VÉDELEM TUDOMÁNY
KATASZTRÓFAVÉDELMI ONLINE TUDOMÁNYOS FOLYÓIRAT

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SHORT COMMUNICATION: QUANTITATIVE ANALYSIS ON GENDER RELATED VULNERABILITIES AND FATALITIES IN DISASTER SITUATIONS IN SOUTH AFRICA.

Abstract

South Africa is a country which faces major challenges with disasters. The aim of this short communication is to report on the findings of current research that assesses the general fatalities which are recurrent over the years and are likely to increase when there is a disaster of magnitude. Representation of data by Statistics South Africa has improved over the years since the previous calculations were done and this has allowed the previous model to be re-designed to suite the available data making the calculations slightly more accurate. The notable increase of disaster related death rates in women since 2015 necessitates further assessments of the risk factors of this cause. Thus there is a need of future studies to focus on monitoring and ensuring that the female disaster related death rates. The socio-economic vulnerability still exists among women in South Africa. The results of this study can therefore be used by relevant stakeholders to assess in detail factors that are leading to increases in DRDR.

Keywords: gender, vulnerability, fatality, statistic

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A TÁRSADALMI NEMEK SEBEZHETŐSÉGÉNEK ÉS ELHALÁLOZÁSÁNAK MENNYISÉGI ELEMZÉSE A KATASZTRÓFÁK SORÁN DÉL-AFRIKÁBAN

Absztrakt

Dél-Afrikában számos katasztrófa nehezíti a hatékony védekezést. A cikkben a szerzők felmérik az évek során bekövetkezett általános haláleseteket. A GII bevezetése megkönnyítette a társadalmi és gazdasági sebezhetőség felmérésének lehetőségét. A Dél-afrikai statisztikai adatok alapján az elmúlt években javulás figyelhető meg az előző időszakokhoz képest, azonban egyes adatok további kockázat értékelést igényelnek. A szerzők vizsgálják, hogy a férfiak és nők egészségi állapota miért tér el egymástól, emellett bemutatásra kerül a dél-afrikai kormány néhány határozata is a katasztrófa kockázatok csökkentéséről, illetve a katasztrófák utáni helyreállításról. A cikk eredményeit az érintett felek felhasználhatják a DRDR növekedéséhez.

Kulcsszavak: társadalmi nem, sebezhetőség, haláleset, statisztika

1. INTRODUCTION

WHO describes gender as the socially constructed characteristics of both men and women, where certain norms, roles and relationships are expected to be followed by men and women differently (WHO, 2018). These norms and behaviours are taught from childhood and anyone who fails to follow these norms can often be stigmatized and discriminated against by the society. This gives a highlight of how the practice of gender differences is important in societies. Access to resources and certain lifetime opportunities can be limited to a certain gender, thus giving rise to vulnerabilities and these can have profound effect on the fate of individuals from a particular society during disaster situations. Power imbalances are seen when certain roles are expected for men rather than for both sexes. This creates a

disadvantage to women in terms lack of access to certain opportunities such as education and healthcare. Some traditional practices such as Female Genital Mutilation increase the vulnerability of the female part of population in many African countries (Abdulcadir et al. 2017).

South Africa is a country located in the southern region of Africa. The latest population estimate was 56.520 million in 2017 (Statistics South Africa, 2017a). Of this population it is estimated that 51% is female (Statistics South Africa, 2017b). In 2015 the human development index (HDI) of South Africa was 0.666, ranking South Africa position 119 out of 188 countries (UNDP, 2017). The HDI of 0.666 is classified as medium level of human development. An increase in HDI has been seen in South Africa, where there was a 7.3% increase from the year 1990 to 2015 (UNDP, 2017). The female HDI is 0.651 and that of men is 0.677 (UNDP, 2017). Gender Development Index (GDI) was introduced internationally in 2014 and it is a ratio of male to female human development (UNDP, 2017). The ratio takes into consideration three indicators of the HDI namely, health, education and command over economic resources (estimated GNI per capita for both men and women) (UNDP, 2017). The GDI of South Africa is 0.962 (UNDP, 2017). The Gender Inequality Index (GII) of South Africa was 0.394 in the year 2015 (UNDP, 2017).

The life expectancy at birth stood at 61.2 years for men and 66.7 years for women in 2017, according to the official government statistics (Statistics South Africa, 2017b). HIV/AIDS is one of the most prevalent diseases in South Africa and it has increased from 4.9 million in 2002 to 7.06 million in 2017 (Statistics South Africa, 2017b). About a fifth of women of ages 15-49 in South Africa are HIV positive (Statistics South Africa, 2017b). This is within the most productive age range. HIV/AIDS is the major contributing factor in maternal mortality where it accounts for more than 30% of maternal deaths (Statistics South Africa, 2015c). To prevent death, all pregnant women who test HIV positive are instantly placed on antiretroviral treatment (Statistics South Africa, 2015c). A study showed that women exposed to gender-based violence are at higher risk of HIV infection (Dunkle et al 2004). This comes with an assumption that abusive men are most likely to have extra-marital relationships, and because of abuse the woman will be afraid to suggest the use of condoms. This highlights the social vulnerability of women.

Gender-based violence is one of the problems faced by women in day to day life and worsens in disaster situations. This compounding factor of disaster impacts has been defined in the United Nations Declaration on the Elimination of Violence against Women (1993; UN, 2018): as "any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life". Spread of infectious and sexually-transmitted diseases has been linked to intimate partner violence and gender inequalities (Jewkes et al. 2010; Dunkle et al. 2004). Some progress was made in South Africa at the end of 2015, where women had 42 parliament seats in 2013 although the 50/50 goal wasn't reached (Statistics South Africa, 2015d). Equality of seats in the parliament would mean that there will be shared decision making in terms of policies and regulations which aim at women empowerment. Prioritization of issues pertaining to women can also be practiced if there are more women to support this in the parliament. Sustainable Development Goal (SDG) 5 focuses on Gender Equality, aiming at eradicating discrimination against women and children. It stresses the importance of empowering women, as a way of helping build economic growth.

In South Africa, the National Senior Certificate pass rate showed that male individuals excel better than females (Statistics South Africa, 2015d). Data from UNDP Human development report showed that 73.7% of women of ages 25 and older had at least secondary education, and this is compared to 76.2% of men in the years 2005-2015 (UNDP, 2015). The level of education determines the type of jobs which a person will qualify for in the labour market. Emergence of women-owned informal businesses has been seen in the past decades (Henning & Akoob 2017). These businesses have come to rise because of widespread female headed households (Henning & Akoob 2017).

Vulnerability refers to social, economic, health and political processes of a disaster-prone area which measures the ability of a population to anticipate, resist, cope and recover from the effects of exposure to a hazard (Cardona, 2005; Blaikie, 2001). The gender aspects of disaster vulnerability fall under both social and economic vulnerabilities. Socio-economic factors which bring rise to gender inequalities are assessed in this research. Women and child headed families are more vulnerable to poverty thus increasing negative effects of disasters. Health factors are also taken into consideration when reviewing gender inequalities.

The current study on gender analysis helps in providing a quicker response system in a disaster situation. Roles of men and women in disaster help in identification of individual needs thus allowing prioritization of people in need for immediate help. The inequalities between men and women worsen in disaster situations, with women being the worst off. By understanding that gender and disasters are closely interconnected, more risk reduction practices can be put in place. It is a continuation of the 2013 study which was published by Tandlich et al. (2013a).

2. METHODOLOGY

Reliable data sources used in this chapter are World Bank data, Statistics South Africa and INDEX MUNDI. A trend of data collection on the respective sites over the years will be assessed to determine accuracy of data used. Key words and phrases used to search for background information to support the study included “gender vulnerability”, “gender & disasters”, “human development” and “disaster fatalities”. Search engines namely Scopus and Google Scholar were used. This study is a follow-up on the vulnerability calculations done by Tandlich et.al. (2013a). Previous study successfully assessed gender disparities using mathematical equations. Assessment of gender related vulnerability trends and disaster related fatalities in South Africa were initially done for the years 1997-2009. The follow-up is for the years 2010 to 2016. Gender inequality was assessed through evaluation of the progressions of health status over the years.

Gender Vulnerability assessment

Life expectancy at birth highlights the health status of a country, as well as the status of the and can be used for comparison between men and women. The comparison gives an idea of the gender disparities between men and women with respect to the average number of years they live up to. INDEX MUNDI, 2019 defines life expectancy at birth as “an indicator of the number of years a new-born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life”. Data from World Bank open data for life

expectancy at birth for both men and women were used to calculate the life-expectancy at birth index (LEABI) using Equation (1) below as defined by Tandlich et al. (2013a).

LEABI= Age (women)/Age (men) **Equation (1)**

Where

"Age (women) is the average life expectancy at birth of women in South Africa in years

Age (men) is the average life expectancy at birth of men in South Africa in years

The equation gives a dimensionless *LEABI* value" (Tandlich et al., 2013a).

Vulnerability will also be calculated by assessing the economic status of households. Unemployment rate can highlight the economic status of a household. The unemployment inequality index (UII) is used to assess which gender has a higher economic vulnerability. UII was calculated using Equation (2), as defined by Tandlich et al. (2013a).

UII= Unemployment Rate (women)/Unemployment Rate (men) **Equation (2)**

"The value of UII is also dimensionless" (Tandlich et al., 2013a).

The GII uses three indicators which are "maternal mortality ratio and adolescent birth rate, number of parliament seats and literacy rate" (Lardner, 2017). A value of GII covers both literacy rate and access to health with respect to the population. It quantifies the disadvantages of women in a society.

Mortality calculations

To quantify the gender aspects of disasters, data for causes of death will be used. The data used should give separate values for both men and women therefore allowing for the comparison between the two. Statistics South Africa database will be used to access morbidity data. Statistics South Africa (2018a) stated that there was 96% completeness of morbidity data between 2011-2016 for ages 15 and above. To ensure accuracy of results in this study all calculations will be for ages 15 and above. The morbidity data given gives a broad set of causes, some of which is not linked to disaster situations. The derivation and justification of the model calculations, as well as weighing of the appropriate data used in terms of non-natural/unnatural causes of death is in accordance with Tandlich et.al. (2013a). In this way, results of the calculations and the model results would only reflect the causes of death which

are directly linked to disaster situations and their impacts. In this instance non-natural/unnatural causes of death were looked at. Knowing that disasters cause unnatural deaths and not all unnatural deaths are directly linked to disasters, it therefore necessitates exclusion of data of indicators such as transport death rates, deaths resulting from medical or surgical errors and intentional harm.

Statistics South Africa provides data for "other external causes of injury (OECI) (WOO-X59). According to the WHO ICD-10 classification of injuries (WHO, 2016), the W00-X59 includes causes of death such as exposure to mechanical force, drowning, exposure to electric current and radiation, extreme climatic events (high ambient temperature or pressure), fire and smoke. The study by Tandlich et. al. (2013a) specified and explained how such causes can be related to natural or man-made disasters. The series X85-Y09 of the WHO ICD-10 shows the cause of injury as a result of assault (ADR) (WHO, 2016). The literature review mentioned the occurrence of gender-based violence. Therefore, assault will be included as a gender related event which can be linked to disasters. The morbidity data from Statistics South Africa gives a figure for death as a result of assault.

Another category of causes of death which was added was death due to legal interventions and operations of war (LIOW) (Y35-Y36). Series Y35-Y36 listed injuries due to refusal of arrest by police or any other law enforcing agents where such injury might be due to firearms, explosions or gas, Y36 lists injuries during war. Adding this as an example of a disaster related death goes in line with the study by Mkwakwami (2018b) which describes social unrest in South Africa as a form of a disaster.

The value for disaster related death rate (DRDR) will therefore be calculated using the Equation (3) below.

DRDR= OECI + ADR + LIOW **Equation (3)**

Where:

OECI is death due to other external causes of injuries which fall under the W00-X59 series if the WHO ICD 10

ADR is assault death rate falling under the X85-Y09 series of the WHO ICD 10

LIOW is death due to legal interventions and operation of war (Y35-Y36).

The values of DRDR should be presented as number of deaths per 100 000 population. The equation below shows how this will be calculated as shown in Equation (4).

OECI= (100000x Gender deaths)/Total population of South Africa Equation (4)

This equation will be used for all parameters of DRDR for each of the years covered by the study.

After calculating DRDR for both males and females, the disaster-related death inequality index (DII) (Tandlich et.al, 2013a) will be calculated using Equation (5).

DII= DRDR (women)/DRDR (men) Equation (5)

Microsoft Excel 2016 was used to perform the calculations (Microsoft Inc., Johannesburg, South Africa). Source data is labelled below all the tables and figures in the results and discussion section. The exact same data was extracted and used for calculations without rounding off at any point.

3. RESULTS AND DISCUSSION

Vulnerability Assessment

The value of Life Expectancy at Birth Inequality Index (LEABI) shows high vulnerability of women compared to men when it is below 1, and values above 1 show lower level of vulnerability of women and higher for men (Tandlich et al., 2013a). The *LEABI* values are above 1 as shown in Figure 1. This is because in South Africa life expectancy at birth of women is higher than that of men. This necessitates assessment in terms of quality of life difference between men and women. One way will be referring to the Gender Inequality Index (GII) to include factors such as maternal mortality, adolescent birth rate, literacy rate and number of seats in the parliament. From Figure 1, low GII gives higher values of LEABI but as GII increases the LEABI drops. A higher GII reflects to the high level of vulnerability and is inversely proportional to LEABI. As explained before low levels LEABI reflect high levels of vulnerability.

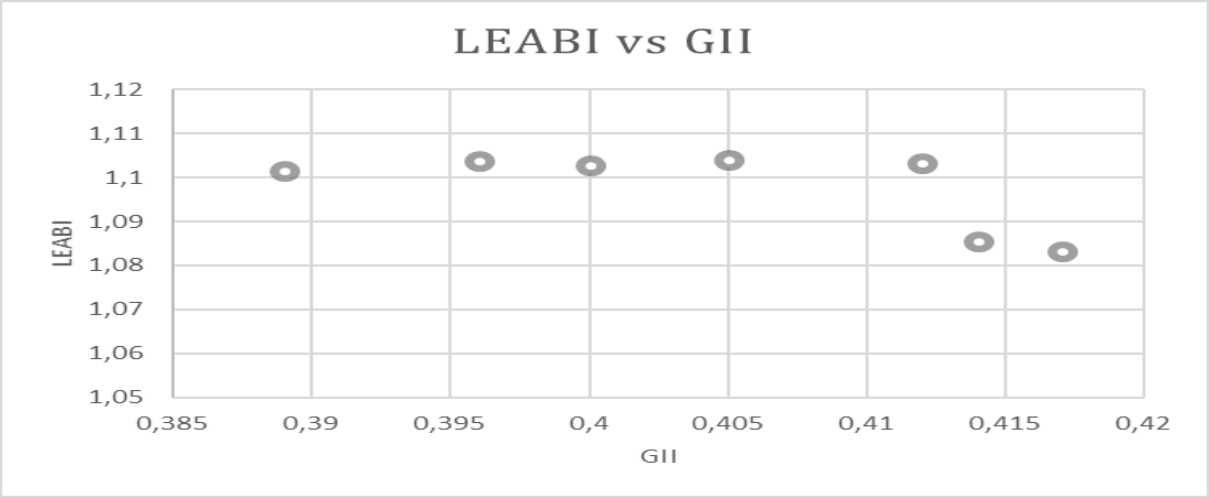

Figure 1: Life Expectancy at Birth Inequality Index (LEABI) vs. Gender Inequality Index (GII), which is an expansion of the model derived by Tandlich et al. (2013a).

The values LEABI values in Figure 1 were calculated for South Africa using equation 1 for the years 2010 to 2016. Data for LEABI was extracted from Statistics South Africa (2018a). GII values were for the years 2010 to 2016 and data was extracted from UNDP (2019b). The United Nations Development Programme (UNDP) has made available data trends on the public domain, statistics which give detail of gender aspect indicators in a country. These include a separate human development index (HDI) for both males and females, unemployment ratio of men and women, gender development index (GDI), estimated gross national income per capita for female and male and percentage of violence against women. All these can also be used to assess the level of vulnerability of female gender. Therefore, an already existing vulnerability can be exacerbated by the occurrence of disasters.

If the value of UII is above one, it shows that women are more vulnerable than men. Figure 2 illustrates the relationship between UII and GII that is to assess the relationship between unemployment and gender inequality. There was no systematic trend shown in Figure 2. Unemployment data for women is larger than that of men throughout the period in question, hence the values of UII larger than 1. The lowest unemployment rate that women ever had was the 2013 value of 26.7% and this corresponds with the estimated gross national income per capita for females which was also highest in 2013 at 9238 PPP$ according to UNDP (Statistics South Africa, 2019; UNDP, 2019a).

Note: The UII values were for South Africa for the years 2011 to 2016. The data was extracted from Statistics South Africa (2019). Equation 2 was used to calculate UII. The quarterly values of unemployment rate values from Statistics South Africa were averaged to give a yearly value. GII data was extracted from UNDP, 2019b. The relationship between HDI and GII is shown in Figure 3 and there is a negative correlation between HDI and GII as expected. A country will show lower gender inequality as the human development increases.

Mortality calculations

Data from 2010 to 2012 was given in broad age group categories. In 2013 Statistics South Africa separated the age groups into 6 different categories. This shows an improvement in the accuracy of the data. The fatalities data provided by Statistics South Africa for the period between 2007-2011 for 15 years and above, had a 94% level of completeness and from 2011 to 2016 this increased to 96%, therefore DRDR was calculated for ages 15 and above to ensure a high level of accuracy in the results (Statistics South Africa, 2014a, Statistics South Africa, 2018b).

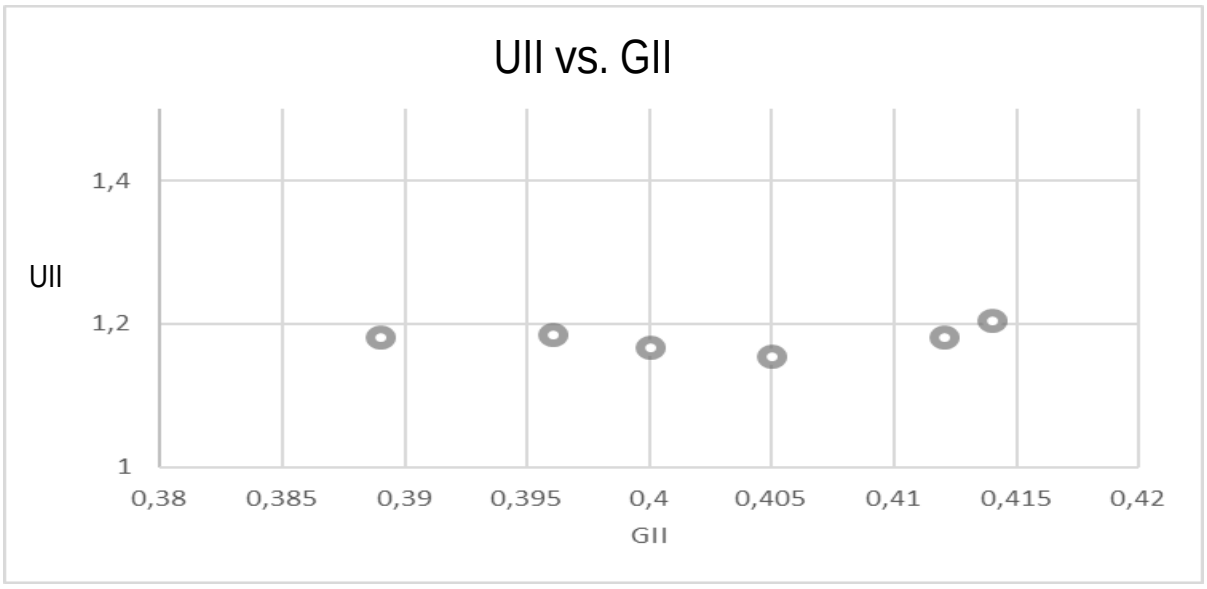

Figure 2: Unemployment Inequality Index (UII) vs Gender Inequality Index (GII)

From Table 1, it can be deduced that the most productive age group (15-49) years has the highest recorded number of disaster related fatalities. Also considering that ages 65+ usually accounts for a smaller number on a population pyramid the number of fatalities in question are very high throughout the years (Table 1). This highlights a very high vulnerability of elderly women. The male age group between 15-49 years had the highest fatalities because of higher OECI figures from 2013 to 2016 (see Table 2 for more detail). In the year 2015 there was a sharp increase in males with a cause of death attributed to OECI in all age groups which was followed by a drop in the numbers in 2016 except for men aged 65 and above.

Table 3 shows how female DRDR has been gradually decreasing from 2010 to 2014 followed by an increase thereof since 2015. This raises a question of how women were suddenly exposed to hazards that result from the unnatural causes of death in question. The previous study by Tandlich et. al. (2013a) showed significantly high figures of male DRDR with the highest being 172.6 per 100000 citizens in 2001. At the end of the previous study the DRDR value had decreased to 38.3 per 100000 citizens in 2009. In the current study Table 4 illustrates a decrease in male DRDR until 2015 where there was a 20.7% increase followed by a 54.5% decrease in DRDR in 2016.

DII can be used as an indicator of vulnerability. If DII is above 1 it would mean that women are more vulnerable to disaster related fatalities, and the closer the value is to zero males are said to be more vulnerable. The values of DII are shown in Table 5 show that men are more vulnerable than women. DII for 2016 indicates that males are two times more vulnerable than women to disaster related fatalities and this is an improvement on the male part since the last study by Tandlich et. al. (2013a) which concluded that men were five times more vulnerable than women with respect to exposure to disaster related fatalities.

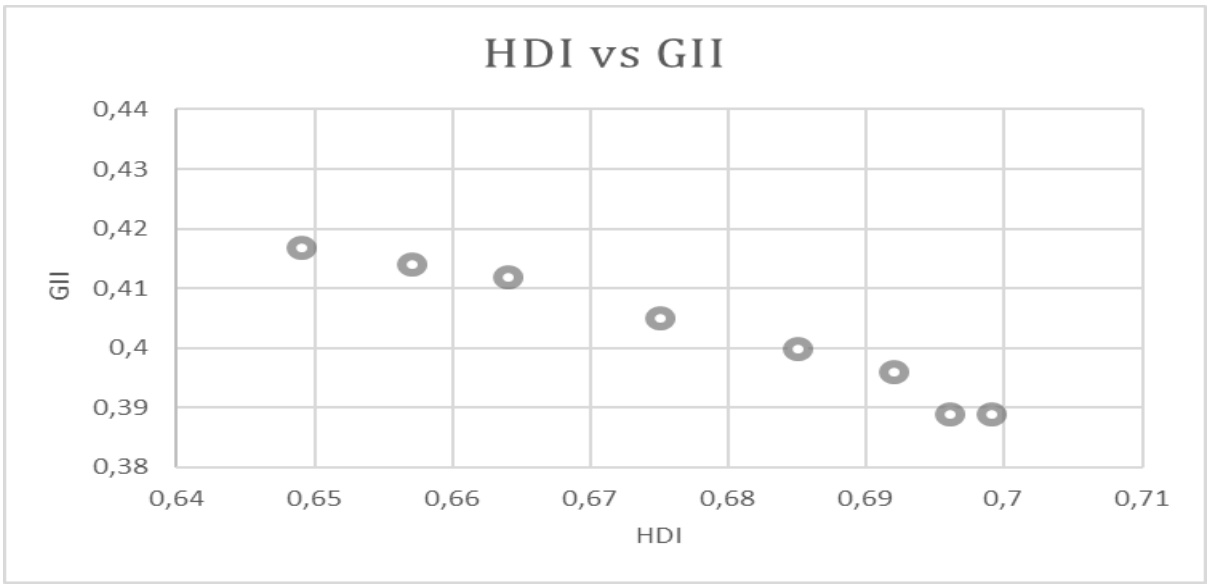

Figure 3: Human Development Index (HDI) vs Gender Inequality Index (GII)

Source: HDI data was extracted from UNDP (2019c) and GII was extracted from UNDP (2019b).

A possible explanation of this could be the nature of occupations which are male dominated which have high exposure to hazards. According to the literature, major disasters/calamities result in greater female fatalities than male as compared to smaller disasters (Neumayer & Plümper, 2007). This justifies the findings of this research since low magnitude disasters were recorded in South Africa during the period of study. This is based on disasters recorded by EMDAT database where 13 disasters occurred between 2010-2016, the highest number of fatalities (40 people both occasions) having been recorded in 2010 and 2011 due to a storm and floods respectively (EMDAT, 2020). This study has attempted to quantify variables which will essentially determine vulnerability and to some extent level of risk. The literature gives ratios of vulnerability based on statistics of number of people affected by a disaster. These statistics vary depending on nature of disaster, some studies say that women are five times and another study states that they are 14 times more likely to die in disasters than men (Habtezion, 2013).

Table 1: Female disaster related fatalities for years 2010 to 2016

Female																
year	2010		2011		2012			2013		2014		2015		2016		
Age	OECI	ADR	OECI	ADR	OECI	ADR	Age	OECI	ADR	OECI	ADR	OECI	ADR	OECI	ADR	LIOW
0-14	1413	29	1232	26	1325	27	0	318	9	344	7	356	4	357	5	
15-49	3706	505	3398	484	3363	477	1-14.	904	19	873	20	975	29	1018	22	
50-64	857	70	933	61	900	51	15-29	1445	229	1340	238	1575	305	1726	318	
65+	1309	56	1389	57	1439	51	30-44	1211	188	1194	179	1502	236	1510	267	
							45-64	1157	89	1135	91	1322	150	1466	141	1
							65+	1334	53	1325	64	1494	72	1584	91	

Source: Data for Other external causes of injury (OECI), Assault death rate (ADR) and Legal interventions and operation of war (LIOW) was extracted from the following sources: Statistics South Africa: 2013a, 2014a, 2014b, 2014c, 2015b, 2016a, 2017b, 2018b.

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Table 2: Male disaster related fatalities for years 2010 to 2016.

Male																	
year	2010		2011		2012			2013			2014		2015			2016	
Age	OECI	ADR	OECI	ADR	OECI	ADR	Age	OECI	ADR	LIOW	OECI	ADR	OECI	ADR	LIOW	OECI	ADR
0-14	2314	40	1232	49	2112	48	0	411	3	0	396	7	428	12	0	357	8
15-49	15867	3997	14714	3816	14706	3741	1-14.	1472	23	0	1488	38	1611	59	0	1018	43
50-64	2791	262	2577	257	2615	266	15-29	6931	2529	0	6544	2641	8191	3545	0	1726	3591
65+	1401	75	1324	71	1417	78	30-44	6020	1286	1	6121	1434	7658	1986	0	1510	2203
							45-64	3686	458	1	3665	462	4696	607	2	1466	701
							65+	1318	79	0	1260	68	1696	113	0	1884	119

Source: Data for Other external causes of injury (OECI), Assault death rate (ADR) and Legal interventions and operation of war (LIOW) was extracted from the following sources: Statistics South Africa: 2013a, 2014a, 2014b, 2014c, 2015b, 2016a, 2017b, 2018b.

Table 3: Female Disaster related death rates (DRDR) in South Africa from 2010 to 2016

Year	DRDR	Total population in South Africa	DRDR (cases/100000)
2010	6503	49991300	13.008
2011	6322	50586757	12.497
2012	6281	52998213	11.851
2013	5706	52982000	10.770
2014	5566	54002000	10.307
2015	6656	54956900	12.111
2016	7104	55908900	12.706

Note: Disaster Related Death Rate (DRDR) was calculated as outlined above using equations 3-5 and converted to cases/100000. The figures for total population of South Africa in the period of the study were extracted from Statistics South Africa: 2010, 2011b, 2013b, 2014d, 2015c and 2016b. The population data for the year 2012 was extracted from World Bank Data, 2019j.

Table 4: Male Disaster related death rates (DRDR) in South Africa from 2010 to 2016

Year	DRDR	Total population in South Africa	DRDR (cases/100000)
2010	24393	49991300	48.794
2011	22759	50586757	44.990
2012	22823	52998213	43.064
2013	22309	52982000	42.107
2014	22195	54002000	41.100
2015	28494	54956900	51.848
2016	13200	55908900	23.610

Note: DRDR was calculated using equations 3-5 as outlined above and was converted to cases/100000. The figures for total population of South Africa in the period of the study were extracted from Statistics South Africa: 2010, 2011, 2013b, 2014d, 2015c and 2016b. The population data for the year 2012 was extracted from World Bank Data, 2019.

Table 5: Disaster Inequality Index (DII) for male and female residents of South Africa

	DRDR per 100000 citizens		
Year	Female	Male	DII
2010	13.008	48.794	0.267
2011	12.497	44.990	0.278
2012	11.851	43.064	0.275
2013	10.770	42.107	0.256
2014	10.307	41.100	0.251
2015	12.111	51.848	0.234
2016	12.706	23.610	0.538

Note: DII was calculated using equation 5 and was rounded off to three decimal places.

4. CONCLUSION

The current research assesses the general fatalities which are recurrent over the years and are likely to increase when there is a disaster of magnitude. Introduction of the GII has eased the assessment of socio-economic vulnerability. Representation of data by Statistics South Africa has improved over the years since the previous calculations were done. This meant that some of the equations by Tandlich et. al. (2013a) had to be slightly adjusted to suite the available data making the calculations slightly more accurate. The notable increase of DRDR in women since 2015 necessitates further assessments of the risk factors of this cause. It also calls for the need of future studies to focus on monitoring and ensuring that the DRDR for females does not continue to increase. An increase in DII values since the last study shows that there has been an improvement in health status of men. However, socio-economic vulnerability still exists in women as GII and UII are still high. Some resolutions from the United Nations on gender inequality were adopted by the government of South Africa. UNCSW urged governments to integrate gender-sensitive policies for disaster risk reduction and response and post-disaster recovery (PMG, 2013). The results of this study can therefore be used by relevant stakeholders to assess in detail factors that are leading to increases in DRDR.

5. ACKNOWLEDGEMENT

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