



Thunderstorm asthma outbreak, a rare phenomenon in southwest Iran: patients' perspectives

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Abstract

Previous studies that described thunderstorm asthma, which is a rare event, are not being well explained. This study was conducted, to describe the patient perspective on their asthma attack experience during Ahvaz post-rain phenomenon. We have interviewed patients present in the Naft clinic of Ahvaz, during 28th October and the first week of November 2015. Recruitment was continued as saturation ensued by 33 participants. An inductive content analysis was used to evaluate the interviews. The key finding indicated a climatic condition, direct or indirect contact with rain, history of allergy, and physical conditions are the main categories. The patient emphasized the importance of dust, humidity, first autumn rainfall, and environmental air pollution in occurrences of the event. When exposed to further rains (third rainfall onward), they were less likely to experience dyspnea or shortness of breath. However, being indoor or out at the time of rainfall reported not to be related to the onset of asthma exacerbation. This study yielded that patients' asthma outbreak is a climate-related health impact and many individual factors triggering this issue. Patients concerns need future investigation and public health emergency planning and response arrangements.

Keywords Thunderstorm asthma · Outbreak · Ahvaz · Rainfall · Qualitative study

Introduction

On 28 October 2015, immediately after the first rainfall, an acute outbreak of asthma occurred in the metropolitan city of Ahvaz, located in the southwest of Iran (Idani, Dastoorpoor, Goudarzi, & Khanjani, 2016). There was an abrupt rise in the number of patients presenting with asthma to the emergency departments. Similar phenomena were reported in the last few years, during

the same period of time (almost November) which was called "Ahvaz post-rain phenomenon" (Feli et al., 2015; Forouzan & Masoumi, 2014). An early observation is that thunderstorm asthma is not well understood, nor are the factors that enable asthma attack to be predicted. Industrialization and technological development brought various achievements to human life. However, unsustainable development often leads to an adverse impact on the ecosystem (Kozlov et al., 2017) and health (Khafaie et al., 2017a; Khafaie et al., 2017b). Air pollution also is mainly consequences of industrialization, which is related to urbanization and biofuel use.

Over the last decade, changes in dust storms characteristics have been observed in different parts of the world. The changing frequency of dust storms in the Khuzestan has led to a growing concern regarding the health of the nation (Maleki, Sorooshian, Goudarzi, Nikfal, & Baneshi, 2016; Mojadam et al., 2018). The world health organization recently recognized Ahvaz as one of the most polluted cities in the world in terms of PM₁₀ (Organization, 2016). The sources of Khuzestan's dust storms are located in Iraq and Saudi Arabia (Broomandi, Dabir, Bonakdarpour, & Rashidi, 2017). However, the main source of dust storms in the province is Hoor al-Azim Wetland, a transboundary lagoon between Iran

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and Iraq. The frequency of dust event days in Khuzestan is rising from 11 in 2002 to 55 in 2008 (Soleimani et al., 2013).

Ahvaz post-rain phenomenon was reported only after the first rainfall in the month of November. Despite the continued industrial pollution and burning of sugar cane and garbage all year long, asthma exacerbation is not observed in other months of the year. The crisis started in 2013 in Khuzestan (Feli et al., 2015). In the year 2013, from the beginning of autumn rainfall in a 2-week period, a total of 23,000 patients with respiratory symptoms were referred to hospitals in Khuzestan. This figure reached 18,000 in the same period in 2014. In the first week of November 2015 (28th October to 3rd November), approximately 24,800 patients with respiratory problems came to hospitals after rainfall, a much higher figure than previous years (Idani et al., 2016).

Since this study is part of a wider study dealing with factors affecting the epidemic of acute dyspnea in Ahvaz, finding a common view on the patients' reasons for referring to the hospital can be the first step in determining the factors affecting this epidemic. Therefore, we have investigated patient self-perception regarding the cause of Ahvaz post-rain phenomenon and potential improvements to future public health emergency planning and response arrangements.

Methods

This qualitative study was conducted to obtain a deeper understanding of patients' experience of dyspnea with the first autumn rainfall in 2015. We have randomly selected the participant from subjects who were referred to Karun clinic of Naft Hospital with shortness of breath after the first rainfall during 28 October and the first week of November 2015. Karun clinic, under the supervision of National Oil Company, offers family medicine free of charge to employees and their families. Patients' information recorded were electronically and this facilitated access to patients and enhanced cooperation for the study. The study was approved by the ethical committee of Ahvaz Jundishapur University of Medical Sciences. Informed consent taken from all patients whom agreed to participate (87%). Participants were interviewed individually and enrolment was continued until data saturation.

Data collection was done using semi-structured questions raised by the researcher. The interviews were recorded and then transcribed. Content analysis started from the first interview along with the subsequent interviews (with simultaneous analysis). The notes were evaluated several times in order to obtain a general understanding of the text; then, the text was read line by line. First-level coding was done first in order to demarcate the sentences uttered in answer to the questions raised in the interview. Subsequently, the main concepts in these sentences were subsumed to different categories. By

evaluating and merging these categories, a list of main themes was obtained.

There was no relationship between researcher and participants, and in order to validate the results, the interviews were repeatedly recounted and went into the judgment of two experts in qualitative research who had a long-term involvement with the data. Also, the external observation was used to increase its reliability. A part of the data was given to a researcher as an external observer who was not involved in the study to determine whether he also had a similar understanding of the data. The study was carried out and reported in accordance with COREQ checklist for explicit and comprehensive reporting of qualitative studies (Tong, Sainsbury, & Craig, 2007).

Results

Total participants include 33 Arab and Fars ethnicity (14 male and 19 female), aged 46 ± 1.2 (ranging from 24 to 67). Almost 90% were married and almost they consist of a good share of students, housewives, and employed at or retired from National Iranian Oil Company (NIOC).

Participants reported asthma-like exacerbation occurred at home and under the rain. Few have reported that windows and doors were kept open the ventilation. However, a number of participants had no underlying illness or respiratory problems before the event. From the text analysis, 234 semantic units and 81 semantic subunits were extracted. After reducing, deleting, and merging different parts, these numbers were reduced to 45 subunits and 15 semantic units (see Table 1). Finally, four main themes, namely "History of physical problems," "Climate problems," "History of allergy," and "Occupational conditions" were obtained (see Table 2).

The overall theme extracted from the participants' comments was related to climate issues that the patients identified as a cause of their shortness of breath. It consists of four semantic subunits of dust, humidity, air pollution, and the first autumn rain. Most participants considered climate problems a reason for their shortness of breath.

In this regard, the participants stated that "...within the last few years, when it's raining, I feel terrible. I used to enjoy the rain, go under it, and put some pots to gather rainwater to drink because it was said to be clean and pure. Rain used to be a sign of God's generosity. But now, when it rains, it is so filthy that everyone says it is acid rain and we should take refuge in a shelter to avoid being hurt. I see this shortness of breath because of air pollution ..." (Participant # 5)

"... with air pollution and the air getting humid, I become short of breath. It had just started to rain when I became short of breath ..." (Participant # 6)

Table 1 Example of participants' statements and explicit codes

Semantic units	Codes
1. "... when it's raining and the air is humid, I have this problem. I have no problem with the sultry weather in summer..."	Humidity
2. "... whenever the dust storm starts, I'm annoyed by the dust. It started 3 days ago ..."	Annoyance in the dust
3. "... With the first and second rain, I get like this, I do not dare at all to go out when it rains."	Fear of rain
4. "... I have breast cancer, and since I am under chemotherapy, I do not go out..."	Not leaving home due to chemotherapy
5. "... I am an injured veteran and I take tranquilizers and when I feel very nervous, I suffer from shortness of breath ..."	Shortness of breath due to nervous discomfort
6. "... I have hypothyroidism and I am under medical treatment ..."	Hypothyroidism
7. "... because my second job is driving and my job is done in the free air, I suffered from shortness of breath ..."	Shortness of breath during rain
8. "... At 2 a.m., I woke up feeling choked ..."	Waking up from sleep due to choking
9. "... I have seasonal allergies and allergies, and I am treated with sprays ..."	Seasonal allergy
10. "... I also have a dermatological allergy. I develop hives when eating banana, pepper, and eggplant ..."	Skin allergy
11. "... when air humidity increases, this happens to me, and that day it was humid ..."	Humidity
12. "... I do not dare at all to go out when it rains, I would close the windows, and turn on the air conditioner to changing the air ..."	Environmental pollution
13. "... When this happened, I had a cold, and I went to the market at the sunset, I felt choked with rain."	Common cold
14. "... I have a history of heart disease. I suffered from dyspnea last year during the rain."	Heart disease
15. "... Both last year and this year, I was under the rain. This year I went under the rain, I wanted to watch the rain ..."	Staying in the open air environment

"... whenever the weather is dusty, I'm annoyed. The dust started 3 days ago, then it rained and stopped. After that, I became short of breath and went to the clinic ..." (Participant # 3)

Of other factors that the participants described as the cause of an outbreak to the clinic was the history of allergy in the patients.

In this regard, one of the participants stated that "... I have a history of dyspnea and asthma. Whenever it is cloudy or it rains, I suffer from shortness of breath. This happens in autumn. It's about 2-3 years that I've got asthma." (Participant # 23)

Another participant said, "... I have been having seasonal allergies for 2-3 years old, and as it rains, I start coughing and become short of breath. I was like this with the first and second rain. I do not dare at all to go out when it rains. As long as I'm home, I keep the

windows closed to turn on the air conditioner to change the air ..." (Participant # 28)

The other theme the patients referred was direct or indirect contact with rainfall, which included four semantic subunits, including occupation, staying in the open, opening doors and windows, and dyspnea during sleep. Some of the participants were in the open air during the rain, while others, although at home, had opened their doors and windows for different reasons such as watching the rain, which they considered was a factor in their shortness of breath. Meanwhile, a participant stated that "... I am an employee at Mahshahr Petrochemical Complex. I am from Mahshahr. I was coming to Ahwaz when I began to cough. It was such that I could not sleep the whole night. I went to the clinic, this air made me feel shortness of breath. I do not think otherwise." (Participant # 22)

Some participants also suffered from choking at midnight during sleep and went to the clinic. A participant

Table 2 Main themes and related codes detected with the semantic approach

Main themes	Codes
1. Climatic problems	Dust, humidity, first autumn rainfall, environmental air pollution
2. Direct or indirect contact with rain	Occupation, staying in the open air environment, keeping the doors and windows open, breathlessness while sleeping
3. History of allergy	Seasonal allergy, dermatological allergy, nervousness
4. Physical conditions	Hypothyroidism, heart problems, chemotherapy, common cold

stated that “... I’ve been having this problem for 2 years, and I did not get it under the rain. I was asleep when I had shortness of breath. Last year, this happened to both my husband and me. We were both at home, and we experiencing the same at night. But in the morning we visited the clinic. We usually have this problem with the first and second rain, but I did not have trouble with further rains ...” (Participant # 18)

Participant # 28 states: “... I do not dare at all to go out when it rains. I would close the windows in my house, and turn on the air conditioner so that the air is changed. It was at 3 a.m. of the rainy night when I felt the air was poisoning me and I had to go to the clinic. I had been breathless since 1:30 a.m. When I went to the clinic, the rain had stopped.”

Another theme extracted from the patient’s statements was the patients’ physical conditions that were divided into seven semantic subunits, including nervousness, hypothyroidism, chemotherapy, heart disease, and common colds. Some patients believed that one of the factors that affected dyspnea was the history of their physical condition.

In this regard, a participant said: “... whenever I feel nervous, I suffer from shortness of breath. In my opinion, my shortness of breath was not related to the rain. I was at home when I suffered from shortness of breath. I often have this problem when I am nervous...” (Participant # 1)

Some participants attributed the effect of taking some medications to dyspnea. Participant # 21 said: “... I was not under the rain, but when it’s raining, I had an attack, I’m doing chemotherapy. That night, I felt breathless, and I think that was because of the chemotherapy drugs ...” (Participant # 21)

Discussion

This study qualitatively focused on the viewpoints of patients referring to Karun clinic affiliated to Ahvaz Naft Hospital regarding the thunderstorm asthma outbreak of October 28th, 2015. As reported by the participants, almost all of the patients blaming the climatic conditions and air pollution as the main factor contributing to their shortness of breath and their visits to the clinic. However, direct or indirect contact with rain, history of allergy, and physical conditions were recognized as important factors.

Also, according to the patients’ statements, a number of patients had no history of underlying illness and physical condition. A previous study (Forouzan & Masoumi, 2014) reported 52% of patients had no history of respiratory problems and

experienced breathing difficulties for the first time. However, a high proportion of patients with no history of asthma previous to the event reported may be due to the fact that only 800 out of 2000 patients responded to the questionnaire and so we have speculated that majority of the participants were those who experienced the less extensive problem and probably with no history asthma. Similarly, our patients reported that onset of symptoms occurred either under the rain or while at home opening the windows and doors for various reasons (breathing the air outside, watching the rain, etc.).

According to extracts from the patients’ statements, some patients considered their allergy history and seasonal allergy as the cause of their shortness of breath following their first autumn rain. We found that patients and families were given very little information about their condition. Accurate, reliable, and up-to-date information around the cause, underlying genetics, treatment options, prognosis, and simply “everything” is vital for patients to be able to make informed choices. This included educating the public about what they should expect from their health care providers.

The elevated bioaerosol concentrations observed on the day of the thunderstorm may be attributed to the sudden onset of high winds during the thunderstorm, which triggered a sudden release of spores and pollens into the atmosphere, which was probably responsible for the epidemic. Thunderstorm asthma phenomena occurred, especially during the pollen seasons (Nasser & Pulimood, 2009). There is evidence that during thunderstorms, pollen rupture may occur due to osmotic shock, and release into the ambient air. This content included respirable allergen components that can reach the lower airways (D’Amato, Liccardi, & Frenguelli, 2007). However, the noisiest things in the current phenomena are why children are not affected. Since current research adopted on a qualitative approach and used patients’ comments, its generalizability is limited. Further research need a telephone or postal survey from a larger number of patients to investigate patient’s satisfaction and quality of care received during such a situation (that means emergency department crowding).

In the present study, the patients believed that after the first and second rainfall, they suffered from shortness of breath and these symptoms decreased with the subsequent rainfalls, and this problem had been recurring for the last 3 years. Despite the fact that some of them did not have any underlying disease and some were even at home and not under the rain and had closed the windows and doors, they had breathing problems or woke up at the bed with choking symptoms at midnight. The press should highlight the crisis, both in terms of awareness and action policy, to draw attention at the highest level and tackle measures to prevent the occurrence (Mojadam et al., 2018). The authenticity of this issue requires further studies in this regard.

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Compliance with ethical standards

The authors declare that they have no conflict of interest.

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