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Respondent driven sampling in a biomonitoring study of refugees from Burma in Buffalo, New York who eat Great Lakes fish

Ming Liu[a,*], **Molly McCann**[b,c], **Elizabeth Lewis-Michl**[a], and **Syni-An Hwang**[a,b]

[a]New York State Department of Health, Bureau of Environmental & Occupational Epidemiology, Empire State Plaza, Corning Tower, Room 1203, Albany, NY, 12237, United States

[b]University at Albany, School of Public Health, Department of Epidemiology & Biostatistics, One University Place, Rensselaer, NY, 12144, United States

[c]University of Rochester, School of Medicine and Dentistry, Departments of Public Health Sciences and Emergency Medicine, 265 Crittenden Blvd, Box 420644, Rochester, NY, 14642, United States

Abstract

Background: Refugees from Burma who consume fish caught from local waterbodies have increased risk of exposure to environmental contaminants. We used respondent driven sampling (RDS) to sample this hard-to- reach population for the first Biomonitoring of Great Lakes Populations program. In the current study, we examined the interview data and assessed the effectiveness of RDS to sample the unique population.

Methods: In 2013, we used RDS to sample 205 Burmese refugees and immigrants residing in Buffalo, New York who consumed fish caught from Great Lakes waters. RDS-adjusted population estimates of sociodemographic characteristics, residential history, fish consumption related behaviors, and awareness of fish advisories were obtained. We also examined sample homophily and equilibrium to assess how well the RDS assumptions were met in the study.

Results: Our sample was diverse with respect to sex, age, years residing in Buffalo, years lived in a refugee camp, education, employment, and fish consumption behaviors, and each of these variables reached equilibrium by the end of recruitment. Burmese refugees in Buffalo consumed Great Lakes fish throughout the year; a majority of them consumed the fish more than two times per week during summer, and about one third ate local fish more than once per week in winter. An estimated 60% of Burmese refugees in Buffalo had heard about local fish advisories.

Conclusions: RDS has the potential to be an effective methodology for sampling refugees and immigrants in conducting biomonitoring and environmental exposure assessment. Due to high fish consumption and limited awareness and knowledge of fish advisories, some refugee and immigrant populations are more susceptible to environmental contaminants. Increased awareness on local fish advisories is needed among these populations.

[*]Corresponding author at: Empire State Plaza, Corning Tower, Room 1203, Albany, NY, 12237, United States. ming.liu@health.ny.gov (M. Liu).

Keywords

Respondent driven sampling; Refugee; Fish consumption; Fish advisory; Great Lakes

1. Introduction

Various studies have shown the risk of exposure to a wide range of environmental contaminants via long-term consumption of fish caught from the Great Lakes and surrounding Areas of Concern (AOCs) (Hanrahan et al., 1999; Humphrey et al., 2000; Spliethoff et al., 2008; Stahl et al., 2014; Turyk et al., 2009). New York State currently contains five of the 27 remaining Great Lakes AOCs, as defined by the U.S.-Canada Great Lakes Water Quality Agreement (United States Environmental Protection Agency, 2017). The New York State Department of Health (NYSDOH) issues waterbody specific fish consumption advisories, primarily based on analysis of fish samples by the New York State Department of Environmental Conservation (NYSDOH, 2017). Contaminants of concern include mercury, polychlorinated biphenyls (PCBs), mirex, and/or dioxins. As part of the Biomonitoring of Great Lakes Populations - I (BGLP-I) program, the NYSDOH and the Agency for Toxic Substances and Disease Registry (ATSDR) collaborated on a biomonitoring project to assess exposure to environmental contaminants among susceptible populations. Individuals who ate fish from any of the four AOCs in Western New York State, including Buffalo River, Niagara River, Eighteenmile Creek, and Rochester Embayment, were of primary interest.

As part of the biomonitoring program, the NYSDOH targeted refugees from Burma residing in the City of Buffalo because of their potential increased risk of exposure to Great Lakes contaminants. Many of the Burmese refugees in Buffalo subsidize their diets by regularly catching and eating fish from local waters (Zremski, 2016), including fish such as carp and channel catfish, which have relatively high levels of PCBs (NYSDOH, 2017). The Burmese are also more likely to have language barriers and little knowledge of local fish advisories, due to low literacy and educational attainment. Other vulnerability factors may include low income, lack of transportation, and cultural dietary norms (high in fish and fish products). Much of the Burmese population in Buffalo is concentrated in three contiguous neighborhoods along the Niagara River AOC, and within three to five miles of the Buffalo River AOC (Fig. 1). The Niagara River AOC consists of the entire 35 miles of the Niagara River from the eastern end of Lake Erie northward to Lake Ontario. The river is a popular spot for anglers and has several recreational beaches within the City of Buffalo. The Buffalo River AOC is a 6-mile segment of this highly industrialized river. Several parks, however, have recently been developed along its banks, providing access for boating and fishing.

The study used respondent driven sampling (RDS) to recruit the Burmese refugees in Buffalo. Recruitment by RDS is considered suitable for reaching “hidden” or hard-to-reach populations, including refugees and migrants (Tyldum and Johnston, 2014). The objectives of the study were twofold. First, we sought information on Burmese refugees in Buffalo related to potential for exposure to Great Lakes contaminants, including sociodemographic characteristics, residential history, the amounts and patterns of Great Lakes fish

consumption, awareness of fish advisories, and other lifestyle factors. Secondly, we aimed to assess the effectiveness of RDS for recruiting Burmese refugees for biomonitoring and exposure assessment surveys using measures suggested in the RDS literature (Johnston et al., 2016a, 2008; Lansky et al., 2012; Montealegre et al., 2013; Townsend et al., 2010).

2. Materials and methods

2.1. Respondent driven sampling

The success of utilizing RDS as a recruitment method relies heavily upon the social networks established among the individuals within a population. Prior to recruitment, we conducted formative research in collaboration with Jericho Road Community Health Center (JRCHC), a faith-based organization that provides resettlement assistance and medical care to refugees and low income community members in Buffalo. We found the Burmese refugees in Buffalo to be socially and geographically connected. There are very few refugees who do not affiliate with any of the Burmese ethnic groups, and most of the refugees had lived in refugee camps in Thailand or Malaysia before coming to the U.S. We also found that the Burmese in Buffalo had knowledge of each other's fishing and fish consumption habits, which corresponds to one of the key RDS assumptions. The collaboration also allowed selection of a small number of participants from the Burmese community to serve as "seeds" who initiated recruitment. Typically in RDS, each seed is given a set of referral coupons to recruit peers from their social network to participate in the project. Once each seed's recruits have redeemed their coupons and participated in the project, these recruits are in turn given a set number of coupons with which to recruit a set of peers from their social networks. All participants are provided a primary incentive to participate and additional incentives for each recruit who participates in the project. Each wave of participants subsequently recruits the next wave of participants until the recruitment goal is reached (Johnston et al., 2016a).

2.2. Study setting

The city of Buffalo, in Erie County, is the second most populated city in the State of New York. It has resettled approximately one-third of refugee arrivals to the state in recent years. From 2003 to 2014, a total of 9723 refugees resettled within Erie County, with almost 4000 from Burma alone, making Burmese the largest refugee group in the state (Fike et al., 2015; New York State Office of Temporary and Disability Assistance, 2016). Recruitment via RDS occurred during the 2013 fishing season (July to October). Sampling events were held at JRCHC, located on the West Side of Buffalo, which is heavily populated by the Burmese.

2.3. Recruitment

Eligible participants were refugees or immigrants from Burma aged 18 years or older who lived in Buffalo at least one year and consumed at least 12 meals of fish caught in the AOCs within the past year. The fish consumption eligibility criterion was set based on formative research, which indicated high levels of local fish consumption among this specific refugee population. Individuals were eligible irrespective of how they obtained the fish (i.e., they caught the fish themselves or ate someone else's catch). Reciprocal relationships were also assessed in the eligibility screening by asking recruits about their relationship with the

person who recruited them. Recruitment of strangers violates the RDS assumption of reciprocal relationships, and such recruits were ineligible to enroll in the study (Tran et al., 2015). To avoid a clustering effect, we limited participation in the project to one person per household by using a screening question: “Have you or anyone you live with already participated in this project?” and by checking participants’ addresses after each sampling session.

We held a total of 11 RDS events, one evening per week (3–4 hours), at JRCHC. Recruitment was initiated by three of the five seeds, identified through JRCHC and selected to reflect ethnic diversity. As previously noted, seeds were each given three referral coupons to recruit the first wave of participants into the project. Subsequent waves of participants who agreed to be recruiters also received up to three referral coupons to recruit additional participants until the recruitment goal was reached. Potential recruiters were also educated on how to recruit their peers and how to receive a secondary incentive. Referral coupons were uniquely numbered to be linked to their recruits, which included all necessary information regarding sampling events and compensations, including the logo and name of the project, corresponding phone numbers, regular hours, and a photo of the event location. Participants received a primary compensation ($75 money order) for completing their participation and an additional secondary compensation ($15 money order) for each recruit who participated in the project.

Because of the high rate of early recruitment and to ensure that recruitment was manageable, we used the coupon reduction strategy (World Health Organization, 2013). The number of referral coupons distributed per participant was reduced from the initial three to two referral coupons per participant after the first three sampling events. As the target goals for enrollment were reached, the number of referral coupons was further reduced to a single coupon, and eventually to none in the last two events. An expiration date was also added to the referral coupons as a means of initiating the completion of recruitment.

2.4. Data collection

Data collection procedures included eligibility screening, obtaining informed consent from participants, and a detailed interview by a trained interviewer. Each interview was administered in the participant’s native language (Karen, Burmese, or other), and the responses were recorded on paper forms in English and later entered into Microsoft Access databases. A paper-based coupon management system was used in the RDS sampling events to record information on the redeemed and distributed coupons and the receipt of primary and secondary incentives. The recorded coupon tracking information was entered into Microsoft Excel after each event in order to track the recruiter-recruit relationships and the number of waves completed for each seed.

The interviews started with a series of questions that measured characteristics of participants’ social networks among the target Burmese refugee community. These data were collected in order to conduct RDS analysis and to assess how well the RDS assumptions were met in the study. Network sizes were measured by responses to the first question that asked, “Of the adults (18 and older) you know who themselves, their parents or grandparents, were born in Burma or in a refugee camp, how many eat fish caught in these

nearby bodies of water (shown on a map)?". To further assess the RDS assumption of reciprocal relationships, participants (excluding seeds) were asked again about their relationship to the person who gave them the coupon (e.g., friend or acquaintance, co-worker, etc.) and whether or not they would have considered referring the person who referred them.

The main questionnaire consisted of items about sociodemographic characteristics, residential history, consumption of fish from Great Lakes waterbodies, awareness of fish advisories regarding nearby waterbodies, and other lifestyle risk factors for exposure to environmental chemicals. Ethnicity was categorized into four groups to avoid very small group sizes: Karen, Burman, Karenni, and other (including Chin, Kachin, Rakhine, and those reporting "other"). Great Lakes fish consumption was assessed by number of fish meals consumed over the past 12 months, and in which season the fish was consumed (summer, winter, fall, spring). Lifestyle exposure questions included use of herbal medicine or supplements, betel nut (a mild stimulant), and Thanaka, a traditional Burmese cosmetic powder. Cigarette smoking and use of chewing tobacco and snuff were also assessed among the participants.

2.5. Data analysis

We used the Respondent Driven Sampling Analysis Tool (RDSAT) version 7.1 (Volz et al., 2012) to calculate sample proportions, estimated population proportions and 95% confidence intervals, and average network sizes (i.e., dual component network size). The RDSAT option regarding the number of re-samples for bootstrap was set to 16,000, and the pull-in outlier option was used to minimize the effect of outliers in social network sizes (upper and lower 4%). The default was used for all other RDSAT options. We also examined homophily and equilibrium on key variables in RDSAT to assess the effectiveness of RDS in recruiting Burmese refugees. Homophily estimates measure the likelihood that recruiters recruit individuals with a similar characteristic to themselves rather than at random (Montealegre et al., 2013). Homophily values range from −1 to 1, with 1 indicating that participants from a particular subgroup recruited entirely within that subgroup and negative values indicating avoidance for recruiting individuals from the same subgroup. Equilibrium is the point at which the proportion for a sample characteristic remains stable despite additional waves of recruitment. An equilibrium distribution indicates that the resulting sample is independent of the initial non-randomly selected seeds and starts to represent the characteristics of the population (Heckathorn, 1997; Townsend et al., 2010; Tyldum and Johnston, 2014). In this study, equilibrium was considered reached when the change in sample proportions between waves was less than 2%, which was the RDSAT default. The key variables we selected to generate population estimates and assess homophily and equilibrium included sociodemographic characteristics (e.g., sex, age, ethnicity, years residing in Buffalo, years lived in a refugee camp, education, employment), as well as variables relating to local fish consumption and awareness of fish advisories. Variables on participants' network characteristics (e.g., relationship to the recruiter), lifestyle variables, and some supplemental data regarding fishing and fish consumption were analyzed using SAS (SAS Institute Inc., Version 9.4, Cary, North Carolina, USA). A diagram of the entire recruitment network was created using NetDraw version 2.148 (Borgatti, 2002).

3. Results

3.1. Recruitment

Between July and October 2013, 205 refugees (including 5 seeds) enrolled in the project. This total was achieved in 11 sampling events and through up to nine waves of recruitment. A total of 311 coupons were distributed, of which 226 (73%) were redeemed. Of those redeeming the coupons and completing the screening questionnaires, 26 were ineligible, and among all participants, 25 declined to accept the recruitment coupons. Fig. 2 illustrates the recruitment chains in the sample. The sample was derived from three active seeds, with 63% of participants derived from one seed (seed 2) over nine recruitment waves; the other two seeds recruited 27% (seed 1) and 10% (seed 5) of the participants. Two seeds did not recruit any participants. Approximately 53% of the participants (n = 109) recruited at least one person. Additionally, there was a steady increase of recruitment between wave 0 (seeds) and wave 4 (Fig. 3). Between wave 5 and wave 9, the number of referral coupons given to participants was reduced from three to two, and eventually to one to help control the sample growth. The recruitment count per wave ranged from one to 48 recruits.

3.2. Demographics and residential history

Almost all the participants were born in Burma (98%), with 2% born in a refugee camp in Thailand (Table 1). A significant proportion of them had lived in a refugee camp prior to coming to the U.S. (84%), with 39% living in camps for 10–20 years, and 16% living in camps for 20–30 years. Slightly over half of the Burmese refugees had spent at least four years in Buffalo (53%), and only 19% of them had lived in a U.S. city other than Buffalo. About 61% percent of the Burmese participants were women and 46% were aged 30–44 years. Karen was the largest ethnic group (47%), followed by Karennis (18%) and Burmans (15%) (with wide confidence intervals). Approximately two thirds of the Burmese refugees were literate (68%), and 35% had not attended any school. Many of the refugees were unemployed (75%) and received public assistance through the food stamp program (86%) and/ or the WIC program (36%).

3.3. Fish consumption

Burmese refugees in Buffalo consumed local fish from nearby Great Lakes waters throughout the year, and more than 90% of them froze fish to eat later. Local fish were most frequently caught and consumed during the summer (June to August), with about half of the Burmese refugees consuming the fish two to six times per week (Table 2). At the time of participation (Mid-July to early October), more than 80% of our participants had eaten fish or shellfish within the last week. In fall (September and October), the median fish consumption was reduced to about one to two times per week. In winter (November to March), most of the Burmese still ate locally caught fish, and approximately one third of them ate local fish more than once per week. Local fish consumption in spring (April, May) is not reported due to a large portion of missing data (40%) caused by a questionnaire error. However, our available data suggested a similar average amount of fish consumption between fall and spring. Fish paste was also commonly consumed among the Burmese; 77% ate fish paste at least once per week. Our participants reported more frequently eating store bought fish paste (79%) than homemade fish paste (31%). Only 39% of the participants had

heard of the health advisories about eating fish from nearby waters. The RDS adjusted estimate, however, showed that 60% of the Burmese population were aware of local fish advisories. When asked the source of fish advisories, the common responses included "community," friends, and JRCHC.

In addition, our participants reported catching the fish themselves (65%) or receiving fish as a gift from a friend or family (74%). Most of the individuals fished in the Upper Niagara River at Squaw Island (83%) and Broderick Park (57%). Other popular fishing spots included the Black Rock Canal at Squaw Island and Foot of Ferry (41%) and ponds on Squaw Island (32%). When asked which types of local fish they had eaten in the past 12 months, participants reported a large variety of fish species; the most popular ones were quillback (72%), common carp (67%), minnow (60%), white perch (51%), white bass (50%), and brown bullhead (50%). Common carp and white perch from this region are known to have higher levels of contaminants (NYSDOH). Some of the less commonly consumed fish that tend to have higher levels of contaminants are channel catfish (45%), yellow perch (30%), largemouth bass (29%), smallmouth bass (29%), walleye (22%), and lake trout (15%). The common ways in which the Burmese cooked the fish were pan or deep frying, drying, making a soup/curry, and fish paste (for smaller fish).

3.4. Lifestyle variables

A very small proportion of the participants reported regularly using herbal medicine or supplements (5%). A total of 18% frequently consumed store-bought betel nut, and 9% used natural or hand-made betel nut. The use of Thanaka powder was popular among female participants, with 68% reporting using the product, typically five times per week. Approximately two thirds of the participants never smoked cigarettes, and 22% were current smokers; moreover, 29% used chewing tobacco or snuff.

3.5. RDS assumptions

Data collected on participants' social networks indicated that they knew each other as members of the target population, which is a key assumption of RDS recruitment. A vast majority (92%) of non-seed participants reported that a friend or acquaintance gave them the referral coupon, and no one reported that their recruiter was a stranger. This could also explain the high eligibility rate (88%) among all persons who redeemed a referral coupon. The median of reported network sizes was 35, with an interquartile range of 10 to 100. When asked whether or not they would have considered referring the person who had referred them, 79% responded "yes," suggesting that the assumption of referral reciprocity was met. Homophily scores were the highest among ethnic groups (0.55–0.88) and those who had lived in a refugee camp (0.60). Homophily was moderate by gender (0.35 for males and 0.40 for females), and low by age groups (0.04 – 0.17). Nine waves of recruitment were sufficient to meet equilibrium requirements for all the key demographic (2–4 waves for sex and age groups) and fish consumption variables with the exception of ethnicity. However, the matrix of cross-recruitments created by RDSAT showed that cross-recruitments were present among the major ethnic groups, suggesting that participants' networks are connected and form a single network; the proportion of cross-recruitments by ethnicity ranged from 14% to 50%.

4. Discussion

Our results suggest that RDS is a feasible and effective methodology to obtain adequate samples of Burmese refugees from their established communities for public health research and surveillance. With three initial seeds, using 11 weekly sampling events during the 2013 summer fishing season, we were able to recruit 205 Burmese refugees in Buffalo who consumed fish caught from Great Lakes AOCs. The sample was diverse with respect to demographics, such as sex, age, years spent in Buffalo, in addition to behaviors relating to local fish consumption. Each of the key variables reached equilibrium by the ninth wave of recruitment, which is an important assumption of RDS sampling methodology. Our sample did not reach equilibrium on ethnicity, most likely as a result of strong homophily within the ethnic groups and small sample sizes among specific groups. However, cross-recruitments were found among the major ethnic groups, which enabled the participants to form a single network and met a key RDS assumption.

Our analysis of the questionnaire data identified the demographic and health-related characteristics of refugees from Burma as well as the patterns of their local fish consumption. The Burmese refugees in Buffalo were likely to have spent four years or longer in the United States and to have lived previously in a refugee camp in Thailand or Malaysia for several years. They were typically unemployed and had little formal education. Local fish consumption occurred throughout the year and was especially popular in the summer fishing season among the Burmese, with approximately half of them eating local fish between two and six times per week. Freezing the fish caught from local waters was very common, which might explain how one third of the Burmese refugees in Buffalo regularly ate fish even in winter.

The RDS analysis estimated that 60% of Burmese refugees in Buffalo had heard about health advisories on eating fish from nearby waters. This weighted population estimate is noticeably higher than the unadjusted sample proportion (40%), probably due to a much smaller average network size for those answering “yes” compared to those answering “no” (8.7 vs 22.5), and thus assigned more weight during analysis. We confirmed the accuracy of the estimated 60% using another RDS data analysis software, the RDS Analyst version 0.57 (Handcock et al., 2016), and obtained the same result. When further examining selected subgroups, we found that females were more likely to be aware of local fish advisories than males, and young people were more likely aware than older people; those who could read (Burmese, Karen, and/or English) were much more likely to have heard about local fish advisories than those unable to read. Moreover, we suspect a low knowledge level regarding the contents of the fish advisories among those who reported awareness; only 35% of the participants reported being able to read some English, and for a majority of those who reported having heard about fish advisories the only source of the information was their “community” or friends. Additional studies are needed to assess the knowledge and attitude toward fish advisories among the Burmese refugees.

This is one of the first published studies reporting use of RDS methodology to recruit refugees for participation in biomonitoring or survey research on environmental exposures. Only recently has RDS been used to conduct health survey research and estimate disease

prevalence among refugees and migrants. In 2010, RDS was used in recruiting undocumented Central American immigrant women in Houston, Texas, USA. The researchers used the interview data to estimate the prevalence of HIV risk, testing behaviors, and healthcare use in the population (Montealegre et al., 2012a,b; Montealegre and Selwyn, 2014). Multiple other studies have been conducted using RDS to recruit and conduct research among migrant populations (Johnston et al., 2016b; Tyldum and Johnston, 2014). Consistent with these RDS studies, our results indicated that RDS is a suitable methodology for studying refugees, migrants, and similar types of populations. Such populations typically have dense social networks, and the structure of social relationships corresponds well with basic RDS assumptions (Tyldum and Johnston, 2014). Recently, researchers in Poland compared the effectiveness of RDS and quota sampling in migration research and found that RDS not only resulted in faster data collection, but also generated higher quality data (Górny and Napierała, 2016).

Our results regarding fish consumption indicate that fishing is culturally and economically important to the Burmese refugee and immigrant populations, and increased awareness of local fish advisories is needed. A study of low income women in California found that immigrants and refugees from Southeast Asia consumed more locally caught fish than their white counterparts, but had markedly lower fish advisory awareness. This is speculated to be the result of language barriers and lower education levels (Silver et al., 2007). Another study among Southeast Asian communities in Rhode Island showed that only a third of the population was aware of fish advisories, and less than half of participants had any knowledge of environmental toxins found in fish, such as mercury and PCBs (Ratnapradipa et al., 2010). However, among the Hmong refugees in northeastern Wisconsin who participated in the Fox River Environment and Diet Study, almost all were aware of fishing advisories for local waters, probably due to wide local media coverage of PCB contamination at the time of the study. Additionally, more than 90% reported changing their fishing habits in response to the advisories such as reducing local fish consumption and changing fishing locations (Schantz et al., 2010).

As with any observational research, our study was subject to limitations. First, the sampling weights used in the RDS analysis are partially dependent on the degree to which refugees would have knowledge of their peers' fishing behaviors and fish consumption. Despite that, our data and field observations during the sampling period indicated that the Burmese refugees in Buffalo have formed well-connected communities, and in this shared social environment, fishing habits and lifestyles of their peers are well known. Secondly, the accuracy of responses on fishing behaviors and fish consumption may have been affected by recall bias. Participants were asked to recall their local fish consumption, in each of the four seasons, over the course of the past 12 months. Additionally, we speculate that some refugees were fishing without a license. Due to social desirability bias associated with fishing without a license, those participants may have underreported their fishing behavior and fish consumption. Some individuals may have overreported their level of local fish consumption in order to receive the $75 incentive for participation. However, we do not believe this to be an issue because our data consistently showed high levels of local fish consumption among the Burmese participants. Thirdly, it is possible for reporting bias to have occurred due to the language difference among the multiple ethnic groups of the

Burmese. However, all interviewers were carefully selected and properly trained using standardized materials.

RDS has the potential to be an effective methodology for sampling refugees and immigrants in conducting biomonitoring and environmental exposure assessment. RDS enables researchers and organizations to access the hard-to-reach populations and generate population-based estimates. We recommend that adequate formative research be conducted to understand the underlying social intricacies of networks and other key population characteristics (Johnston, et al., 2010). Expanding collaboration to include local organizations that are well connected to the population can improve upon the efficiency of the RDS methodology. Due to high fish consumption and limited knowledge of fish advisories, some refugee and immigrant populations are more susceptible to exposure to environmental contaminants. Therefore, fish advisory awareness needs improvement by use of more tailored and effective health messaging (media, resettlement staff, etc.) in these communities, especially among the elderly and people of low literacy.

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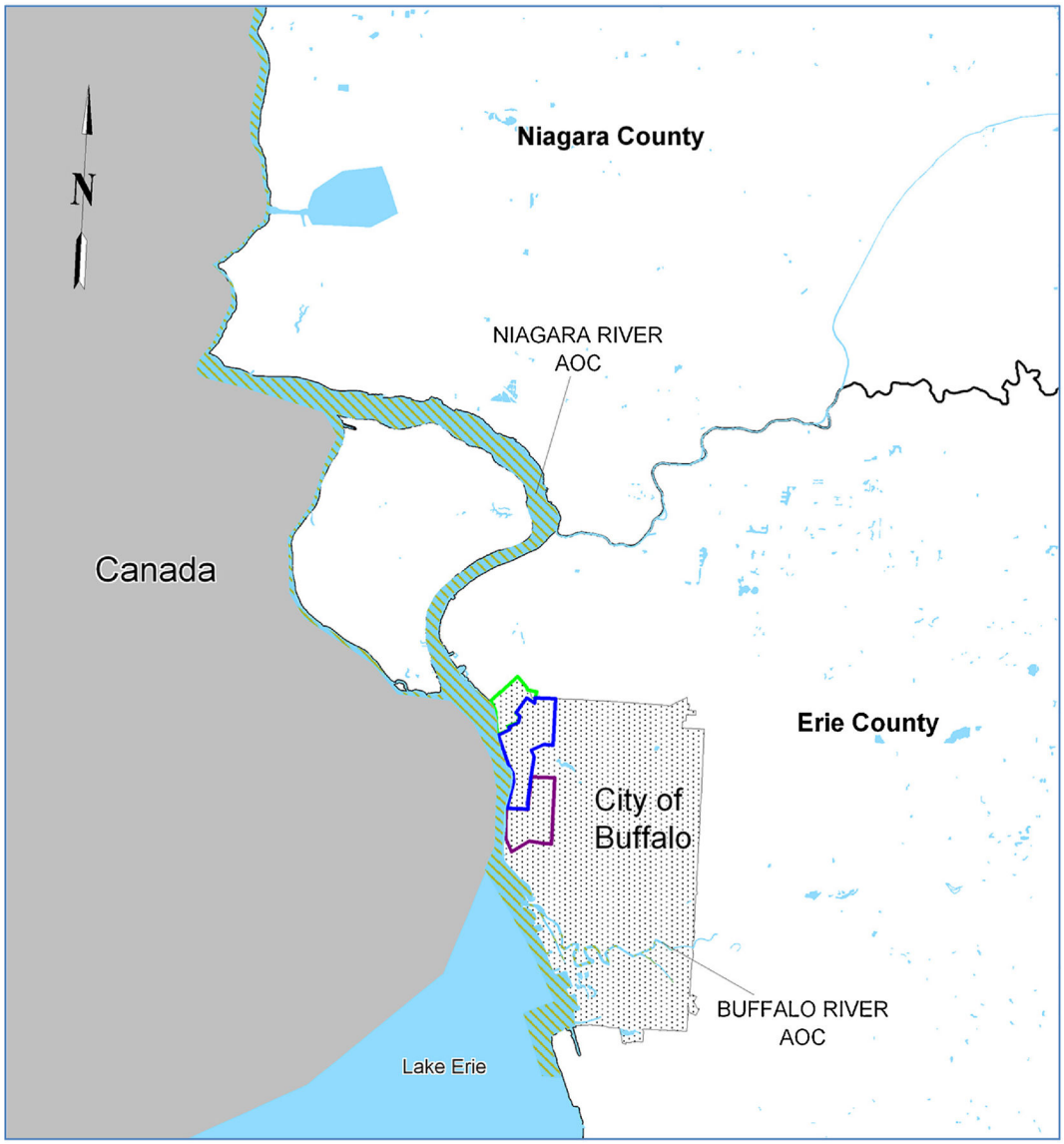

Fig. 1.

Map of the Buffalo River and Niagara River Areas of Concern, the City of Buffalo and three neighborhoods (outlined in green, blue, and purple) where refugees from Burma reside. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

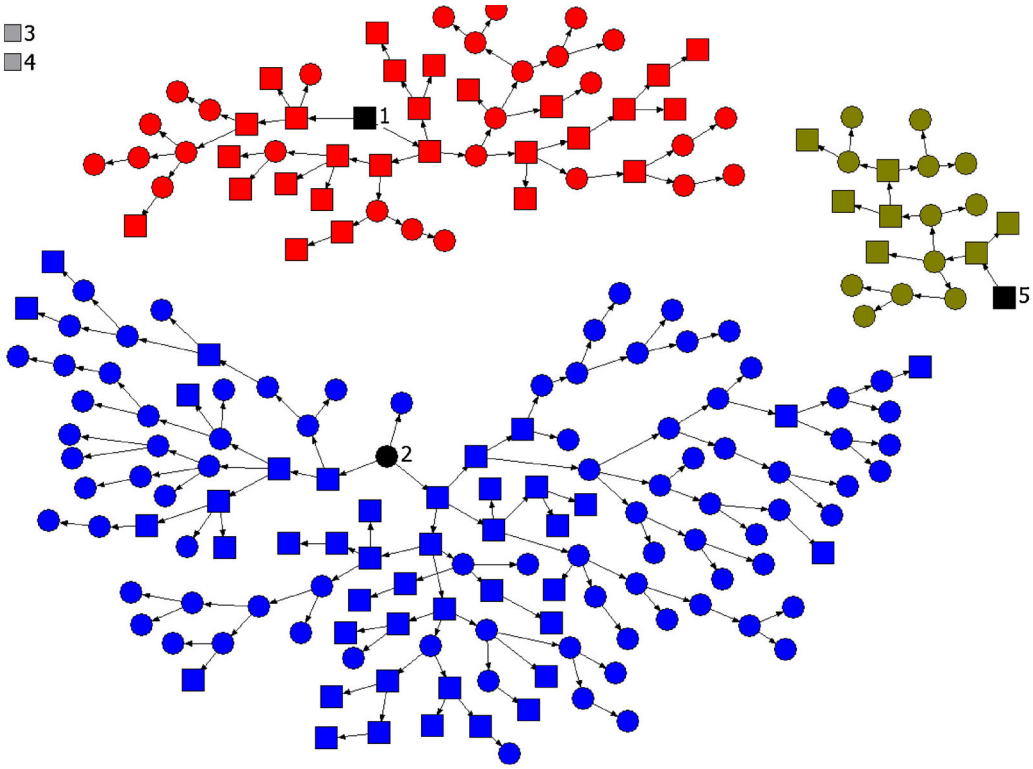

Fig. 2.

Recruitment diagram for a respondent driven sample of 205 Burmese refugees in Buffalo, NY, USA who ate Great Lakes fish. This figure illustrates the recruitment chains by seed and a maximum chain length of nine waves. The figure also illustrates cross-group recruitment using gender as an example. Gender was one of the key variables assessed for homophily and equilibrium. Gender homophily was found to be moderate, and the sample reached equilibrium on gender before the final wave. Black = active seed. Red = recruits derived from seed 1. Blue = recruits derived from seed 2. Green = recruits derived from seed 5. Grey = inactive seed. Square = male. Circle = female. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

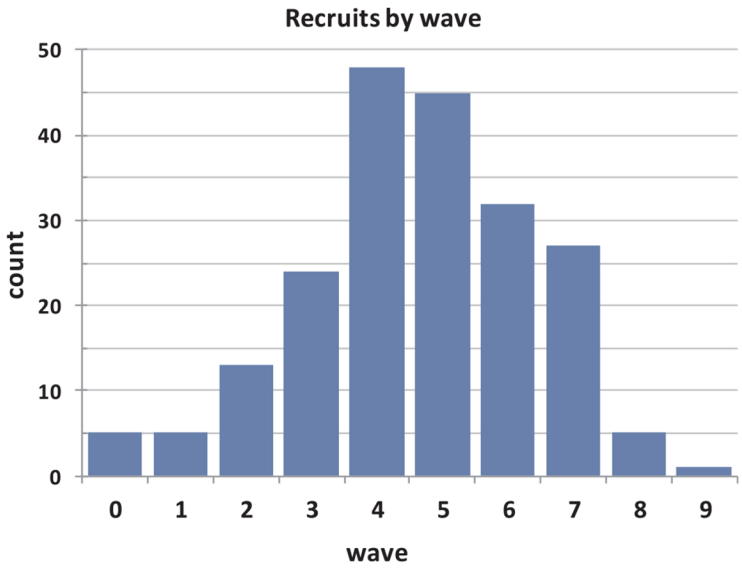

Fig. 3.
Recruitment by wave in the RDS sample of Burmese refugees in Buffalo, NY.

Table 1

Demographics and residential history of 205 Burmese refugee study participants, Buffalo, NY.

Variable	N	Unadjusted %	Adjusted[a] %	Adjusted 95% CI
Sex				
Male	81	39.5	39.5	(26.5, 53.1)
Female	124	60.5	60.5	(46.9, 73.5)
Age				
18–29	49	23.9	20.5	(11.3, 29.3)
30–44	100	48.8	45.7	(34.6, 56.8)
45–59	43	21.0	26.4	(16.3, 38.2)
60 +	13	6.3	7.4	(1.8, 15.8)
Ethnicity				
Karen	95	50.3	46.9	(21.0. 66.7)
Burman	39	20.6	15.2	(3.1, 26.9)
Karenni	27	14.3	17.9	(0.0, 53.7)
Other (Chin, Kachin, Rakhine, other)	28	14.8	20.0	(8.9, 34.3)
Country of Origin				
Burm a/My anmar	185	97.4	98.0	(93.2, 99.9)
Thailand	5	2.6	2.0	(0.1, 6.8)
Years in USA				
< 4	83	40.7	42.8	(29.8, 55.4)
≥4	121	59.3	57.2	(44.6, 70.2)
Years in Buffalo				
< 4	98	48.3	47.4	(34.5, 59.9)
≥ 4	105	51.7	52.6	(40.1, 65.5)
Lived in Other USA Cities				
Yes	36	17.8	18.5	(9.8, 26.8)
No	166	82.2	81.5	(73.2, 90.2)
Lived in Refugee Camps				
Yes	174	86.1	83.9	(71.4, 94.4)
No	28	13.9	16.1	(5.6, 28.6)
Years in Refugee Camps				
< 10	82	47.7	45.3	(33.1, 62.2)
10– < 20	67	39.0	39.2	(23.2, 49.3)
20–30	23	13.4	15.5	(5.9, 29.8)
Literacy Status				
Yes	151	74.0	67.5	(56.8, 78.4)
No	53	26.0	32.5	(21.6, 43.2)
Years of School Completed				
None	56	28.0	34.9	(23.0, 44.7)
1–4	48	24.0	23.9	(15.9, 36.2)
5–9	51	25.5	26.7	(15.6, 35.0)

Variable	N	Unadjusted %	Adjusted[a] %	Adjusted 95% CI
10–16	45	22.5	14.4	(7.9, 25.6)
Employment Status				
Yes	59	28.9	24.6	(15.4, 35.8)
No	145	71.1	75.4	(64.2, 84.6)
Receive Food Stamps				
Yes	172	84.3	86.1	(75.7, 93.9)
No	32	15.7	13.9	(6.1, 24.3)
Receive WIC Services				
Yes	77	38.9	36.1	(27.6, 49.1)
No	121	61.1	63.9	(50.9, 72.4)
Cigarette Smoking				
Never	138	68.7	66.8	(54.9, 76.9)
Previous	18	9.0	6.8	(2.2, 13.6)
Current	45	22.4	26.3	(17.2, 36.9)

[a]Adjusted population proportion and 95% confidence intervals calculated by RDSAT.

Table 2

Fish consumption among Burmese refugee study participants, Buffalo, NY.

Variable	N	Unadjusted. %	Adjusted[a] %	Adjusted 95% CI
Freeze Fish Locally Caught				
Yes	192	94.1	92.5	(86.5, 97.2)
No	12	5.9	7.5	(2.8, 13.5)
Times per Week Ate Local Fish in Summer (June-August)				
Up to 2	69	33.8	37.5	(27.4, 48.9)
> 2 to 3	66	32.4	31.3	(20.4, 41.7)
> 3 to 6	44	21.6	19.5	(12.1, 28.1)
> 6	25	12.3	11.7	(4.7, 20.1)
Times per Week Ate Local Fish in Fall (September and October)				
Up to 1	53	27.2	31.8	(17.9, 43.6)
> 1 to 2	57	29.2	26.9	(17.3, 38.3)
3	48	24.6	18.0	(10.5, 25.8)
> 3	37	19.0	23.3	(13.4, 37.1)
Times per Week Ate Local Fish in Winter (November-March)				
None	56	29.5	39.1	(26.0, 55.5)
Up to 1	50	26.3	26.6	(12.0, 35.6)
> 1 to 2	38	20.0	16.3	(8.1, 27.3)
3 or more	46	24.2	17.9	(9.2, 32.0)
Times per Week Eating Fish Paste				
< 1	32	18.7	23.0	(13.5, 36.9)
l-< 2	40	23.4	14.9	(7.6, 28.6)
2–4	49	28.7	30.4	(15.4, 40.8)
> 4	50	29.2	31.7	(18.9, 43.5)
Awareness of Local Fish Advisories				
Yes	78	38.8	60.2	(52.7, 73.2)
No	123	61.2	39.8	(26.8, 47.3)

[a] Adjusted population proportion and 95% confidence intervals calculated by RDSAT.