

Facilitating mental health screening of war-torn populations using mobile applications

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Abstract

Background War-torn populations are often hard to screen for mental health disorders. Classical data collection approaches, such as paper-based, online, or SMS-operated, are either infeasible or lack accuracy due to a variety of challenges associated with dynamics and consequences of war.

Methods In this paper, we introduce a novel approach for accurate and fast screening using free open-source software, Open Data Kit (ODK) mobile application. This approach was developed by the Palestine Children's Relief Fund (PCRF) to assess the mental health symptoms of 986 Palestinian children (age 6–18) in the aftermath of Israel's Operation Protective Edge (OPE) in 2014. The organization developed assessment questionnaires and trained local field workers on the use of the mobile application, and on recruiting and interviewing war victims.

Results War-affected children were found to suffer from several alarming symptoms associated with post-traumatic stress disorder (PTSD), depression, and somatic symptoms. Children with highest number of psychological symptoms were referred for further evaluation and treatment.

Conclusions The use of ODK mobile technologies facilitated efficient screening of affected children in war zones.

The offline data collection capability was crucial for handling the difficult conditions associated with war-torn areas, enabling timely intervention for urgent cases. Further applications of the novel mobile technology are to be explored.

Keywords PTSD · Mental health screening · ODK · Gaza · War trauma

Introduction

As a consequence of war and military assaults, civilians including children are subjected to a multitude of traumatic events. Consequently, they develop various outcomes from social malfunctions (e.g., aggression, isolation, and lost sense of safety [1–4]) to more serious psychopathologies (e.g., adjustment difficulties, depression, anxiety, and post-traumatic stress disorders [1–7]). These psychiatric disorders can be amplified in an ongoing war zone where the anticipation of another round of military violence compounds the severity of the trauma experienced [8–10]. Detecting these symptoms and disorders during or after war is crucial towards developing successful mental health intervention programs.

However, mental health screening and even basic data collection procedures within a war-zone face several methodological challenges and barriers. First, the safety of the field workers conducting the mental health screenings and those participating will always be at risk in a war zone [11]. Second, war-affected countries often lack the capacity (and often the interest) to provide adequate technical guidance to mental health organizations [11], leaving them with culturally and technically inconvenient tools that generate low-quality data. Third, the lack of basic

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infrastructure and human resources limits the accessibility to target populations and the ability to collect the required data [11]. A fourth challenge arises from the political pressure and trepidations of residents of war zones that might affect recruiting enough participants to obtain valid results [12]. These challenges call for innovative data collection approaches to facilitate accurate and well-timed screenings while guaranteeing the security and safety of both the field workers and participants.

In this paper, we introduce a groundbreaking data collection approach that mitigates these challenges using free open-source software. We present how it was designed and applied to measure the extent of psychological damage experienced by children living in Gaza after the 2014 Israeli military offensive, known as Operation Protective Edge [13]. The screening procedures were conducted by the Palestine Children's Relief Fund (PCRF) [14]; a registered non-governmental organization. PCRF has been providing otherwise inaccessible medical and surgical services to children since 1991. We discuss how we were able to overcome the logistic obstacles of data collection with the PCRF to successfully conduct a mental health screening for 986 children living in the Gaza strip in the summer of 2014. This paper is organized as follows: in "Preliminaries," we list required backgrounds and related work; "Methodology" covers the methodology used in this screening, and in "Results" we report the results of the screening, and provide a thorough discussion and concluding remarks in "Discussion" and "Conclusions," respectively.

Preliminaries

Classical screening methods

Data collection in developing countries and areas that lack information system infrastructure mainly relies on paper-based tools, which is associated with typical problems in data transmission, storage, and data analysis [15, 16]. Moreover, a large overhead is expected when digitizing paper-based data (e.g., time consumed for training workers and post-processing). Other methods that have been employed in under-resourced areas are online surveys and Short Messaging Services (SMS). While they have special accessibility advantages when short surveys are conducted, they have many length and usability limitations [16, 17].

Background on Gaza

In brief, the Gaza strip is a narrow zone of land (50 km long and 5–12 km wide) along the Mediterranean Sea

between Israel, the occupied Palestinian territories, and Egypt, populated by roughly 1.8 million people. It is comprised of three main zones: North, Central, and South Gaza, which includes Khan Yunis and Rafah; see Fig. 1. Gaza has been under continuous siege and military blockade since 2006 with significant restrictions to movement as well as limited access to clean water, healthcare, and medical services [18, 19]. Over half of its residents (55%) are registered refugees living in refugee camps [20]. Gaza has experienced multiple military offensives since 2008. For children in Gaza, the latest Israeli offensive in 2014 marked the third of its kind in less than 6 years [21]. Operation Protective Edge (OPE) lasted for 51 days in the summer of 2014 and claimed the lives of more than 2220 Palestinians, including at least 547 children [13].

Methodology

Shortly after the Israeli military attack on Gaza in the summer of 2014, PCRF decided to conduct a mental health screening for children in Gaza. The aim of the screening was to assess the severity of the psychological impact of the military offensive to identify and refer high risk children for further clinical evaluation and management in addition to helping further guide the development of multi-layered psychosocial mental healthcare interventions in Gaza. Throughout the years of operations in Gaza, the PCRF team has accumulated knowledge about the socio-economic and conflict dynamics in Gaza, making it apparent that traditional data collection tools (paper-based,



Fig. 1 Map of Gaza strip (photo credit: Le Monde)

online surveys, SMS-based surveys) are not convenient options for Gaza. In fact, the unpredictability of events in that context might at any time jeopardize the data collection, storage, or dissemination of information. In this section, we describe the methodologies used by PCRf to conduct its surveys, recruit participants and train its field workers.

Mobile data collection application

To develop a convenient and sustainable data collection approach, PCRf used the Open Data Kit (ODK) software [22]. ODK is a free and open-source set of tools designed to empower individual users or organizations to build information services that collect, store and distribute data in developing countries and under-resourced areas [23, 24]. ODK is composed of three main set of functionalities: *Build*, *Collect*, and *Aggregate*. *Build* is a form designer that enables users to create surveys using drag and drop options without the need for sophisticated programming skills. *Collect* is an application that runs on Android devices which display the created surveys. *Collect* also sends the collected survey data from the Android devices to the server for storage. *Aggregate* manages collected data on the server and allows for the extraction of data in many formats (e.g. spreadsheets). ODK tools can be used together or independently. Through ODK, we were able to easily build a web-based mental health screening survey without the need to hire a third party developer. Data collected using ODK is stored on computers, local servers, or cloud servers. We chose to upload the data to a cloud server for safe storage, avoiding the risk of damage to local storage by potential military activity. Once the collected data was verified, it was imported into a software system called Netsuite. Netsuite is an online database that allows the PCRf to organize the data and decide on the best way to allocate resources. The end result of using the ODK was establishing a feasible, easy to use, and efficient system for data collection, storage, and management.

Training field workers

Training on using software

PCRf provided the field workers with battery powered Android devices (tablets and smartphones) where they downloaded the collect application to display the created surveys. PCRf *information technology director* provided training to the field workers on how to navigate the survey and upload the collected data using the ODK software. The PCRf team reported that the survey application hosted by *collect* was easy to use and navigate. Moreover, field

workers were able to retrieve the entered data when needed even if it was already uploaded to the server. This feature was found to be very useful as often errors in data entry or missing information were detected by the information technology director allowing the field workers to revise their data entry. This facilitated a very efficient process of data entry and resulted in zero missing values. Furthermore, the *collect* application, once downloaded on the Android devices, can operate offline without the need for internet connectivity. Thus, data was stored in the device and uploaded to the server whenever internet connection was available. In addition, the *collect* application supports different languages, including Arabic allowing appropriate language usage.

Training on conducting screenings

Since interviewer effects can seriously impact the quality of collected data [25], PCRf arranged multiple training sessions for the field workers in an attempt to standardize the interview process prior to administering the surveys. The training was conducted by the *lead psychiatrist* and a translator and included basics around common symptoms of trauma, depression and anxiety, trauma responses and appropriate language to use in addressing traumatic events. Each item from both screening questionnaires was discussed individually to review the translations and address questions social workers had about the content of the screenings. In addition, to ensure that data collection procedures were culturally and linguistically sensitive, field workers chosen were fluent in Arabic, originally from Gaza, and had relevant experience working with children.

Measures

Two screening questionnaires were initially developed in English to identify both traumatic events exposure as well as subsequent mental health symptoms. Traumatic events questions were based on the types of destructive events relevant to the recent war in Gaza, including home destruction, witnessing loss of life, homelessness, witnessing injury, shelling, etc. The screening of mental health symptoms was devised based on DSM-IV [26] criteria for Post-Traumatic Stress Disorder. Since the traumatic effects of war are usually interrelated, we included questions that screen for depression, anxiety, and somatic symptoms [27, 28]. A brief description of the survey sections is illustrated in Table 1. For easier administration and scoring, PCRf used binary responses for both screening questionnaires. The traumatic events survey was part of the screening process to examine the relationship between the amount and nature of traumatic events to the development of psychiatric symptoms in this population. The two

Table 1 Description of PCRf mental health survey sections

Section	Brief description
Demographics section	Includes questions about age, gender, area of residence (Gaza North, Central, and South)
War-related medical injuries	A brief question asking about the presence of physical injury related to war (e.g. bombing, shelling, and shot wounds)
Mental health evaluation	
PTSD	Includes 15 questions assessing re-experiencing, hyper-arousal and avoidance/numbness criterion. The questions were based on DSM-4 PTSD criteria
Depression	Includes five questions evaluating concentration, feelings of sadness, fatigue, change in appetite, and crying spells
Somatic symptoms	Includes four questions evaluating physical symptoms that usually accompany depression or PTSD, e.g., abdominal pain, headaches, and urinary incontinence
Other symptoms	Two items were developed asking about fear related to sleeping or being alone (often reported by children in crisis)
Mental health care received	To screen for those receiving mental healthcare, in the form of therapy and/or medications
Observational notes	An open-ended section where the field workers documented their observations about the mental health status of the child

questionnaires were reviewed and translated by several native Arabic speakers and medical professionals to ensure the screenings were linguistically accurate and culturally appropriate. After the instruments were translated into Arabic, an independent bilingual physician reviewed the translation to ensure it matched with the English version. The final questionnaires were available in both Arabic and English; the interviews were conducted with children in Arabic.

Recruiting participants

In the aftermath of the 2014 military offensive, PCRf social workers identified 1400 children as candidates for mental health screening. The 1400 children were identified from the PCRf registry. Their families were receiving aid from PCRf. The screening was conducted to identify children from the registry with medical and psychological needs. Of these 1400 children, 327 were displaced and could not be reached. All the families contacted agreed to participate in the screening except for one family who did not participate for cultural reasons. Out of the remaining 1072 children, 986 met the target age of 6–18 and their parents and children consented orally to take part in the psychological screening. The field workers explained the purpose and the nature of the mental health screening to the families prior to obtaining the parental agreement. In total, 986 surveys were administered; all were fully completed and uploaded to the ODK database. Field workers were supervised by the lead psychiatrist who provided guidance on how to deliver culturally and linguistically sensitive interviews. The entire screening process was completed and data were uploaded to the cloud in a period of six weeks.

Results

Data was examined for normality and missing values using SPSS version 20 (Statistical Package for Social Sciences software). No missing values were detected in our sample. Given the large sample size, a normal distribution was assumed and parametric tests (Pearson correlation) were applied. In this section, we summarize our findings using frequency and percentage statistics.

Demographics

The mean age of the participants was 11.5, while the standard deviation was 3.6 (range 6–18). The sociodemographic section revealed that the sample comprised of 405 (41.1%) girls and 581 (58.9%) boys. Nearly, half of the participants lived in south Gaza (48.3%). Frequencies and percentages of the demographic variables are summarized in Table 2.

Table 2 Frequencies and percentages of the demographic variables

Characterization	Frequency	Percentage (%)
Gender		
Female	405	41.1
Male	581	58.9
Living area		
North Gaza	289	29.3
Central Gaza	221	22.4
South Gaza	476	48.3
Medical injury		
Yes	438	44.4
No	548	55.6

Table 3 Frequencies and percentages of traumatic events experienced by the screened children

#	Traumatic event	Frequency	Percentage (%)
1	House shelling	530	53.8
2	House Demolition	404	41.0
3	Injured by occupying forces (shelling, tanks, bombing, and artillery)	684	69.4
4	Shot at with live ammunition	50	5.1
5	Beaten by occupied forces	4	0.4
6	Family members been killed by occupying forces	213	21.6
7	Family members been injured by occupying forces	547	55.5
8	Witnessed anyone being beaten by occupying forces	22	2.2
9	Witnessed anyone being killed by occupying forces	130	13.2
10	House or community used by the occupying forces for their operations	207	21.0
11	Used as human shield by occupation forces	0	0
12	Family used as human shield by occupation forces	4	0.4
13	Family arrested by occupation forces	4	0.4
14	Denied access to access to medical care	39	4.0
15	Family denied access to medical care	41	4.2
16	Became homeless	361	36.6
17	Family became homeless	372	37.7

Traumatic war experiences

Children from Gaza have experienced a wide range of atrocious war-related experiences as illustrated in Table 3. These 17 war experiences were identified by the lead psychiatrist with the help of local health professionals working in Gaza as a comprehensive list of war traumatic events that Gazan children might have experienced. Of the 17 war experiences, the mean number of reported war traumatic events was four (SD 2, range 1–12). The most reported traumatic experience was being injured by the occupying forces (69.4%) and having a family member injured by the occupying forces (55.5%), and having their house shelled (53.8%). The least reported traumatic events were having a family member used as a human shield (0.4%) or being arrested by the occupying forces (0.4%). None of the children were used as a human shield. Table 3 illustrates the frequency and percentages of traumatic events experienced.

Post-traumatic symptoms

Screened children suffered from a wide range of hyperarousal, re-experiencing, depressive, and somatic symptoms as illustrated in Table 4. Of the 26 possible post-traumatic reactions, the mean number of symptoms experienced was 15 (SD 5, range 2–26). The median PTSD symptoms reported by the children was 15. The most reported symptoms were feeling upset (85.1%) and jumpy

or easily startled (84.4%). On the other hand, 67.2% of the children reported suffering from at least one somatic symptom. The most reported somatic symptoms were headaches or nausea (38.3%) and daytime or bed wetting (31.3%), as shown in Table 4. To stratify children for referrals, as a first step, we chose to refer children with the highest 10% of total post-traumatic symptoms for further clinical evaluations. This resulted in 120 children with a total trauma score above 21.

Discussion

While the aim of the PCRf screening was to identify children in need of further mental health interventions, it also revealed important information about the prevalence of mental health symptoms and disorders in Gaza in the aftermath of the 2014 military offensive. The PCRf mental health screening indicated a high prevalence of a variety of psychological symptoms (of PTSD and depression) among 986 Gazan children. Half of the children suffered from a total of 15 post-traumatic symptoms. The high prevalence of PTSD symptoms among children living in Gaza is consistent with similar findings reported in the literature [6, 8, 20, 29, 30]. In addition, the comorbidity of depression has previously been reported about children living in war zones [20]. This indicates the importance of screening for a broad spectrum of disorders to accommodate for the complexity of the expected trauma. More than half of the

Table 4 Statistics of post-traumatic stress and depression as well as somatic symptoms experienced

	#	Symptom	Frequency	Percentage (%)
Post-traumatic stress and depression symptoms	1	Upsetting or hurtful pictures	787	91
	2	Feel the event happening again	650	75.1
	3	Feel upset	736	85.1
	4	Nightmares or bad dreams	592	68.4
	5	Body problems when think or hear about the event	399	46.1
	6	Think, feel, or talk about the traumatic event	562	65
	7	Avoid activities, people, and places	423	48.9
	8	Trouble remembering in the past two months	219	25.3
	9	Trouble with expressing feelings	350	40.5
	10	Irritable or anger fits	638	73.8
	11	Overly careful	663	76.6
	12	Jumpy or easily startled	730	84.4
	13	Trouble focusing	596	68.9
	14	Loss of interest	456	52.7
	15	Sleep disturbances	496	57.3
	16	Feeling down, depressed or hopeless	408	47.2
	17	Low energy	328	37.9
	18	Thinking about death	387	44.7
	19	Crying a lot	388	44.9
	20	Changes in appetite	357	41.3
Somatic symptoms	1	Daytime or bed wetting.	271	31.3
	2	Bowel changes (stomach aches, diarrhea, or constipation)	204	23.6
	3	Headaches or nausea	331	38.3
	4	Heart beats fast or sweat	195	22.5
Others	1	Afraid to be alone	713	82.4
	2	Trouble sleeping alone at night	701	81

children were reported to experience somatic symptoms in the form of headaches, stomach aches, appetite changes, bowel changes, enuresis, and palpitations. This adds to the growing body of literature that examines the relationship between trauma spectrum disorders (e.g., PTSD and depression) and somatic symptoms [31].

The use of ODK technology proved to be an easy, efficient, and feasible data collection tool in resource constrained communities like Gaza for a multitude of reasons. First, the compatibility of ODK with smart phones and tablets resulted in lower costs compared to the use of computers and laptops in data collection. In addition, training the field workers on data entry using smart phones and tablets was relatively easy given that most of them were already familiar with this type of technology. Moreover, mobile phones and tablets have the ability to run in disconnected environment with power and internet shortages. The field workers could keep the data stored on their devices until internet access became available. Second, uploading the data to cloud computing infrastructure to be

stored on servers that are located outside Gaza protected the data from being lost from potential military activity. Moreover, the use of ODK saved the PCRf the costs associated with building and running local servers for data storage. In addition, creating and maintaining a local data storage system requires technical expertise that is usually difficult to find in under-resourced areas. Third, we found *ODK build* to be an easy application for designing data entry surveys. Field workers were able to navigate back and forth through the survey and retrieve the data entered efficiently. Finally, stored data could be retrieved from *ODK aggregate* in many forms which facilitated its exportation to other storage sites or data analysis software. To ensure secure data collection and retrieval procedures and to protect patient privacy, access was always guarded by passwords. There are different levels of access and sharing of data depending on the person's tasks and responsibilities.

Several limitations of the mental health screening exist. Although the development of the questions of the mental

health screening was based on DSM-4, we did not validate the screening instrument. Further studies are needed to validate the screening instrument. Second, Gaza has a unique economic and geographical climate. In addition, the nature of the trauma in Gaza is repetitive and continuous. Findings from the mental health screening cannot be generalized to other regions in Palestine or elsewhere.

Conclusions

We have presented a novel screening approach using ODK technology to facilitate efficient and accurate data collection, aggregation and analysis, particularly in war zones. We highlight the importance of finding appropriate, cost-efficient, secure, and efficient data collection strategies in low resource areas to promote the development of effective clinical interventions. On the other hand, the efficiency of using ODK for offline data collection makes it appealing for several other survey applications, particularly in war zones or other post-disaster settings.

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