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(RESEARCH ARTICLE)

The people with disabilities in Goma city; Their experience and coping mechanisms during the eruptions of Nyiragongo volcano

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Abstract

Population growth, especially that of persons with disabilities, PWD increases human vulnerability to the risks of the Nyiragongo volcano. The experience of PWD in the face of eruptions already lived could provide necessary guidance for disaster prevention. Through a survey coupled with a purposive and snowballing techniques, the data collected were subject to descriptive and inferential analysis. The results revealed that the majority of our respondents, 46.2% are young people who only experienced the 2021 eruption. Among those who experienced the 2021 eruption, that of 2002 and the one of 1977, i.e. 11.9%, no one of them is under 50 years old. During the volcanic crisis, most of our respondents, i.e. 68.7%, went through hardships, were left without support and felt abandoned in despair even by those around them. As a survival mechanism, 35.8% of our respondents said they had no choice but to wait for the alert like everyone else, while 31.3% of our respondents immersed themselves in prayer. Through the test of independence, a significant relationship had been observed between experience with eruptions and the survival mechanism. The more experienced, the respondent, the less likely it is to manage the crisis through inappropriate mechanisms. The authors recommend strengthening communication on volcanic risks including PWD in schools, universities and workplaces, as well as creating safer evacuation sites in the city and means of transportation for people with disabilities.

Keywords: Eruptions; Disabled people; Goma; Survival mechanisms; Nyiragongo volcano

1. Introduction

Among the eight volcanoes in the Virunga volcanic chain, two are still active, including Nyiragongo and Nyamulagira (Fiama, Mavonga, Subira, et al. 2017; Rusangiza, Mavonga, & Subira, 2017). Concerning volcanic risk in Virunga, Nyiragongo remains the most threatening, not only due to its more or less permanent activity but also and especially due to the size of the population within its reach, and particularly in the city of Goma [3]. Older lava flows that have already been studied scientifically bear witness to a series of gigantic ancient eruptions of Nyiragongo [4]. At the same time, scientists consider that the first well documented and best known eruption is that of January 10, 1977. Among the serious consequences recorded from the this one include losses of human life caused by the volcanic lava flow, the number of which is estimated between 74 and 400 people and between 800 and 1000 people lost shelters and agricultural land [5]. The eruption of Nyiragongo on 17 January 2002 was neither without human and material damage. It also took the lives of around 140 people and left around 120,000 people homeless and 300,000 people forced to evacuate the city of Goma [3]. As of May 22, 2021, Nyiragongo erupts again, the lava flow causes victims including 32 direct deaths and 450,000 people forced to move; some to Sake, Bukavu, Uvira and others to Rwanda[6]. The population growth in this area and the limited resilience, especially that of the population of people living with disabilities, PVH and those with chronic diseases, increases human vulnerability to this natural disaster which has already caused loss of human lives directly during and after the eruption; through lava flows, earthquakes and particularly the human

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suffocating gaseous emanations including the Mazuku [7]–[10]. These negative experiences of the eruptions of the Nyiragongo volcano required that the inhabitants of the city of Goma should be able to own a certain number of survival mechanisms under the guidance of the authority, both scientific, technical and political. And this is a permanent call for vigilance following the alert codes, staying tuned to the communication of the authority but also staying away from high-risk areas and waiting for evacuation in the case of a possible threat of eruption to be confirmed by the authority [11]. Particular attention should be paid to People with Disabilities (PWD) in the contingency plan because the limited mobility of this category, their inability to communicate and access information make them more vulnerable to volcanic risk than any other group[12]. The disabled people are two to four times more likely than the general population to die or sustain injuries during disaster events. The risk to this group is greater than the general population due to the effect of impairments including motor, sensory, cognitive-linguistic and activity limitations. Mobility and communication affect their ability to prepare, evacuate and recover from disaster events[13]. Despite the existence of several studies on the risks related to the volcanism and its impact in Virunga, the situation of PWD remains less addressed in the region [14]. At the same time, taking disability into account has become mandatory in disaster management since the entry into force of the United Nations Convention on the Rights of Persons with Disabilities in 2008. The Convention pertains a commitment made by states world over to take all necessary measures to ensure the protection and safety of persons living with disabilities in all conditions of risk, including natural hazards, conflict, and humanitarian emergencies [12], [15]. In addition, all individuals, families and communities exposed to disasters should be supported to develop coping mechanisms based on their own skills, knowledge, social and institutional networks with greater attention to persons with disabilities [14]. This study was conceived as an interrogation of the individual experience and survival mechanisms of people living with disabilities in the face of eruptions in order to see how to reinforce what helped, but also and above all to provide the necessary guidance to improve disaster prevention and reduction.

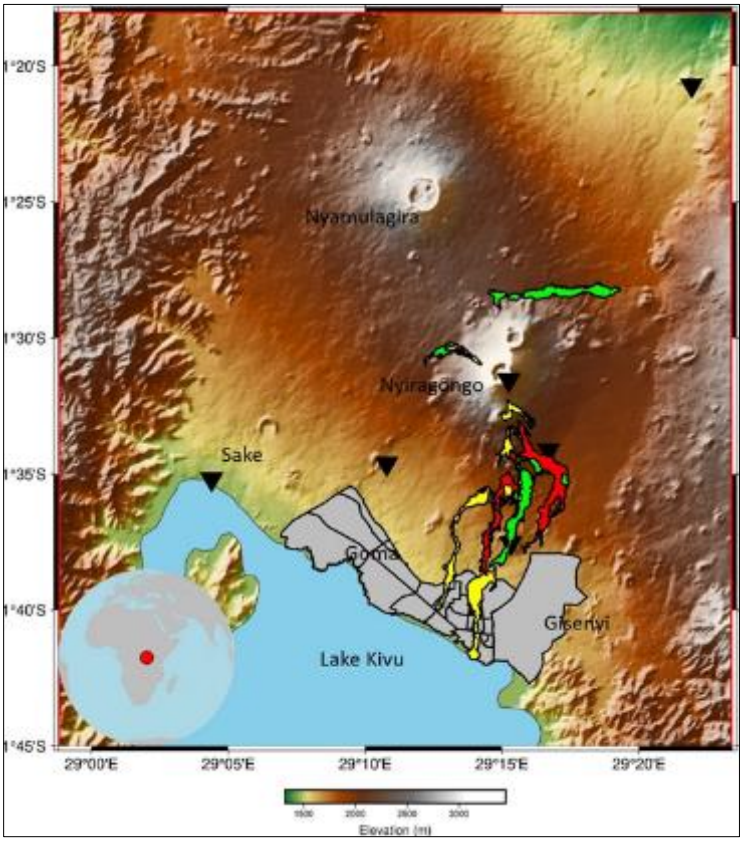

Figure 1 Location of Goma City and the documented destructive lava flows of Nyiragongo Volcano (Lava flow of 2021 (Red); Lava flow of 2002 (Yellow); and Lava flow of 1977 (Green))

2. Material and methods

To reach its main targets, this study used the purposive technique to identify key informants, including the responsible of organizations working to protect PWD who were even the final targets. In addition, snowballing technique made it possible to go from one key informant to another until satisfying information and location of important targets was achieved. To meet its objective, this study used these same techniques under a survey to collect data and then, the latter

were subject to descriptive and inferential analysis. We know that descriptive analysis consists of describing a trend, a condition or an attitude of an individual or a phenomenon. Under a case study approach, this analysis describes each unit, person or group individually according to their activity, their particular needs, their life situation, their life history or their experience[16], [17]. The experience of this study concerns the opinions of Persons with Disabilities, PWD, their witnesses over the crisis linked to Nyiragongo volcanic eruptions as well as the involvement in the popularization of the necessary precautions by the stakeholders of the protection against this crisis in the city of Goma. Our survey population mainly PWD was estimated to an average of 10,000 people according to the head of the Assistance and Protection Program for Disabled People, PAPH, the best-known local organization of assistance to PWD in the Goma city. From this population, we drew a representative sample of 336 people following the simple random sampling technique as pre-calculated for the study population between 2,500 and 25,000 proportionally adapted with a confidence level of 95% and 5% which is the acceptable margin of error.[18], [19]. To collect the different opinions of our respondents, a survey questionnaire was designed for this purpose. The data thus collected were imported into SPSS v22 for a descriptive analysis of the univariate type but also for a bivariate differential analysis by independence test using the Karl Pearson Chi square (X^2) formula. The independence test consists of evaluating whether certain categorical variables are correlated with certain members of the said population because variables tend to differ within populations [20]–[23]

For ethical consideration under the principle of "do no harm" we requested and obtained permission from the head of organizations working for the protection of disabled people before we carried out our investigation. Particularly, we requested and obtained the participation of the PAPH, the support of the Goma Volcano Observatory, GVO which provided us with support letters and then we also obtained the informed consent from the disabled people who responded to our questionnaire cheerfully for their worries to be heard.

3. Results and discussion

The United Nations Convention on the Rights of Persons Living with Disabilities a commitment by states to take all necessary measures to ensure the protection and safety of people living with disabilities in all conditions of risk, including conflict, humanitarian emergencies and natural hazards[12], [15]. In addition, all individuals, families and communities exposed to disasters develop coping mechanisms based on their own skills, knowledge, social and institutional networks. And people living with disabilities are no exception [14] The application of the convention consists in considering disabilities through disaster risk management and capacity building to enable handicapped people to respond effectively in the event of a crisis. The objective of this study was to question the individual experience and the survival mechanisms of people living with disabilities in the face of volcanic eruptions in the city of Goma and see how to strengthen what helped, but also and above all to provide the necessary guidance to improve disaster prevention. The following results from the survey helped to draw attention and bring some light over the question.

Table 1 Distribution of respondents by gender, age, marital status and level of education

Sexe		
Variable	**Frequency**	**Percentage**
Male	215	64.2
Female	120	35.8
Total	335	100.0
Group of age		
Variable	**Frequency**	**Percentage**
Between 15 & 25 Years	90	26.9
Between 25 & 35 Years	70	20.9
Between 35 & 45 Years	75	22.4
Between 45 & 55 Years	60	17.9
Between 55 & 65 Years	35	10.4
More than 65 Years	5	1.5
Total	335	100.0

Civil Status		
Variable	**Frequency**	**Percentage**
Married	200	59.7
Single	110	32.8
Divorced	20	6.0
Widow (Widower)	5	1.5
Total	335	100.0
Level of Education		
Variable	**Frequency**	**Percentage**
Primary	115	34.3
Secondary	165	49.3
University	25	7.5
None	30	9.0
Total	335	100.0

Source: Survey, December 2024

Comment: Reading the results above (Table 1), it emerges that the majority of our respondents, i.e. 64.2% (n=215) are male, while 35.8% (n=120) are female. Regarding age, the vast majority of our respondents, i.e. 70.2% (n=235) are young people under 45 years old with a predominance of those aged 15 to 25 (n=90) followed by those aged 35 to 45 (n=75) and those between 25 and 35 (n=70). While 17.9% (n=60) are between 45 and 55 years old, 10.4% (n=35) are between 55 and 65 years old and only 1.5% (n=5) are over 65 years old. This reveals that the possibility of finding old people who have enough experience on the last 3 eruptions of the Nyiragongo volcano is reduced. This indicates that the possibility of finding old people with sufficient experience of past eruptions of Nyiragongo is reduced. Hence the chance for young people to talk about it in their families would also be limited. However, 56.8% of the participants have a secondary education level or higher. This level of education observed seems to be moving in a competitive direction, a factor that would allow them to exploit the warning message on said risks more easily provided that it is adapted to their specific capacity of perception and disabilities.

Table 2 Distribution of respondents according to the type and origin of the disability

Type of Disability		
Variable	**Frequency**	**Percentage**
Paraplegic (less than 4 limbs affected)	285	85.1
Tetraplegic (4 limbs affected)	15	4.5
Visually impaired (blind)	15	4.5
Hearing impaired (deaf)	20	6.0
Albino	0	0.0
Total	335	100.0
Origin of disability		
Variable	**Frequency**	**Percentage**
Injured in war	55	16.4
Physical malformation	45	13.4
Traffic accident	50	14.9
Paralysis related to an illness	180	53.7

Amputated	5	1.5
Total	335	100.0

Source: Survey, December 2024

The above results (Table 2) reveal that the vast majority of our respondents, 85.1% (n=285) are paraplegics with one to three of the four limbs affected by the disability and 4.5% (n=15) are quadriplegics with all four limbs affected by the disability. While 6% (n=20) are hearing impaired, 4.5% (n=15) are visually impaired, commonly referred to as blind. While most of our respondents, 53.7% (n=180) stated that their disability was caused by a disease, mainly poliomyelitis, 16.4% (n=55) stated that they were war wounded, 14.9% (n=50) confirmed that their disability was due to a traffic accident and 13.4% (n=45) stated that it was a physical malformation. Other mechanisms for communicating volcanic risks in schools and universities are a constant necessity. Regarding the type of disability, most of our participants are paraplegics. This is a sign that mobility remains the biggest problem. Albinos are not present in the organizations of the groups of PLWH at all.

Table 3 Distribution of respondents according to the eruption of Nyiragongo which took place in their presence in Goma, their mood during the volcanic crisis and their survival mechanism

Eruption experienced by the respondent		
Variable	**Frequency**	**Percentage**
Eruption of 2021	175	52.2
Eruption of 2021 and 2002	145	43.3
Eruption of 2021, 2002 and 1977	15	4.5
Total	335	100.0
Respondent's mood during the volcanic crisis		
Variable	**Frequency**	**Percentage**
I felt abandoned and desperate	230	68.7
I felt assured by my knowledge over the risk	35	10.4
I feared and got troubled	35	10.4
I felt assured due to the assistance from my surrounding	30	9.0
I felt carefree due to a drink taken	5	1.5
Total	335	100.0
Survival mechanism		
Variable	**Frequency**	**Percentage**
Anticipated evacuation	50	14.9
Waited for the alert like everyone	120	35.8
Prayers	105	31.3
Could do nothing at all	40	11.9
I ran away	20	6.0
Total	335	100.0

Source: Survey, December 2024

Reading the results above (Table 3), it is visible that the majority of our respondents, 52.2% (n=175), experienced the 2021 eruption only, while 43.3% (n=145) experienced the 2021 and 2002 eruption; and only 4.5% (n=15) experienced the 1977 eruption as well. Regarding the state of mind during the eruptive crisis, the vast majority of our respondents, 68.7% (n=230) felt abandoned in despair even by their own surrounding, only 10.4% (n=35) felt reassurance due to their knowledge about the risk. While another 10.4% (n=35) remained troubled with a feeling of fear, 9% (n=30) felt

reassured thanks to the assistance of those around them and 1.5% (n=5) felt reassured due to a drink taken. As a survival mechanism, 35.8% (n=120) of our respondents said that they had no choice but to wait for the alert like everyone else. Added to these are 31.3% (n=105) of our respondents who immersed themselves in prayer while waiting desperately for the probable alert. While 14.9% (n=50) said they had personally anticipated an evacuation, 11.9% (n=40) did not know how to do anything and 6% (n=20) only fled. This is proof that people with disabilities find themselves in difficulty during volcanic crises. Regarding the status of their mind during the volcanic crisis, our participants, felt abandoned in despair even by their own family circle. Very few felt the assurance due either to their knowledge of volcanic risk or due to the assistance of those around them or due to a drink. As a survival mechanism, the majority of our respondents did nothing other than wait for the alert like everyone else while a special attention to PLWH is currently required [12], [24], [25].

Table 4 Distribution of respondents according to their suggested volcanic risk reduction strategy

Survival strategy		
Variable	**Frequency**	**Percentage**
Appropriate early warning for the PWD	115	34.3
Team for assistance and anticipated evacuation	85	25.4
More secure site in the City of Goma for the PWD	85	25.4
Popularize the relevant information concerning the prevention of volcanic risks	45	13.4
Wait for God's Will because our leaders do not care	5	1.5
Total	335	100.0
Other Independent comment		
Variable	**Frequency**	**Percentage**
Grant tricycle disability bikes	45	13.4
Assist us the PWD in medications and food	35	10.4
A means of transport for quick displacement of PWD	50	14.9
Well inform before the volcanic eruption	30	9.0
Nothing additional to mention	105	31.3
Create more secure sites for the PWD in Goma City	10	3.0
The governor should take our problems in consideration	55	16.4
Assist us accordingly with our respective disabilities	5	1.5
Total	335	100.0

Source: Survey, December 2024

The results above (Table 4), reveal that the majority of our respondents, 34.3% (n=115), propose to set up an appropriate early warning for PWD, while 25.4% (n=85) suggest strengthening the caring system and early evacuation team; and another group of 25.4% (n=85) proposed to create a more secure site for PWD in the city of Goma. While another 13.4% (n=45) suggest just to properly popularize the necessary information on volcanic risk prevention, 1.5% (n=5) suggest just waiting for God's will because, according to them, the authorities are screwed and will not be able to do anything. As another comment, 31.3% (n=105) of our respondents say they have nothing else to report. However, 16.4% (n=55) ask the governor to take their problems into account. In addition to these, 14.9% (n=50) of our respondents are asking for a means of transport for rapid travel in the event of a crisis. While 13.4% (n=45) are asking for tricycles, 10.4% (n=35) are asking for assistance with medicines and food, 9% (n=30) are asking for good information on the volcano and 1.5% (n=5) are asking for assistance taking into account the diversity of their disabilities. This reveals that the chance of finding old people who have sufficient experience on the last 3 eruptions of the Nyiragongo volcano is very small.

Table 5 Distribution of eruptions experienced* the respondent's age group

Respondent's age group	Eruption experienced by the respondent					Total
	None	Eruption of 2021	Eruption of 2002	Eruption of 2021 & 2002	Eruption of 2021, 2002 & 1977	
15 - 25 Years	10	60	0	0	0	85
25 -35 Years	0	45	5	35	0	70
35 - 45 Years	0	30	0	40	0	70
45 - 55 Years	0	10	0	40	15	65
55 - 65 Years	5	5	0	5	25	40
More than 65 Years	0	5	0	0	0	5
Total	15	155	5	120	40	335

Source: Survey, December 2024

From the above results (Table 5), it is visible that there is no significant difference (X^2 = 194.275; P = 000 test of independence using the Karl Pearson formula) between the age groups and the respondents' experience on volcanic crises. The older the respondent, the more experience there is on volcanic eruptions, (those who only experienced the 2021 eruption are the youngest compared to those who experienced the 2002 and 1977 eruption). Most of our respondents, 46.2% (n=155) are young people who have only experienced the eruption of May 2021. While those between 15 and 25 years old count up to 17.9% (n=60), those between 25 and 35 years old count 13.4% (n=45), those between 35 and 45 years old 8.9% (n=30). On the other hand, those who experienced the 2021 eruption and that of 2002 are the oldest; they are 35.8% (n=120) among which 11.9% (n=40) are between 35 and 45 years old, 11.9 (n=40) others are between 45 and 55 years old and 10.4% (n=35) are between 25 and 35 years old.

The younger ones of those who experienced the 2021 eruption, that of 2002 and the one of 1977, i.e. 11.9% (n=40), declared their age between 45 and 55. However, none of them claimed to be under 50 years old.

Table 6 Distribution of Survival mechanisms* the eruptions experienced by the respondent

Eruption experienced the respondent	Survival Mechanism					Total
	Anticipated Evacuation	Waited for alert like everyone else	Prayers	Could do nothing	I ran away	
None	0	0	0	0	0	0
Eruption of 2021	35	50	60	20	5	155
Eruption of 2002	0	0	0	5	0	5
Eruption of 2021 & 2002	15	55	35	15	0	120
Eruption of 2021, 2002 & 1977	0	15	10	0	15	40
Total	50	120	105	40	20	335

Source: Survey, December 2024

In view of the above results (Table 6), it is remarkable that there is no significant difference (X^2 = 148.122; P = 0.000 test of independence using the Karl Pearson formula) between the survival mechanism depending on whether the respondents have experience of previous volcanic crises. The more experience there is with the volcanic crisis, the more there is a tendency to wait for the alert and the less experience there is, the more there is a tendency to manage the crisis based on inappropriate beliefs (those who have only experienced the 2021 eruption recommend means such as prayer compared to those who have experienced that of 2021 and that of 2002) The majority of our respondents, 35.8% (n = 120) are those who wait for the alert like everyone else. This group is mainly made up of those who experienced the 2021 eruption as well as that of 2002, i.e. 16.4% (n=55) and 14.9% (n=50) respectively. In addition, there are those who resort to prayer; this is 31.3% (n=105) among which there are those who only experienced the 2021 eruption, constituting 17.9% (n=60) and those who experienced the 2021, 2002 and 1977 eruption, i.e. 10.4% (n=35) and those

who experienced the 2021, 2002 and 1977 eruptions, constituting 2% (n=10). There is also a significant relationship between experience over eruptions and the survival mechanism.

4. Conclusion

This study was conceived to examine the individual experience as well as the survival mechanisms of people living with disabilities while facing volcanic eruptions in the city of Goma and see how to strengthen what helped, but also provide the necessary guidance to empower those who have no experience. The majority of participants were young below 50 years old. The possibility of finding old people with sufficient experience over past eruptions of Nyiragongo seems to be limited. Hence the chance for young people to talk about it in their families appears to be limited as well. However, the level of education observed among participants gives the impression that people are developing in a competitive direction, a factor that would allow them to easily exploit any warning message related to the risks, as long as that tunes accordingly with their perceptive capacity. The emotional status of our respondents during the volcanic crisis had been reported to be a feeling of abandonment and despair. Some felt abandoned even by their own family. Very few have experienced assurance related to their knowledge on volcanic risk or to the assistance of their surroundings. The vulnerability and needs of people with disability in Goma City facing volcanic hazards are obviously still ignored by the authority. Thus, they are still prone to suffering and die in volcanic crisis to come. As a survival mechanism, most of our respondents did nothing other than waiting for the alert like everyone else and yet special attention to Persons with Disabilities, PWD is currently endorsed worldwide. Others just prayed God to spare them from the danger. As a strategy, the majority of our participants think that a contextualized early warning in accordance with PWD is the preferred mechanism. While others suggest setting up an accompaniment, early evacuation brigade, others suggest to set up a more secure site for PWD in the city of Goma. The authority should consider a common ground where the experience of PWD is taken into account in volcanic risk prevention and disaster reduction process. Every reason to exclude them ought to be avoided. The authors recommend strengthening communication on volcanic risks including PWD in schools, universities and workplaces, as well as creating safer evacuation sites in the city for people with disabilities and means of transportation.

Compliance with ethical standards

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No conflict of interest recorded.

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