Introduction

As the population ages, the impact of asthma in the elderly is expected to be enhanced over the forthcoming decades. We investigated the prevalence of asthma and its socioeconomic factors in the elderly, Shiraz, Iran.

Methods

In this population-based study, 1527 subjects older than 60 years were selected based on the stratified random sampling method. The data on asthma symptoms, current asthma, physician diagnose asthma, and allergic rhinitis were collected using the translated ECRHS (European Community Respiratory Health Survey) questionnaire. Information on individual socioeconomic status was derived from the participants' self-reported educational level and their occupation, income, and residence. A p-value of less than 0.05 was considered to be statistically significant.

Results

The prevalence of asthma, current asthma, physician diagnose asthma, and allergic rhinitis was found to be 8.97, 6.81, 4.78 and, 23.51%, respectively. The most common asthma symptoms were nocturnal chest tightness (15.52%, n = 237/1,527). In univariate analysis, the prevalence of asthma was higher in illiterate patients (12.7%), subjects with the lowest income level (10.6%), and patients living in urban areas (24.1%). Having age more than 80 (OR = 2.01; 95% CI = 1.10-3.65), being a current smoker (OR = 2.76; 95% CI = 1.69-4.51) and living in a suburban area (OR = 3.01; 95% CI = 1.20-7.50) were significant predictive factors for asthma in the regression model.

Conclusions

Asthma and allergic rhinitis in the elderly should be more focus in the southwest of Iran. Moreover, our findings highlighted the effect of socio-economic status, disparities and inequality on community health.

Keywords

Asthma • Elderly • Prevalence • Socioeconomic factors
Asthma was defined as a positive answer to all three following questions in the preceding 12 months: 1) Have you had wheezing or whistling in your chest?; 2) Have you been breathless at all when the wheezing noise was present?; and 3) Have you had this wheezing or whistling when you did not have a cold? Current asthma was defined as a positive answer to each of the following questions: 1) Have you had an attack of asthma in the last 12 months?; or 2) Are you currently taking any medicine (including inhalers, aerosols or tablets) for asthma? [16].

A feeling of tightness, by an attack of shortness of breath and an attack of coughing in one’s chest at any time in the last 12 months were considered as respiratory symptoms. Information on individual SES was collected from the participants’ self-reports on the level of education, occupation, income, and residence (urban or suburban). Educational levels were rated as bachelor’s degree or higher, high school graduate, middle school graduate, or less. The self-reported education level of the research subjects was combined into a single variable. This composite variable contained four categories of illiterate, primary, secondary/high school, and academic. Occupations were collected with an open-ended question and then categorized into four groups of non-manual, manual, jobless, and unspecified. Subjects who were unable to work, retired persons, and those with an unknown job were classified as having an unspecified occupation. The income earned was the total income received by households for one year. The classification was based on the average income of all households in Iran [14]. Income was divided into four categories ranging from less than $3,500 to more than $7,000 per year.

Statistical analysis
Data were entered into the Statistical Package for the Social Sciences software version 15.0 (SPSS Inc., Chicago, IL, USA) by a trained operator and double-checked by an investigator. In addition to descriptive statistics, chi-square test was used to find the associations between asthma and socioeconomic factors and group differences. To derive predictive socioeconomic factors, we entered all variables of interest with a p-value less than 0.05 in univariate analysis into the multiple logistic regression models to estimate the adjusted odds ratios and 95% confidence intervals (CI). A p-value less than 0.05 was considered to be statistically significant.

Results
In this population-based study, a total of 1,527 subjects aged older than 60 years completed the study. Forty-seven out of 1,574 (2.9%) potential participants were not willing to complete the interview process and were considered as a non-respondent in this study. Frequency analysis of their demographic characteristics did not show a substantial difference from respondents. The mean age of the participants was 69.32 ± 6.70 years. Considering the total respondents, 53.8% were male, 79.1% lived with family, and 11.9% were current smokers. In socioeconomic variables, 42.4% had a primary school education, 44.7% had a manual job, 71.8% earned ≤ $3,500 per year, and 98.1% lived in an urban area (Tab. I).

Prevalence
The prevalence of asthma, asthma symptoms, current asthma, physician diagnose asthma, and allergic rhinitis in total population are summarize in Table II. Accordingly, the prevalence of asthma was found to be 8.97% (137/1,527), (95% CI = 7.59-10.52%). The most common asthma symptoms were nocturnal chest tightness (15.52%, n = 237), nocturnal cough (10.22%, n = 156), and nocturnal dyspnea (9.76%, n = 149). The prevalence of current asthma, physician diagnose asthma and allergic rhinitis was 6.81% (95% CI = 5.60-8.19%), 4.78% (95% CI = 3.77-5.97%), and 23.51% (95% CI = 21.40-25.72%), respectively.

Table I illustrates the prevalence of asthma by sociodemographic and socioeconomic variables. The prevalence of asthma among the subjects older than 80 years was significantly higher than the younger (61-80) participants (P = 0.005). We found no statistically significant association between the asthma prevalence and gender, BMI or living situation. The prevalence of asthma was 16, 8.6, 10.1, and 7.6% among current, ex-, passive, and non-smokers, respectively (p = 0.003). Among socioeconomic factors, the prevalence of asthma was higher in illiterate patients (12.7%), subjects with the lowest income level (10.6%), and patients living in urban areas (24.1%). All of these differences were statistically significant (P = 0.009, P = 0.008 and P = 0.004).

Predictive factors
An adjusted logistic regression model was used to identify the predictive factors for asthma (Tab. III). Being more than 80 years old (OR = 2.01; 95% CI = 1.10-3.65), being a current smoker (OR = 2.76; 95% CI = 1.69-4.51), and living in a suburban area (OR = 3.01; 95% CI = 1.20-7.50) were significant predictive factors for asthma in the regression model.
Discussion

The burden of asthma in the elderly has remained high globally. Although it is a multifactorial issue, identifying the epidemiological data of asthma in this age group and the related socio-economic factors is crucial to set future directions, especially in developing countries with rapid aging of population [3, 7-9]. The current study examined the prevalence of asthma in the elderly and related sociodemographic and socio-economic factors based on the 2015 SARDS.

The prevalence of asthma, current asthma, physician diagnosis asthma, and allergic rhinitis was 8.97, 6.81, 4.78, 23.51% in urban and suburban non-institutionalized elderly inhabitants of Shiraz, Iran. The prevalence of asthma in the elderly was higher significantly among the subjects older than 80 years, smokers, illiterate subjects, and individuals with the lowest annual income, and those who lived in suburban areas. In a multivariate logistic regression model, those with advanced age, current smokers, and those living in suburban areas were more likely to have asthma.

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### Tab. I. Asthma prevalence among the elderly by demographic and sociodemographic data, univariate analysis.

| Variables         | Asthma (n = 137) | Non-asthma (n = 1,390) | Total (n = 1,527) | P-value |
|-------------------|------------------|------------------------|-------------------|---------|
| Age groups        |                  |                        |                   |         |
| 61-70             | 88 (8.6%)        | 951 (91.4%)            | 1,019 (66.7%)     | 0.005   |
| 71-80             | 31 (7.6%)        | 576 (92.4%)            | 407 (26.7%)       |         |
| > 80              | 18 (17.8%)       | 85 (82.2%)             | 101 (6.6%)        |         |
| Gender            |                  |                        |                   |         |
| Male              | 82 (10.0%)       | 739 (90%)              | 821 (55.8%)       | 0.13    |
| Female            | 55 (7.8%)        | 651 (92.2%)            | 706 (46.2%)       |         |
| BMI               |                  |                        |                   |         |
| Under weight      | 7 (10.4%)        | 60 (89.6%)             | 67 (4.4%)         | 0.69    |
| Normal weight     | 57 (8.6%)        | 608 (91.4%)            | 665 (44.1%)       |         |
| Overweight        | 45 (8.7%)        | 472 (91.3%)            | 517 (34.3%)       |         |
| Obese             | 28 (10.9%)       | 230 (89.1%)            | 258 (17.1%)       |         |
| Living situation  |                  |                        |                   |         |
| Alone             | 27 (8.5%)        | 291 (91.5%)            | 318 (20.9%)       | 0.72    |
| With family       | 110 (9.1%)       | 1,095 (90.9%)          | 1,205 (79.1%)     |         |
| Smoking habits    |                  |                        |                   |         |
| Current smoker    | 29 (16%)         | 152 (84%)              | 181 (11.9%)       | 0.003   |
| Ex-smoker         | 9 (8.6%)         | 96 (91.4%)             | 105 (6.9%)        |         |
| Passive-smoker    | 18 (10.1%)       | 161 (89.9%)            | 179 (11.7%)       |         |
| Non-smoker        | 81 (7.6%)        | 981 (92.4%)            | 1,062 (69.5%)     |         |
| Occupation        |                  |                        |                   |         |
| Manual            | 63 (9.3%)        | 616 (90.7%)            | 679 (44.7%)       | 0.86    |
| Non-manual        | 11 (8.6%)        | 117 (91.4%)            | 128 (8.4%)        |         |
| Jobless           | 7 (11.3%)        | 55 (88.7%)             | 62 (4.1%)         |         |
| unspecified       | 55 (8.5%)        | 595 (91.5%)            | 650 (42.8%)       |         |
| Education level   |                  |                        |                   |         |
| illiterate        | 55 (12.7%)       | 378 (87.3%)            | 433 (28.4%)       | 0.009   |
| Primary           | 54 (8.4%)        | 592 (91.6%)            | 646 (42.4%)       |         |
| Secondary         | 16 (6.0%)        | 251 (94%)              | 267 (17.5%)       |         |
| Academic          | 12 (6.8%)        | 165 (93.2%)            | 177 (11.6%)       |         |
| Income (per year) |                  |                        |                   |         |
| Less than 3,500 $ | 116 (10.6%)      | 981 (89.4%)            | 1,097 (71.8%)     | 0.008   |
| 3500 to 4,750 $   | 17 (5.2%)        | 312 (94.8%)            | 329 (21.5%)       |         |
| 5250 to 7,000 $   | 3 (4.8%)         | 59 (95.2)              | 62 (4.1%)         |         |
| More than 7,000 $ | 1 (3.0%)         | 32 (97.0%)             | 33 (2.2%)         |         |
| Residency         |                  |                        |                   |         |
| Suburban          | 7 (24.1%)        | 22 (75.9%)             | 29 (1.9%)         | 0.004   |
| Urban             | 130 (8.7%)       | 1,357 (91.3%)          | 1,487 (98.1%)     |         |

BMI: body mass index.

### Tab. II. Prevalence of asthma, asthma symptoms and allergic rhinitis in the elderly based on ECRHS questionnaire.

| Parameters | Prevalence (95.0% Confidence Interval) |
|------------|----------------------------------------|
| Asthma (wheezing + dyspnea + absence of a cold) | 8.97% (137) 7.59% (137) 10.52% (137) |
| Asthma symptoms |                                       |
| Awake with chest tightness | 15.52% (237) 13.74% (237) 17.44% (237) |
| Awake with dyspnea | 9.76% (149) 8.32% (149) 11.36% (149) |
| Awake with cough | 10.22% (156) 8.74% (156) 11.85% (156) |
| Current asthma (attack of asthma/ taking asthma medication) | 6.81% (104) 5.60% (104) 8.19% (104) |
| Physician diagnose asthma | 4.78% (75) 3.77% (75) 5.79% (75) |
| Allergic rhinitis | 23.51% (358) 21.40% (358) 25.72% (358) |
as significantly predicted the prevalence of asthma in the elderly.

There are no epidemiologic data or population-based study about asthma prevalence in older population of Iran. Only two large population-based studies reported the prevalence of asthma in the age group of older than 60 years. Idani et al. in 2018 reported the rates of asthma-like symptoms, current asthma, physician diagnosis asthma, and allergic rhinitis 26.8, 11.3, 8.7 and 23.9% respectively in the 45-65 year old population of Khuzestan Province [17]. Advanced age was a significant predictive factor of asthma in this study. Specific condition of Khuzestan province regarding more exposure to micro-waste, industrial and non-industrial pollutants can be explained by this higher rate. In another population-based study conducted in the north-east of Iran, the prevalence of asthma symptoms had an increasing trend and was highest in older age groups: 7% in 60-64 years, 8.4% in 65-69 years, and 8.4% 70-104 years [18].

In the recent national survey, the prevalence of asthma was 8.9%, current asthma 4.7%, physician-diagnosed asthma 3.7%, and the history of allergic rhinitis 21.1% in 60-64 years, 8.4% in 65-69 years, and 8.4% 70-104 years [18].

In the study of Nejjari et al., cumulative asthma prevalence was reported 6.1% in the French elderly [4]. This rate was significantly higher among manual workers. The prevalence of current asthma was 6.3% in the elderly population of West Texas [25]. In the multiple logistic regression analysis, low income (OR = 1.84; 95% CI = 1.04, 3.27) and history of smoking cigarettes (OR = 1.48; 95% CI = 1.03, 2.14) were among the independent risk factors for current asthma. The lack of national studies and the methodological heterogeneity in international studies made achieving the desirable comparison difficult, especially in socioeconomic areas.

**Strengths and Limitations**

To the best of the authors’ knowledge, this is the first population-based study evaluating the asthma prevalence in the elderly and its related socioeconomic factors in Iran. To increase the response rate, the questionnaires were completed by a team of trained interviewers. This study had at least two limitations. First, a validated ECRHS questionnaire was used to facilitate international comparisons; however, this questionnaire was used more in the age range of 20-44 years, and some variability in asthma symptoms was reported in 90 elderly subjects. Another limitation was that using self-reported income as an indicator of socioeconomic status does not essentially imply the real income; it is associated with underreporting because of social undesirability of this variable in our cultural setting [26].

Tab. III. Predictive factors of asthma prevalence in the elderly based on OR and 95% CI using multiple logistic regression analysis.

| Variables          | B    | SE    | Adjusted OR (95% CI) | P-value |
|--------------------|------|-------|----------------------|---------|
| **Age groups**     |      |       |                      |         |
| 61-70              | Baseline | -     | -                    | -       |
| 71-80              | -0.15 | 0.22  | 0.86 (0.55-1.33)     | 0.50    |
| More than 80       | 0.69  | 0.30  | 2.01 (1.10-3.65)     | 0.02    |
| **Smoking habits** |      |       |                      |         |
| Non-smoker         | Baseline | -     | -                    | -       |
| Current smoker     | 1.01  | 0.25  | 2.76 (1.69-4.51)     | 0.00    |
| Ex-smoker          | 0.09  | 0.38  | 1.09 (0.51-2.31)     | 0.80    |
| Passive smoker     | 0.23  | 0.28  | 1.26 (0.72-2.18)     | 0.40    |
| **Residency**      |      |       |                      |         |
| Urban              | Baseline | -     | -                    | -       |
| Sub-urban          | 1.10  | 0.46  | 3.01 (2.20-7.50)     | 0.01    |
| **Education**      |      |       |                      |         |
| Academic           | Baseline | -     | -                    | -       |
| Illiterate         | 0.32  | 0.38  | 1.58 (0.65-2.96)     | 0.59    |
| Primary            | -0.11 | 0.36  | 0.89 (0.45-1.84)     | 0.76    |
| Secondary          | -0.27 | 0.40  | 0.76 (0.34-1.69)     | 0.50    |
| **Income**         |      |       |                      |         |
| More than 7,000 $  | Baseline | -     | -                    | -       |
| Less than 3,500 $  | 1.00  | 1.04  | 2.72 (1.35-5.10)     | 0.05    |
| 3,500 to 4,750 $   | 0.38  | 1.05  | 1.47 (0.78-2.77)     | 0.71    |
| 5,250 to 7,000 $   | 0.49  | 1.18  | 1.64 (0.16-16.65)    | 0.67    |

B: beta; SE: standard error; OR: odds ratio; CI: confidence interval.
Conclusion

The findings provide helpful information to develop targeted interventions in order to reduce the burden of asthma in the elderly especially among vulnerable groups; active smokers, and those living in suburban areas. Moreover, this study highlighted the effect of socio-economic status, disparities and inequality on community health.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors’ contributions

Conception of study: HM, SS. Study design: HM, SM, SS. Acquisition, analysis, and interpretation of data: HM, SM. Drafting of manuscript: HM, SS. Critical revision: SM. Final approval of manuscript: HM, SS, SM.

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