Gender-Based Evaluation of Physical, Social, and Economic Challenges in Natural Disasters Management

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ABSTRACT

The characteristics and interrelations of each gender are constructed under geographic, cultural, social, and economic conditions. The differences in their understanding of and vulnerability to natural disasters cause them to evaluate the importance of probable challenges through post-disaster recovery process differently. Without considering gender-based requirements in post-disaster recovery planning, it is not possible to fully meet the needs of the community. In this study, the physical, social, and economic challenges after a disaster were evaluated according to both women's and men's opinions. To meet the objectives of this study, (1) the potential challenges were identified through a thorough literature review, (2) a survey was developed and distributed to women and men who had been involved in at least one major disaster during the last decade, (3) the results were statistically analyzed, and (4) the challenges were weighted and prioritized. Twenty-seven challenges were identified from which 19 were determined statistically significant. In addition, the top-three weighted challenges for natural disaster management were "low revenue of the local government," "low level of average household income," and "lack of family/friends who can help emotionally." Overall, the results indicated that women had a different perspective of disaster recovery challenges comparing to men. The results of this study establish a basis for better understanding the differences between women's and men's insights into disaster recovery challenges, and can be utilized to develop policies that enhance the resiliency of the communities and reduce their vulnerabilities to extreme natural events.

INTRODUCTION

While natural disasters often impact communities broadly, residents are not equally at risk of loss and harm, nor are they equally able to recover. Gender-specific effects can be a source of increasing vulnerabilities (Gaillard et al., 2015; Kermanshachi et al., 2019). Women, girls, boys, and men belonging to different age and socio-economic strata have distinct vulnerabilities that shape the way they experience and recover from disasters (Bolin, 1993). In countries where gender discrimination is tolerated, women and girls are particularly vulnerable to natural hazards (Enarson and Chakrabarti, 2009).

Women are more severely affected by the impacts of disasters; however, they remain active, and their assistance needs to be considered during the recovery planning phase (Islam et al., 2014; Kermanshachi and Rouhanizadeh, 2018). Therefore, their

needs, based on their gender-based characteristics, should be specifically considered. While the post-disaster context presents a host of challenges for women, it is important to recognize that women are not just victims of disasters. Rather, significant evidence demonstrates that women are powerful agents of change during and after disasters (Lindell and Prater, 2003; Moreno, 2018).

Gender has rarely been considered as an important attribute in the process of post-disaster recovery, and women are more prone to be considered victims than men. Yet, few attempts have been made to perform a gender-based evaluation of post-disaster recovery challenges. Thus, this study aimed to perform a comparative analysis of men's and women's perspectives on the challenges and obstacles of post-disaster recovery. Potential social, economic, and physical challenges were identified, and a survey, based on the identified challenges, was developed and distributed to participants of both genders. After collecting the inputs, statistical analysis was performed to determine the weighted impact of each challenge, based on the input of each gender. The output of this research determines how differently men and women evaluate the post-disaster recovery challenges, and will help decision-makers develop disaster-recovery policies that increase the resiliency of the communities and reduce their vulnerabilities to devastating natural events.

LITERATURE REVIEW

Gender and Post-Disaster Recovery

There exist differences in women and men's perception about challenges and their importance after a disaster (Hettige et al., 2018). Traditionally, women perceive disaster threats more serious than men do (Islam et al., 2014). In addition, the roles men play in the post-disaster recovery phase totally varies with the one of women (Siriwardana et al., 2018). For example, in Hurricane Andrew, the responsibility of women was to care the household affairs and family members. In the meanwhile, men took the responsibility of areas out of houses (Zorn and Shamseldin, 2014; Nipa and Kermanshachi, 2020).

To avoid ignorance of women and men's needs and capabilities in post-disaster recovery, understanding both side's concerns and perspectives toward potential challenges could be crucial (Jordan and Javernick, 2013; Rouhanizadeh and Kermanshachi, 2020a). Social justice between the two genders varies; therefore, it is important to consider the perspectives of men and women separately while evaluating the importance of challenges in the process of post-disaster recovery (Drolet et al., 2015; Nipa et al., 2019). In fact, since women are more vulnerable to the consequences of natural disasters (Gaillard et al., 2015), gaining a proper understanding of their concerns could be a key to reducing and preventing the negative consequences affecting their situation. Gender analysis has grown both in influence and scope during the past decades (Enarson and Chakrabarti, 2009; Rouhanizadeh and Kermanshachi, 2020b). As a result, governments have increasingly strived to address the specific gender challenges in their planning, even though they are still far from adequate considerations (Jordan et al., 2011; Rouhanizadeh et al., 2019a).

In the aftermath of Hurricane Mitch that devastated Honduras and Nicaragua in 1998, women organized disaster recovery efforts, including hauling cement and

building temporary shelters and latrines, in addition to undertaking governance initiatives and working to restore livelihoods (Jordan and Javernick, 2013). After the 2015 earthquake in Nepal, women played a crucial role in rebuilding efforts, despite the major impact that the disaster had on this vulnerable community (Hettige et al., 2018). Some women were trained as masons to help repair and reconstruct houses, infrastructure, and cultural sites, and women's groups successfully advocated for the integration of gender equality and women's empowerment in disaster recovery and reconstruction efforts (Zorn and Shamseldin, 2015; Rouhanizadeh et al., 2019b). In 2017, a series of earthquakes in Mexico prompted women's groups to step up and actively contribute to rescue efforts and the rebuilding of their communities (Hettige et al., 2018; Safapour and Kermanshachi, 2020). Yet, too often women's contributions to recovery and reconstruction are undervalued or invisible, despite evidences that demonstrate that deeper and more sustainable recovery can be achieved when promoting gender equality and women's empowerment during disaster recovery processes.

Post-Disaster Recovery Challenges

Different factors might cause challenges in post-disaster recovery context. In the literature, it was shown that researchers used different challenges to measure the recovery of society after disaster. Table 1 shows the list of identified challenges from the literature that are labeled C1 to C27, and identifies their literature source. The identified challenges were classified in three categories including economic, social, and physical. In addition, a brief discussion of some of these challenges is provided.

The average household income, which shapes recovery in many ways was one of such challenges (Islam et al., 2017; Rouhanizadeh and Kermanshachi, 2019a). According to Islam et al. 2017, a community with a small monetary gap between the annual incomes of its citizens is able to overcome the sudden economic shock better than one where the gap is larger. Another challenge in disaster recovery is the number of active contractors after the disaster (Lindel and Prater, 2003). The existence of the same number of active contractors before and after a disaster is a clear indication that the society is restoring itself (Mozumder et al., 2014). Throughout the literature, employment and employment sources were acknowledged as two important measuring tools for disaster recovery (Smith et al., (2013); Jordan et al., 2013; Rouhanizadeh and Kermanshachi, 2019b).

Voluntary public participation of business organizations, governmental and non-governmental organizations, volunteer groups, international agencies, the civil society, and affected community is another challenge in post-disaster recovery process (Hwang et al., 2014). The average level of education of the residents creates knowledge and behavior divisions and consequently affects the recovery process (Jordan and Javernick, 2013). Experience in having faced a similar kind of disaster is also very important to the recovery process, and actions related to disaster recovery that resulted from natural instincts and were passed down through generations have often been more effective than simply obeying the authority (Bolin 1993). Having close family members and/or relatives in times of disaster helps people recover mentally (Bolin, 1993; Enarson and Chakrabarti, 2009; Moreno, 2018). Researchers also found that air quality, erosion rate, water quality, and amount of debris are important environmental recovery

challenges (Siriwardana et al., 2018), with debris as the most cited challenge. Damage to major infrastructure systems is another important recovery challenge; thus having a development plan can have positive impacts on the quality of recovery (Jordan et al., 2011; Hettige et al., 2018). The next important recovery challenge is managing the volume of highway traffic after the disaster (Drolet et al., 2015). The loss of access can harm the business sector by making the business location inaccessible for the employees, or it can make it difficult for the contractor to bring the resources that are necessary for the reconstruction to the site.

Table 1. List and Sources of Identified Challenges

ID	Challenge and Category	Source(s)
	Economic	
C1	Low level of average household income	Islam et al. (2017).
C2	Insufficient number of available contractors	Lindel and Prater (2003).
C3	High rate of unemployment	Smith et al., (2013).
C4	High level of average housing value	Aguirre (2000).
C5	High level of average lost household income	Islam et al. (2017).
C6	Low revenue of the local government	Lindel and Prater (2003)
C7	High level of lost business income	Drolet et al. (2015).
C8	Diversity in types of industry	Gaillars et al. (2015).
C9	Insufficient number of active businesses	Jordan et al. (2011).
	Social	
C10	Lack of voluntary public participation	Hwang et al. (2014).
C11	Low education level of residents	Jordan and Javernick (2013)
C12	Unavailability of disaster recovery training	Bolin (1993).
C13	Lack of family/friends to help financially	Hwang et al. (2014).
C14	Lack of family/friends to help emotionally	Bolin (1993); Moreno (2018).
C15	Lack of a community looking for each other	Moreno (2018).
	Physical	
C16	High population density	Jordan et al. (2011).
C17	Unavailability of medical services	Zorn and Shamseldin (2014).
C18	Late debris removal	Siriwardana et al. (2018).
C19	Late resolution of air/water quality issues	Drolet et al. (2015).
C20	Environmental harm affecting industry	Alston (2013).
C21	Environmental contamination	Alston (2013).
C22	Damage to residential housing	Jordan et al. (2011).
C23	Damage to high-rise buildings	Siriwardana et al. (2018).
C24	Damage to medical services	Hettige et al. (2018).
C25	Insufficient number of infrastructures	Zorn and Shamseldin (2014).
C26	Damage to major infrastructure systems	Zorn and Shamseldin (2014).
C27	Highway traffic volume	Hettige et al. (2018).

RESEARCH METHODOLOGY

The methodology of the current study consisted of six major steps. First, a thorough literature review was conducted through which peer-reviewed articles, conference papers, and other documents were analyzed. Then, based on the literature,

the potential physical, social, and economic challenges were identified. In the third step, a survey was developed to determine the gender-based importance of each post-disaster recovery challenge. In step four, the survey was distributed among two targeted groups, women and men. Fifth, the inputs of both groups were statistically analyzed and tested. Finally, men and women's perspectives toward the potential challenges were evaluated and compared. Figure 1 shows the research methodology of this study.

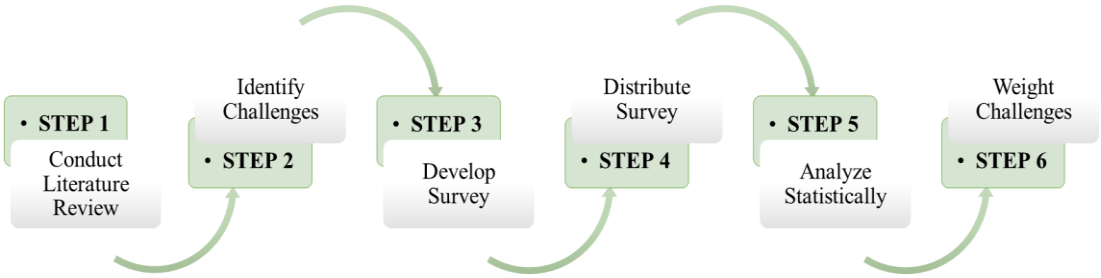

Figure 1. Research methodology

Kruskal-Wallis Test

The Kruskal-Wallis test is a non-parametric test that determines whether there is a significant difference between two groups of an independent variable, based on a continuous or ordinal dependent variable. The test statistic, H, can be obtained by using equation 1.

$$H = (N-1)\frac{\sum_{i=1}^{g} n_i(\bar{r}_i-\bar{r})^2}{\sum_{i=1}^{g}\sum_{j=1}^{n_i}(r_{ij}-\bar{r})^2} \quad (1)$$

Where,
n_i is the number of observations in group i,
r_{ij} is the rank,
N is the total number of observations in all groups,
$\bar{r}_i$ is the average rank of all observations in group i, and
$\bar{r}$ is the average of all r_{ij}.

Chi-Epsilon Method

Epsilon squared measures the effect size and is one of the least common measures of effect sizes, namely omega squared and eta squared. This method is defined as another name for adjusted R^2. The effect sizes are computed by utilizing equation 2.

$$E_R{}^2 = {H}/{(n^2-1)/(n+1)} \quad (2)$$

Where,
H is the obtained value from the Kruskal-Wallis test,
n is the total number of observations, and
$E_R{}^2$ is the coefficient that assumes the value from to 1.

Research Hypothesis

The significance of the challenges in post-disaster recovery process, based on women's perspectives, was tested. The challenges that were shown to be insignificant were excluded from the list of potential post-disaster recovery challenges. Thus, the proposed hypothesis was:

- Null hypothesis (H_0): Gender does not have any impact on individual's perceptions regarding post-disaster recovery challenges.
- Alternative Hypothesis (H_1): Gender has impact on individual's perceptions regarding post-disaster recovery challenges.

The hypothesis was tested for each of the potential challenges, using statistical methods that were based on inputs from the surveys.

DATA COLLECTION

The list of potential challenges identified from literature was utilized to develop a survey that consisted of questions and sub-questions based on each challenge. The challenges were scored by the participants in a 1 to 7 Likert-scale format. The survey was first pilot tested by 10 people to ensure the clarity of the questions. A sample question from the survey was:

What types of disaster damages do you think make the recovery process difficult or slow?

- Damage to major infrastructure systems: Score from 1 (not at all important) to 7 (extremely important).

The survey was distributed, using email, hard copies, and social media, to men and women who had been involved in at least one major and critical disaster in the last decade. The gender distribution of the participants is shown in Table 2. The survey respondents consisted of 16% of women and 84% of men.

Table 2. Gender Distribution of Participants in the Survey

Gender	Percent (%)
Female	16
Male	84
Total	100

In addition, 77% of the women and 78% of the men had an education level beyond that of a high school degree, and the majority had earned a bachelor's degree. The education level of the participants is shown in Table 3.

Table 3. Education Level of Participants in the Survey

Education Level	Percent (%)	
	Women	Men
High School Diploma	23	21
Some College, No Degree	8	9
Two-year College	11	13
Bachelor's Degree	37	41
Master's Degree	21	15
Doctoral Degree	0	1
Total	100	100

RESULTS AND DISCUSSION

The mean score of each potential post-disaster recovery challenge was calculated, and comparisons of the responses of men and women are shown in Figure 2. As demonstrated in Figure 2, women scored the importance of all of the challenges higher than men. This might be justifiable by considering that women are more vulnerable, and consequently may worry more about uncertain events (Gaillard et al., 2015). Lack of education (0.73), environmental contamination (0.46), and damage to residential housing (0.40) were the challenges that were scored men and women score most differently.

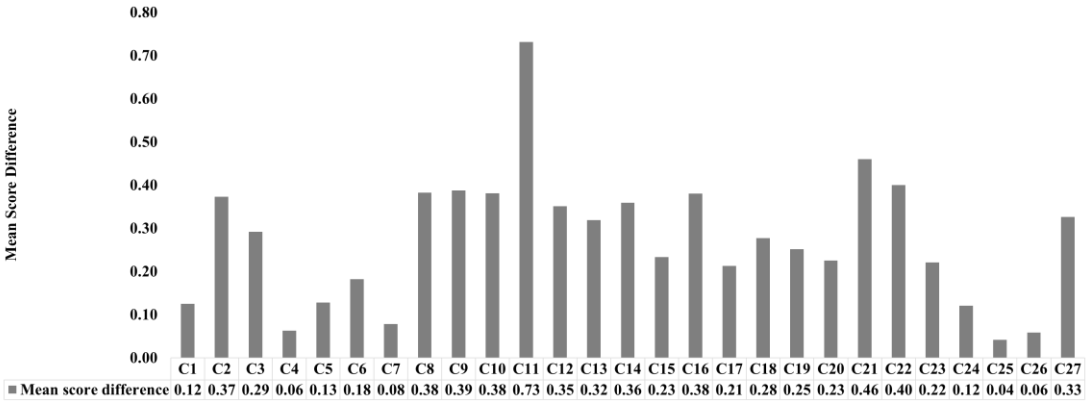

Figure 2. Differences between mean score of challenges given by women & men

The significance of the differences between the women and men groups regarding their perceptions of post-disaster recovery challenges was tested, using the Kruskal-Wallis test. The P-value of each potential challenge with 95% significance level was estimated for each group. Among the 27 identified challenges, 19 challenges were determined statistically significant, as indicated in the third column of Table 4.

Weighting and Prioritizing the Challenges

Prioritizing the potential challenges, based on the gender inputs, can provide the decision-makers with insight that will enable them to develop disaster-recovery policies that will enhance the resiliency of the communities and reduce their vulnerabilities to natural disasters. For this purpose, the challenges should be measured and prioritized. Different techniques are available for weighting, and the Chi Epsilon method, which enables comparing the calculated size effects of challenges, was found to be the most appropriate method for this study.

As shown in the fourth column of Table 4 “low revenue of the local government,” “low level of average household income,” and “lack of family/friends who can help emotionally” weighted the top-three challenges with regard to gender. The costs of recovery process should be initially provided by the local governments; thus, if they are not prepared financially, delays in this process of post-disaster recovery and reconstruction is likely to happen. Furthermore, a low income community faces with more difficulties recovering after a disaster occurs. For example, for purpose of housing in the affected area, the families with higher level of income would perform the reconstruction faster than the low-income families. In addition, after a disaster, one

of the main challenges is to bring back the community to normal health situation. For this purpose, the affected individuals having people help them emotionally would recover faster than the ones with no help.

Table 4. Significance Test and Weighting Results

ID	Challenge	P-value	Weight	Rank
C6	Low revenue of the local government	0.004*	0.1000	1
C1	Low level of average household income	0.019*	0.0947	2
C15	Lack of family/friends who can help emotionally	0.020*	0.0895	3
C2	Insufficient number of available contractors	0.020*	0.0842	4
C19	Late resolution of air and water quality issues	0.031*	0.0789	5
C8	Diversity in types of industry	0.032*	0.0737	6
C24	Damage to medical services	0.037*	0.0684	7
C11	Low education level of residents	0.035*	0.0632	8
C18	Late debris removal	0.038*	0.0579	9
C27	Highway traffic volume	0.039*	0.0526	10
C23	Damage to high-rise buildings	0.041*	0.0474	11
C5	High level of average lost household income	0.039*	0.0421	12
C17	High population density	0.043*	0.0368	13
C25	Insufficient number of infrastructures	0.049*	0.0316	14
C10	Lack of voluntary public participation	0.045*	0.0263	15
C21	Environmental contamination	0.049*	0.0211	16
C14	Lack of family/friends who can help financially	0.048*	0.0158	17
C16	Lack of a community looking out for each other	0.050*	0.0105	18
C7	High level of lost business income	0.049*	0.0053	19

**Significant differences with 95% confidence.*

The results also showed that integrating gender analysis is vital to planning for post-disaster recovery because of the different viewpoints women and men. Transferring the results of this analysis to practitioners and policymakers might assist in achieving a more resilient and less vulnerable community.

CONCLUSION

The impacts of gender distribution in vulnerable communities rarely have been studied. This study conducted a gender-based evaluation of post-disaster recovery challenges. Twenty-seven potential challenges from physical, economic, and social categories were identified among which 19 were significant statistically. Furthermore, the top-three weighted challenges were “low revenue of the local government,” “low level of average household income,” and “lack of family/friends who can help emotionally.” The results also showed that integrating gender analysis while planning for post-disaster recovery is vital, due to the different viewpoints of women and men. Transferring the knowledge resulting from this integration to practitioners and policymakers might be helpful in achieving a more resilient and less vulnerable community. Furthermore, gender challenges should be integrated into disaster research, planning, and organizational practice.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support and generosity of the Center for Transportation Equity, Decisions and Dollars (CTEDD), without which the present study could not have been completed.

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