The prevalence and associated factors of symptomatic cervical Spondylosis in Chinese adults: a community-based cross-sectional study

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Abstract

Background: Cervical spondylosis adversely affects life quality for its heavy disease burden. The report on the community-based prevalence and associated factors of cervical spondylosis is rare, especially in Chinese population. Whether prevention is needed and how to prevent it is not clear. This study aims to explore its prevalence and related lifestyle factors and provide evidence on prevention of cervical spondylosis.

Methods: A community-based multistage cross-sectional survey of six communities from the Chinese population was conducted. A face-to-face interview was conducted to obtain individual information, and prevalence was calculated. Single-factor analysis and multivariable logistic regressions were used to explore the associated factors in total and subgroup populations.

Results: A total of 3859 adults were analyzed. The prevalence of cervical spondylosis was 13.76%, although it differed significantly among the urban, suburban, and rural populations (13.07%, 15.97%, and 12.25%, respectively). Moreover, it was higher in females than in males (16.51% vs 10.49%). The prevalence among different age groups had an inverted U shape. The highest prevalence was in the age group from 45 to 60 years old. The associated factors differed by subgroups. There were positive associations between engaging in mental work, high housework intensity, and sleep duration of less than 7 h/day with cervical spondylosis. Going to work on foot was a negative factor of cervical spondylosis in the total population. For people aged less than 30 years, keeping the same work posture for 1–2.9 h/day was a special related factor. Exposure to vibration was an associated factor for females aged 45–60 years. Menopause was a special related factor for women.

Conclusions: Prevalence of cervical spondylosis was high in Chinese population. People younger than 60 years were the focus of prevention for cervical spondylosis. Moreover, the characters between male and female and among different age groups were different and required targeted interventions.

Keywords: Cervical spondylosis, Community-based, Cross-sectional study, Prevalence, Associated factors
Background
Cervical spondylosis is a chronic degenerative process of the cervical spine. It affects the vertebral bodies and intervertebral disks of the neck and leads to herniated intervertebral disks, osteophytes, and ligament hypertrophy. This may eventually cause compression of the nerve roots and spinal cord [1]. Numbness, weakness, and tingling in the neck and/or arms, pain in the neck and/or arms, neck stiffness, and headaches are the usual symptoms of cervical spondylosis [2]. According to the reports, pain, numbness, and other symptoms were related to depression and insomnia [3, 4]. Although many asymptomatic adults have spondylotic changes according to the imaging examination, cervical spondylosis can cause stenosis of the spinal canal, lateral recess, and foramina and cause clinical symptoms, such as neck pain [5–7]. Neck pain was the most common symptom of cervical spondylosis [8]. The lifetime prevalence of the adult population was 48.5%, and the prevalence of screen-using workers was 55% [9, 10]. According to the global burden of disease study of 2013 [11], in 301 acute and chronic diseases and injuries in 188 countries, neck pain was one of the top 10 causes of years lived with disability. It ranked the fourth globally and the second in China, relatively. Cervical spondylosis not only affects the life quality but also increases the economic burden, since high-cost surgery is a regular treatment method. Therefore, cervical spondylosis might become a public health concern.

Cervical spondylosis is an age-related degeneration and chronic noncommunicable disease. Previous studies showed that age was the main risk factor and a contributor to the incidence of cervical spondylosis. The risk increased with aging [2, 12, 13]. Moreover, several other factors, such as occupational factors, exercises, and so on, exist [14]. In China, the prevalence and related factors were mainly hospital-based studies. However, the community-based prevalence and related factors of cervical spondylosis were rarely reported in Chinese population. With the social development of China and the onset of population aging, a large number of patients with cervical spondylosis may exist. The lifestyle has changed a lot in Chinese population, but the evidence of whether it needs to be controlled and how to control is lacking.

Therefore, the objective of this study was to report the baseline of the prevalence of cervical spondylosis and its related lifestyle influence factors of Chinese adults and provide evidence on its prevention and management.

Methods
Study participants
The present community-based cross-sectional study was conducted in December 2010. A multistage, stratified sampling method was used to select a representative sample of persons aged 18 years or older and living in Beijing for at least 6 months. The sampling process referred to a previous study [15]. The study protocol was approved by the institutional review board and the ethics committee of the Beijing Jishuitan Hospital, Beijing, China. Written informed consent was obtained from each participant before the data was collected.

Diagnostic criteria
The patients of cervical spondylosis were self-reported doctor-diagnosed. Participants who had been diagnosed in the hospital were the patients. According to the consensus guide, cervical spondylosis was diagnosed by the clinical symptoms, signs and imaging examinations if needed in China. Clinical symptoms and signs were the diagnosis base of cervical spondylosis (Table 1) [16]. According to the clinician judgment, radiography or/and computed tomography or/and magnetic resonance imaging were used for the imaging examinations, and they were mandatory for diagnosing cervical spondylosis.

Data collection
The face-to-face interview was used to collect the information. The information included sociodemographic information, such as place of residence, age, sex, per capita monthly income, education, type of medical insurance, and education level; physical measurement index, including

Table 1 The symptoms and signs of cervical spondylosis

| symptoms                                      | signs                                      |
|-----------------------------------------------|--------------------------------------------|
| Cervical pain aggravated by movement          | Poorly localised tenderness                |
| Referred pain (occiput, between the shoulder blades, upper limbs) | Limited range of movement (forward flexion, backward extension, lateral flexion, and rotation to both sides) |
| Retro-orbital or temporal pain (from C1 to C2) | Minor neurological changes like inverted supinator jerks (unless complicated by myelopathy or radiculopathy) |
| Cervical stiffness—reversible or irreversible|                                           |
| Vague numbness, tingling, or weakness in upper limbs |                                         |
| Dizziness or vertigo                          |                                           |
| Poor balance                                  |                                           |
| Rarely, syncope, triggers migraine, pseudo-angina |                                         |
body mass index (BMI, measured as weight in kg divided by height in m²) and waist–hip ratio (WHR, the ratio of waist circumference and hip circumference); and lifestyle information containing smoking, drinking, nature of labor (physical-based, mental-based, or mixed), vibration, job posture, working intensity, duration of the same working posture during the day, transportation tools (nonmanpower transportation tool, bicycle, and walking), housework intensity, exercise frequency, exercise intensity, and sleep duration per day. People presently smoking at least one cigarette per day for at least 1 month or having used at least 100 cigarettes during lifetime were defined as smokers. The alcohol drinking group referred to persons whose alcohol consumption was 1000 mL of beer or 100 mL of liquor per week and lasting 1 year or more. Vibration denoted people operating a motor or a similar working environment in which movement was felt as a vibration. Body weight and height were measured by the researchers. A feasibility test of data collection and survey process optimization was done via a pilot study conducted prior to the actual study. A technical training of the investigators was conducted before being sent to interview the participants. Data were doubly entered in parallel using the EpiData 3.1 software (The EpiData Association, Odense, Denmark).

Statistical analysis
Prevalence was reported with a standard error. Area-, age-, and sex-specific prevalences were also reported. Moreover, the prevalence associated with different education levels, BMI, nature of labor, income, drinking, smoking, job posture, transportation tools, sleep duration, vibration, duration of working posture, exercise frequency, exercise intensity, WHR, and menopause of women subgroup was calculated. The single-factor analysis was examined by \(\chi^2\) tests or the Kolmogorov – Smirnov test. The multivariate analysis of associated factors was analyzed by the multivariable logistic regression model in the total population and in gender and age subgroup populations. Only significant variables in the single factor analysis were included in the multivariable model. The variables were selected by stepwise method. All \(p\) values were two tailed, not adjusted for multiple tests, and considered significant at \(p < 0.05\). All statistical tests were carried out using the SPSS 18.0 software (SPSS Inc., IL, USA).

Results
Participant demographics
The study included 3900 participants, of which 3888 completed the study and 3859 had adequate disease information and were included in the analysis finally. The response rate was 99.7% in total, and 99.6% for males and 99.8% for females. Among the participants, 1820 were males (47.27%) and 2029 were females (52.73%). The mean age was 45.85 ± 16.19 years.

Prevalence of cervical Spondylosis
Among 3859 subjects, 531 were diagnosed with cervical spondylosis, and the prevalence of cervical spondylosis was 13.76% [95% confidence interval (CI): 12.67–14.85%]. The prevalence of cervical spondylosis in the suburban (15.97%) area was higher than that in the urban and rural areas (13.07% and 12.25%; \(p = 0.016\); Fig. 1). The prevalence presented a rising trend with increasing age \((P < 0.001; \text{Fig. 2})\). The females had a higher prevalence of cervical spondylosis compared with the males \((P < 0.001; \text{Fig. 3})\). Participants with less education had a higher prevalence of cervical spondylosis compared with the males \((P < 0.001; \text{Fig. 3})\). Participants with less education had a higher prevalence of cervical spondylosis \((P < 0.001)\). The prevalence of cervical spondylosis increased with increasing BMI \((P = 0.001)\). A significant difference in the prevalence was found among the three kinds of transportation modes \((P = 0.013)\). The sleep duration less than 7 h/day had a higher prevalence compared with those sleeping for no less than 7 h/day \((P < 0.001)\). People holding the same working posture for about 1–2.9 h were
more likely to experience cervical spondylosis ($P = 0.015$). The prevalences of higher and lower exercise frequencies groups were both higher than other group ($P < 0.001$). Exercise intensity was related to the prevalence of cervical spondylosis ($P < 0.001$). People whose WHR was central obesity had a higher prevalence compared with the normal people ($P = 0.002$). Menopausal women had a higher prevalence than the nonmenopausal group ($P < 0.001$) \text{(Table 2}). Housework intensity was associated with cervical spondylosis \text{(Table 3)}.

**Associated factors for cervical Spondylosis in the Total population**
People living in the suburban area, those 30 years or older, females, those engaged in mental work, housework intensity, and those sleeping for less than 7 h/day had a positive association with cervical spondylosis. Going to work on foot was a negative associated factor for cervical spondylosis; the odds ratio (OR) was 0.690 (95% CI: 0.512–0.929) \text{(Table 4)}.

**Associated Factors for Cervical Spondylosis in the Gender Subgroup**
The associated factors for cervical spondylosis were significantly different between men and women. For males, age 30 years or older and having vibration characteristics during their working environment were associated factors for cervical spondylosis. For females, place of residence, age, menopause, mental-based work, housework intensity, and sleeping for less than 7 h/day were associated factors for cervical spondylosis, whereas going to work on foot was a protective associated factor for cervical spondylosis \text{(Table 5)}.

**Associated factors for cervical Spondylosis in the age subgroup**
The characteristics of cervical spondylosis differed by age groups. For the people aged less than 30 years, work
Table 2 Regional and Population-Based Distribution and Characteristics of Cervical spondylosis

|                                | N    | n   | p    | Sp   | $\chi^2$ | p       |
|--------------------------------|------|-----|------|------|----------|---------|
| Place of residence             |      |     |      |      |          |         |
| Urban                          | 1293 | 169 | 13.07| 0.94 | 8.257    | 0.016   |
| Suburban                       | 1284 | 205 | 15.97| 1.02 |          |         |
| Rural                          | 1282 | 157 | 12.25| 0.92 |          |         |
| Age(years)                     |      |     |      |      |          |         |
| < 30                           | 813  | 37  | 4.55 | 0.73 | 118.304  | < 0.001 |
| 30-                            | 1065 | 114 | 10.70| 0.95 |          |         |
| 45-                            | 1199 | 245 | 20.43| 1.16 |          |         |
| ≥ 60                           | 772  | 130 | 16.84| 1.35 |          |         |
| Sex                            |      |     |      |      |          |         |
| Male                           | 1820 | 191 | 10.49| 0.72 | 29.432   | < 0.001 |
| Female                         | 2029 | 335 | 16.51| 0.82 |          |         |
| Education                      |      |     |      |      |          |         |
| Undergraduate or higher        | 598  | 60  | 10.03| 1.23 | 18.503   | < 0.001 |
| Junior college                 | 689  | 75  | 10.89| 1.19 |          |         |
| Senior high school             | 1121 | 167 | 14.90| 1.06 |          |         |
| Junior high school or lower    | 1414 | 225 | 15.91| 0.97 |          |         |
| BMI(kg/m²)                     |      |     |      |      |          |         |
| < 18.5                         | 235  | 15  | 6.38 | 1.60 | 15.559   | 0.001   |
| 18.5-                           | 1912 | 250 | 13.08| 0.77 |          |         |
| 24.0-                           | 1324 | 201 | 15.18| 0.99 |          |         |
| ≥ 28.0                         | 366  | 59  | 16.12| 2.92 |          |         |
| Nature of labor                |      |     |      |      |          |         |
| Physical-based                 | 1466 | 202 | 13.78| 0.90 | 2.785    | 0.426   |
| Mental-based                   | 919  | 140 | 15.23| 1.19 |          |         |
| Mixed                          | 894  | 114 | 12.75| 1.12 |          |         |
| Per capita monthly income level (¥) |    |    |      |      |          |         |
| < 2000                         | 2194 | 300 | 13.67| 0.73 | 0.765    | 0.682   |
| 2000-                           | 1400 | 198 | 14.14| 0.93 |          |         |
| 5000-                           | 217  | 26  | 12.98| 2.21 |          |         |
| Drinking                       |      |     |      |      |          |         |
| Yes                            | 768  | 115 | 14.97| 1.29 | 1.191    | 0.275   |
| No                             | 3091 | 416 | 13.46| 0.61 |          |         |
| Smoking                        |      |     |      |      |          |         |
| Yes                            | 929  | 110 | 11.84| 1.06 | 3.798    | 0.051   |
| No                             | 2930 | 421 | 14.37| 0.65 |          |         |
| Job posture                    |      |     |      |      |          |         |
| Sitting                        | 1280 | 180 | 14.06| 0.97 | 5.746    | 0.219   |
| Standing                       | 799  | 104 | 13.02| 1.19 |          |         |
| Frequently stooping            | 216  | 37  | 17.13| 2.57 |          |         |
| Moving                         | 1156 | 166 | 14.36| 1.03 |          |         |
| Other                          | 405  | 44  | 10.86| 1.55 |          |         |
intensity, keeping the same work posture 1–2.9 h/day and the gender were the associated factors for cervical spondylosis. For the group between 30 years and 45 years old, housework intensity was the only associated factor. For 45 and 60 years group, living in the rural area, female gender, engaging in mental work, sleeping less than 7 h/day and vibration exposure in working condition were the associated factors. Going to work on foot was a protective factor for cervical spondylosis. For people aged no less than 60 years, housework intensity, engaging in mental work and mixed work, and daily sleep duration less than 7 h were the associated factors for cervical spondylosis (Table 6).

Discussion
This was an epidemiological study of cervical spondylosis in Chinese population. The prevalence of cervical spondylosis was 13.76%, which was higher than the prevalence of diabetes (9.7%) [17]. According to the data of the population census in 2011, approximately 2.75 million patients suffered from cervical spondylosis in Beijing, a city having a population of 20 million. The prevalence of cervical spondylosis was high not only in the Chinese population but also in other areas of the world. According to a cohort study, the incidence of cervical spondylosis was 13.1% overall, in a total of 47,560 patients [18]. A study in the southwest region of Nigeria found a prevalence of 10.7%

Table 2 Regional and Population-Based Distribution and Characteristics of Cervical spondylosis (Continued)

|                          | N  | n  | p    | Sp | χ²  | p    |
|--------------------------|----|----|------|----|-----|------|
| Daily transportation tools |    |    |      |    |     |      |
| Non manpower transportation tool | 2116 | 271 | 12.81 | 0.73 | 8.744 | 0.013 |
| Bicycle                  | 743 | 127| 17.09 | 1.38 |
| On foot                  | 992 | 132| 13.31 | 1.08 |
| Sleep duration per day (hours/day) |    |    |      |    |     |      |
| ≥ 7                      | 3002 | 374 | 12.46 | 0.60 | 28.354 | < 0.001 |
| < 7                      | 762 | 152| 19.95 | 1.45 |
| Vibration                |    |    |      |    |     |      |
| Yes                      | 334 | 50 | 14.97 | 2.96 | 0.451 | 0.502 |
| No                       | 3525 | 481 | 13.65 | 0.58 |
| Duration of the same work posture (hr/d) |    |    |      |    |     |      |
| < 1                      | 981 | 124| 12.64 | 1.06 | 10.440 | 0.015 |
| 1-                       | 987 | 164| 16.62 | 1.19 |
| 2-                       | 477 | 69 | 14.47 | 1.61 |
| ≥ 3                      | 1411 | 174 | 12.33 | 0.88 |
| Exercise frequency       |    |    |      |    |     |      |
| ≥ 2 times/week           | 1107 | 201 | 18.16 | 1.16 | 35.174 | < 0.001 |
| 1 time/week              | 281 | 41 | 14.59 | 2.11 |
| 1 time/2 weeks           | 77  | 8  | 10.39 | 3.50 |
| ≤ 1 time/month           | 37  | 10 | 27.03 | 7.40 |
| No exercise              | 2336 | 267 | 11.43 | 0.66 |
| Exercise intensity       |    |    |      |    |     |      |
| None                     | 2389 | 272 | 11.39 | 0.65 | 45.389 | < 0.001 |
| Mild                     | 759  | 150 | 19.76 | 1.45 |
| Moderate                 | 158  | 36 | 22.78 | 3.35 |
| Vigorous                 | 553  | 73 | 13.20 | 1.44 |
| Waist–hip ratio          |    |    |      |    |     |      |
| Normal                   | 1602 | 187 | 11.67 | 0.80 | 9.369 | 0.002 |
| Central obesity          | 2243 | 339 | 15.11 | 0.76 |
| Menopause                |    |    |      |    |     |      |
| Yes                      | 775  | 188 | 24.26 | 1.54 | 52.193 | < 0.001 |
| No                       | 1145 | 134 | 11.70 | 0.95 |
for cervical spondylosis [19], which was similar to the results of the present study. This indicated that cervical spondylosis was a major public health problem that needed a large-scale intervention.

The prevalence among different age groups had an inverted U shape. The group aged between 45 years and 60 years had the highest prevalence. This might cause absence from work because of the symptoms caused by cervical spondylosis, such as neck pain and so on [20–22]. Therefore, this group needed more preventive measures. Several factors might affect cervical spondylosis. Irrespective of the case–control or longitudinal study, age was an important related factor for cervical spondylosis [23, 24]. These results were consistent with the findings of the present study. Moreover, the present study also revealed that the strength of association in different age groups was different. Compared with the youngest age group, the adjusted OR was the highest in people aged between 45 and 60 years (OR = 5.303, 95% CI: 3.417–8.229) and second highest in those aged more than 60 years (OR = 4.722, 95% CI: 2.945–7.571). Several reasons might explain this. The first and the most important reason is that the characters might be different in the four age groups (Table 6). For example, for the youngest people aged less than 30 years, work intensity and keeping the same working posture for 1–3 h/day were the associated factors for cervical spondylosis. For people aged 30–45 years, housework intensity was the only associated factor for cervical spondylosis. For people aged 45–60 years, housework intensity was the only associated factor for cervical spondylosis. This result indicated that the prevention measures should be

| Table 3 | The Influence of Working Intensity and Housework Intensity on Cervical spondylosis |
|---------|----------------------------------|
| Cervical spondylosis | Not Cervical spondylosis | Kolmogorov-Smirnov Z | P |
| Working intensity | median | QL | median | QL | Kolmogorov-Smirnov Z | P |
| Working intensity | 5 | 3 | 5 | 3 | 1.145 | 0.145 |
| Housework intensity | 3 | 3 | 3 | 3 | 2.918 | < 0.001 |

| Table 4 | Associated Factors of Cervical spondylosis by Multivariable Logistic Regression |
|---------|----------------------------------|
| Place of residence | 7.172 | 0.028 |
| Urban | 1.000 |
| Suburban | 0.383 | 0.147 | 6.809 | 0.009 | 1.467 | 1.100 | 2.957 |
| Rural | 0.302 | 0.160 | 3.544 | 0.060 | 1.352 | 0.988 | 1.851 |
| Age(years) | 68.947 | < 0.001 |
| < 30 | 1.000 |
| 30- | 0.845 | 0.226 | 13.980 | < 0.001 | 2.327 | 1.495 | 3.623 |
| 45- | 1.668 | 0.224 | 55.351 | < 0.001 | 5.303 | 3.417 | 8.229 |
| ≥ 60 | 1.552 | 0.241 | 41.538 | < 0.001 | 4.722 | 2.945 | 7.571 |
| Sex | 1.000 |
| Male | 0.591 | 0.120 | 24.146 | < 0.001 | 1.805 | 1.426 | 2.285 |
| Female | 10.446 | 0.005 |
| Nature of labor | 1.000 |
| Physical-based | 0.207 | 0.157 | 1.742 | 0.187 | 1.230 | 0.905 | 1.671 |
| Mixed | 0.502 | 0.157 | 10.260 | 0.001 | 1.653 | 1.215 | 2.247 |
| Mental-based | 0.086 | 0.026 | 10.850 | 0.001 | 1.090 | 1.035 | 1.147 |
| Housework intensity | 6.014 | 0.049 |
| Modes of daily transportation | 1.000 |
| Bicycle | -0.089 | 0.151 | 0.348 | 0.555 | 0.915 | 0.681 | 1.229 |
| On foot | -0.371 | 0.152 | 5.966 | 0.015 | 0.690 | 0.512 | 0.929 |
| Sleep duration per day (<7 h/day) | 0.383 | 0.132 | 8.410 | 0.004 | 1.466 | 1.132 | 1.899 |
different for different age groups. Second, the occurrence of cervical spondylosis as a chronic disease was the result of the long-term effect of the aforementioned factors. Considering the hysteresis effect, people younger than 60 years were the focus of prevention.

According to the report of Singh S et al., sex showed no significance with cervical spondylosis [23]. Sex was related with cervical spondylosis in this study. In the analysis of gender subgroups, age 30 years or older and vibration exposure in work environment were independent associated factors for cervical spondylosis in males; age 30 years or older, exposure to vibration during their daily work, menopause, those engaged in mental work, housework intensity, and those sleeping for less than 7 h/day were also the associated factors for cervical spondylosis for females, and going to work on foot was a protective factor for cervical spondylosis. The associated factors for females might be related to physiological characteristics and their division of labor.

Work-related factors, such as carrying head loads, were associated with cervical spondylosis [25–27]. For the youngest people aged less than 30 years, work
intensity and keeping the same work posture ranging from 1 to 3 h/day were the associated factors for cervical spondylosis in the present study. Work intensity and the duration of keeping the same work posture were both indicators of neck loading. For this group of people, the cervical spine activity during the appropriate time interval might have some effects, such as turning the head. Occupation, sedentary lifestyle, and unhealthy working posture were the risk factors for cervical spondylosis [28]. For people younger than 30 years, those holding the same work posture for 1–1.9 h and 2–2.9 h had positive relation with cervical spondylosis, respectively, compared with those who held the same posture for less than 1 h. The present study did not find a significant difference between people holding the same work posture for more than 3 h and those holding the same posture less than 1 h. It might be due to the adaptability of the human body. The present study suggested that the appropriate activity time interval was 1 or less than 1 h.

Occupational low back pain is strongly associated with vibration [29–33]. A positive dose relationship exists between them [34]. The whole-body vibration during daily

### Table 6 Epidemiological Characteristics of Cervical spondylosis among Different Age Groups

|                              | β    | Se  | Wald | P       | OR    | 95% CI lower | 95% CI upper |
|------------------------------|------|-----|------|---------|-------|--------------|--------------|
| **< 30 years group**         |      |     |      |         |       |              |              |
| Work intensity               | 0.329| 0.091| 13.242| < 0.001 | 1.390 | 1.164        | 1.660        |
| Duration of the same work posture (hours) |      |     |      |         |       |              |              |
| < 1                          |      |     |      |         |       |              |              |
| 1-                           | 2.527| 1.049| 5.805 | 0.016   | 12.522| 1.602        | 97.850       |
| 2-                           | 2.169| 1.078| 4.050 | 0.044   | 8.750 | 1.058        | 72.346       |
| ≥ 3 h                        | 1.629| 1.038| 2.462 | 0.117   | 5.099 | 0.666        | 39.013       |
| Gender (Female)              | 0.917| 0.427| 4.614 | 0.032   | 2.501 | 1.084        | 5.771        |
| **30-years group**           |      |     |      |         |       |              |              |
| Housework intensity          | 0.111| 0.052| 4.530 | 0.033   | 1.117 | 1.009        | 1.237        |
| **45- years group**          |      |     |      |         |       |              |              |
| Place of residence           | 8.023| 0.018|      |         |       |              |              |
| Urban                        |      |     |      |         |       |              |              |
| Suburban                     | 0.387| 0.239| 2.619 | 0.106   | 1.473 | 0.921        | 2.355        |
| Rural                        | 0.696| 0.246| 8.020 | 0.005   | 2.066 | 1.239        | 3.248        |
| Gender (Female)              | 1.085| 0.193| 31.782| < 0.001 | 2.961 | 2.030        | 4.318        |
| Nature of labor              | 7.135| 0.028|      |         |       |              |              |
| Physical-based               |      |     |      |         |       |              |              |
| Mixed                        | 0.067| 0.248| 0.072 | 0.788   | 1.069 | 0.657        | 1.739        |
| Mental-based                 | 0.616| 0.243| 6.439 | 0.011   | 1.852 | 1.151        | 2.980        |
| Daily transportation tools   | 6.017| 0.049|      |         |       |              |              |
| Non manpower transportation tool | -0.109 | 0.217 | 0.252 | 0.615   | 0.897 | 0.586        | 1.372        |
| Bicycle                      | -0.561| 0.233 | 5.793 | 0.016   | 0.571 | 0.361        | 0.901        |
| On foot                      | 0.506| 0.194| 6.771 | 0.009   | 1.658 | 1.133        | 2.426        |
| Sleep duration per day (<7 h/day) | -0.563| 0.276 | 4.156 | 0.041   | 0.570 | 0.332        | 0.979        |
| Vibration (Yes)              |      |     |      |         |       |              |              |
| ≥ 60 years group             |      |     |      |         |       |              |              |
| Nature of labor              | 7.872| 0.020|      |         |       |              |              |
| Physical-based               |      |     |      |         |       |              |              |
| Mental-based                 | 0.733| 0.294| 6.237 | 0.013   | 2.082 | 1.171        | 3.703        |
| Mixed                        | 0.667| 0.294| 5.153 | 0.023   | 2.948 | 1.095        | 3.464        |
| Housework intensity          | 0.136| 0.054| 6.426 | 0.011   | 1.145 | 1.031        | 1.272        |
| Sleep duration per day (<7 h/day) | 0.518| 0.254 | 4.166 | 0.041   | 1.679 | 1.021        | 2.760        |
work was an associated factor of cervical spondylosis in males in this study. Although no report demonstrated the relationship between vibration and cervical spondylosis, occupational factors contributing to the acceleration of spinal degeneration included vehicle driving [35]. Vehicle driving caused vibration. Vibration could cause bone metabolism disorder and bone damage of lumbar vertebra [36]. Therefore, the whole-body vibration was related with the cervical spine. This result could explain why people who traveled by foot had lower prevalence than those who used nonmanpower transportation tool to some degree. Also, going to work on foot gave the body some exercise. Although some exercises had higher risk, some had no risk and others have protective effect [22, 37–41], on foot had positive association on cervical spondylosis in this study.

One study found menopause as an associated factor for cervical spondylosis (OR = 1.772, 95% CI: 1.159–2.710). Estrogens can maintain collagens that protect the intervertebral disk [42]. Lou et al. found a relationship between menopause and the degeneration of intervertebral disk [43]. Moreover, the changes in hormones during menopause could lead to the degeneration of vertebral endplate, which affected the nutritional distribution of the intervertebral disk, ending in the degeneration of the spine [44]. Females in the perimenopausal period need some health interventions to protect their spine health.

BMI ≥28 kg/m² had a higher risk for lumbar osteoarthritis in the present study [15]. Obesity was a risk factor for intervertebral disk degeneration and spine disease [45, 46]. Obesity increased the weight of the skeleton and accelerated the intervertebral disk degeneration [47]. Besides, obesity was an inflammatory disorder that could cause the degeneration of intervertebral disk [48]. However, according to a 10-year cohort study [22], no association was found between obesity and degenerative cervical disease. In this study, the prevalence of cervical spondylosis was significantly different in different BMI groups and between normal and central obese groups according to the single-factor analysis. However, obesity and central obesity had no relation to cervical spondylosis in the multivariate analysis. This was probably because the anatomical position of the cervical vertebra was high in the body. It was less influenced by the weight of the body.

Moreover, the negative association between sleeping duration and cervical spondylosis was significant. This was possibly due to biomechanics and emotions. Weight loading was one of the important causes of spinal degeneration [49]. Short hours of sleep per day increased the weight loading time of the spine, thus accelerating its degeneration. Shorter sleep duration per day was associated with emotional stress. Emotional stress was associated with neck pain [50]. Neck pain usually was one of the possible symptoms in the process of cervical spondylosis.

The present study had two limitations. First, the prevalence of cervical spondylosis might have been underestimated because of the definition of cervical spondylosis. In this study, patients with cervical spondylosis were people not only having imaging changes but also having clinical symptoms. Therefore, people even having cervical degeneration imaging changes but no clinical symptoms were excluded. However, according to the current clinical guideline, people having not only imaging changes but also clinical symptoms needed treatment. In addition, if people don’t diagnosed in hospital, they were not classified to cervical spondylosis patients. There may be more cervical spondylosis patients in Chinese population. Therefore, the influence of underestimation on policy decisions was less. Second, regarding the evidence level and the relevant strength of the cross-sectional study, a cohort study is needed to provide further evidence of the correlation between the associated factors and cervical spondylosis. However, our findings supplemented the information of cervical spondylosis prevalence in community people which has received little attention from other studies. At the same time, we also reported the prevalence and associated factors in both middle-young and old age group, which was scarcely reported before. Since the middle-young-aged population were the main social labor and should be the focal point for the prevention of cervical spondylosis. Our findings would provide valuable information for the prevention of the disease on lifestyle, especially for middle-young-aged population.

**Conclusions**

The prevalence of cervical spondylosis was high in Chinese population. People younger than 60 years were the focus of prevention. Moreover, the characters of between male and female and among different age groups were different and required targeted interventions.

**Acknowledgements**

The Second Hospital of Yanqing arranged the sampled community. The authors thank Tang Xun of Peking University for the design of this study. The authors also thank Xu Xiaochuan, Dr. Wang Yan, Dr. Zhang Guoying, Wang Fei, and Dr. Zhang Lifeng for their support in this survey.

**Funding**

This study was funded by Chinese National Natural Science Foundation (no:81400923), Beijing Municipal Administration of Hospitals’ Youth Programme (no:QML20150405) and Key Project of Chinese National Programs (no:2016YFC0105800 & 2016YFC0105801).

**Availability of data and materials**

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

**Authors’ contributions**

LVY designed this study and analyzed the data and was a major contributor in writing and revising. TIANW was a major contributor in conception and design and revising. CHEND was a major contributor in conception and design and revising it critically. LIUY made contributions in data collecting and drafting. WANGL contributed in analysis and interpretation of data and
writing. DUAN F made contributions in analysis of data and Writing. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study protocol was approved by the institutional review board and the ethics committee of the Beijing Jishuitan Hospital, Beijing, China. Written informed consent was obtained from each participant before the data was collected.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Received: 17 July 2017 Accepted: 16 August 2018

Published online: 11 September 2018

References

1. Xiong W, Li F, Guan H. Tetraplegia after thyroidectomy in a patient with cervical spondylosis: a case report and literature review. Medicine (Baltimore). 2015;94:352.
2. Wang C, Tian F, Zhou Y, He W, Cai Z. The incidence of cervical spondylosis – twins 70-102 years of age. Spine (Phila Pa 1976). 2004;29:576.
3. Stoffman MR, Roberts MS, King JJ. Cervical spondylotic myelopathy, depression, and anxiety: a cohort analysis of 89 patients. Neurosurgery. 2005;57:307–13. 307-313.
4. Paanalahti K, Holm LW, Magnusson C, Carroll L, Nordin M, Skillgate E. The common features in old age: a population-based study of 4,486 Danish twins 70-102 years of age. Spine (Phila Pa 1976). 2004;29:576–80.
5. Goode AP, Freiburger J, Carey T. Prevalence, practice patterns, and evidence for chronic neck pain. Arthritis Care Res (Hoboken). 2010;62:1594–601.
6. Vogt MT, Cavethorn PM, Kang JD, Donaldson WF, Gauley JA, Nevitt MC. Prevalence of symptoms of cervical and lumbar stenosis among participants in the osteoarthritic fractures in men study. Spine (Phila Pa 1976). 2006;31:1445–51.
7. Klussmann A, Gebhardt H, Liebers F, Rieger MA. Musculoskeletal symptoms of the upper extremities and the neck: a cross-sectional study on prevalence and symptom-predicting factors at visual display terminal (VDT) workplaces. BMC Musculoskelet Disord. 2008;9:96.
8. 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.
9. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015;386:743–800.
10. Nagashima H, Doki T, Hashiguchi H, Ishii H, Kameyama Y, Kates Y, et al. Clinical features and surgical outcomes of cervical spondylotic myelopathy in patients aged 80 years or older: a multi-center retrospective study. Eur Spine J. 2011;20:240–6.
11. Hadjipavlou AG, Tzeriamanios MN, Bogduk N, Zindrick MR. The pathophysiology of disc degeneration: a critical review. J Bone Joint Surg Br. 2008;90:1261–70.
12. Kepler CK, Hillbrand AS. Management of adjacent segment disease after cervical spinal fusion. Orthop Clin North Am. 2011;42:53–62.
13. Tian W, Lv Y, Liu Y, Xiao B, Han X. The high prevalence of symptomatic degenerative lumbar osteoarthritis in Chinese adults: a population-based study. Spine (Phila Pa 1976). 2014;39:1301–10.
14. Binder AI. Cervical spondylosis and neck pain. BMJ. 2007;334:527–31.
15. Yang W, Lu J, Weng J, Jia W, Li L, Xiao J, et al. Prevalence of diabetes among men and women in China. N Engl J Med. 2013;362:1090–101.
16. Schairer WW, Carrer A, Lu M, Hu SS. The increased prevalence of cervical spondylosis in patients with adult thoracicolumbar spinal deformity. J Spinal Disord Tech. 2014;27:E305–8.
17. Oguntona SA. Cervical spondylosis in south west Nigerian farmers and female traders. Ann Afr Med. 2014;13:61–4.
18. Labbafinejad Y, Imanizade Z, Danesh H. Ergonomics factors and their association with lower back and neck pain among pharmaceutical employees in Iran. Workplace Health & Safety. 2016;64:85–9.
19. Andersen LL, Mortensen OS, Hansen JV, Burr H. A prospective cohort study on severe pain as a risk factor for long-term sickness absence in blue- and white-collar workers. Occup Environ Med. 2011;68:500–2.
20. Mesas AE, Gonzalez AD, Mesas CE, de Andrade SM, Magro IS, Del LJ. The association of chronic neck pain, low back pain, and migraine with absenteeism due to health problems in Spanish workers. Spine (Phila Pa 1976). 2014;39:1243–53.
21. Okada E, Matsumoto M, Ichiara D, Chiba K, Toyama Y, Fujisawa H, et al. Aging of the cervical spine in healthy volunteers: a 10-year longitudinal magnetic resonance imaging study. Spine (Phila Pa 1976). 2005;34:706–12.
22. Singh S, Kumar D, Kumar S. Risk factors in cervical spondylosis. J Clin Orthopa. 2014;3:221–6.
23. Yang H, Haldeman S, Nakata A, Choi B, Delp L, Baker D. Work-related risk factors for neck pain in the US working population. Spine (Phila Pa 1976). 2014;40:184–92.
24. Nordander C, Hansson GA, Ohlsson K, Arvidsson I, Balogh L, Stromberg U, et al. Exposure-response relationships for work-related neck and shoulder musculoskeletal disorders–analyses of pooled uniform data sets. Appl Ergon. 2016;55:70–84.
25. Arndor RN, Haq SA. Occupational use syndromes. Best Prac Res Clin Rheumatol. 2008;22:677–91.
26. Haldeman S, Carroll L, Cassidy JD. Findings from the bone and joint decade 2000 to 2010 task force on neck pain and its associated disorders. J Occup Environ Med. 2010;52:424–7.
27. Wijers RA. Epidemiology of occupational low back pain. Clin Occup Environ Med. 2006;5:501–28.
28. Murgia N, Dell’Omo M, Gambelunghe A, Folletti I, Muzi G, Abbritti G. Epidemiological evidence of possible musculoskeletal, cardiovascular and neoplastic effects in professional drivers. G Ital Med Lav Ergon. 2013;24:310–3.
29. Murtezani A, Ibraimi Z, Sllamniku S, Osmani T, Sheriff S. Prevalence and risk factors for low back pain in industrial workers. Folia Med (Plovdiv). 2011;53:68–74.
30. Palmer KT, Griffin M, Ntani G, Shambrook J, McNee P, Sampson M, et al. Professional driving and prolapsed lumbar intervertebral disc: assessed by magnetic resonance imaging: a case-control study. Scand J Work Environ Health. 2012;38:577–81.
31. Milosavljevic S, Baghni R, Vasiljevic RM, McBride DJ, Rehn B. Does daily exposure to whole-body vibration and mechanical shock relate to the prevalence of low back and neck pain in a rural workforce? Ann Occup Hyg. 2012;56:10–20.
32. Teschke K, Nicol AM, Davies H, Ju S. Whole body vibrations and back disorders among motor vehicle drivers and heavy equipment operators: a review of the scientific evidence. Occup Hyg. 1999.
33. Magna A. Investigation of the relation between low back pain and occupation. IMS Ind Med Surg. 1970;39:465–71.
34. Chang Q, Wei F, Zhang L, Xu J, Zhu L, Huang C, et al. Effects of vibration in forced posture on biochemical bone metabolism indices, and morphometric and mechanical properties of the lumbar vertebrae. PLoS One. 2013;8:e78640.
35. Toueg OW, Mac-Thiong JM, Grimard G, Parent S, Poitras B, Labelle H. Prevalence of spondylolisthesis in a population of gymnasts. Stud Health Technol Inform. 2010;158:132–7.
36. Triantafillou KM, Lauerman W, Kalantar SB. Degenerative disease of the cervical spine and its relationship to athletes. Clin Sports Med. 2012;31:509–20.
39. Chang SK, Tominaga GT, Wong JH, Weldon EJ, Kaan KT. Risk factors for water sports-related cervical spine injuries. J Trauma. 2006;60:1041–6.
40. Rastogi R, Bendore P. Effect of naturopathy treatments and yogic practices on cervical Spondylosis—a case report. Indian J Physiol Pharmacol. 2015;59:442–5.
41. Shakoor MA, Ahmed MS, Kibria G, Khan AA, Mian MA, Hasan SA, et al. Effects of cervical traction and exercise therapy in cervical spondylosis. Bangladesh Med Res Coun C Bull. 2002;28:61–9.
42. Calleja-Agius J, Muscat-Baron Y, Brincat MP. Estrogens and the intervertebral disc. Menopause Int. 2009;15:127–30.
43. Lou C, Chen HL, Feng XZ, Xiang GH, Zhu SP, Tian NF, et al. Menopause is associated with lumbar disc degeneration: a review of 4230 intervertebral discs. Climacteric. 2014;17:700–4.
44. Wang YX, Griffith JF. Menopause causes vertebral endplate degeneration and decrease in nutrient diffusion to the intervertebral discs. Med Hypotheses. 2011;77:18–20.
45. Teraguchi M, Yoshimura N, Hashizume H, Muraki S, Yamada H, Minamida A, et al. Prevalence and distribution of intervertebral disc degeneration over the entire spine in a population-based cohort: the Wakayama spine study. Osteoarthr Cartil. 2014;22:104–10.
46. Fanuele JC, Abdu WA, Hanscom B, Weinstein JN. Association between obesity and functional status in patients with spine disease. Spine (Phila Pa 1976). 2002;27:306–12.
47. Ricart W, Lopez J, Mozas J, Pericot A, Sancho MA, Gonzalez N, et al. Body mass index has a greater impact on pregnancy outcomes than gestational hyperglycaemia. Diabetologia. 2005;48:1736–42.
48. Rannou F, Concol MT, Hudry C, Antract P, Dumontier MF, Tsagris L, et al. Sensitivity of anulus fibrosus cells to interleukin 1 beta. Comparison with articular chondrocytes Spine (Phila Pa 1976). 2002;25:17–23.
49. Inoue N, Espinoza DA. Biomechanics of intervertebral disk degeneration. Orthop Clin North Am. 2011;42:487–99.
50. Cote P, van der Velde G, Cassidy JD, Carroll LJ, Hogg-Johnson S, Holm LW, et al. The burden and determinants of neck pain in workers: results of the bone and joint decade 2000-2010 task force on neck pain and its associated disorders. J Manip Physiol Ther. 2009;32:570–86.