another compared to those who did not view screens or rarely did. Furthermore, females exhibited 2.31 times the odds of increasing the frequency of CNP compared with males, and each additional year of life increased the odds of increasing the frequency of CNP by 2% (Table 5). The post-hoc statistical power reached by the sample was 99.9%, considering the reduced model (three predictors), MacFadden R^2=0.0299, a significance level of 5%, and 1,159 observations.

DISCUSSION

In Peru, during the transition back to normalcy after the COVID-19 restrictions, the prevalence of CNP occurring daily or almost daily, or at least once a week doubled in comparison to the period preceding the pandemic restrictions (14.8 vs. 6.1 and 27.8% vs. 12.4%, respectively). To our knowledge, this study represents the first attempt to estimate the prevalence of CNP before and after the implementation of pandemic-related social restrictions at a population level. Additionally, we found that DDCI screen viewing for ≥8 h/day increased the frequency of CNP independent of age and sex.

Our findings may diverge from other studies due to methodological differences and population heterogeneity. The high prevalence of CNP observed in our study may be attributed to our approach to pain assessment, which considered the presence of pain without specifying its intensity. Similar to other studies, our pain-related questions gathered information based on pain frequency [24,25]. Through this approach, we classified CNP into persistent pain (daily or almost daily) and recurrent pain (at least once a week) [4,26]. Additionally, it is possible

Table 5. Ordinal logistic regression to evaluate the association between viewing at internet-connected electronic devices' screen and chronic neck pain in the Peruvian population

Variate	Model 1 (complete)[a)]			Model 2 (reduced)[b)]			
	β	ORa (95% CI)	p-value	β	ORa (95% CI)	p-value	p-value[c)]
Intercept 1	2.31	-	-	2.25	-	-	-
Intercept 2	3.28	-	-	3.22	-	-	-
Intercept 3	4.12	-	-	4.05	-	-	-
No. of hours viewing at screens							
0		Ref			Ref		0.131
<4	-0.16	0.86 (0.59–1.24)	0.410	-0.16	0.85 (0.59–1,22)	0.380	
4 to <8	0.19	1.21 (0.79–1.85)	0.378	0.17	1.19 (0.79–1.79)	0.408	
≥8	0.54	1.71 (1.07–2.75)	0.025	0.48	1.61 (1.04–2.50)	0.033	
Sex							
Male		Ref			Ref		0.693
Female	0.83	2.28 (1.76–2.95)	<0.001	0.84	2.31 (1.79–2.98)	<0.001	
Age (yr)	0.02	1.02 (1.01–1.03)	<0.001	0.02	1.02 (1.01–1.03)	<0.001	0.006[d)]
Socioeconomic level	0.07	1.08 (0.95–1.22)	0.248	-	-	-	0.140
Region	-0.08	0.93 (0.84–1.02)	0.116	-	-	-	0.911

Intercept 1: Pain on a daily basis versus I have not had pain, pain once a month on average and pain once a week.
Intercept 2: Pain on a daily basis and once a week on average versus I have not had pain and pain once a month on average.
Intercept 3: Pain on a daily basis, pain once a week on average and pain once a month versus I have not had pain.
ORa, adjusted odds ratio; 95% CI, 95% confidence interval; Ref, reference.
[a)]Model 1: Test to evaluate the proportional odds assumption: Wald test=1.433, gl1=14.0, gl2=1,158.0, p=0.130. Test of goodness of fit model: Pseudo-R square by McFadden=0.031, Nagelkerke=0.081.
[b)]Model 2: Test to evaluate the proportional odds assumption: Wald test=1.631, gl1=10.0, gl2=1,162.0, p=0.093. Test of goodness of fit model: Pseudo-R square by McFadden=0.0299, Nagelkerke=0.078.
[c)]Test of parallel lines for each independent variate: Wald test p-value.
[d)]The test of parallel lines was applied considering the age in three categories (18 to less than 30, 30 to less than 60, and 60+): Wald test=1.962, gl1=4.0, gl2=1,198.0, p=0.098.

that individuals with mild pain typically do not seek medical attention, making them more likely to be identified in population-based studies. Most epidemiological studies measuring the frequency of CNP during the COVID-19 pandemic were conducted in specific groups, such as university students [11,27,28], office workers [29,30], and outpatients [31], rather than in representative samples from the general population.

Another factor that may affect the comparability of our study results is the definition of the anatomical neck region. In this study, we structured the question to encompass the area below the upper nuchal line and the external occipital protuberance, extending over the scapular spine, the upper edge of the collarbone, and the interclavicular notch, with or without radiation to the head, trunk, and limbs [26]. Some studies have used a duration criterion, defining CNP as pain lasting more than 3 months [26,32]. However, in our study, we adopted a different approach by examining the occurrence of neck pain over the previous 6 months. This observation period criterion ensures that the duration of pain experienced by individuals exceeds 3 months, i.e., more than the time required to heal the tissues or resolve any underlying disease, thereby meeting the criteria for defining a chronic condition.

Studies on CNP prevalence before and after COVID-19 restrictions are limited worldwide, and their results are inconsistent. In Portugal, the prevalence of neck pain among computer workers increased from 45% to 62.5% between June 2019 and January 2021 (the early second year of the pandemic) [30]. However, other studies did not observe this increase. In Switzerland, no changes in CNP intensity or disability rates were found among office workers in the last 4 weeks between data collected in January (10 weeks before restrictions) and April 2020 (5 weeks in lockdown) [29]. In Turkey, the proportion of neck pain in workers who stayed at home decreased from 33.6% to 20.3% during the 3-month lockdown period [33]. One possible explanation for the disparate findings in the latter two studies could be the brief period between measurements, and it is plausible the conditions caused by social restrictions did not lead to significant changes in neck pain within such a short timeframe.

We found that DDCI screen-viewing for ≥8 h/day increased the CNP frequency level. This association has also been reported in other population-based cross-sectional studies. For instance, a representative study of individuals aged over 18 years in southern India found that among mobile telephone users, 17.3% reported CNP, resulting in a doubled risk compared to non-users [34]. Similarly, a study conducted in the state of Pelotas, southern Brazil, found that in a cohort of young adults born in 1993, the use of mobile telephones for ≥7 h/day increased the risk of CNP by 81% during the last 3 months, and by 41% when the device was used between 4 and 7 h/day. This effect was observed independently of confounders, such as sex, education level, and physical activity [35].

Two mechanisms may explain how DDCI screen viewing for ≥8 hours is associated with CNP. The first involves poor head and neck posture. Evidence suggests that neck pain is related to forward head posture, which is common during viewing DDCI screens [36]. However, although a positive correlation exists between forward head posture and increased thoracic kyphosis, thoracic posture and mobility were not uniformly associated with neck pain intensity and disability [37]. This controversy may be explained, at least in part, by a second proposed mechanism related to sedentarism and prolonged static posture. CNP could develop even with a good posture and an ergonomic position of the head and neck because maintaining a fixed position for extended periods could result in degenerative changes of these structures, leading to chronic inflammation and impairments of cervical proprioception [38]. The cervical region exhibits the highest degree of spine mobility, but its vertebral discs and ligaments have minimal vascularization. Nutrients and waste substances are mainly transported through diffusion and convection [39], and therefore dynamic loads are essential to maintaining fluid balance and the integrity of these spine components [40]. When using DDCI for prolonged periods, taking regular breaks to perform active head and neck exercises is essential to maintain neck health. Moreover, if CNP is present, a proper rehabilitation treatment is recommended.

Strengths and limitations

Our study has several strengths. First, the sampling design generated prevalence estimates for the nationwide adult population in Peru according to the country areas (urban/rural) and macro-regions. Second, to our knowledge, this is the first study to compare CNP prevalence before and after the COVID-19 pandemic restrictions on a nationwide scale. This is particularly noteworthy as previous studies have primarily estimated this change in specific occupational groups or patients attending healthcare facilities. Third, the survey was conducted in a structured manner using questions previously applied in a population study in 2016 [20], thus allowing for a comparison of CNP prevalence changes over time. Fourth, this study placed emphasis on measuring pain specifically in the cervical region.

Consequently, the questions were tailored to target this specific body area, unlike other studies that employed more generalized assessments or evaluated pain across multiple body areas. This approach served to mitigate recall bias.

This study also has some limitations. Firstly, the identification of CNP was based on self-reports rather than case history or physical examination conducted by healthcare professionals. Secondly, estimates of pre-pandemic CNP rates may be subject to recall bias, as participants (interviewed in November 2022) were asked to remember the presence and frequency of neck pain in March 2020 and at least 6 months earlier. However, it is known that the presence of unusual historical or major events (in this case, the beginning of the pandemic lockdown) tends to improve recall. Thirdly, certain population characteristics, such as education, occupation, or history of COVID-19, were not captured to better characterize the distribution of CNP. This limitation also extended to the study of the relationship between CNP and screen-viewing as they were not included as potential confounders. Fourthly, exposure was also measured via self-reports, and establishing a causal association with CNP was challenging due to the inability to define the temporal sequence between exposure and outcome. Lastly, our study did not explore the intensity or specific causes of CNP.

In conclusion, after lifting COVID-19 social restrictions in Peru, CNP occurring daily or almost daily, or at least once a week, affected approximately four out of ten adults, representing over a two-fold increment compared to the pre-pandemic values. The most affected subgroups were females and adults aged >60 years. Additionally, those who spent ≥8 h/day viewing DDCI screens were at increased risk of suffering CNP compared to those who did not, and this association was found to be independent of age and sex. These findings underscore the broader public health challenges stemming from the COVID-19 pandemic. Moreover, our research revealed that viewing DDCI screens for extended periods is a specific and modifiable risk factor, which is more widely spread across the general population and a potential target for developing preventive strategies to reduce the prevalence of CNP and accompanying disabilities.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

FUNDING INFORMATION

The study had partial funding from the Universidad de Piura, Lima, Peru (Grant No. PI-2305).

AUTHOR CONTRIBUTION

Conceptualization: Nakazato T, Quezada P. Methodology: Nakazato T, Quezada P, Gutiérrez C. Formal analyisis: Romaní F, Gutiérrez C, Nakazato T. Funding adquisition: Nakazato T. Project administration: Nakazato T. Visualization: Romaní F, Gutiérrez C, Nakazato T. Writing – original draft: Nakazato T, Romaní F. Writing – review and editing: Nakazato T, Quezada P, Gutiérrez C, Romaní F. Approval of final manuscript: all authors.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via https://doi.org/10.5535/arm.230030.

ORCID

Tomas Nakazato, https://orcid.org/0000-0002-3771-8249
Pablo Quezada, https://orcid.org/0009-0007-4806-8054
César Gutiérrez, https://orcid.org/0000-0002-0237-321X
Franco Romaní, https://orcid.org/0000-0002-6471-5684

REFERENCES

1. Kazeminasab S, Nejadghaderi SA, Amiri P, Pourfathi H, Araj-Khodaei M, Sullman MJM, et al. Neck pain: global epidemiology, trends and risk factors. BMC Musculoskelet Disord 2022;23:26.
2. Vasseljen O, Woodhouse A, Bjørngaard JH, Leivseth L. Natural course of acute neck and low back pain in the general population: the HUNT study. Pain 2013;154:1237-44.
3. Safiri S, Kolahi AA, Hoy D, Buchbinder R, Mansournia MA, Bettampadi D, et al. Global, regional, and national burden of neck pain in the general population, 1990-2017: systematic analysis of the Global Burden of Disease Study 2017. BMJ 2020;368:m791.
4. Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain 2019;160:19-27.
5. Mahmoud NF, Hassan KA, Abdelmajeed SF, Moustafa IM, Silva AG. The relationship between forward head posture and neck pain:

a systematic review and meta-analysis. Curr Rev Musculoskelet Med 2019;12:562-77.
6. Lee R, James C, Edwards S, Snodgrass SJ. Posture during the use of electronic devices in people with chronic neck pain: a 3D motion analysis project. Work 2021;68:491-505.
7. Lee S, Kang H, Shin G. Head flexion angle while using a smartphone. Ergonomics 2015;58:220-6.
8. Namwongsa S, Puntumetakul R, Neubert MS, Boucaut R. Effect of neck flexion angles on neck muscle activity among smartphone users with and without neck pain. Ergonomics 2019;62:1524-33.
9. Al-Hadidi F, Bsisu I, AlRyalat SA, Al-Zu'bi B, Bsisu R, Hamdan M, et al. Association between mobile phone use and neck pain in university students: a cross-sectional study using numeric rating scale for evaluation of neck pain. PLoS One 2019;14:e0217231.
10. Behera P, Majumdar A, Revadi G, Santoshi JA, Nagar V, Mishra N. Neck pain among undergraduate medical students in a premier institute of central India: a cross-sectional study of prevalence and associated factors. J Family Med Prim Care 2020;9:3574-81.
11. Sirajudeen MS, Alzhrani M, Alanazi A, Alqahtani M, Waly M, Unnikrishnan R, et al. Prevalence of text neck posture, smartphone addiction, and its association with neck disorders among university students in the Kingdom of Saudi Arabia during the COVID-19 pandemic. PeerJ 2022;10:e14443.
12. Bertozzi L, Negrini S, Agosto D, Costi S, Guccione AA, Lucarelli P, et al. Posture and time spent using a smartphone are not correlated with neck pain and disability in young adults: a cross-sectional study. J Bodyw Mov Ther 2021;26:220-6.
13. Chan LLY, Wong AYL, Wang MH, Cheung K, Samartzis D. The prevalence of neck pain and associated risk factors among undergraduate students: a large-scale cross-sectional study. Int J Ind Ergon 2020;76:102934.
14. Zheng B, Zheng L, Li M, Lin J, Zhu Y, Jin L, et al. Sex differences in factors associated with neck pain among undergraduate healthcare students: a cross-sectional survey. BMC Musculoskelet Disord 2022;23:842.
15. Voss C, Shorter P, Mueller-Coyne J, Turner K. Screen time, phone usage, and social media usage: before and during the COVID-19 pandemic. Digit Health 2023;9:20552076231171510.
16. Yang Q, Shi M, Zeng L, Xu P. University freshmen's excessive smartphone use and psychological safety during the COVID-19 pandemic. Front Psychiatry 2022;13:993555.
17. El Peruano. Decreto Supremo que declara Estado de Emergencia Nacional por las graves circunstancias que afectan la vida de la Nación a consecuencia del brote del COVID-19. Decreto Supremo Nº 044-2020-PCM [Internet]. El Peruano; 2020 [cited 2023 Mar 8]. Available from: https://cdn.www.gob.pe/uploads/document/file/566448/DS044-PCM_1864948-2.pdf?v=1584330685.
18. Fundación Telefónica. Sociedad digital en latinoamérica. 2020-2021 [Internet]. Penguin Random House Grupo Editorial; 2021 [cited 2023 Mar 8]. Available from: https://www.fundaciontelefonica.com/cultura-digital/publicaciones/.
19. Onyeaka H, Anumudu CK, Al-Sharify ZT, Egele-Godswill E, Mbaegbu P. COVID-19 pandemic: a review of the global lockdown and its far-reaching effects. Sci Prog 2021;104:368504211019854.
20. Nakazato T. Prevalencia del dolor cervical crónico en el Perú: resultados de encuesta nacional 2016 [Preprint]. 2017 [cited 2023 Feb 13]. Available from: https://doi.org/10.13140/RG.2.2.36605.41443.
21. El Peruano. Decreto Supremo que deroga el Decreto Supremo N° 016-2022-PCM, Decreto Supremo que declara Estado de Emergencia Nacional por las circunstancias que afectan la vida y salud de las personas como consecuencia de la COVID-19 y establece nuevas medidas para el restablecimiento de la convivencia social, sus prórrogas y modificaciones. Decreto Supremo Nº 130-2022-PCM [Internet]. El Peruano; 2022 [cited 2023 Feb 15]. Available from: https://busquedas.elperuano.pe/normaslegales/decreto-supremo-que-deroga-el-decreto-supremo-n-016-2022-pc-decreto-supremo-n-130-2022-pcm-2119571-1/.
22. Plataforma Nacional de Datos Abiertos. Población electoral (Elecciones Generales 2021) - [Registro Nacional de Identificación y Estado Civil-RENIEC] [Internet]. Plataforma Nacional de Datos Abiertos; 2021 [cited 2023 Feb 16]. Available from: https://www.datosabiertos.gob.pe/dataset/reniec-poblaci%C3%B3n-electoral-elecciones-generales-2021-registro-nacional-de-identificaci%C3%B3n-y.
23. Instituto Nacional de Estadística e Informática. PERÚ: Estimaciones y Proyecciones de Población por Departamento, Provincia y Distrito, 2018–2020 [Internet]. Instituto Nacional de Estadística e Informática; 2020 [cited 2023 Feb 13]. Available from: https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1715/libro.pdf.
24. Hakala P, Rimpelä A, Salminen JJ, Virtanen SM, Rimpelä M. Back, neck, and shoulder pain in Finnish adolescents: national cross sectional surveys. BMJ 2002;325:743.
25. Ståhl MK, El-Metwally AA, Rimpelä AH. Time trends in single versus concomitant neck and back pain in Finnish adolescents: results from national cross-sectional surveys from 1991 to 2011. BMC Musculoskelet Disord 2014;15:296.
26. Fejer R, Kyvik KO, Hartvigsen J. The prevalence of neck pain in the world population: a systematic critical review of the literature. Eur Spine J 2006;15:834-48.

27. Daher A, Halperin O. Association between psychological stress and neck pain among college students during the coronavirus disease of 2019 pandemic: a questionnaire-based cross-sectional study. Healthcare (Basel) 2021;9:1526.
28. Salameh MA, Boyajian SD, Odeh HN, Amaireh EA, Funjan KI, Al-Shatanawi TN. Increased incidence of musculoskeletal pain in medical students during distance learning necessitated by the COVID-19 pandemic. Clin Anat 2022;35:529-36.
29. Aegerter AM, Deforth M, Johnston V, Sjøgaard G, Volken T, Luomajoki H, et al. No evidence for an effect of working from home on neck pain and neck disability among Swiss office workers: short-term impact of COVID-19. Eur Spine J 2021;30:1699-707.
30. Moreira S, Criado MB, Ferreira MS, Machado J, Gonçalves C, Mesquita C, et al. The effects of COVID-19 lockdown on the perception of physical activity and on the perception of musculoskeletal symptoms in computer workers: comparative longitudinal study design. Int J Environ Res Public Health 2022;19:7311.
31. Jacob L, Oh H, Smith L, Koyanagi A, Konrad M, Kostev K. Impact of the coronavirus disease 2019 (COVID-19) pandemic on the diagnosis of neck and low back pain in outpatient practices in Germany. Prev Med Rep 2023;31:102096.
32. Guzman J, Hurwitz EL, Carroll LJ, Haldeman S, Cote P, Carragee EJ, et al. A new conceptual model of neck pain. Eur Spine J 2008;17(Suppl 1):14-23.
33. Toprak Celenay S, Karaaslan Y, Mete O, Ozer Kaya D. Coronaphobia, musculoskeletal pain, and sleep quality in stay-at home and continued-working persons during the 3-month COVID-19 pandemic lockdown in Turkey. Chronobiol Int 2020;37:1778-85.
34. Stalin P, Abraham SB, Kanimozhy K, Prasad RV, Singh Z, Purty AJ. Mobile phone usage and its health effects among adults in a semi-urban area of Southern India. J Clin Diagn Res 2016;10:LC14-6.
35. Blumenberg C, Wehrmeister FC, Barros FC, Flesch BD, Guimarães F, Valério I, et al. Association of the length of time using computers and mobile devices with low back, neck and mid-back pains: findings from a birth cohort. Public Health 2021;195:1-6.
36. Quek J, Pua YH, Clark RA, Bryant AL. Effects of thoracic kyphosis and forward head posture on cervical range of motion in older adults. Man Ther 2013;18:65-71.
37. Joshi S, Balthillaya G, Neelapala YVR. Thoracic posture and mobility in mechanical neck pain population: a review of the literature. Asian Spine J 2019;13:849-60.
38. Peng B, Yang L, Li Y, Liu T, Liu Y. Cervical proprioception impairment in neck pain-pathophysiology, clinical evaluation, and management: a narrative review. Pain Ther 2021;10:143-64.
39. Frost BA, Camarero-Espinosa S, Foster EJ. Materials for the spine: anatomy, problems, and solutions. Materials (Basel) 2019;12:253.
40. Neumann DA, Threlkeld AJ. Basic structure and function of human joints. In: Neumann DA, editor. Kinesiology of the musculoskeletal system: foundations for rehabilitation 2. Mosby; 2010. p.28-46.