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Original Research

Association of the length of time using computers and mobile devices with low back, neck and mid-back pains: findings from a birth cohort

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ABSTRACT

Objectives: Neck and low back pains are the leading causes of years lived with disability, and using computers or mobile devices in excess could be risk factors for back pain. Our aim was to evaluate the association of the length of time using computers and mobile devices with neck, mid-back and low back pains and the number of regions with pain.
Study design: Cross-sectional study nested in the 1993 Pelotas birth cohort with young adults aged 22 years.
Methods: Outcomes analyzed were neck, mid-back and low back pains and the number of regions with pain. Exposures were the number of daily hours using computers and mobile devices. Crude and adjusted analyses were performed to estimate prevalence ratios using Poisson regression.
Results: Almost half of the sample reported having back pain, the low back pain being the most prevalent. Compared with individuals using mobile devices for less than one hour, the prevalence of neck pain was 1.41 and 1.81 times higher among individuals using mobile devices from three to seven hours and for seven or more hours per day, respectively. Neck pain prevalence was 1.47 times higher among individuals using computers for more than two hours than among those not using computers. Using mobile devices for seven hours or more was associated to 1.19 times higher prevalence of low back pain.
Conclusion: Using mobile devices in excess was associated to neck and low back pains, while the use of computers in excess was associated only to neck pain. It is important that guidelines are developed to recommend the adequate length of time that computers and mobile devices should be used to prevent back pain.

Introduction

The World Health Organization defines musculoskeletal disorders as disturbances in muscles, tendons, peripheral nerves or vascular system.[1] Among several musculoskeletal disorders, back pain deserves attention and can be divided according to the region where the pain occurs: neck, mid-back or low back pain.[2] According to the Global Burden of Diseases, low back pain leads the ranking of diseases that contribute to years lived with disability in 65% of the countries.[3] Worldwide, the neck pain is in the ninth and eleventh positions in the ranking of diseases that contribute to years lived with disability among women and men, respectively.[3] In Brazil, both injuries lead the ranking, reinforcing that these are relevant public health subjects.[4]

In the last few decades, there was a steep increase of the prevalence of Internet access around the globe, reaching almost half of the world population in 2017.[5] In turn, this contributed to the increase of the length of time that computers, smartphones and other electronic devices are being used.[6] Although these devices are important sources of information and facilitate social interactions, their use in excess could be related to some adverse health outcomes, including musculoskeletal disorders.[6,7] Some studies showed that back discomfort was more prevalent among individuals using the Internet in excess and that individuals with high Internet usage had higher odds of reporting back pain.[7–9] These studies were limited to investigate the presence of back pain, not

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reporting in which regions it occurred—even though this is an important information to support future interventions and recommendations.

One hypothesis that might explain the association of Internet, computer and mobile device use with back pain is the posture adopted by individuals during the long hours of use.[10] Some studies comparing individuals with and without back pain showed no differences on their postures,[11,12,13] while others indicate associations between inadequate postures and back pain.[10,14–16] Owing to the mixed findings, further research investigating these factors is needed.

The aim of this study was to evaluate how the length of time using computers and mobile devices are associated to the prevalence of neck, mid-back and low back pains and the number of regions of the back with pain in young adults from the 1993 Pelotas birth cohort.

Methods

Study design and sample

Our study followed a cross-sectional design and is nested in the context of the 1993 Pelotas birth cohort. This birth cohort takes place in Pelotas, a Southern Brazilian city, with nearly 340,000 inhabitants. In 1993, all births occurring in maternity hospitals in the city were monitored, and mothers of live born children were invited to participate. The original sample of the 1993 Pelotas birth cohort is composed of 5249 children; however, our study used data from the 22-year follow-up. This follow-up was conducted in 2015–2016, where all members of the birth cohort were invited to participate. A total of 3810 individuals were interviewed, representing a 76.3% follow-up rate (including confirmed deaths). In order to be eligible to our study, the members of the 1993 Pelotas birth cohort had to: i) had participated of the 22-year follow-up; ii) had provided valid answers for the outcomes analyzed (Which and how many regions of the back did they have pain in?); iii) had provided valid answers for the exposures analyzed (length of time using computers and mobile devices during leisure time); and iv) had no disability, including musculoskeletal and physical conditions. A total of 3782 individuals were eligible, representing 99.3% of those interviewed during the 22-year follow-up (72.1% of the original cohort). Detailed information about the 1993 Pelotas birth cohort can be obtained elsewhere.[17]

Outcomes

We analyzed four outcomes: prevalence of neck, mid-back and low back pains and the total number of regions of the back with pain, using the validated version for Portuguese of the Standardized Nordic Questionnaire for musculoskeletal symptoms.[18] The presence or absence of an episode of back pain in the last three months was self-reported by the participants and evaluated through the following question: 'In the last three months, did you have back pain?'. In case of a positive answer, an image with the three back regions was shown to the individuals (Supplementary Fig. 1), and they were asked to point in which regions they had had pain in the last three months. The pain in each region of the back was evaluated binarily, while the number of regions of the back with pain was generated by totalizing the number of different back regions with pain (outcome variable ranging from 0 to 3 regions).

Exposures

The main exposures were the length of time using computers and mobile devices during leisure time. Participants self-reported the number of hours using each device (computers, cell phones and tablets) for leisure activities by answering the following question: 'How long do you use [type of device] to surf the Internet or to play a game in a regular weekday?'. Owing to questionnaire limitations, we examined the hours of use of these devices only from Monday to Friday, without considering weekends. The length of time using mobile devices was the total number of hours per day using cell phones and tablets, which was further divided into four categories: from 0 to 1 hour, more than 1 to 3 or less hours, more than 3 to less than 7 h and 7 h or more. The length of time using computers was divided into three categories: 0 h, more than 0 to 2 or less hours and more than 2 h. These thresholds were determined in an arbitrary way, aiming to obtain a good sample size balance between the categories, but taking into consideration the thresholds from two other studies.[19,20]

Statistical analyses

We estimated prevalence ratios (PR) for all outcomes (neck pain, mid-back pain, low back pain and the number of regions of the back with pain) using Poisson regression with robust variance. Crude and adjusted analyses were performed, and the following confounding factors were considered: sex (female/male), years of schooling (0–4/5 to 8/9 to 11/12 years or more), current study or work (none, only working, only studying, studying and working), physical activity (inactive/insufficiently active/active) and sitting hours per day (<4/4 to 5.9/6 to 7.9/≥8). Schooling categories were defined based on the Brazilian educational system, which has eight years of middle school and three years of high school. Any additional years would refer to a college degree.[21] Physical activity was examined by a list of exercises and calculated as the total number of minutes practicing any physical activity in the last week. Individuals were considered inactive if they had practiced 0 min of physical activity in the last week, insufficiently active if practiced less than 150 min and active if they had practiced 150 min or more in the last week.[22] Sitting time per day was self-reported by the participants and included the number of hours that participants were sitting during transportation, working and studying. The number of sitting hours per day was divided into four categories (<4 h/day; 4–5.9 h/day; 6–7.9 h/day; ≥8 h/day) based on cutoff values used in the literature.[23] The confounding factors were forward selected using a hierarchical conceptual model, and only those with a P value < 0.2 were kept in the adjusted model. After selection, all the confounding variables that respected our selection criterion were included together in the final adjusted models, generating a mutually adjusted model. Thus, adjusted analyses were able to estimate the association between the exposures and outcomes keeping the effect of confounding variables fixed. For the outcome assessing the number of regions of the back with pain, the PRs depict how much higher, or lower, would be the prevalence of having pain in one additional region of the back according to the exposure being analyzed.

All analyses were conducted using Stata 15.1 software (Stata Corp. LLC, College Station, TX), and we considered a 5% significance level for all analyses. Results are presented as PRs with their respective 95% confidence intervals. PRs are also presented as percentages (%PR) using the following equation: % PR = (1 − PR) * 100%.

Results

The characteristics of the sample analyzed are described in Table 1. Most part of the individuals were female, studied for nine years or more and were only working. Two-thirds of the sample were considered physically active, and 56.2% reported being seated

Table 1
Demographic and socioeconomic characteristics of the sample and information regarding the length of use of computers and mobile devices, 1993 Pelotas birth cohort, 22-year follow-up

Variables	Analyzed sample (N = 3782)	
	N (%)	95% CI
Sex		
Male	1769 (46.8)	45.2; 48.4
Female	2013 (53.2)	51.6; 54.8
Schooling (years)		
0–4	103 (2.8)	2.3; 3.3
5–8	1004 (26.6)	25.2; 28.0
9–11	1553 (41.1)	39.6; 42.7
12 or more	1117 (29.5)	28.1; 31.1
Current study or work		
No	833 (22.0)	20.7; 23.4
Only studying	557 (14.7)	13.6; 15.9
Only working	1615 (42.8)	41.1; 44.3
Studying and working	777 (20.5)	19.3; 21.9
Physical activity		
Inactive	459 (12.1)	11.1; 13.2
Insufficiently active	849 (22.5)	21.2; 23.8
Active	2472 (65.4)	63.9; 66.9
Sitting time (hours/day)		
<4	2124 (56.2)	54.6; 57.7
4–5.9	623 (16.5)	15.3; 17.7
6–7.9	365 (9.7)	8.7; 10.6
≥8	670 (17.7)	16.5; 19.0
Mobile device use (hours/day)		
0–1	959 (25.4)	24.0; 26.8
>1 and ≤3	1344 (35.5)	34.0; 37.1
>3 and <7	999 (26.4)	25.0; 27.8
≥7	480 (12.7)	11.7; 13.8
Computer use (hours/day)		
0	1556 (41.1)	39.6; 42.7
>0 and ≤2	1637 (43.3)	41.7; 44.9
>2	589 (15.6)	14.5; 16.8

CI, confidence interval.

for less than four hours per day. The majority reported using mobile devices for three hours or less per day, while 85% reported using computers for at most two hours per day.

Almost half of the sample (48.8%) reported having back pain, regardless of the region. Around 10% reported neck pain, 25% mid-back pain and 32% low back pain. A total of 613 individuals (16.2%) reported having pain in at least two regions of the back, while one out of five individuals in this group (or 3.3% of the total sample) reported having pain in all three regions of the back (Fig. 1).

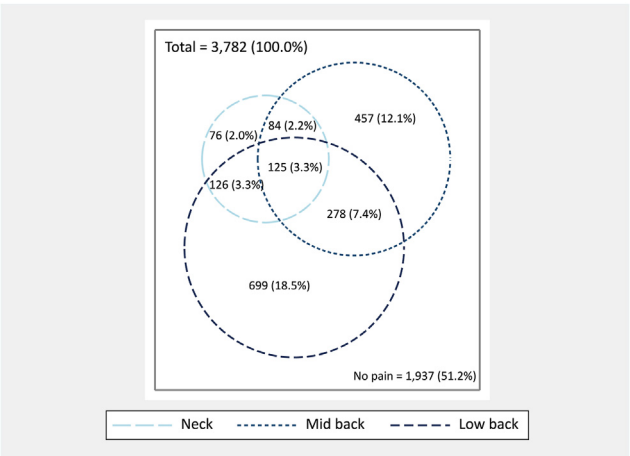

Fig. 1. Prevalence of overall back pain and according to back region. 1993 Pelotas birth cohort, 22-year follow-up.

As shown in Table 2, there was a direct association between the length of time using mobile devices and the prevalence of neck pain. Individuals using mobile devices between three and seven hours per day had 41% (PR = 1.41; 95% confidence interval [CI]: 1.07; 1.86) higher prevalence of neck pain than the reference group. The prevalence of neck pain was even higher for those using mobile devices for seven hours or more (PR = 1.81; 95% CI: 1.33; 2.46). The length of use of mobile devices was also associated to a 19% higher prevalence of low back pain, but only among individuals that reported using for seven hours or more per day (PR = 1.19; 95% CI: 1.03; 1.37). In contrast, the length of use of computers was directly associated only with neck pain, where individuals using devices for more than two hours per day had 47% (PR = 1.47; 95% CI: 1.12; 1.92) higher prevalence than those that did not use computers.

In Figs. 2 and 3, the outcome analyzed was the number of regions of the back with pain according to the length of use of mobile devices and computers, respectively. The group that reported using mobile devices for seven hours or more had 1.22 times (PR = 1.22; 95% CI: 1.08; 1.38) higher risk of having pain in one additional region of the back than the reference group (Fig. 2). In turn, the length of use of computers did not influence the number of regions of the back with pain (Fig. 3).

In order to describe the influence of confounding variables on the outcomes, we show the crude prevalence of cervical, mid back and low back pains for each level of confounding variable in Supplementary Table 1. The prevalence of the number of back regions with pain is presented in Supplementary Table 2. Finally, the daily hours of mobile device and computer use according to the confounding variables are described in Supplementary Tables 3 and 4, respectively.

Discussion

Our results showed an alarming high prevalence of back pain among young adults, with almost half of the sample having pain in at least one region of the back. A direct relation was identified between the number of hours using mobile devices during leisure time and neck pain. Besides that, using computers during long periods was associated to a higher prevalence of neck pain, and using mobile devices for seven hours of more was also associated to higher prevalence of low back pain.

The prevalence of back pain in our sample was high, almost 50% of the sample reported having at least one episode of back pain (neck, mid back or low back pain). Similar findings were already described for other populations and age groups.[24,25] A study analyzing neck pain described a global prevalence of almost 5%,[26] while in our study, this prevalence reached 10%. Another study, analyzing the global prevalence of low back pain, described that approximately 18% of the individuals aged between 20 and 29 years had low back pain.[27] In our study, 30% of the sample reported an episode of low back pain. These differences might have occurred because of the high sensitivity of our question, which considered any episode of back pain occurring in the three months preceding the survey. Related research also included studies that considered activity-limiting pain and chronic pain.[26,27]

Our findings bring light to an important public health matter, as low back pain leads the world ranking of years lived with disability.[3] Between 2007 and 2017, the number of years lived with disability because of low back pain increased around 17.0%, while its contribution to the total number of years lived with disability considering all injuries together increased by 21.0%.[3] In Brazil, back pain is also a relevant issue because the total number of years lived with disability because of low back and neck pains increased 79.7% between 1990 and 2016.[4] Some studies described that using computers and mobile devices in excess was a risk factor for back

Table 2
Crude and adjusted analyses of the influence of the length of the time using computers and mobile devices on the back pain according to regions, 1993 Pelotas birth cohort, 22-year follow-up

Exposure	Neck pain		Mid-back pain		Low back pain	
	Crude PR (95% CI)	Adjusted[a] PR (95% CI)	Crude PR (95% CI)	Adjusted[a] PR (95% CI)	Crude PR (95% CI)	Adjusted[a] PR (95% CI)
Mobile device use (hours/day)	P < 0.001	P = 0.001	P = 0.329	P = 0.378	P = 0.013	P = 0.004
>0 to ≤1	1.00	1.00	1.00	1.00	1.00	1.00
>1 to ≤3	1.31 (1.01; 1.72)	1.23 (0.94; 1.61)	0.91 (0.79; 1.10)	0.93 (0.80; 1.07)	0.93 (0.83; 1.05)	0.92 (0.81; 1.04)
>3 to <7	1.54 (1.17; 2.02)	1.41 (1.07; 1.86)	0.94 (0.81; 1.10)	0.96 (0.83; 1.13)	0.98 (0.86; 1.12)	0.98 (0.86; 1.12)
≥7	1.92 (1.42; 2.60)	1.81 (1.33; 2.46)	1.06 (0.88; 1.27)	1.08 (0.90; 1.30)	1.17 (1.01; 1.35)	1.19 (1.03; 1.37)
Computer use (hours/day)	P = 0.019	P = 0.008	P = 0.132	P = 0.248	P = 0.993	P = 0.800
0	1.00	1.00	1.00	1.00	1.00	1.00
>0 to ≤2	1.12 (0.91; 1.38)	1.03 (0.83; 1.28)	0.88 (0.78; 1.00)	0.91 (0.80; 1.03)	1.00 (0.90; 1.10)	0.99 (0.89; 1.10)
>2	1.43 (1.12; 1.85)	1.47 (1.12; 1.92)	0.94 (0.80; 1.11)	1.00 (0.84; 1.18)	0.99 (0.86; 1.14)	1.04 (0.90; 1.20)

CI, confidence interval.
[a] Adjusted by sex, schooling, current study or work, physical activity and sitting time.

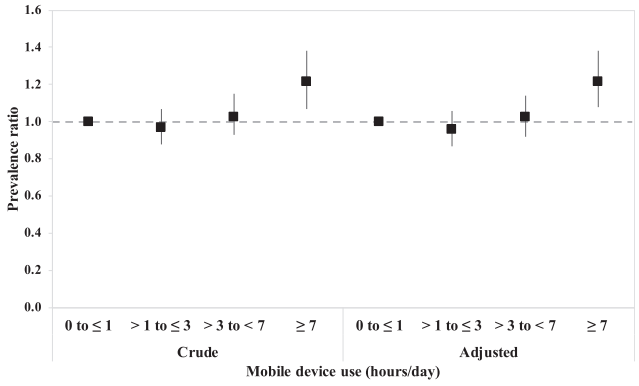

Fig. 2. Crude and adjusted prevalence ratios of the number of back regions with pain according to the length of use of mobile devices. 1993 Pelotas birth cohort, 22-year follow-up.

pain;[6,7] however, the literature is not conclusive about these findings. Although the increasing access to computers, mobile devices and the Internet is important and positively related to the financial development of a country, individuals should avoid using these devices in excess to prevent health injuries.[6]

A Swedish cohort analyzed the association between the number of text messages sent and received with neck pain using both cross-sectional and longitudinal approaches.[19] The cross-sectional analysis showed that women with higher levels of messaging had 50.0% increased probability of having neck pain; in men, this probability was twice bigger. In the longitudinal analysis, no association was found.[19] The Swedish cohort analyzed the number of text messages sent or received as a proxy for the length of time that individuals

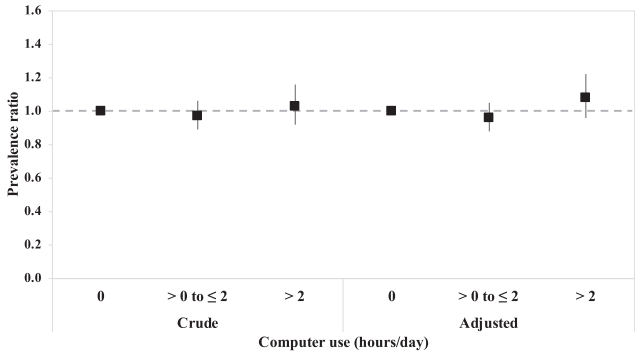

Fig. 3. Crude and adjusted prevalence ratios of the number of back regions with pain according to the length of use of computers. 1993 Pelotas birth cohort, 22-year follow-up.

used cell phones. In our study, we directly measured the number of hours per day using mobile devices and found similar results compared with the cross-sectional analyses of the Swedish cohort. We could not analyze the association in a longitudinal manner, as the questions investigating the length of time using computers and mobile devices were applied for the first time at the 22-year follow-up of the 1993 Pelotas birth cohort (the most recent wave of the birth cohort).

Other studies investigated the association between the length of use of mobile devices and computers and neck pain.[28–32] Smith et al. described that using computers for at least 8.5 h per week could increase by 70.0% the probability of having neck pain.[29] The work by Ben Ayed et al. found 50.0% higher probability of neck pain among those using computers four hours per week.[31] Another study evaluating the daily use of computers found increased prevalence of neck pain among those using computers for six hours or more.[30] A Finish study reported that individuals using computers or mobile devices for more than five hours per day had two-fold the probability of experiencing neck pain compared with individuals that did not use these technologies.[28] It is interesting to note that these studies found associations between neck pain and computer or mobile device use. However, there was high fluctuation regarding how long the use of these technologies could become harmful. The high variability emphasizes that the pattern of use of computers and mobile devices is context- and sample-dependent and should be derived taking these into consideration.

It is important to clarify that the use of computers and mobile devices is not the cause of back pain but could be considered proxies for the incorrect posture adopted during their use. The relation between the use of computers and mobile devices with neck pain is mainly due to the head position. Intolo et al. described that individuals reported more neck pain when using laptops at sofa or bed than at a low-height table and that the greater neck flexion was responsible for that.[10] Other two studies also revealed associations between forward head position and neck pain among office workers and university students.[14,15] Most users tend to lean the head forward when using computers or mobile devices, generating excessive weight over the neck region. It is estimated that keeping the head in a 45° angle in relation to the spine confers 48.5 pounds over the neck. If a 60° angle is adopted, the weight could be higher than 59.5 pounds.[33] Ideally, the head should be aligned to the spine (with a 0° angle) to avoid extra weight over the neck. However, a study with Brazilian college students showed that only 10.0% of the sample adopted an adequate head position while using mobile devices.[34]

Contrasting findings about the association of posture and back pain are found in the literature. Most studies that show no association between posture and back pain observe the posture of

individuals with and without back pain.[11–13] However, there is no evidence that evaluating posture through observation is a valid or reliable method, especially with the absence of blinding.[13] In contrast, a systematic review evaluating the effectiveness of therapeutic exercises on forward head posture found moderate reductions on neck pain.[35]

Our findings described association between the use of mobile devices for seven hours or more and low back pain. This can be explained by the relaxed and non-ergonomic positions adopted to use mobile devices, such as incorrect sitting or lying down positions.[33,34,36] In contrast, our results showed no relation between the length of computer use and low back pain. Hakala et al. also evaluated this relation and did not find an association as well.[28] We hypothesize that the lack of association between computer use and low back pain could be explained by the way computers are usually used—leaning on a table with its users sitting on a chair and adopting a straight position. Thus, the chair backrest would confer protection to the low back region, even with long periods of computer use.[37] In contrast, the position adopted while using computers could vary according to the type of device being used (i.e., desktop or laptop) and the environment that it is used.[10] However, we could not assess which type of computers were used by the individuals from our sample.

Another important finding from our study was the lack of associations between the length of computer and mobile device use with pain in the mid-back region. The mid-back is the region with less mobility in the back, suffering less from the inadequate postures adopted while using these technologies. This region can also be considered the least sensitive region of the back, presenting higher thresholds of pain than the neck and low back regions.[38]

Our study is not free of limitations. First, the length of use of computers and mobile devices was self-reported and included only the use during leisure time (hours of use during work and study were not assessed.). Sometimes, if users are engaged into immersive activities, it is possible that they lose the idea of how long they have used these technologies. If this information bias is present, it is expected that individuals had underestimated the length of time using computers and mobile devices.[39,40] Hence, in the absence of this bias, the magnitude of our associations would be higher. A second potential limitation is the thresholds used to categorize our exposures. As there is no formal definition about how long the use of computers and mobile devices could become harmful to health, we defined our thresholds taking into consideration the literature and the sample size balancing between the categories. Initially, we proposed using thresholds based on percentiles, but the heterogeneity within each category was very high, then we decided not to use this approach. A third limitation is the fact that device usage was investigated only during weekdays because of questionnaire limitations. If computer and mobile device usage during weekends were also considered, the length of use could be even higher, and the associations found in our study would be probably stronger. Finally, it is possible that our findings are affected by reverse causality, when individuals presenting back pain reduce their use of computers and mobile devices. If this had occurred, we would expect a higher frequency of zero hours using computers and mobile devices. In addition, it is not be expected that young adults, aged 22 years, would reduce the length of time using these technologies because of back pain.

Our study also presents some strengths, including the way our outcome was identified. In order to assess the presence or absence of back pain according to its regions, we showed to the interviewees an image and asked for them to indicate in which regions they felt pain in the last three months. The graphic representation made easier for them to distinguish between the regions of the back, increasing the validity of the data collected. Another strength is that our study, although following a cross-sectional design, is inserted in the context of a consolidated birth cohort. In this sense, it would be possible to study the association between the length of time using computers and mobile devices with back in the future, also using a longitudinal design. Doing so, it would be able to determine the real effect of this association, identifying if it is exclusively proximal, or if it is also distal or cumulative.

Our findings showed a direct association between the length of time using mobile devices during leisure time and the prevalence of pain in the neck and low back regions. A direct association was also found between the length of time using computers and the prevalence of neck pain. Considering that the popularity of Internet, computers and mobile devices is increasing worldwide, it is important that specific recommendations are produced to avoid increasing the prevalence of these musculoskeletal conditions. More studies are needed to identify what length of time in using these technologies could become harmful for the back to avoid future health issues. Also, longitudinal studies are encouraged to help understand how the cumulative effect of the length of use of computers and mobile devices acts on back pain.

Author statements

Ethical approval

The Ethics Committee of the Faculty of Social Medicine of the Federal University of Pelotas approved the 22-year follow-up of the 1993 Pelotas birth cohort (registry number 1.250.366). All individuals were informed about the objectives of the study and had to sign a consent form to participate.

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Competing interests

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2021.04.003.

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