



Impact of herpes zoster and post-herpetic neuralgia on health-related quality of life in Miyun District of Beijing, China: An EQ-5D survey

Dan Zhao^a, Luodan Suo^a, Li Lu^{a,*}, Jingbin Pan^a, Xinghui Peng^b, Yanfei Wang^b, Xinghuo Pang^a

^a Beijing Center for Disease Prevention and Control, Beijing, China

^b Miyun District of Beijing Center for Disease Prevention and Control, Beijing, China

ARTICLE INFO

Keywords:

Herpes zoster
Post-herpetic neuralgia
Quality-adjusted life years
EQ-5D

ABSTRACT

Background: Herpes zoster (HZ) and post-herpetic neuralgia (PHN) cause considerable morbidity, especially in elderly adults, but the burden is under-recognized in mainland China.

Methods: We conducted a case registry and follow-up study of HZ in Miyun District, Beijing from January 1, 2017 through December 31, 2018. Registered HZ cases were followed-up for pain to 365 days. The first 50 patients with HZ in each age group (≤ 14 , 15–29, 30–39, 40–49, 50–59, 60–69, 70–79, ≥ 80 years) and all those with PHN completed the EuroQoL five dimensions questionnaire (EQ-5D) to evaluate health-related quality of life (HRQoL) in patients with HZ and PHN. Ratings using the EQ-5D dimensions, visual analogue scale (VAS), health utility score (HUS) and quality-adjusted life years (QALYs) lost were compared among age groups.

Results: In total, 2008 patients with HZ were followed for a median 22 days (interquartile range [IQR] = 20–90), with an estimated incidence of 4.39 per 1000 person-years. We identified 122 (6.08 %) PHN cases. The median age of patients with PHN (65 years, IQR = 55–71) was older than that of patients with HZ (54 years, IQR = 43–64) ($P < 0.001$). The median duration of pain was 170 days (IQR = 144–355.5) for PHN and 15 days (IQR = 9–25) for HZ. All 95 patients with PHN and 319 sampled patients with HZ completed the EQ-5D survey. The median QALY loss of HZ increased from 0.004 (IQR = 0.001–0.02) in patients 50–59 years old to 0.02 (IQR = 0.01–0.06) in those ≥ 80 years old ($P < 0.01$). After weighting for age, the mean QALY loss per HZ case was estimated at 0.02 (standard deviation [SD] 0.04). The mean QALY loss per PHN case was 0.13 years (SD 0.12). **Conclusions:** HZ and PHN caused a substantial burden, especially among adults aged ≥ 50 years in Miyun District, Beijing, China. Vaccination should be considered to alleviate the burden of this painful disease.

Introduction

Herpes zoster (HZ) is a reactivation of varicella zoster virus (VZV), which causes varicella during childhood [1]. HZ can occur in all age groups, but the risk increases sharply after 50 years of age [2]. This disease is characterized by a painful, blistering rash that affects a single dermatome [3]. The rash is localized and pain typically resolves within 1 month [4]. However, cases of HZ, can evolve into postherpetic neuralgia (PHN), particularly in elderly people. Pain that persists for 90 days or more after the onset of rash is the most widely used definition of PHN [5]. Thirty percent of patients with PHN can experience pain for more than 1 year [6]. The acute pain in HZ and chronic neuropathic pain in PHN can be worse than labor pain, post-surgical pain, arthritis, spinal cord injury, or pain in chronic cancer [7]. Such a high level of pain has a serious impact on patients' daily lives owing to poor physical function

and increased emotional distress, which together reduce patients' quality of life [8].

HZ is a serious global health problem, and is expected to increase in the near future as the population ages [6]. Zoster vaccine has been demonstrated to significantly reduce the incidences of HZ and PHN, in addition to the severity and duration of pain associated with HZ [9]. In the United States, Zostavax (Zoster Vaccine Live [ZVL]; Merck & Co, Kenilworth, NJ, USA) was recommended in 2008 for adults aged ≥ 60 years, Shingrix® (Zoster Vaccine Recombinant, Adjuvanted [RZV]; GlaxoSmithKline, Research Triangle Park, NC, USA) was recommended for adults aged ≥ 50 years in late 2017. As of November 2020, ZVL is no longer available for use in the United States. Before introduction of the first vaccine, several studies were conducted to examine the incidence rates and temporal trends of HZ [5]. The evidence suggested the cost-effectiveness of vaccination and supported the formulation of national

* Corresponding author at: Beijing Center for Disease Prevention and Control, No. 16, Hepingli Middle Street, Dongcheng District, Beijing 100013, China.
E-mail address: lulibj@sina.com (L. Lu).

<https://doi.org/10.1016/j.jvaxc.2023.100415>

Received 14 August 2022; Received in revised form 23 November 2023; Accepted 27 November 2023

Available online 29 November 2023

2590-1362/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

immunization strategies. The costs per quality adjusted life year (QALY) gained are mainly used to prioritize among competing programs for the purposes of resource allocation [5]. Under most assumptions of the Advisory Committee on Immunization Practices of the United States Centers for Disease Control and Prevention, vaccination with RZV prevented more disease at a lower overall cost than did vaccination with ZVL. It is estimated that vaccination with RZV, compared with no vaccination, costs USD 31,000 per QALY gained on average, for immunocompetent adults aged ≥ 50 years [10].

Over 90 % of US adults aged ≥ 40 years have serological evidence of primary infection with VZV [11], and the incidence of HZ ranges from 1.2 to 3.4 cases per 1000 person-years, with people aged ≥ 65 years having the highest incidence (3.9–11.8 cases per 1000 person-years) [5,12,13]. In a study in China examining both the HZ incidence (adjusted, 1.90/1000 for the whole population, 4.7/1000 for people aged ≥ 50 year) and hospitalization rate (0.04/1000), the estimated number of cases per year was 2.77 million (with 1.38 billion population) [14], nearly three times that of the estimated 1 million cases annually in the United States [5]. China has a large population, and it is estimated that elderly people will account for one-third of the total population by 2035 [15]. In the year 2020, Shingrix® was licensed in China and made available to adults aged ≥ 50 years who pay an out-of-pocket cost of RMB 1598. However, substantial knowledge gaps exist regarding the burden of HZ in mainland China [16–18], especially the impact of HZ on health-related quality of life (HRQoL). Such information is essential for health policymakers to understand the magnitude of the HZ burden and determine which age groups should be prioritized for vaccination against HZ. Miyun District in Beijing has minimal population mobility, with more than 0.41 million registered residents, nearly 86 percent of the population. In order to complete the follow-up, we conducted the cohort study in Miyun District to estimate the QALYs lost among patients with HZ and PHN.

Methods

Cases registry of patients with HZ

This was a prospective observational cohort study of outpatients with HZ in the general hospital of Miyun District, Beijing, China, a secondary care hospital that serves 47.7 % of the population in Miyun district [19]. Through this hospital we could recruit about 50 % of the patients with HZ.

An HZ case was defined as: 1) a diagnosis of HZ made by a clinician with an International Classification of Diseases, Tenth Revision (ICD-10) diagnosis code for HZ (ICD-10 codes B02 and all subcategories) or with a character string of “herpes zoster” in Chinese, 2) patients visiting the hospital because of HZ for the first time, and 3) agreeing to be followed for 1 year after HZ rash onset. We excluded patients with one of the following conditions: 1) recurrent visits to the hospital, 2) not residing in Miyun District, and 3) refusal to participate.

Between January 1, 2017 and December 31, 2018, we created a registry of patients with HZ who met the above case definition in the outpatient departments of the whole hospital. To ensure the accuracy and completeness of diagnosed HZ cases in the registry, we established a program within the hospital outpatient system. If a doctor diagnosed a patient using an ICD code of HZ or input a diagnosis name containing the key word “shingles,” a prompt would pop up at the workstation to remind the clinician to ask the patient if they were willing to be included in the registry. After obtaining verbal informed consent, patients were given a diary card to record times when the pain occurred, when the pain disappeared, and other necessary information for the investigation. We abstracted each patient’s demographic characteristics (e.g., name, age, and sex), clinical information (e.g., date of pain/rash onset) and telephone number from the medical charts using a standardized case reporting form (CRF). A patient with HZ was defined as having PHN if pain persisted for ≥ 90 days after rash onset during the follow-up visits.

Data collection and EQ-5D instrument

Follow-up visits were conducted via telephone among registered patients with HZ on days 21, 90, 180 and 365 after rash onset. Trained interviewers verified the respondents’ basic information as recorded in the CRF (e.g. name, age, sex, and date of illness onset), and asked them to provide all critical clinical information (i.e., the affected site, pain score, and date of pain resolution). All study participants were followed up to the resolution of pain. If pain was still present on day 365 after rash onset, the patient was censored. Each patient was called up to three times on different days before being classified as lost to follow-up.

We selected the first 50 enrolled patients with HZ from each age groups (≤ 14 , 15–29, 30–39, 40–49, 50–59, 60–69, 70–79, and ≥ 80 years) and asked them to complete the EuroQoL five dimensions questionnaire (EQ-5D) during the telephone follow-up on day 21 after rash onset. All patients with PHN were asked to complete the EQ-5D survey at each visits.

The EQ-5D is a widely used generic instrument for measuring HRQoL, which includes two parts: a visual analogue scale (VAS) and a descriptive portion. The VAS is used to assess the health status on a scale between 0 (the worst imaginable health state) and 100 (the best imaginable health state). The descriptive system defines health in five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression; each dimension has three categories: no problems, some problems and extreme problems. We used the EQ-5D telephone interview version in simplified Chinese for patients who could be reached by telephone [20].

Data analysis

Considering that the secondary care hospital in Miyun District serves 47.7 % of the district population, we calculated the estimated incidence of HZ or PHN as the number of HZ/PHN cases in the registry during 2017–2018 divided by ($2 \times 0.477 \times$ population in Miyun District). The population in Miyun was 0.48 million in 2017, according to the Demographic Data Statistics Yearbook 2017.

Responses in the EQ-5D descriptive system were converted into a health utility score (HUS) using China-specific tariffs fitted to time trade-offs for respondents [21], with 0 representing death and 1 representing full health. QALYs were measured as $1 - \text{HUS} \times \text{duration of pain}/365$. The duration of pain was calculated as (date of pain disappearance - date of pain onset); for patients who still had pain at day 365, the duration of pain was arbitrarily assigned a duration of 365 days.

We used chi-square or Fisher’s exact tests for categorical variables, and Mann-Whitney U tests or Kruskal-Wallis tests for continuous variables. Cochran–Armitage trend tests were used to evaluate trends across age groups. A two-sided P-value of < 0.05 was considered statistically significant. The weighted HRQoL was calculated for HZ according to the age distribution of all registered cases. Data analysis was performed using IBM SPSS version 19.0 (IBM Corp., Armonk, NY, USA).

Results

Characteristics of enrolled patients

In total, 2314 HZ cases were registered. A total of 2008 patients were eligible for enrollment and were followed up for a median of 22 days (interquartile range [IQR] = 20–90), resulting in an estimated HZ incidence of 4.39 per 1000 person-years. During follow-up, 122 (6.08 %) PHN cases were identified, resulting in an estimated PHN incidence of 0.27 per 1000 person-years. The median duration of pain was 15 days (IQR = 9–25) for HZ and 170 days (IQR = 144–355.5) for PHN. A total of 34 HZ cases were admitted to hospital for treatment, among which three had PHN. There was no difference in the sex distribution between PHN (female, $n = 65$, 53.28 %) and HZ (female, $n = 1059$, 52.74 %, $P = 0.91$). However, the median age of patients with PHN (65 years, IQR = 55–71)

was older than that of patients with HZ (54 years, IQR = 43–64, $p < 0.001$). The proportion of patients with PHN aged ≥ 50 years ($n = 108$, 88.52 %) was higher than that of patients with HZ ($n = 1288$, 64.14 %, $P < 0.001$) (Table 1).

In the first telephone follow-up on day 21, a total of 319 patients with HZ were successfully interviewed using the EQ-5D. During the 1-year follow-up, 27 (22.13 %) patients with PHN were lost to follow-up. Among 95 patients with PHN included in the final analysis, 71 (74.74 %) were followed to the resolution of pain, and 24 (25.26 %) were censored at day 365 (Fig. 1).

EQ-5D dimension results in patients with HZ and PHN

A total of 319 patients with HZ were interviewed using the EQ-5D on day 21 after rash onset. The proportion of patients with HZ who reported problems increased with increased age (p value all < 0.05). From participants aged ≤ 14 years to those aged ≥ 80 years, the proportion with reported problems related to mobility increased from 0 % to 61.54 %; these proportions were 0 % to 50 % for self-care, 0 % to 53.85 % for usual activity; 20 % to 57.69 % for pain/discomfort; and 0 % to 34.62 % for anxiety/depression. 23 patients with PHN among the 319 patients with HZ were interviewed using the EQ-5D on day 21 after rash onset. The proportions with reported problems of 23 patients with PHN aged ≥ 50 years were higher than that of 319 patients with HZ (Fig. 2). For 95 patients with PHN interviewed on day 90 after rash onset, problems with pain/discomfort (73, 78.49 %) and anxiety/depression (38, 40.86 %) were the most commonly reported, followed by mobility problems ($n = 21$, 22.58 %), self-care problems ($n = 7$, 7.53 %), and problems with usual activities ($n = 22$, 23.66 %). Only problems with mobility showed significant differences among age groups ($P < 0.02$). For 45 patients with PHN on day 180 after rash onset and 24 patients with PHN on day 365 after rash onset, the proportions of reported problems in each dimension did not change appreciably according to age groups ($P > 0.05$) (Fig. 2).

HRQoL of HZ and PHN patients

For 319 patients with HZ, the weighted mean VAS was 83.25 (standard deviation[SD] 11.61), and the mean HUS was 0.86 (SD 0.18); both these scores decreased with older age among patients aged ≥ 50 years old ($P < 0.001$) (Table 2). Compared with patients with HZ, the HRQoL values of patients with PHN were lower (mean VAS 69.8, SD 16.42; mean HUS 0.69, SD 0.25) at day 21, and increased after 90 days

(Fig. 3). The QALYs lost for patients with HZ and PHN are shown in Table 3. After weighting for age, the QALY loss per HZ case was estimated at 0.02, which increased from age 50–59 years to ≥ 80 years ($P < 0.001$). The QALY loss of patients with PHN was 6.5 times (per case 0.13 years) than that for patients with HZ. There were no significant differences in VAS, HUS or QALY loss among patients with PHN by age group ($P > 0.05$).

Discussion

We conducted a prospective follow-up study of HZ in a well-defined cohort of individuals in Miyun District, Beijing. We found a substantial burden of HZ and PHN, especially among participants aged 50 years and over. The estimated incidence of HZ was 4.39 per 1000 person-years, with people aged ≥ 50 years having the highest incidence (6.4–10.6 cases per 1000 person-years). For patients older than 50 years, the mean QALY loss during the episode was 0.01–0.04 years for patient with HZ and 0.11–0.23 years for patient with PHN, which was worse than the mean QALY loss for patients aged < 50 years old (0.003–0.02 and 0.08, respectively). Compared with other acute infectious diseases of national importance, the estimated QALY loss related to HZ and PHN per case was 0.02 years and 0.13 years, respectively. These are worse than the impact on HRQoL of influenza (QALY loss of 0.005–0.02 per year [22]) and varicella (QALY loss 0.004–0.005 per year [23]). Although the duration of HZ and PHN symptoms (15 days for HZ cases, 170 days for PHN cases) is much shorter than those of chronic diseases in older populations, the HUS of patients with HZ during an acute episode (≥ 60 years old: 0.68–0.84) is worse than that of older patients with diabetes (≥ 60 years old: 0.865) or other common diseases (hypertension: 0.88, coronary heart disease: 0.87, and stroke: 0.90)[24]. The HUS of patients with PHN (0.75–0.81) is similar to that of chronic obstructive pulmonary disease (0.71) [25] and active chronic hepatitis B (0.773)[26].

A World Health Organization position paper states that countries with an aging population and demographic shift toward older ages, who bear an important burden of HZ and consider the vaccination beneficial, might choose to introduce routine HZ vaccination [27]. A number of studies among patients with HZ have been conducted in Canada, Israel, Japan, Taiwan, the United States, and countries in Europe. These studies report an incidence of HZ in the total population ranging from 2.0 to 5.0 per 1000 person-years and an increase with older age, with a marked increase after 50 years of age [27,28]. Because 306 cases lost at the time of the first survey, we used 2008 confirmed patients with HZ to estimate the incidence of HZ in Miyun District (4.39 per 1000 person-

Table 1
Characteristics of included patients with herpes zoster (HZ) and post-herpetic neuralgia (PHN) in the cases registry of Miyun District, Beijing, China.

Characteristics	HZ Patients			p-value	PHN per episode zoster (%)	Estimated incidence of HZ (per 1000PY)	Estimated incidence of PHN (per 1000PY)
	Total no. (%)	Non-PHN patients, no. (%)	PHN patients, no. (%)				
Total	2008	1886	122		6.08	4.39	0.27
Sex							
male	949(47.26)	892(47.30)	57(46.72)	0.90	6.01	4.08	0.24
female	1059 (52.74)	994(52.70)	65(53.28)		6.14	4.72	0.29
Age group, years							
0–14	9(0.45)	9(0.48)	0(0)	<0.001	0	0.14	0.00
15–29	146(7.27)	143(7.58)	3(2.46)		2.05	1.61	0.03
30–39	276(13.75)	274(14.53)	2(1.64)		0.72	5.29	0.04
40–49	289(14.39)	280(14.85)	9(7.38)		3.11	3.33	0.10
50–59	537(26.74)	507(26.88)	30(24.59)		5.59	6.40	0.36
60–69	433(21.56)	396(21.00)	37(30.33)		8.55	10.58	0.90
70–79	220(10.96)	183(9.70)	37(30.33)		16.82	7.83	1.32
≥ 80	98(4.88)	94(4.98)	4(3.28)		4.08	8.38	0.34
Inpatient							
Yes	34(1.69)	31(1.64)	3(2.46)	0.75	8.82	–	–
No	1974 (98.31)	1855(98.36)	119(97.54)		6.03	–	–

Estimated incidence of HZ /PHN= (HZ/PHN cases registry during 2017–2018)/ (2*47.7%*population in Miyun district (0.48 million in 2017).

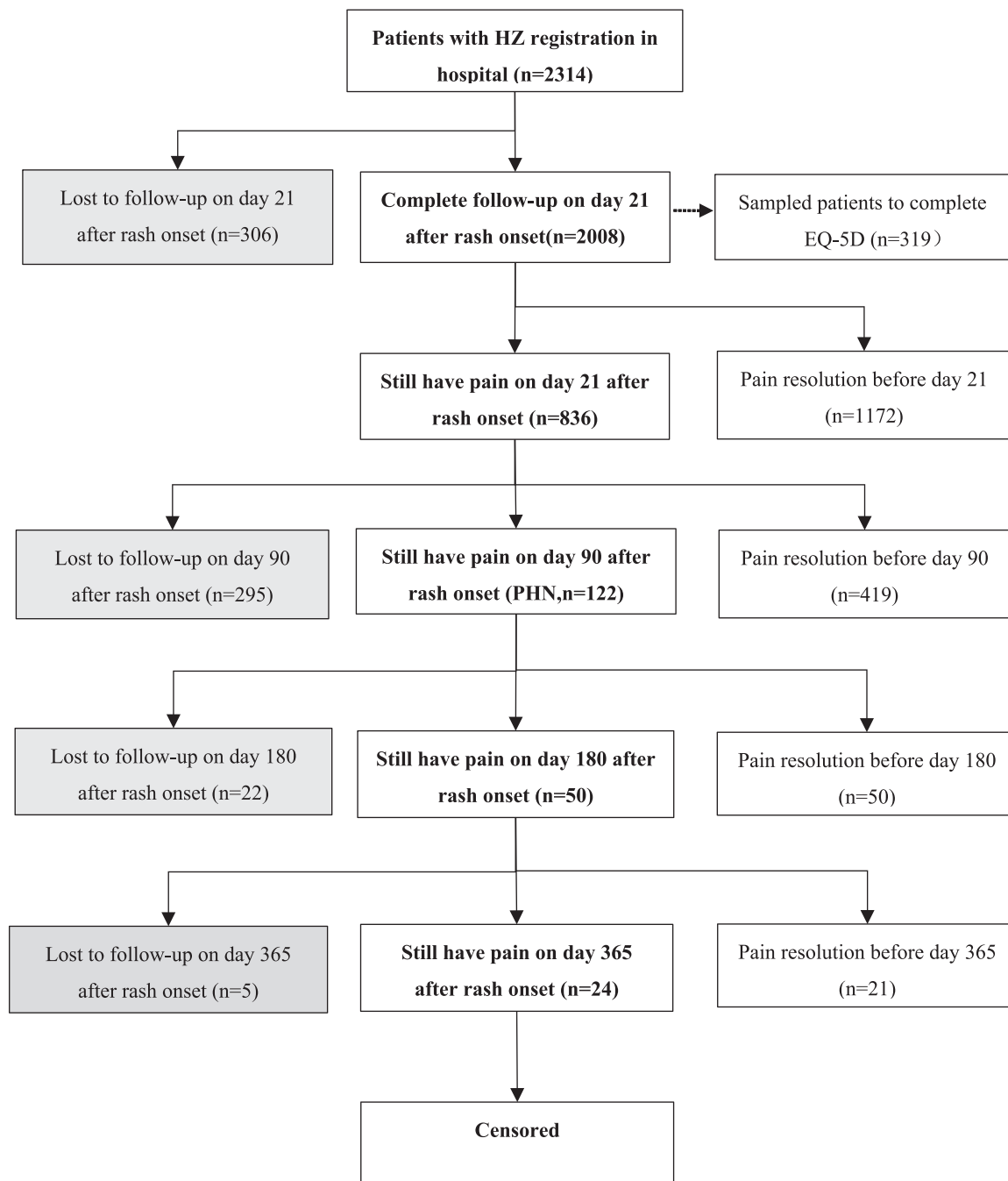


Fig. 1. Study design and flow chart.

years) conservatively, even there was a risk of underestimated. The incidence which increased with age was similar to the findings of those previous studies. The incidence of PHN was estimated at 0.27 per 1000 person-years in Miyun District. The risk of PHN among patients with HZ patients in our study (6.08 %) was higher than that in a retrospective survey in Beijing city (4.6 % [14]), but lower than that in studies from other countries that used the same definitions [28,29]. For HRQoL, in research data and integrated studies in North America and European [29], that mostly used estimates from the EQ-5D, the average QALY loss in patients with HZ (including PHN) aged ≥ 50 years varied widely from 0.017 to 0.22 years. The QALY loss in each age group estimated in our analysis was lower than those in the above studies. The reasons for this may be that the pain duration and proportion of PHN in patients with HZ patients (7–9 months, 4.08 %–16.82 %, respectively) were lower than

those of the above studies (8 months–3 years, 3 %–52 %, respectively). Also, the presence of PHN was associated with a greater impact on most domains of QoL [29–31]. However, the QALY loss in patients with HZ in Miyun District (0.02) was worse than that reported in a Hong Kong study (0.00529) [32]. Based on the predicted 2.77 million cases of HZ and 127,420 cases of PHN per year in China [14], the QALY loss in China is 71,965 per year in our estimation, which represents had a substantial impact on HRQoL and a greater health burden than that in United States (67,000 QALYs lost per year) [33].

The impact on HRQoL of HZ-associated physical and mental pain is increased in older age groups among patients with HZ. The incidence rate of HZ and PHN exhibits a steep rise after 50 years of age, with older adults more seriously affected. With increased life expectancy, China has the largest elderly population in the world and this population continues

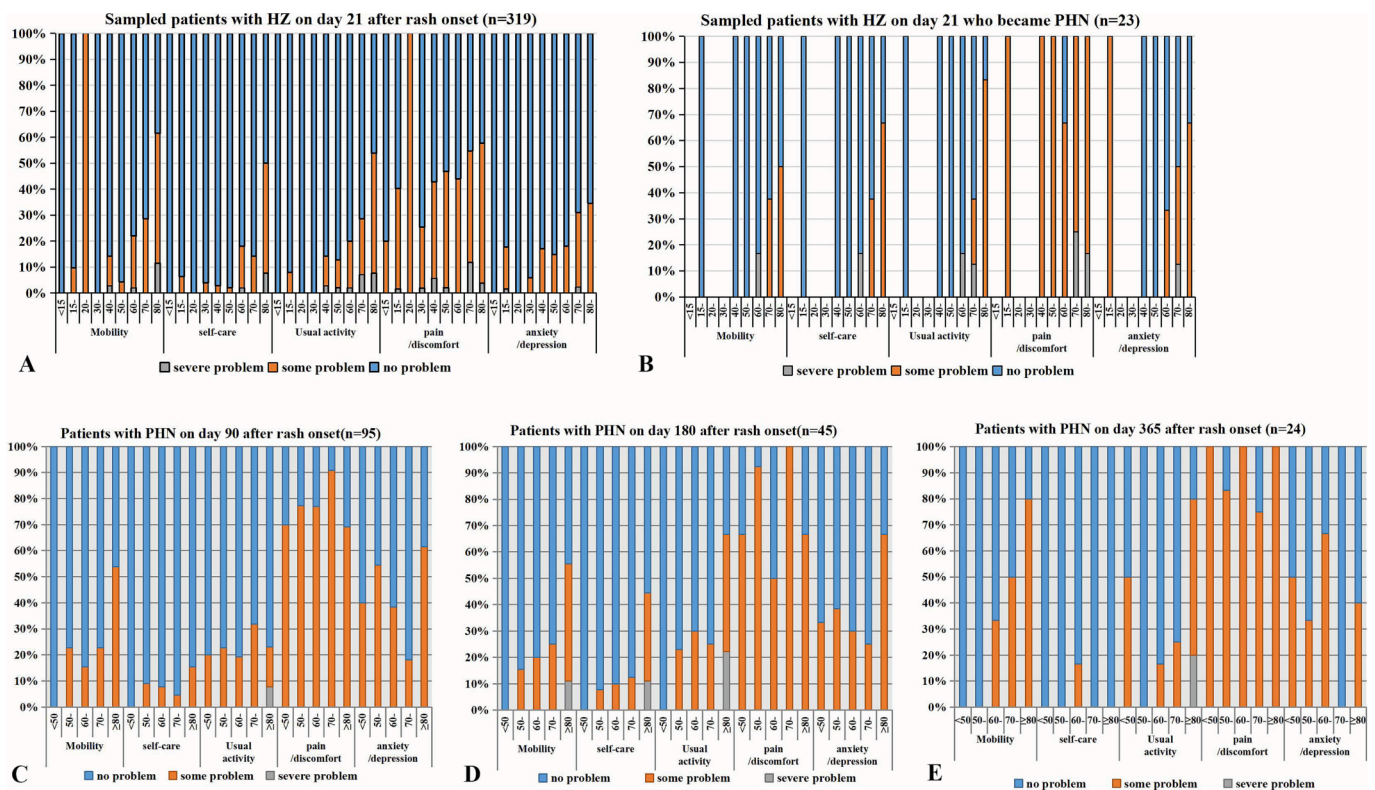


Fig. 2. Ratings of EuroQoL five dimensions (EQ-5D) by survey dimension for patients with herpes zoster (HZ) (n = 319) and post-herpetic neuralgia (PHN) in the follow-up study.

to age rapidly [34]. The burden associated with HZ can be expected to increase gradually over time. In our investigation using the EQ-5D, problems reported by patients with PHN showed no significant differences among age groups, except for problems with mobility, however, this may be related to the physical decline with aging. Our findings indicates that PHN has a similar serious impact on HRQoL at different ages, and the reported proportion and QALY loss in each dimension with PHN were higher than those with HZ, indicating a much greater impact of PHN than that of HZ. PHN can also affect the physical and mental QoL of younger working populations who must returned to work while still experiencing substantial pain and other symptoms [35]. Among patients aged 0–14 years, no problems were reported in the four dimensions except for pain/discomfort, which may be related to the small number of patients (n = 5) and short duration of disease (13.20 days). Although the incidence in this age group was much lower than in elderly people, considering the hypothesis that varicella vaccination may influence the incidence of HZ, cases in younger age groups may be a future concern.

This study has three limitations. First, using the EQ-5D questionnaire, we asked respondents to evaluate their HRQoL “today” at each investigation. At the time of the survey, some patients may have recovered since rash onset whereas other patients had longer episodes but achieved remission; in such cases, HRQoL would be underestimated. In the 1.20% (24/2008) of patients with PHN who had a disease course of more than 1 year, QALY-losses would also be underestimated. Second, there are no datasets of HRQoL measures in the general population of China; therefore, we could not determine the background health utility before HZ onset in this study. Third, in this cohort study, outpatients with HZ were recruited in one hospital that serves 47.7% of the population in Miyun District; thus, there is a risk of bias in the recruited case representation.

This prospective observational follow-up study measured the impact on HRQoL changes during the episode, the HUS Value in different investigation during the long episode of HZ and PHN could help to

obtained relatively accurate QALY loss values. The estimated proportion of PHN cases was more similar to the real situation than that of cross-sectional surveys. Our results regarding how HRQoL is affected by HZ-associated pain, combined with epidemiological data, highlight the need for further measures to reduce the burden of HZ-associated disease, particularly in older age groups. These data also will be helpful in health economic evaluations of HZ- or PHN-related interventions, such as vaccination. Improving the understanding of this disease in China would enable long-term planning for the anticipated health needs of the growing older population.

In summary, HZ and PHN cause a substantial HRQoL burden, especially in adults aged 50 years or more in Miyun, Beijing, China. Vaccination should be considered to alleviate the burden of this painful diseases.

Ethics approval and consent to participate

This study was reviewed and approved by the Human Research Ethics Committee of the Beijing Center for Disease Prevention and Control (Beijing, China).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Dan Zhao: Conceptualization, Formal analysis, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. **Luodan Suo:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. **Li Lu:** Conceptualization, Methodology, Project administration, Supervision, Validation, Writing – review & editing. **Jingbin Pan:** Conceptualization,

Table 2

Health-related quality of life in patients with herpes zoster (HZ) and post-herpetic neuralgia (PHN) in the cases investigation, Miyun district, Beijing, China.

Age group	N(%)	Pain duration, days			Health utility score (HUS)			Visual analogue scale (VAS)		
		Mean(SD)	P50(P25-P75)	P	Mean(SD)	P50(P25-P75)	P	Mean(SD)	P50(P25-P75)	P
HZ ^{a, #}	319	34.4(52.15)	17(11–35)		0.86 (0.18)	0.96 (0.80–0.96)		83.25 (11.61)	85(80–93)	
0–14	5(1.57)	13.20(2.95)	15(10–15.5)	<0.001	0.90 (0.05)	0.87 (0.86–0.96)	<0.001	93.40(6.15)	90(88.5–100)	0.01
15–29	63 (19.75)	16.79(23.17)	12(8–17)		0.88 (0.12)	0.96 (0.87–0.96)		87.18 (11.36)	90(80–95)	
30–39	51 (15.99)	15.41(10.96)	14(9–18)		0.93 (0.07)	0.96 (0.87–0.96)		85.78 (13.24)	90(80–95)	
40–49	35 (10.97)	33.51(60.20)	17(13–40)		0.86 (0.17)	0.96 (0.86–0.96)		83.80 (12.79)	85(80–95)	
50–59	47 (14.73)	28.51(29.60)	18(12–38)		0.88 (0.10)	0.96 (0.80–0.96)		84.68 (12.13)	85(80–93)	
60–69	50 (15.67)	53.52(69.99)	29(16–58.75)		0.84 (0.18)	0.88 (0.78–0.96)		81.00 (16.21)	85(70–95)	
70–79	42 (13.17)	59.52(76.93)	23(13.75–83.25)		0.79 (0.22)	0.87 (0.67–0.96)		79.52 (14.46)	80(75–90)	
≥80	26(8.15)	52.89(57.89)	24(13.75–74.75)		0.68 (0.22)	0.68 (0.60–0.87)		78.27 (16.12)	80(70–90)	
PHN ^b	95	227.04(103.31)	170(144–365)		0.80 (0.12)	0.80 (0.76–0.87)		75.74 (12.92)	80(70–85)	
<50	10 (10.53)	182.30 (100.768)	138(113.25–242.75)	0.257	0.85 (0.09)	0.83 (0.78–0.96)	0.41	72.50 (13.99)	70(60–82.5)	0.93
50–59	22 (23.16)	255.55(101.33)	290.5(144.75–365)		0.79 (0.13)	0.78 (0.75–0.87)		76.10 (12.23)	77(70–85)	
60–69	28 (29.47)	215.32(106.27)	167(129.75–350.25)		0.80 (0.14)	0.87 (0.73–0.87)		75.46 (13.36)	80(60–85)	
70–79	32 (33.68)	213.32(92.487)	159.5 (147.5–303.25)		0.81 (0.08)	0.83 (0.78–0.87)		76.96 (14.23)	80(70–85.75)	
≥80	3(3.16)	261.69 (111.908)	276(142.5–365)		0.75 (0.16)	0.76 (0.65–0.87)		76.15 (11.39)	75(67.5–85)	

SD: standard deviation

#: Description for HUS and VAS on day 21 After HZ rash onset.

^a: HUS and VAS were adjusted for age.

^b: Description for HUS and VAS on day 90 After HZ rash onset.

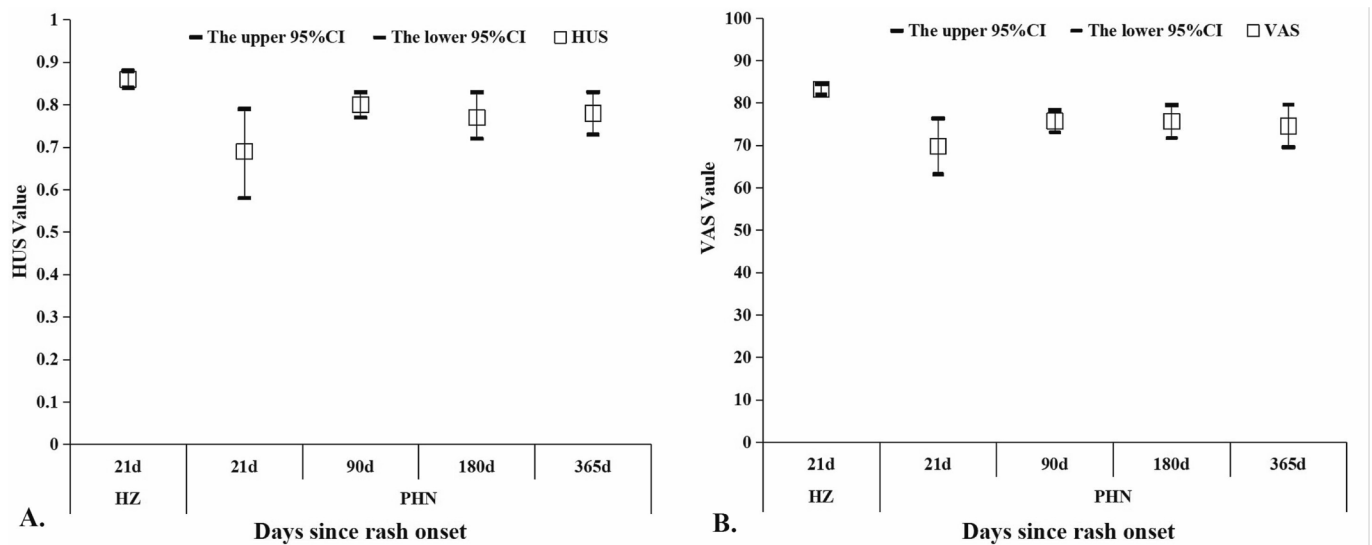


Fig. 3. Health utility score (HUS) and visual analogue scale(VAS) for patients with herpes zoster (HZ) on day 21 and those with post-herpetic neuralgia (PHN) on days 21, 90, 180, and 365 after rash onset.

Methodology. **Xinghui Peng:** Data curation, Investigation, Project administration. **Yanfei Wang:** Data curation, Investigation, Project administration. **Xinghuo Pang:** Conceptualization, Resources, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 3

Quality-adjusted life years (QALYs) lost in patients with herpes zoster (HZ) and post-herpetic neuralgia (PHN).

	QALY loss per case			Estimated disease burden per year in Miyun district, Beijing, China	
	Mean (SD)	P50 (P25-P75)	P	No. of Patients*	QALY loss
HZ[#]		0.02(0.04)	0.004(0.001–0.01)	2100	42
Age group					
	0–14	0.003(0.002)	0.003(0.002–0.03)	9	0.03
	15–29	0.006(0.01)	0.002(0.001–0.006)	153	0.92
	30–39	0.004(0.005)	0.002(0.001–0.003)	289	1.16
	40–49	0.02(0.04)	0.002(0.001–0.02)	302	6.04
	50–59	0.01(0.02)	0.004(0.001–0.01)	562	5.62
	60–69	0.03(0.07)	0.008(0.002–0.03)	453	13.59
	70–79	0.04(0.05)	0.007(0.002–0.07)	230	9.20
	≥80	0.04(0.05)	0.02(0.01–0.06)	102	4.08
PHN		0.13(0.12)	0.10(0.05–0.17)	127	16.51
Age group					
	<50	0.08(0.07)	0.07(0.02–0.11)	14	1.12
	50–59	0.13(0.10)	0.12(0.08–0.16)	31	4.03
	60–69	0.11(0.11)	0.06(0.04–0.17)	39	4.29
	70–79	0.11(0.08)	0.09(0.06–0.13)	39	4.29
	≥80	0.23(0.18)	0.21(0.05–0.35)	4	0.92

[#]QALY loss were adjusted for age. *No. of Patients were calculated as the estimated incidence of HZ × population in Miyun District.

Data availability

Data will be made available on request.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jvacx.2023.100415>.

References

- [1] Cohen JI. Herpes zoster. *N Engl J Med* 2013;369(3):255–63.
- [2] Yawn BP, Saddier P, Wollan PC, St Sauver JL, Kurland MJ, Sy LS. A population-based study of the incidence and complication rates of herpes zoster before zoster vaccine introduction. *Mayo Clin Proc* 2007;82(11):1341–9.
- [3] Hope-Simpson RE. The nature of herpes zoster: a long-term study and a new hypothesis. *Proc R Soc Med* 1965;58(1):9–20.
- [4] Schmader K, Gnann Jr JW, Watson CP. The epidemiological, clinical, and pathological rationale for the herpes zoster vaccine. *J Infect Dis* 2008 Mar;1(197 Suppl 2):S207–15.
- [5] Harpaz R, Ortega-Sanchez IR, Seward JF, Advisory Committee on Immunization Practices(ACIP) Centers for Disease Control and Prevention(CDC). Prevention of herpes zoster: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep*. 2008, 57(RR-5):1–30.
- [6] Kawai K, Gebremeskel BG, Acosta CJ. Systematic review of incidence and complications of herpes zoster: towards a global perspective. *BMJ Open* 2014 Jun 10;4(6):e004833.
- [7] Katz J, Melzack R. The McGill pain questionnaire: development, psychometric properties, and usefulness of the long-form, short-form, and short-form-2. In: Turk DC, Melzack R, editors. *Handbook of pain. assessment*. 3rd ed. New York: Guilford Press; 2011.
- [8] Katz J, Cooper EM, Walthers RR, Sweeney EW, Dworkin RH. Acute pain in herpes zoster and its impact on health-related quality of life. *Clin Infect Dis* 2004;39(3):342–8.
- [9] Oxman MN, Levin MJ, Johnson GR, Schmader KE, Straus SE, Gelb LD, et al. A vaccine to prevent herpes zoster and postherpetic neuralgia in older adults. *N Engl J Med* 2005 Jun 2;352(22):2271–84.
- [10] Dooling KL, Guo A, Patel M, Lee GM, Moore K, Belongia EA, et al. Recommendations of the Advisory Committee on Immunization Practices for Use of Herpes Zoster Vaccines. *MMWR Morb Mortal Wkly Rep* 2018 Jan 26;67(3):103–8.
- [11] Choo PW, Donahue JG, Manson JE, Platt R. The epidemiology of varicella and its complications. *J Infect Dis* 1995 Sep;172(3):706–12.
- [12] Donahue JG, Choo PW, Manson JE, Platt R. The incidence of herpes zoster. *Arch Intern Med* 1995 Aug;7–21;155(15):1605–9.
- [13] Insinga RP, Itzler RF, Pellissier JM, Saddier P, Nikas AA. The incidence of herpes zoster in a United States administrative database. *J Gen Intern Med* 2005 Aug;20(8):748–53.
- [14] Lu L, Suo L, Li J, Pang X. A retrospective survey on herpes zoster disease burden and characteristics in Beijing. *China Human vaccines & immunotherapeutics* 2018;14(11):2632–5.
- [15] Luo Y, Su B, Zheng X. Trends and Challenges for Population and Health During Population Aging - China, 2015–2050. *China CDC Wkly* 2021 Jul 9;3(28):593–8.
- [16] Yang F, Yu S, Fan B, Liu Y, Chen YX, Kudel I, et al. The Epidemiology of Herpes Zoster and Postherpetic Neuralgia in China: Results from a Cross-Sectional Study. *Pain Ther* 2019;8(2):249–59.
- [17] Li Y, An Z, Yin D, Liu Y, Huang Z, Xu J, et al. Disease Burden Due to Herpes Zoster among Population Aged ≥50 Years Old in China: A Community Based Retrospective Survey. *PLoS One* 2016;11(4):e0152660.
- [18] Zhu Q, Zheng H, Qu H, Deng H, Zhang J, Ma W, et al. Epidemiology of herpes zoster among adults aged 50 and above in Guangdong. *China Hum Vaccin Immunother* 2015;11(8):2113–8.
- [19] Suo L, Zhao D, Pan J, Wang YC, Wang Q, Wang HH, et al. Analysis of herpes zoster incidence and hospitalization in three areas of Beijing in 2015 based on health information system of medical institutions. *Chin J Prev Med* 2019;53(5):503–7. in Chinese.
- [20] EuroQol Group. EQ-5D Products. Available: <https://euroqol.org/>. Accessed 20 Mar 2020.
- [21] Liu GG, Wu H, Li M, Gao C, Luo N. Chinese time trade-off values for EQ-5D health states. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2014;17(5):597–604.
- [22] Yang J, Jit M, Zheng Y, Feng L, Liu X, Wu JT, et al. The impact of influenza on the health related quality of life in China: an EQ-5D survey. *BMC Infect Dis* 2017;17(1):686.
- [23] Brisson M, Edmunds WJ. Varicella vaccination in England and Wales: cost-utility analysis. *Arch Dis Child* 2003;88(10):862–9.
- [24] Pan CW, Sun HP, Zhou HJ, Ma Q, Xu Y, Luo N, et al. Valuing Health-Related Quality of Life in Type 2 Diabetes Patients in China. *Medical decision making : an international journal of the Society for Medical Decision Making* 2016;36(2):234–41.
- [25] Zhou T, Guan H, Yao J, Xiong X, Ma A. The quality of life in Chinese population with chronic non-communicable diseases according to EQ-5D-3L: a systematic review. *Qual Life Res Int J Qual Life Asp Treat Care Rehab* 2018;27(11):2799–814.
- [26] Jia YX, Cui FQ, Li L, Zhang DL, Zhang GM, Wang FZ, et al. Comparison between the EQ-5D-5L and the EQ-5D-3L in patients with hepatitis B. *Qual Life Res* 2014 Oct;23(8):2355–63.
- [27] World Health Organization. *Varicella and herpes zoster vaccines: WHO position paper, June 2014*.
- [28] Pinchinat S, Cebrián-Cuenca AM, Bricout H, Johnson RW. Similar herpes zoster incidence across Europe: results from a systematic literature review. *BMC Infect Dis* 2013;13:170.
- [29] Kawai K, Preaud E, Baron-Papillon F, Largeron N, Acosta CJ. Cost-effectiveness of vaccination against herpes zoster and postherpetic neuralgia: a critical review. *Vaccine* 2014;32(15):1645–53.
- [30] Lukas K, Edte A, Bertrand I. The impact of herpes zoster and post-herpetic neuralgia on quality of life: patient-reported outcomes in six European countries. *Z Gesundh Wiss* 2012 Aug;20(4):441–51.
- [31] Weinke T, Edte A, Schmitt S, Lukas K. Impact of herpes zoster and post-herpetic neuralgia on patients' quality of life: a patient-reported outcomes survey. *Z Gesundh Wiss* 2010 Aug;18(4):367–74.
- [32] You JHS, Ming WK, Lee CF, Tsang OT, Chan PK. Potential cost-effectiveness of adjuvanted herpes zoster subunit vaccine for older adults in Hong Kong. *Vaccine* 2018 Jul 25;36(31):4610–20.
- [33] Harvey M, Prosser LA, Rose AM, Ortega-Sanchez IR, Harpaz R. Aggregate health and economic burden of herpes zoster in the United States: illustrative example of a pain condition. *Pain* 2020;161(2):361–8.
- [34] Wu L, Huang Z, Pan Z. The spatiality and driving forces of population ageing in China. *PLoS One* 2021 Jan 11;16(1):e0243559.
- [35] Johnson KD, Brennenman SK, Newransky C, Sheffler-Collins S, Becker LK, Belland A, et al. A cross-sectional survey of work and income loss consideration among patients with herpes zoster when completing a quality of life questionnaire. *BMC Health Serv Res* 2018;18(1):662.