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## Preference-Based Assessments

# Estimation of Health-Related Quality of Life Losses Owing to a Technological Disaster in Brazil Using EQ-5D-3L: A Cross-Sectional Study



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## ABSTRACT

**Objectives:** In 2015, a dam collapsed at Samarco iron ore mine in the municipality of Mariana, Brazil, and contaminated more than 600 km of watercourses and destroyed almost 1600 acres of vegetation. Nineteen people died and more than 600 families lost their homes. This study aimed to estimate health-related quality of life (HRQoL) losses owing to this disaster.

**Methods:** We collected data from a probabilistic sample of 459 individuals aged 15 years or older. Household face-to-face interviews were conducted in December 2018. Pre-event data were not available for this population, so respondents were asked to evaluate at present and in retrospect their health status using EQ-5D-3L. The Minas Gerais societal value sets for EQ-5D-3L health preferences, estimated in 2011, were used to calculate utility losses. The health loss estimation from EQ-5D will form the basis for the calculation of compensation payments for the victims.

**Results:** Approximately 74% of the study population suffered some HRQoL loss. On average, EQ-5D index values decreased from 0.95 to 0.76. The greatest effects were observed for the anxiety/depression dimension, followed by pain/discomfort. Before the tragedy, the proportion of individuals with severe anxiety/depression and pain/discomfort was equal to 1% rising to 23% and 11%, respectively.

**Conclusions:** Catastrophic losses owing to the Samarco disaster were found. The EQ-5D-3L instrument showed feasibility and sensitiveness to measure HRQoL losses owing to a negative health shock in a low-income Brazilian population.

**Keywords:** compensation and redress, disaster victims, disasters, observational study, quality of life.

VALUE HEALTH REG ISSUES. 2021; 26:66–74

## Introduction

In November 2015, the municipality of Mariana, Brazil, experienced one of the largest technological disasters worldwide.<sup>1</sup> After a tailings dam collapsed at the Samarco iron ore mine (a joint venture between Vale S.A. and BHP Billiton Ltd), more than 600 km of watercourses were contaminated and almost 1600 acres of vegetation was destroyed. The path traveled by the mud left several communities temporarily without adequate water supply and permanently affected agricultural, fishing, and commercial activities. A total of 229 municipalities and 3.3 million individuals were somehow affected by the disaster. In Mariana alone, 19 people died, 1 miscarriage was reported, 1 individual disappeared, and approximately 900 families had their lives affected.<sup>2,3</sup>

Empirical studies have already shown the more intense and pervasive impact of technological disasters on individuals' well-being compared with natural disasters.<sup>4,5</sup> They differ in terms of etiology, social, environmental, and health impacts and in how communities react and recover. Although natural disasters are

commonly perceived as inevitable or “acts of God,” technological disasters are associated with human failure. In this sense, the affected population is likely to associate the disaster with responsible individuals and companies.<sup>4,6</sup> Even when the parties are recognized, the lack of consensus around the identification of the damages caused by a technological disaster can make it difficult to assign liabilities and make reparations to the victims. Therefore, it is not possible to have the well-defined linear chronological structure usually observed in natural disasters (ie, preparation, answer, recovery, and mitigation). Instead, a cycle of guilt, social unrest, and revolt, which contributes to enhancing the impact on health-related quality of life (HRQoL), is often observed.<sup>4,5,7–9</sup>

Three main groups of risk factors are usually associated with an increased likelihood of health disorders owing to disasters.<sup>10</sup> The first is related to the extension of the disaster that causes deaths, morbidity, destruction, environmental adversities, and evacuation of communities.<sup>11–17</sup> The second group is associated with post-disaster circumstances that may alleviate or exacerbate the socioeconomic, health, and environmental impacts. The ability of

the responsible actors in providing prompt emotional and financial support is crucial for the healing process of the affected communities.<sup>9,18–23</sup> In Mariana, Samarco and the government failed to take immediate action. Only in 2016, after most of the damage has occurred, a settlement agreement was signed among Vale, Samarco, BHP, and the Brazilian government to develop socio-environmental and economic mitigation actions against damages.<sup>24,25</sup> The third group of risk factors is associated with personal vulnerabilities such as sex, age, and socioeconomic status.<sup>11,17,26–28</sup> Individuals of lower socioeconomic status and those with lower levels of social support were more likely to develop mental health disorders. Cherry et al<sup>19</sup> analyzed the impact of disasters on post-traumatic stress disorder (PTSD) among individuals who were differently exposed to the 2005 Hurricanes Katrina and Rita and the 2010 British Petroleum Deepwater Horizon oil spill. According to the authors, the coastal fishers, who were unable to work for 1 year or more owing to the consequences of the disaster, were the most vulnerable group in terms of health losses. An analogous context is observed in Mariana, where displaced families lost their subsistence activities such as family farming, fishing, and handicraft business.<sup>7,8,17,21,28</sup>

Another concern is the stigmatization and prejudice against the victims owing to the economic impacts they suffered and, in some cases, the risk of contamination as, for example, in Chernobyl. Technological disasters usually affect global and local economies depending on its extension and the economic importance of the company.<sup>7,9</sup> In the State of Minas Gerais (MG), where Mariana is situated, the mining activities have been largely relevant, responding on average for 4.5% of the total MG gross domestic product during the 2005 to 2011 period.<sup>29</sup> Recent data showed that the unemployment rate in Mariana increased by 30% after the disaster insofar as mining activities were interrupted by the Government of MG.<sup>2</sup> Therefore, affected individuals have been blamed for the economic collapse experienced by the municipality after the event.<sup>3</sup> Empirical evidence for health impacts owing to technological disasters is mostly associated with the Chernobyl nuclear power explosion in 1986,<sup>10,12,14,30–34</sup> Buffalo Creek dam collapse in 1972,<sup>26,27,35,36</sup> British Petroleum Deepwater Horizon oil spill in 2010,<sup>7,8,28</sup> Graniteville train crash in 2005,<sup>37</sup> and the Three Mile Island nuclear accident in 1979.<sup>38,39</sup> There is a consensus regarding the long-term effects of technological disasters mainly on mental health, including first responders and cleanup workers.<sup>10,16,26,30–33,36,40</sup> Few studies analyze the HRQoL loss owing to technological disasters using the 36-Item Short Form Survey (SF-36) instrument<sup>19,20,41–43</sup> and the World Health Organization Quality of Life.<sup>7,44</sup>

Some short-term health consequences of the Samarco tragedy, including infectious, respiratory, skin, and psychological diseases, have already been reported elsewhere.<sup>45,46</sup> In 2017, a high prevalence of depression (28.9%) and PTSD (12%) was observed among affected individuals. The prevalence of depression is 5 times higher than what is observed in the general population.<sup>3</sup> Much less is known about the HRQoL losses, which represents more comprehensively the individuals' well-being. This article aimed to fill this gap by using the EQ-5D-3L instrument to measure the negative health shock suffered by an entire community. The EQ-5D descriptive system is a widespread instrument used to measure preferences-based HRQoL. Besides standing out as one of the shortest and simplest instruments, EQ-5D-3L societal preferences were already available for MG population. The EuroQol instrument has already been used to measure HRQoL losses owing to natural disasters with significant consequences for the survivors.<sup>47,48</sup> To the best of our knowledge, this is the first application of EQ-5D-3L to measure health losses owing to technological disasters. This

analysis is important owing to the differences between both types of disasters regarding their conception and consequences to the affected individuals. Besides, the estimation of health losses will form the basis for the calculation of compensation payments for the victims.

## Methods

### Study Design and Data Collection

This study was a cross-sectional evaluation of the HRQoL of individuals affected by the Samarco tailings dam collapse. Household face-to-face interviews were conducted in December 2018 with the application of the EQ-5D-3L questionnaire.<sup>49</sup> An independent external company was hired to perform the interviews. The application of the instrument was approved by the EuroQol Group (ID #27832). To evaluate HRQoL losses caused by the dam collapse, health status measurements for at least 2 points in time were necessary. Pre-event data were not available for this population, so respondents were asked to evaluate, at present and in retrospect, their health status using EQ-5D-3L. Because the level of education is low among the affected individuals, it is more natural for them to figure out how they are currently feeling. The retrospective questions referred to the year of 2015, representing a point in time before the disaster. They were evaluated after the assessments of current health status to minimize any potential bias related to the induction effect. It would be harder for them to anticipate that they would later evaluate their pre-event health status. Individuals may have more incentives to overstate their current adverse health conditions after evaluating pre-event health status as they become more aware of the research purposes. Additionally, because longitudinal data were measured using retrospective questions, selectivity owing to sample attrition is probably less important.

The EQ-5D-3L questionnaire is composed of 5 dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) with 3 levels of severity (no problems, moderate problems, and severe problems) and a visual analog scale (VAS).<sup>49</sup> After answering the EQ-5D instrument, information about age, sex, and self-reported health status composed of 5 levels (very good, good, regular, bad, or very bad) were collected. A parental consent was obtained for individuals younger than 16 years. Individuals aged 16 years or older signed a consent term authorizing their participation in the field survey. This study was approved by the research ethics committee (protocol CAAE #10975718400005149).

### Sample

The size of the affected population was obtained from a general registry database (GRD) used by stakeholders to identify the affected families for social support and compensation purposes. A sample of 451 adult individuals from a total of 2452 in the GRD was estimated from a multinomial probability distribution with a 5% precision error for the estimated proportions and a 5% significance level for the confidence interval.<sup>50</sup> The probabilistic sample encompassed individuals at least 15 years old and was stratified by sex and age groups (15 to 49 years, 50 to 69 years, and 70 years or more). A replacement was accepted after 2 failed attempts to reach the selected subjects.

### Data Analysis

The main challenge to estimate the HRQoL losses is the absence of pre-event health status. To address this issue, we

**Table 1.** Proportion of individuals in each dimension and level of the EQ-5D-3L scale of the affected individuals before the dam collapse compared with the standardized distribution for MG and their EQ-VAS and EQ-5D mean utility scores.

EQ-5D dimension	Samples	Levels of severity		
		No problems	Some problems	Extreme problems
Mobility	MG*	90.84	9.06	0.1
	Mariana	91.5	7.9	0.7
Self-care	MG*	97.6	2.06	0.34
	Mariana	98.7	1.4	0.0
Usual activities	MG*	90.15	9.4	0.45
	Mariana	96.0	4.0	0.0
Pain/discomfort	MG*	57.13	38.93	3.94
	Mariana	77.7	22.1	0.3
Anxiety/depression	MG*	64.07	31.64	4.29
	Mariana	86.9	12.3	0.9
Scale	Samples	Mean scores		
EQ-VAS	MG*	$\bar{x}$ = 83.0		
	Mariana	$\bar{x}$ = 90.8		
EQ-5D utility	MG*	$\bar{x}$ = 0.885		
	Mariana	$\bar{x}$ = 0.952		

Note: The MG EQ-5D-3L value set was used to estimate utilities for both samples. The Mariana sample was restricted to individuals between 18 and 64 years old. EQ-VAS indicates EuroQol-visual analogue scales; MG, Minas Gerais;  $\bar{x}$ , mean.

\*The MG data were standardized by the age and sex distribution of the population of Mariana.

proposed 2 pre-event sources for the EQ-5D estimates. The first one was based on the retrospective EQ-5D questions and the second on individuals' health status taken from a representative sample of the State of MG. This sample comprises 3362 individuals aged between 18 and 64 years.<sup>51</sup> Ideally, we should match individuals one to one from the MG to the Mariana samples using observable characteristics. Because sample sizes are very different, it was not possible to conduct one-to-one pairing. To improve the comparability between these 2 samples, we used the only 2 observable characteristics available in both data sets (age and sex). To conduct a direct standardization, 5-year age and sex groups were considered. That is, the distribution of EQ-5D health states for the MG population was standardized by the age and sex distribution of the Mariana sample by direct standardization.<sup>52</sup> Because the age range is larger in Mariana distribution, we restricted this sample only to individuals aged between 18 and 64 years.

The HRQoL losses were estimated by comparing the health utilities (EQ-5D index values) of the Mariana sample before and after the disaster using the 2 potential pre-event EQ-5D health statuses. The MG societal value sets for EQ-5D-3L health preferences estimated by Andrade et al<sup>51</sup> were used to determine the utility associated with the respondents' health status. Utility changes were calculated for the whole sample and for a subsample of individuals who experienced health losses. Differences between groups were evaluated by the Pearson chi-square test for categorical variables and by the Kruskal-Wallis test for continuous variables. A Kolmogorov-Smirnov test for stochastic dominance was applied for the utility distribution before and after the disaster. For hypothesis testing, *P* values lower than .05 were considered statistically significant. Mean losses conditional to the individuals reporting any damages will also be reported. The conditional mean loss is an important metric because the population reporting health damages is the primary focus of the compensation lawsuits.

## Results

In total, 459 interviews were conducted during the study period. Of these, 74.5% were in individuals initially selected and 25.5% in individuals from the replacement sample. No relevant differences were found in terms of age, sex, education status among the sampled individuals, and the GRD, as expected. The affected population is mostly female and aged between 15 and 49 years. Education distribution is bimodal, presenting almost 40% of individuals with less than middle school and only 31% with complete high school (Appendix 1 in Supplemental Materials found at <https://doi.org/10.1016/j.vhri.2021.02.003>).

### EQ-5D-3L Health Status Distribution Before the Dam Collapse

Table 1 reports pre-event EQ-5D health status for the 2 potential measures. Compared with the standardized MG population, affected individuals reported better health conditions before the dam collapse. Differences are larger for the pain/discomfort and the anxiety/depression dimensions. In Mariana, 77.7% and 86.9% of individuals reported not having problems in these dimensions, respectively, compared with 57.13% and 64.07% for the MG standardized population. In MG, a relatively high number of individuals had moderate problems compared with the inferred rate for individuals in Mariana before the disaster (38.93% and 31.64% compared with 22.1% and 12.3%) (Table 1). For the other EQ-5D dimensions, the distributions in both samples are similar. In Mariana, 91.5%, 98.7%, and 96.0% reported no problems with mobility, self-care, and usual activities before the dam collapse, whereas the figures for MG were 90.84%, 97.6%, and 90.15%. The average EQ-5D and EQ-VAS utility for the Mariana respondents were respectively 7.5% and 9.4% higher than that of the standardized MG sample (0.952 vs 0.885 for EQ-5D and 90.8 vs 83.0 for EQ-VAS).

**Figure 1.** Cumulative distribution of EQ-5D-3L health states of the affected individuals before the dam collapse compared with the standardized and non-standardized Minas Gerais sample sorted by decreasing order of utility. Note: The utility EQ-5D health index was extracted from Andrade et al. (2013).

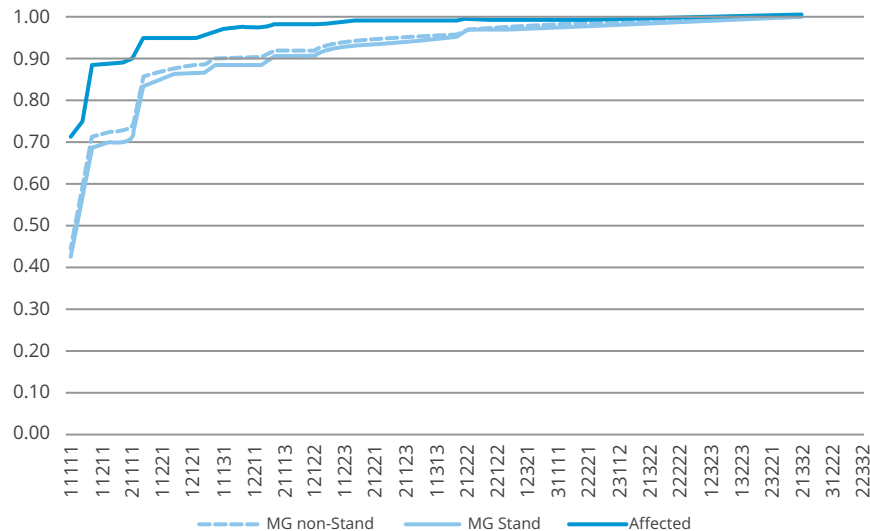


Figure 1 shows the cumulative distribution of the individuals' health states in decreasing order of utility for both samples. For the MG sample, we plot 2 curves, standardized and non-standardized, which are very similar. The Mariana curve is above both curves for the MG sample. The area between Mariana and MG curves shows that the largest differences between these distributions occur for moderate health states. For instance, the proportion of affected individuals aged between 18 to 64 years with full health before the event reaches 71.3%, against 42.6% in the standardized MG sample.

### HRQoL Losses Estimation

We estimated HRQoL owing to the Samarco disaster using the 2 potential measures for the pre-event. First, the retrospective EQ-5D-3L scores reported for 2015 by the Mariana sample were compared with the current scores. For this estimation, all age groups in the Mariana sample were considered. Catastrophic losses owing to the Samarco disaster were found. Approximately 74% of the adult population suffered some HRQoL loss. Figure 2 shows the cumulative distribution of the individuals' health states from Mariana before and after the disaster in decreasing order of utility. The curve associated with the pre-event utility is above its analog after the event ( $P < .001$ ) showing the higher proportion of individuals in better health states before the dam collapse. Before the tragedy, 69.9% of the sample reported full health compared with only 16.2% in 2018 ( $P < .001$ ). On average, EQ-5D index values for the adult population decreased from 0.947 to 0.759 ( $P < .001$ ).

Health losses were found for all 5 dimensions. The proportion of individuals without any problems in mobility, self-care, and usual activities decreased by 19%, 7%, and 31%, respectively, between 2015 and 2018. In 2015, before the dam collapse, 5%, 1%, and 3% reported moderate problems in these dimensions. In 2018, these proportions increased to 22%, 7%, and 31%, respectively ( $P < .001$ ). The greatest changes were observed for the anxiety/depression dimension, followed by pain/discomfort. The prevalence of individuals with no problems in these dimensions reduced from 89% and 76% to 30% and 28% after the collapse ( $P < .001$ ). In contrast, the proportion of individuals with severe

anxiety/depression and pain/discomfort, approximately 1% before the tragedy, increased to 23% and 11%, respectively ( $P < .001$ ) (Fig. 3).

Considering the whole sample, the mean difference in utility was  $-0.188$  ( $-19.5\%$ ), ranging between  $-1.22$  ( $-122\%$ ), the biggest loss, and  $0.308$  ( $65\%$ ), the biggest gain. On average, women showed higher losses than men ( $-21.4\%$  vs  $-17.5\%$ ,  $P = .004$ ; or in utility values  $-0.206$  vs  $-0.169$ ,  $P = .04$ ). The conditional mean loss, including only individuals that had some loss, was  $-0.26$ . Women and the elderly reported larger health losses than men and young individuals, ranging from  $-24\%$  for 15- to 49-year-old men until  $-37\%$  for women above 60 years old (Table 2).

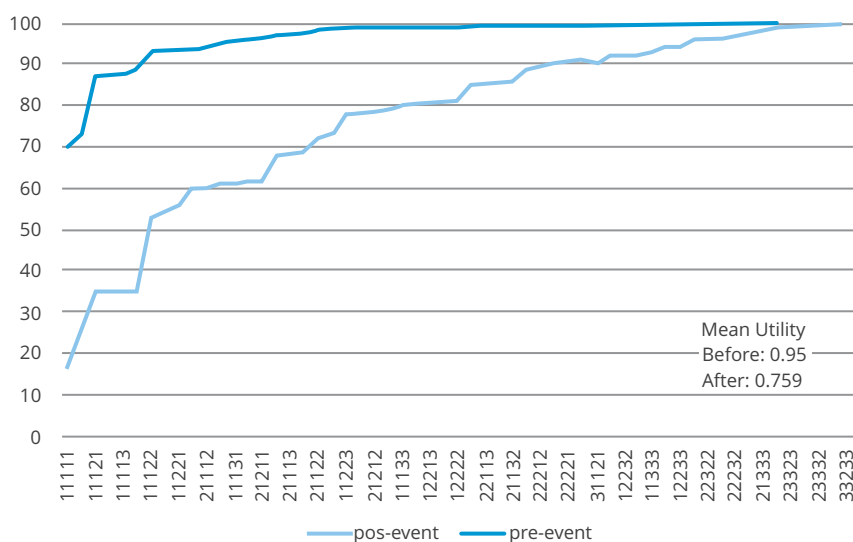
The second estimation for HRQoL loss was built using standardized scores distribution for MG as a proxy for pre-event health status. In this case, HRQoL loss is estimated considering only affected individuals aged between 18 and 64 years. Figure 4 reports the EQ-5D health states distribution for both potential measures of pre-event and for post-dam collapse. As expected, the HRQoL loss is smaller when the standardized MG distribution is used as a pre-event measure than the retrospective measure.

### Discussion

This article evaluated HRQoL loss owing to the dam collapse at Samarco iron ore mine. We found catastrophic losses for affected individuals, because 74% reported health losses after the dam collapse, with a conditional average loss of 27%. Before the disaster, the average health utility was 0.95, decreasing to 0.76 after the disaster considering the retrospective measure as the pre-event distribution.

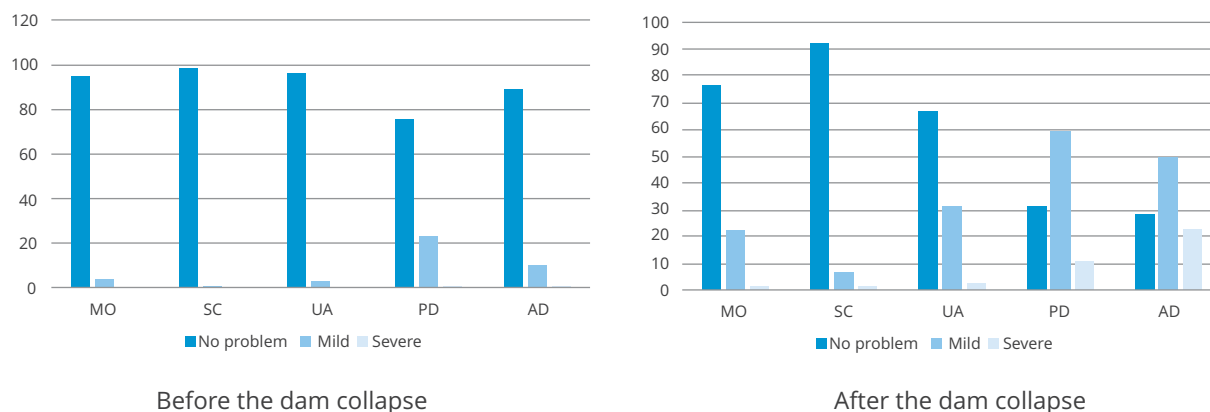
Most studies evaluating HRQoL loss in technological disasters use SF-36. Sabucedo et al.<sup>42</sup> analyzed health impacts of the 2002 Prestige oil disaster in Spain and found that the decrease in general health was 6.61 (9.21%) score points larger among individuals with a high level of exposure than those with a low level of exposure. Cherry et al.<sup>19</sup> also found health losses among individuals who were severely affected by Hurricanes Katrina and Rita and the 2010 British Petroleum Deepwater Horizon oil spill.

**Figure 2.** Cumulative distribution of EQ-5D-3L health states of the affected individuals before and 3 years after the dam collapse sorted by decreasing order of utility.



\*This figure considers the assessment of health states of the Mariana sample in two moments: a retrospective before assessment and the current assessment 3 years after the dam collapse.

**Figure 3.** The proportion of affected individuals in each dimension and level of the EQ-5D-3L scale before and 3 years after the dam collapse. Note: MO, mobility; SC, self-care; UA, usual activities; PD, pain/discomfort; AD, anxiety/depression.



According to the authors, the current coastal fishermen who had their economic activities affected by one of these disasters were 76% less likely to present higher physical and mental SF-36 subscales scores. A few studies have used EQ-5D to estimate health impacts owing to natural disasters.<sup>47,48,53,54</sup> Hugelius et al<sup>47</sup> analyzed health impacts among the survivors and health professionals after a natural disaster in the Philippines. The main findings showed that anxiety/depression and pain/discomfort were the most affected dimensions after 30 months: 19% and 13% of individuals reported having moderate or severe problems. In Mariana, these figures after the dam collapse were extremely higher: 72% and 69%, respectively.

The HRQoL of the affected individuals after the Samarco dam collapse is comparable with Brazilian patients living under severe health conditions such as HIV (0.88),<sup>55</sup> Parkinson's disease (0.5),<sup>56</sup> and diabetes mellitus type 1 (0.74) and type 2 (0.66).<sup>57</sup> In Mariana, the health effects of the dam collapse were even more severe for

older individuals. Among those who experienced some HRQoL loss, the average EQ-5D index score was equal to 0.91 before the dam collapse and deeply decreased to 0.59 after the tragedy. This severe negative effect observed for older individuals is associated with their poor ability to adapt and recover from traumas.<sup>20,58</sup> These losses are comparable with patients with severe chronic conditions. Ock et al,<sup>59</sup> using EQ-5D-3L, estimated differences in utility weights between healthy controls and ill people along their life cycle. For men aged older than 80 years, with stroke the difference in utility weights was 0.34 in Korea.

The analysis of EQ-5D health dimensions showed different consequences by level of severity. Anxiety/depression and pain/discomfort were the domains with the largest differences in the distribution after the dam collapse. PTSD is among the most commonly reported health consequences observed in individuals exposed to technological disasters.<sup>60</sup> These health consequences are expected because technological disasters strongly disrupt



**Table 2.** Absolute values of HRQoL loss (%).

Sex	Age groups	All observations		Considering only individuals with some HRQoL losses	
		$\Delta$ utility	$\Delta\%$ utility	$\Delta$ utility	$\Delta\%$ utility
Female	15 a 49	-0.19	-19.8	-0.24	-24.5
	50 a 59	-0.21	-21.0	-0.32	-33.2
	60 +	-0.25	-27.6	-0.33	-37.2
Male	15 a 49	-0.16	-16.4	-0.24	-24.1
	50 a 59	-0.17	-18.4	-0.27	-28.4
	60 +	-0.20	-21.1	-0.32	-34.6

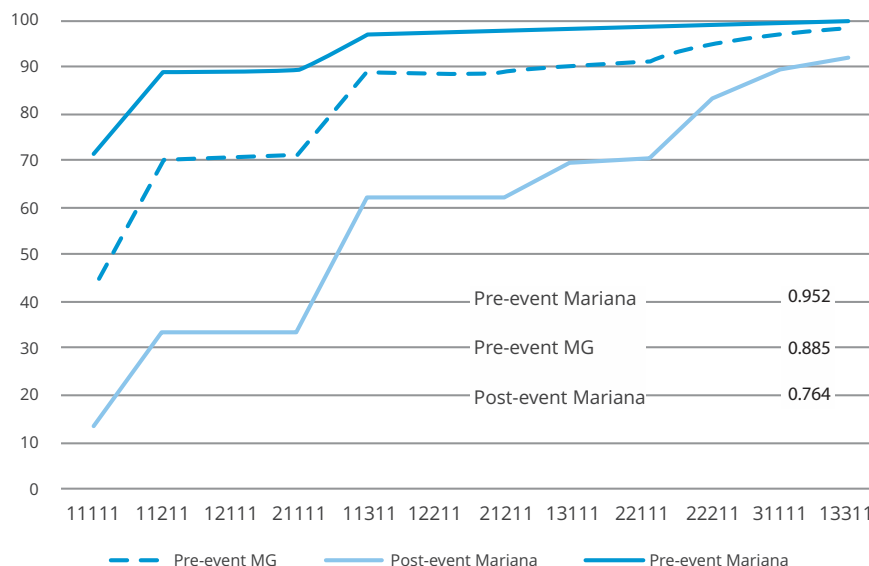
HRQoL indicates health-related quality of life.

social networks and economic activities. Furthermore, the healing process is delayed by the slow response of the stakeholders.<sup>7,9,23</sup> An important adverse health effect was also observed for the usual activities and the mobility dimensions. The affected population used to live in rural communities based on family agricultural activities, and their lifestyle was deeply dependent on environmental and social conditions. After the dam collapse, they were abruptly displaced to the urban area of Mariana and confined in temporary lodges being deprived of any agricultural or community activities.

Some limitations of our study should be addressed. The first one concerns the GRD of affected individuals from which our sampled individuals were randomly selected. The identification of victims of disasters is one of the main challenges for the recovery and repairing process.<sup>23</sup> In the Mariana case, individuals voluntarily adhered to the GRD organized by the Renova Foundation and Caritas-MG. This process has been too long and still incomplete. Besides, some of the registered families were not directly affected by the dam collapse because they did not live there at the time of the disaster. Nevertheless, the GRD is a more accurate

identification method than the usual approach that relies on exposure metrics and household distance to the event to define the affected individuals.

Another limitation is related to the absence of pre-event information about the health status of the affected population. To overcome this lack of data, we made use of 2 pre-event measures. In comparison with the standardized MG adult population, it was estimated that a better pre-event health status existed among affected individuals, 71% of whom were deemed to have no problems on any of the EQ-5D dimensions compared with 43% for the general population. Accordingly, on average, the pre-event EQ-5D index values are relatively higher among the victims. There are at least 2 possible explanations that might account for these health status differences. The first concerns the characteristics of the 2 populations. Differences in age-sex distribution were accounted for by the standardization procedure. Nevertheless, other non-observable differences could play a role. For instance, before the dam collapse, most of the affected individuals lived in rural areas whereas the MG sample comprises only urban areas.<sup>61</sup> Second, in the MG study, respondents were asked to assess their

**Figure 4.** Cumulative distribution of EQ-5D-3L health states of the affected individuals before and 3 years after the dam collapse considering two potential measures for pre-event sorted by decreasing order of utility.

current health status whereas in Mariana pre-event health status relies on retrospective information. Therefore, there might be a recall bias in reporting the past health status.<sup>62–64</sup>

Retrospective self-reported health may also be affected by changes in the perception of individuals. This phenomenon, known as response shift is observed owing to the individuals' experiences through their life cycle.<sup>62,63</sup> According to the response shift theory, by using retrospective health evaluations, individuals would have more information when making judgments about their past health and the same anchorage when evaluating their health status before and after the event.<sup>64,65</sup> The majority of empirical evidence for response shift is associated with positive events such as medical intervention including the intake of medicines, surgeries, and rehabilitation programs. According to longitudinal studies, average HRQoL scores at the beginning of medical treatment tend to be higher for evaluations that occurred at that period. After being under treatment, the patients' judgments about their initial conditions are down-scaled.<sup>65,66</sup> The main explanation for this change is the ability of individuals to adapt to adverse conditions imposed by the disease before treatment. After recovering their health, looking backward, patients would have a more accurate perception of their past limitations, especially compared with their current condition.<sup>64</sup> In contrast, under negative circumstances, such as injuries, individuals tend to assign higher values to their past health status than if the evaluation was taken before the traumatic event.<sup>65</sup> Current adverse conditions will make individuals more optimistic about their pre-event health status. For the affected population of Mariana in particular, in the light of the response shift theory individuals would have greater optimism regarding their past health status, which justifies the genuine feeling of enhanced HRQoL loss. Evidence suggests that conventional (prospective) evaluation of change has a fair concordance (intraclass correlation coefficient = 0.49) with retrospective change and that response shift might be more important than recall bias in the evaluation of past health states with EQ-5D-3L in a 3-month follow-up time.<sup>67</sup> As recall bias increases with time, there is a chance that it might become more important than response shift in longer time horizons.

This article opens an opportunity to use EQ-5D to measure HRQoL losses and widens its scope far beyond health technology assessment. The use of EQ-5D-3L as a retrospective measure confirms its potential value for studies when longitudinal data is not an option. Unfortunately, Brazil has recently experienced another dam collapse of large proportions in Brumadinho, MG. More than 200 people immediately died, others are still missing, and several families lost their homes. All these local communities are struggling with environmental and socioeconomic consequences. Our findings can help the assessment of health damages in Brumadinho and put EQ-5D as a potential metric for this type of health loss estimation.

## Supplemental Materials

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.vhri.2021.02.003>.

## Article and Author Information

**Accepted for Publication:** February 28, 2021

**Published Online:** June 10, 2021

doi: <https://doi.org/10.1016/j.vhri.2021.02.003>

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**Conflict of Interest Disclosures:** Drs Andrade, Noronha, Santos, Guedes, Campolina, Cavalcante, Magalhães, and Duarte and Ms de Souza reported receiving grants and personal fees from Caritas Brasileira during the conduct of this study. Mr Kind reported being a founding member of the EuroQoL Group and contributed to the development of EQ-5D-3L. No other disclosures were reported.

**Funding/Support:** This study was funded by Caritas Brasileira Regional Office of Minas Gerais to estimate the compensation payments for the victims of the Samarco Dam Failure in Mariana, Brazil.

**Role of the Funder/Sponsor:** The sponsor supported the project with resources and helping with the access to the participants. They had no role in the concept and design of the study; data collection, analysis, and interpretation of data; drafting the manuscript or statistical analysis.

**Ethics Approval:** The application of the instrument was approved by the EuroQoL Group (ID#27832). This research was approved by the Research Ethics Committee of the Federal University of Minas Gerais (CAAE#10975718400005149).

**Acknowledgment:** Dr Santos receives funding from the Brazilian research promoting organizations Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; protocol 381587/2018-5) and Instituto de Avaliação de Tecnologias em Saúde. Professor Andrade receives resources from Fundação de Amparo a Pesquisa do Estado de Minas Gerais and CNPq (a Research Productivity Scholarship). Professors Noronha and Guedes also received Research Productivity Scholarships from CNPq. We would also like to thank the EuroQoL Group that allowed us to use their tool. The authors thank the team of the Caritas Brasileira Regional Office of Minas Gerais for the technical and logistic support during the field survey.

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