

## The Knowledge of the Residents Concerning the Health Risk of Arsenic (As) Contamination in the Blackfoot Disease (BFD) Area, Taiwan

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**Abstract.** Many endemic cases of blackfoot disease (BFD), caused by arsenic (As) contamination, have been recorded in the coastal regions of southwest Taiwan. Local people in these regions stopped drinking groundwater for daily use after the popularity of tap water; however, the fishermen started to use groundwater for aquaculture. Ingestion of those As-contaminated fish could lead to adverse health effects; The realization of the residents from the BFD area concerning the risk of As contamination remains unknown. The results of questionnaire, conducted to interview 102 residents from the BFD area, show that the residents from the BFD area have lack of the knowledge concerning BFD and As contamination. Only 26% of them know that BFD is caused by As. There are 72% of the residents have never even heard of As. More environmental education concerning As pollution and the risk in human health needs to be undertaken.

**Keywords:** Arsenic (As), blackfoot disease (BFD), groundwater, water pollution

### 1. Introduction

Arsenic (As), widely found in nature, is a well-known toxicant[1]. Mainly transferred by water, As can be easily accumulated in aquatic organisms via direct contact or ingestion[2]. By the same pathways, As can also be accumulated in the human body and in this way causes harm to humans[3]. In the southwest coastal regions (including Chiayi and Tainan) in Taiwan, the groundwater contains high amount of As. According to the monitoring results of water quality of groundwater from these regions, the As concentrations of groundwater in Chiayi and Tainan exceed the EPA standard for drinking water ( $10 \mu\text{g L}^{-1}$ ), as well as the Taiwan standard for aquacultural water ( $50 \mu\text{g L}^{-1}$ ).

Blackfoot disease (BFD), first observed in the 1930s and peaking in the 1950s, is correlated with the consumption of groundwater by local inhabitants living in the coastal area, southwestern Taiwan. Blackfoot disease is correlated with the consumption of groundwater by local inhabitants living in these regions. Nowadays most of the people living in this area do not use groundwater as potable water, but the groundwater is still used for aquaculture since the rivers in these regions have been polluted[4].

Fish farming is a promising practice with high market value in Taiwan. Most of the fish aquaculture in Taiwan is located in these coastal regions. From many researches we know that the As concentrations in pond water and in the bodies of reared fish from the aquacultural ponds using groundwater are higher than the standards mentioned above. The residents living in these area have suffered from various cancers with higher mortality than the populations from other regions in Taiwan[5]. Several studies have been conducted to demonstrate that to use groundwater for aquaculture may cause an overexposure of As[6]. The knowledge of the residents from the blackfoot disease area concerning the health risk of As pollution was not well analyzed. The aim of this study is to investigate the knowledge of the local residents, especially the

fishermen own the aquacultural ponds using groundwater, concerning the health risk of intake of As. The health risk will be analyzed, based on the questionnaire interview.

## 2. Materials and Methods

### 2.1. Questionnaire

Questionnaire interviews have taken place at the four townships, including Putai, Yichu, Peimen and Hsuehchia, in the regions of Chiayi and Tainan. These towns were the endemic areas for BFD. A total amount of 102 residents from the BFD area were interviewed to understand the knowledge of those residents concerning the health risk of As contamination. Due to the limited ability of the older fishermen to read and to fill in questionnaire, face-to-face interviews were conducted in order to help the respondents to fully understand and to assist them answering the questions verbally.

### 2.2. Statistical Analysis

After removing the incomplete questionnaires, the data of valid questionnaires were analyzed using the software Excel.

## 3. Results

Besides of one incomplete questionnaire, the resulting data show that 93% of the residents have heard of “black foot disease” (Table 1). Among these people who have heard of “black foot disease”, 42% of them learned it from "media", including "TV news" (37%) and "newspaper" (5%); another 42% learned from "neighbors, relatives or friends", including "neighbors" (25%), "relatives" (13%) and "friends" (4%); only 11% learned from "schools" (Fig. 1).

Table 1. Summary of the resulting data from questionnaire

Subject	Percentage
Residents who have heard of “blackfoot disease”	93%
Residents who have heard of “blackfoot disease” can point out where “the BFD locations” are	38%
Residents who have heard of “blackfoot disease” know that BFD is caused by “water pollution”	41%
Residents who have heard of “blackfoot disease” know that BFD is caused by “arsenic”	26%
Residents who have heard of “arsenic”	28%
Residents who have heard of “arsenic” know that “As is a toxicant”	33%
Residents who have heard of “arsenic” know “the pollution pathways of As”	8%
Residents who have heard of “arsenic” know “other disease, besides of BFD, caused by As”	2%

Only 38% of residents could point out where BFD had occurred (Table 1, Fig. 2). Among those 38% people, 24%, 8 %, 4% and 1% of them could indicate that the locations for BFD were in Peimen, Putai, Hsuehchia and Yichu, respectively.

From the residents, 41% have known that BFD was caused by “water pollution” (Table 1). Even though, only 26% of these people could pointed out that the main reason causing BFD is “arsenic”. Among the 28% of residents who have heard of “arsenic”, only 28% of them have known that arsenic is a toxicant (Table 1).

Concerning the sources of As pollution, 40% of the residents could indicate that water is the main route for As pollution; only 1% of the residents have mentioned that air could also be one of the routes causing As pollution (Fig. 3).

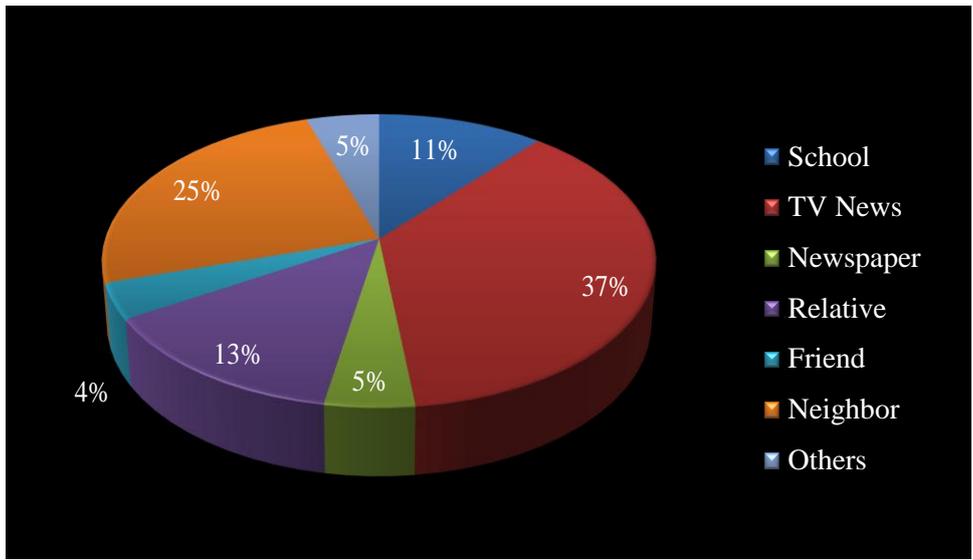


Fig. 1: The sources of knowledge concerning the “blackfoot disease (BFD)”

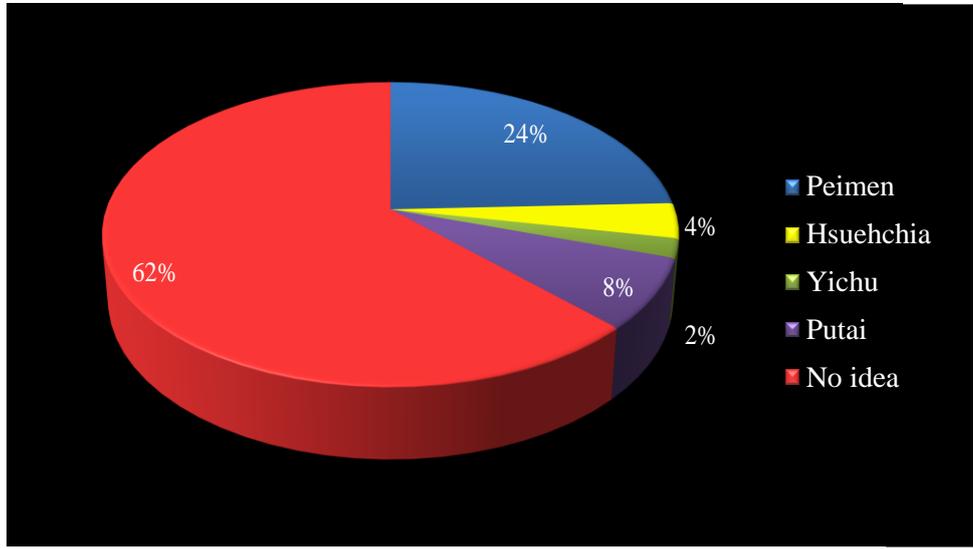


Fig. 2: Locations of “blackfoot disease (BFD)” pointed out by the residents who have heard of BFD

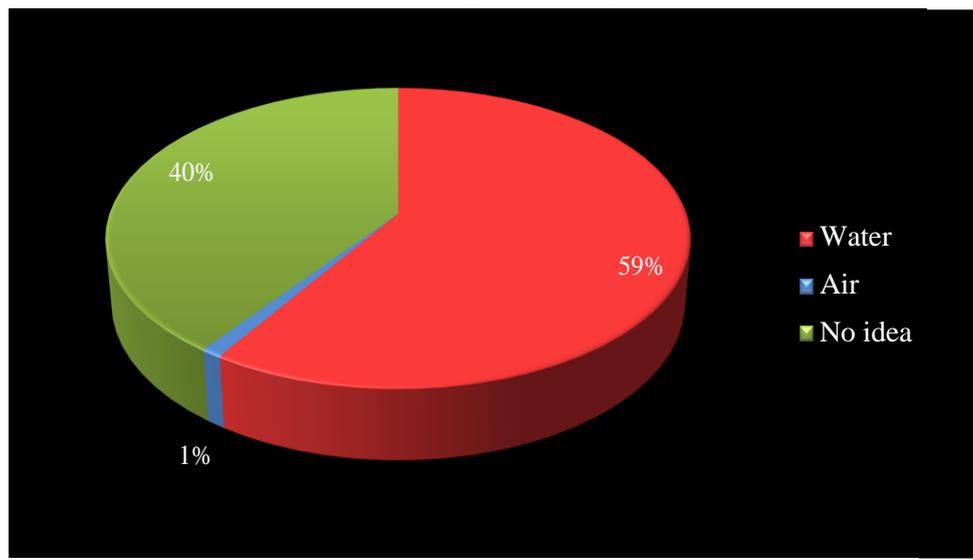


Fig. 3: “Pollution source of Arsenic (As)” pointed out by the residents who have heard of As

#### 4. Discussion

Blackfoot disease used to be one of the severe epidemic hazards in the history of Taiwan[7]. Although BFD has almost disappeared nowadays, there are still some patients suffering from this disease[8]. At the present time people do not pay much attention to BFD, neither the As pollution in groundwater. And therefore, it is a common situation that fishermen draw groundwater for an aquacultural purpose.

According to the investigation of this study, we have revealed that the residents from the BFD area have limited knowledge concerning the health risk of As contamination. Most of the information about BFD are heard from neighbors, relatives and friends, as well as from TV news and newspaper. Those information could be incomplete or even incorrect. As arsenic has been identified as an endocrine disruptor[9], the residents living in the BFD area should pay more attention to this issue. More environmental education concerning the health risk of BFD and As contamination should also be undertaken. A warning to the public to refrain from eating the fish cultured using As-contaminated groundwater should be immediate issued by the government.

## 5. Acknowledgements

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