IDRiM (2025) 15 (2) **ISSN: 2185-8322**
DOI10.5595/001c.150381

Journal of Integrated Disaster Risk Management

Regular Article

Am I at Risk if an Earthquake Occurs? An Initiative for Raising Seismic Risk Awareness and Knowledge Transferring in the Community

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Received: 27/02/2025 / Accepted: 10/06/2025 / Published online: 09/12/2025

Abstract The assessment of seismic risk generates key information for disaster risk reduction and management (DRR). Nonetheless, for such knowledge to have an effective impact on DRR, collaborative efforts across all stakeholders are needed. Such efforts include risk knowledge transferring in such a way that final users can make risk-informed decisions. The challenge of knowledge transferring implies those who generate the knowledge (mainly researchers) to consider the needs of the potential users, among them the community.

Among natural hazards, seismic activity, although not the most recurrent phenomenon, is one of the most catastrophic. Several efforts to increase seismic risk knowledge have been carried out at world, national and regional levels. Nowadays, seismic risk assessment follows a relatively established methodology which generates seismic risk metrics related to monetary, human and physical impact that are useful for DRR. Despite the advances on seismic risk knowledge, community seismic risk perception may significantly differ from the perception of those involved in DRR, especially in regions such as Colombia, where there has not been a devastating earthquake in the last two decades. Risk perception is not only influenced by direct information (i.e., having experienced a damaging earthquake); indirect experience gathered from the media and education is also fundamental. As an effort to increase community seismic risk perception, a seismic risk awareness workshop was designed and implemented by a collaborative effort between public and private institutions. The workshop generates a space for dialogue with the attendees to answer questions about earthquakes, the components of seismic risk and seismic risk management, among other relevant aspects. To share this activity, a workshop guide was developed, and videos were made focusing on Medellín and its metropolitan area and the city of Santiago de Cali (Colombia).

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IDRiM (2025) 15 (2) ISSN: 2185-8322
DOI10.5595/001c.150381

The workshop has been offered since 2021, and it has been delivered to the community, students, children, decision-makers, among others. The execution of the workshop has allowed us to identify the attendees' interest in topics related to seismic risk, concerns of the inhabitants with respect to the quality of the construction of their homes, interest in obtaining more information, and willingness to be informed on topics that usually do not include citizens due to its scientific complexity.

Keywords: seismic risk, risk awareness, disaster risk management, knowledge transfer, risk perception

1. INTRODUCTION

Disaster risk reduction and management (DRR) aims to decrease the effects of disasters. Actions for DRR require the availability of making informed decisions, which must be based on reliable knowledge. Therefore, understanding disaster risk is the first priority of the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015), which states that "such knowledge can be leveraged for the purpose of pre-disaster risk assessment, for prevention and mitigation and for the development and implementation of appropriate preparedness and effective response to disasters". Both disaster response and management actions require collaborative efforts of all stakeholders, i.e., government agencies, non-governmental organizations, community groups, and individual citizens (Sensin & Gokmenoglu, 2024).

Risk assessment, i.e., the estimation of consequences due to hazards, is fundamental for DRR as it provides information about the potential impact of hazards in the built environment and society. Risk assessment requires understanding three components: *hazard*, i.e., the intensities that may occur at a place in a given period of time; *exposure*, which refers to the description of the people and infrastructure at the site; and *vulnerability*, or possible damaging effect in the exposed elements due to the severity of the hazard. Risk occurs when these three components overlap in time and space (UNDRR, 2015). Risk assessment results (i.e., risk knowledge), must be integrated into disaster and management policies and practices. A successful integration of risk knowledge requires, as already mentioned, collaborative efforts of all stakeholders; in addition, risk knowledge must address social vulnerability and resilience to have an impact on DRR (Weichselgartner & Pigeon, 2015).

Among natural hazards, earthquakes are one of the most catastrophic since, by their nature, they can affect thousands of people in a few seconds and generate considerable damage and economic losses. The recent earthquakes in Turkey and Syria on February 6, 2023, in which more than 50,000 people lost their lives, more than 115,000 were injured, almost 40,000 buildings completely collapsed, and more than 240,000 buildings were rendered unusable (Tukey Disaster and Emergency Management Authority – AFAD, 2023), evidence the great impact that earthquakes can have. In the case of Colombia, its geographical location in the upper corner of South America makes earthquakes a relevant hazard for the country due to

the interaction of the Caribbean, Nazca, and South American tectonic plates. Most of the Colombian population (87%) live in zones of medium and high seismic hazard according to the current seismic-resistant standard (NSR-10: AIS, 2010). In Colombia's recent history, the 1983 Popayán earthquake (magnitude 5.6) and the Armenia earthquake of 1999 (magnitude 6.1) generated considerable human and economic losses: 287 deaths and estimated losses of 1.5% of the gross domestic product in the Popayán earthquake (AIS, 2009) and 1,185 deaths and losses of 1.88% of the gross domestic product in the Armenia earthquake (Cardona et al., 2004). Another significant event is the 1906 Tumaco earthquake, with a magnitude of 8.8, the largest ever recorded in Colombia. Although intensities greater than 8 on the European macroseismic scale (EMS98) were reported in southwestern Colombia (Sarabia & Cifuentes, 2007), most of the fatalities (between 400 and 600 according to estimates) and damage were mainly due to the associated tsunami (SGC, 2019). The effects of the aforementioned earthquakes reflect the seismic risk to which the country is exposed.

Medellín—the second largest city in Colombia—and the municipalities of its metropolitan area (sub-region of the Aburrá Valley), have a considerable seismic risk. More than 4 million people live in the Aburrá Valley, 95% of them in the urban zone, which has an area of 1,152 km^2; the high population density evidences the high exposure in the territory. Additionally, several studies indicate a high concentration of buildings that do not comply with current seismic-resistant requirements (e.g. Acevedo et al., 2017; Acevedo et al., 2020; Salgado-Gálvez et al., 2014). The municipalities of the Aburrá Valley are classified with medium seismic hazard according to the hazard study by Arcila et al. (2020) and medium-high hazard according to the current seismic-resistant standard (NSR-10: AIS, 2010). The seismic hazard in the territory, its high exposure and the high number of vulnerable infrastructures imply that there is a seismic risk that should not be underestimated.

The concepts of risk and its components are well understood by the people involved in disaster risk management in its different processes (knowledge, reduction and management), as evidenced in Colombia's Law 1523 of 2012 where risk assessment is defined as "...the model through which the hazard and vulnerability of the exposed elements are related, in order to determine the possible social, economic and environmental effects and their probabilities". Although risk-related concepts are routinely addressed in DRR, a thorough understanding of the different models related to seismic risk requires a high level of scientific knowledge, which makes it difficult to transfer and communicate risk assessment results to different users. In addition, risk researchers do not always consider the final users in their analyses, or the outcomes of the risk assessment do not produce risk information easy to use by decision-makers (Weichselgartner & Pigeon, 2015). The challenge of ensuring that risk assessment models and results are relevant to society has been addressed on several occasions: Pohl et al. (2021) concluded that there is a need for model developers, communication experts, and decision makers to collaborate and co-create the products.

Recognizing that there is no unique way to communicate risk and seeking that the information related to seismic risk reaches the general public, a collaborative effort among academia (EAFIT University), the urban environmental authority Metropolitan Area of the Aburrá Valley and its strategic project Early Warning System of Medellín and the Aburrá

Valley (SIATA)—which is executed by EAFIT University—and the public-private non-profit institution GEM Foundation (which in turn was supported by the United States Agency for International Development, USAID), designed and implemented a seismic risk awareness workshop. This workshop, developed through a co-creation process, aims to stimulate meaningful changes among participants by encouraging critical reflection, so they can increase their earthquake awareness and have tools to increase their resilience and seismic risk management. The authors acknowledge that the workshop alone cannot fully address the challenge of seismic risk knowledge transferring. Rather, the workshop serves as a contribution within a broader framework to enhance the use of seismic risk knowledge in DRR, along with other initiatives such as cross-sectoral partnerships, risk-related data sharing, risk transfer strategies, etc. In the workshop, we encourage the attendees to reflect on their seismic risk at different levels, including the personal one, an important issue, as risk perception and knowledge addressed at the household level influences the success of disaster risk management policies and interventions (Rahman et al., 2021)

The present manuscript is organized as follows: Section 2 describes the use of seismic risk knowledge in the DRR of Medellín and its metropolitan area, and its relationship with citizens' seismic risk perception. Section 3 describes the generation and implementation of the seismic risk awareness workshop, while Section 4 describes the knowledge transferring approaches included in the workshop. Finaly, Section 5 presents conclusions and recommendations.

2. SEISMIC RISK PERCEPTION IN MEDELLÍN AND ITS METROPOLITAN AREA

At the national and local level, different strategies have been developed for addressing seismic risk management, including efforts in risk knowledge (AMVA, 2007; UNGRD, 2018; Acevedo et al., 2017; Acevedo et al., 2020; Salgado-Gálvez et al., 2014, among others), seismic monitoring strategies (accelerograph network of Medellín and the Aburrá Valley, national network of accelerographs in Colombia), generation of the Financial Management Strategy for Disaster Risk (AMVA, 2019), etc. Although these strategies are widely known by academics and people related to disaster risk management, most of them are unknown to many citizens. One of the main reasons is that, contrary to other hazards such as floods and landslides, damaging earthquakes in the Aburrá Valley are not frequent: in the last decades there has not been an earthquake that has generated a significant impact in Medellín and its metropolitan area. The most relevant recent earthquakes in the Aburrá Valley are presented in Table 1.

The experience of previous natural hazards is one of the most important factors or risk perception (Wachiger et al., 2013): it constitutes a direct experience that usually has a positive effect on risk awareness. However, as damaging earthquakes have not been so frequent in Medellín and its metropolitan area (relevant events occurred approximately 40-50 years ago), the percentage of the population that has experienced a significant event is low.

Therefore, many of the current inhabitants of the Aburrá Valley have in their imaginary that earthquakes are not a plausible hazard in the region. A challenge arises from this situation: the need to change the seismic risk perception of the inhabitants of the Aburrá Valley (mainly of those who have not personally experienced a damaging earthquake). Fortunately, risk perception is not only influenced by direct experience: indirect experience, i.e., external experience gathered from the media and education, is an important factor in increasing risk perception (Wachiger et al., 2013). The challenge to increase the seismic risk perception in the Aburrá Valley requires raising awareness, training and education strategies. As mentioned previously, academics and people involved in DRR are aware of the seismic risk; nonetheless, efforts to transfer such knowledge to the community are needed.

Table 1. Characteristics of earthquakes with relevant effects in the Aburrá Valley
Adapted from historical seismicity information of the Colombian Geological Service (SGC), Coral et al. (1993) and SGC seismicity catalog

Date	Magnitude (Mw)	Epicenter	Depth (km)	Effects in Medellín
23/11/1979	7.2	4.73°, -76.16°	110.0	VII EMS-98 intensity. More than 100 dwellings, three churches, one theater and one hospital with damage.
17/10/1992	6.6	7.01°, -76.80°	21.1	VI/VII EMS-98 intensity. More than 243 private structures with damage; 25 with severe damage. 20 public buildings and 247 schools were affected.
18/10/1992	7.1	6.85°, -76.73°	12.8	

Mw: moment magnitude; EMS-98: European macroseismic scale

2.1 Knowledge Implementation in Disaster Risk Reduction

As stated in the Sendai Framework for Disaster Risk Reduction, informed decision making requires reliable knowledge; therefore, it is important to enhance the connection between disaster risk, knowledge and learning (Weichselgartner & Pigeon, 2015). One of the main challenges of risk knowledge implementation is the proper transferring of knowledge from scholars to final users (i.e., decision makers, community) in such a way that the best available knowledge is used in the best possible way at community and other levels. Risk knowledge requires the use of facts, data and information to "provide a framework of evaluating and incorporating new experiences and information" (Davenport & Prusak, 1998). Finally, risk knowledge must be effectively transferred into applied knowledge, which corresponds to the higher level of knowledge, also referred as "wisdom" (Weichselgartner & Pigeon, 2015). Applied knowledge implies the availability of dealing with future situations. Ideally, everyone involved in disaster risk management (including the community) should have a wisdom level of risk understanding, in such a way that risk-informed decision-making is achieved.

Several strategies for seismic risk knowledge have been developed worldwide, and specifically for Medellín and its metropolitan area. This knowledge requires its transferring to

have the desired impact, i.e., to increase seismic risk perception and awareness so that final users acquire the knowledge level of wisdom.

2.2 Accessibility to Seismic Risk Knowledge

Results from risk assessments, or risk metrics, allow for the quantification of key risk information. These metrics may include, among others, the level of damage caused in the infrastructure (e.g., slight, moderate, extensive, complete), human impact (displaced, injured, deceased), volume of debris, economic losses, the identification of the elements contributing to the risk and their respective proportions of contribution. Those who assess seismic risk and/or its components (seismic hazard, exposure and vulnerability) are individuals with high scientific rigor, who have acquired knowledge on the subject through high-level training and/or experience in a relatively reduced field of action.

While the results of seismic risk assessment are relatively standard, it is important to recognize that there is not a standard way to communicate risk knowledge. For the information resulting from the seismic risk assessment to reach the greatest number of users, it is necessary to generate educational and knowledge transferring strategies with differential approaches according to the end user (community, disaster risk managers, policymakers, etc.). To the knowledge of the authors, no survey has been conducted on the perception of seismic risk in Medellín and its metropolitan area. At the national level, a recent initiative by the National Unit for Disaster Risk Management (UNGRD, 2025) formulated community risk scenarios for 69 municipalities of Colombia. Surprisingly, only two municipalities recognized earthquakes as a plausible risk scenario. As most of the inhabitants of the Aburrá Valley are not aware of the seismic risk to which they are exposed (i.e., they have low seismic risk perception), in the event of an earthquake, they lack the necessary information to make fundamental decisions. Similarly, it is possible that everyday actions are increasing their level of risk, for example, by obstructing evacuation routes in their homes or by not having a family emergency plan. Knowledge transferring, as mentioned in Section 4, allows informing citizens about issues that have an impact on their quality of life, contributes to generating a positive change in their daily practices, and, consequently, improves the territory's disaster preparedness.

3. SEISMIC RISK AWARENESS WORKSHOP

When an earthquake occurs, a large part of a correct response depends on the actions of each of the inhabitants; therefore, an important effort must be made to prepare the community. Disaster preparation implies informing about the nature of earthquakes, how to act before, during and after an earthquake, carrying out earthquake drills, etc. In other words, a correct knowledge transferring that enhances its application (wisdom level of knowledge) must be guaranteed, allowing citizens to have the best possible response in the event of an earthquake. Within this context, an inter-institutional collaborative effort generated and implemented a

risk awareness workshop, which aims to contribute to the self-management of seismic risk in a space for dialogue where concepts related to seismic risk are clarified, and tools are given for attendees to make a critical reflection of their relationship with the phenomenon of earthquakes.

The purpose of the seismic risk awareness workshop presented in this article is to generate space for dialogue with the attendees, where answers are given to the doubts they have regarding the process of earthquake generation, the components of seismic risk, and how to manage risk at a personal and family level, among other relevant aspects. A guide was generated to facilitate the development of the workshop and its dissemination, which is available online (GEM-AMVA-EAFIT, 2022). In addition, audiovisual material was developed focusing on the Aburrá Valley[4] and later extended to the city of Santiago de Cali (Colombia)[5].

Table 2 summarizes the process of generating the workshop, which was created from the identification of the need to provide indirect experience to the community on seismic risk, aiming to increase their seismic risk perception, and to transfer the expert's knowledge to the community. The workshop, with the objective of building a strategy to facilitate a dialogue with the community on the risk associated with earthquakes, was generated through periodic co-creation meetings between academics, professionals and decision makers from social, science communication, seismic engineering and audiovisual production components. Three aspects were considered fundamental for the creation of the workshop: i) the use of simple and clear language, ii) the need to create a space to facilitate dialogue and the integration of participants' contributions, and iii) the need to create support material to be used during the workshop, which could also be accessed and shared by the participants at any time.

Table 2. Generation process of the seismic risk awareness workshop

Challenges identified	People involved in the creative process	Knowledge transferring strategy
✓ Difficulties in transferring scientific complex information to the community. ✓ Inhabitants' lack of seismic risk perception.	✓ Scientists (seismic risk modelers). ✓ Experts on science communication. ✓ Audiovisual producers. ✓ Decision-makers.	✓ Development of a written guide. ✓ Development of audiovisual material. ✓ Search for existing material related to seismic risk knowledge. ✓ Training of trainers.

The workshop objective was defined as: "to contribute to the self-management of seismic risk in a space for dialogue where concepts related to seismic risk are clarified, and tools are provided for the attendees to make a critical reflection on their relationship with the earthquake phenomenon". The target audience of the workshop is the community, without the need to have previous knowledge of the subject. As will be shown later, the workshop is open

[4] https://www.youtube.com/watch?v=U1QWqsCSPNw
[5] https://www.instagram.com/reel/ClSXQOgjIyf/?igshid=cjFyeDl0MHR3cThi

to any type of participants and, as the starting point of the workshop is to gather questions, experiences and doubts from the attendees, each workshop is unique. The methodology for the design of the workshop is summarized below.

3.1 Creation of the Working Group

The working team included seismic risk modelers, decision makers and experts in science and communication, from public and private institutions. The diversity of the team members made it possible to approach the topics from different perspectives, always bearing in mind the need to generate a product that would be adapted to a public with no previous knowledge about seismic risk. During this stage, the co-creation team met weekly for two and a half months.

3.2 Identification of Topics to be Covered by the Workshop

The working team identified that the critical points that would allow participants to become aware of seismic risk can be grouped into three fundamental topics: i) understanding earthquakes as a natural event that can affect them (hazard), ii) understanding the other components of risk (exposure and vulnerability), which facilitates associating how the seismic hazard by itself does not constitute risk, as risk requires the interaction of hazard with infrastructure and population, and iii) understanding how to act effectively if an earthquake takes place. During the creative process, we decided that the workshops to be held with the general community would not address the socialization of the results of technical studies on seismic risk, since a correct interpretation of these results requires an interlocutor with advanced knowledge. Nonetheless, these topics are addressed in the workshop when the level of the public allows it.

The workshop was designed as a two-hour session to accommodate the challenges of scheduling a common time slot with the stakeholders. Given the difficulty of aligning availability across different sectors, the condensed format ensures greater participation while maintaining the effectiveness of the knowledge transferring process. In addition, the workshop was conceived with a focus on minimizing logistical complexities and costs, making it more accessible and easier to implement across various contexts and potentially facilitating its scalability.

3.3 Definition of Methodological Strategies

The planning phase of activities began once the topics to be included in the workshop were identified. Activities that would allow a dynamic and friendly understanding of each of the topics to be addressed were proposed; for this purpose, the interaction of the scientific staff with the science communication experts was fundamental. Based on the experience of the work with the community that the Metropolitan Area of the Aburrá Valley and its SIATA Project constantly carry out, the seismic risk awareness workshop starts with a dynamic

activity where the attendees express their expectations of the workshop and are prepared for the following activities. The workshop involves different methodologies such as: an ice-breaker activity (opening activity); creating spaces for dialogue where participants can resolve doubts about issues related to the seismic phenomenon and where they can also share their experiences; generating activities to develop individually and collectively; promoting changes in activities that keep participants active and minimize the loss of attention; using drawing as a tool to recognize the spaces inhabited by the participants (risk knowledge addressed at household level).

3.4 Creation of Material for the Development of the Workshop

An important part of the workshop was a video designed and created in conjunction with audiovisual producers. For the creation of this video the scientific staff generated an initial script that served as the basis for the interactions with the audiovisual producers (who from the beginning were part of the co-creation team). The 3:51 minute video covers topics related to i) earthquake generation: earth structure, interaction of tectonic plates, earthquake parameters (magnitude, depth, location), crustal faults; ii) exposure and vulnerability: inhabitants and infrastructure in the Aburrá-Valley, building characteristics and its relation to seismic capacity; iii) seismic risk, as the result of the interaction between seismic hazard, exposure and vulnerability; and iv) seismic risk awareness, stressing the need for risk awareness and preparedness. The inclusion in the video of information and graphic elements of the territory of the Aburrá Valley, such as landmarks and well-known locations, favors a greater receptivity of the information by those attending the workshops. Figure 1 presents examples of the graphic elements of the video. Finally, the strong visual appeal and concise format of the video makes it an effective resource for dissemination on social media, allowing it to reach a broader audience beyond workshop attendees and further raising public awareness of seismic risk.

The activities to be developed in the workshop and their corresponding methodology are available in GEM-AMVA-EAFIT (2022) in which the associated physical resources and the estimated execution time were included for each activity. Due to the inherent technical nature of the information on seismic risk, once the workshop activities were established, the group of technical experts searched for support material on the subject. This material was compiled to facilitate the understanding of the concepts addressed in the workshop; it includes a variety of visual and textual resources obtained from scientifically supported sources that cover topics such as Colombian seismicity, concepts of building' seismic behavior, common construction practices in Colombia, site effects and seismic microzonation and seismic risk management. In addition, a list of common myths and misbeliefs related to earthquakes is included, with its corresponding scientific explanation. The availability of this set of resources not only enriches the participants' experience during the workshop but also provides a valuable training tool for the moderators in charge of transferring knowledge. The step-by-step activities to be developed in the workshop and the information from the supplementary material were consolidated in the written material or workshop guide, which serves as an integral reference for the workshop's effective execution. Table 3 presents the

list of activities designed for the workshop and its relation to knowledge transferring approaches (see Section 4).

Figure 1. Graphic elements of the video that include references to Colombia and the Aburrá Valley

Table 3. Activities included in the risk awareness workshop guide and their relation to knowledge transferring

Activity	Knowledge transferring approach
1. Presentation and ice breaking activity	Participation
2. *Ensoñación* (daydream) – home drawing	Context recognition
3. What do we know about earthquakes? Myths and realities	Participation
4. Video about seismic hazard and risk	Context recognition
5. Dialogue about seismic hazard and risk concepts	Dialogue of knowledge and know-how
6. Recognition of my home	Context recognition, transformation
7. Solving myths and doubts	Dialogue of knowledge and know-how, transformation
8. What should I do if an earthquake happens?	Critical reflection

3.5 Training of Trainers

Once the workshop creation stage was completed, spaces were generated to "train trainers". In this stage, the seismic risk experts who participated in the co-creation process led the execution of a workshop for an audience made up of people from the institutions participating

in the co-creation, identified as future workshop moderators. It is important to keep in mind that those that moderate the workshop have the task to facilitate knowledge transferring and that, in this task, trust becomes a key issue for risk perception (Wachinger et al., 2013). As the workshops are an indirect experience for attendees (many of them with low seismic risk perception), participants should trust the moderators, who must be prepared to face a two-hours space in which, even though there is a guideline, differences arise between workshops as each one is developed according to the concerns, knowledge and experience of the attendees (see Section 4).

The training of trainers was carried out in two different sessions. From those sections, adjustments were made in terms of estimated times for the development of the activity, and they served to validate the methodology and the order proposed in the workshop. Figure 2 shows records of the first training session of the workshop for people involved in science communication activities and technical staff of the institutions that co-created the workshop. The experience that we have gathered since the workshop was implemented in 2021 has shown that at least one moderator in each workshop should have knowledge of earth science, geology and/or civil engineering. The workshop greatly benefits if an expert on science communication is also part of the moderators.

Figure 2. Training of personnel of the institutions involved in the development of the workshop (left) and detailed step-by-step guide of the workshop (right)

Training the trainers not only enhances their ability to communicate seismic risk effectively but also provides an opportunity to strengthen their own understanding of key concepts. The multidisciplinary teams working in DRR offices come from diverse professional backgrounds, and while they may be familiar with the terminology, certain concepts may remain unclear or only partially understood. By participating in the workshop, technical staff can refine their knowledge, clarify misconceptions, and develop a more

cohesive understanding of seismic risk. This, in turn, improves both their internal discussions and their ability to transfer accurate information to the communities they serve.

3.6 Pilot Workshops

The first workshops conducted with the community (pilot workshops) were attended by several moderators with various roles: following up on the timing of the activities, leading the various activities of the workshop, and taking notes of the concerns of the attendees, among others. These spaces allowed fine-tuning the way the workshop was delivered, both in terms of methodology as well as in the execution time of each activity. They also made it possible to identify the number of people required to moderate the workshop according to the number and type of participants.

3.7 Implementation of the Workshop

As of the date of the workshop's implementation (end of 2021), approximately 20 workshops have been held annually moderated by staff from the co-creating institutions. The number of attendees varies, with a maximum of approximately 25 people per session. Each workshop is different, since the emphasis of each session is defined by the audience's concerns and background: some focus on the physical phenomenon, others on infrastructure components, and some on risk management. Additionally, as mentioned above, when the workshop is given to a specialized audience such as risk managers, it is complemented with specific information and results from seismic risk studies carried out for the territory.

The workshop video was adapted for the city of Santiago de Cali (Colombia), where a workshop was held with members of the city's risk management team (as a strategy for training trainers) and with decision-makers and Red Cross personnel. Figure 3 presents some of the graphic elements of the video adapted for Santiago de Cali, and how results from seismic risk studies of the city are being shared with DRR personnel.

Also noteworthy was the development of the workshop in the city of Tijuana (Mexico), where co-creators of the workshop moderated sessions with risk managers, students and people from the community. The development of these workshops allowed personnel from the Universidad Autónoma de Baja California (UABC) to gain experience in the execution of the workshop, so that in Tijuana, teachers and students from the UABC are currently leading seismic risk awareness workshops adapted to the needs of their territory.

4. RISK KNOWLEDGE TRANSFERRING

Knowledge transferring approaches proposed in the Colombian National Policy on Knowledge Transferring (Torres et al., 2021) are presented below in the context of the seismic risk awareness workshop.

IDRiM (2025) 15 (2)
DOI10.5595/001c.150381 ISSN: 2185-8322

Figure 3. Seismic risk awareness workshop of Santiago de Cali for disaster risk managers. Left: adaptation of the video for Santiago de Cali; right: analysis of seismic scenarios

4.1 Context Recognition

The identification and interpretation of local realities is crucial for achieving true knowledge transferring. Therefore, the workshop begins with the projection of a video that explains the fundamental concepts related to the generation of earthquakes, taken to the local context, as in the case of the Aburrá Valley, where the geographical position of Colombia as a point of convergence of tectonic plates and the proximity of the Valley to fault systems are highlighted. By exposing these concepts and emphasizing the fact that earthquakes occur daily in the country, in addition to facilitating the understanding of the participants and reinforcing the workshop objectives, it is possible to make them consider earthquakes as a real possibility in the territory. The workshop also includes an activity called *Ensoñación* (daydream) that connects with the local reality at a more individual level. This activity responds to the need to increase seismic risk perception in a region with many vulnerable structures, and where, as residents are not aware of the seismic risk to which they are exposed, it is common for them to unconsciously but routinely perform actions that may increase their level of risk. In the activity, each person is asked to close his/her eyes and mentally walk through his/her home, starting with its access, identifying the elements found along the way and considering the location of partition and additional elements. At the end of the exercise, the participants draw their home freely, including as many details as possible. Drawing their own households generates in the participants an expectation of wanting to know more about their own security, which has been shown to generate greater concentration and interest in the rest of the workshop. Figure 4 shows photographs of the two components included in the workshop as part of context recognition (video projection and daydream exercise). At the

ISSN: 2185-8322
DOI10.5595/001c.150381

final part of the workshop, the drawing is addressed again to explore aspects related to structural vulnerability and how to respond if an earthquake takes place (see section 4.5).

Figure 4. Recognition of the environment: visualization of the video and *Ensoñación* (daydream) exercise

4.2 Participation

Participation seeks citizen intervention, recognizing a plural and diverse context, where all attendees have diverse knowledge and expertise. In this order of ideas, the workshop constantly encourages the participation of the attendees within an environment of trust (a key factor in knowledge transferring; Wachinger et al., 2013) and closeness with the workshop moderator or expert. During the workshop, the attendees are asked to share their ideas and previous experiences (direct experience) about earthquakes. Myths or beliefs about earthquakes are shared, and a space is provided where attendees can express their doubts and concerns. All contributions are valued and recorded to later enrich the dialogue and exchange of knowledge. During this part of the workshop, myths are written down by the moderators, who differentiate them based on their relation to seismic hazard (earthquake generation and expected intensities) and risk (consequences resulting from the combination of hazard, exposure and vulnerability). Table 4 presents some of the myths that are commonly expressed during the workshops.

Table 4. Example of earthquake-related myths and beliefs

Hazard related	Risk related
Earthquakes are related to the increase in temperature.	If an earthquake occurs, do I stay home or should I run outside?
Are more earthquakes happening this year?	All the buildings will suffer damage.
Someone told me that this year a big earthquake will happen in my city.	High-rise buildings suffer greater damage than low-rise buildings.
What is the difference between magnitude and intensity?	The best place to stay during an earthquake is under the door lintel.
We are in a region where earthquakes do not occur.	Shaking is stronger on the upper floors of a building.
“Earthquake” is only used if the shaking is strong, otherwise it is a “tremor”.	When an earthquake happens lifts should not be used.
Some animals can predict earthquakes.	Only earthquakes with a large magnitude can generate damage.

The participatory methodology of the workshop allows it to be adapted to the needs and interests of each group, using strategies to create an enjoyable and dynamic environment throughout the session. Figure 5 shows photographic memories of these participatory spaces in which interaction objects such as palettes are often used.

Figure 5. Resolving myths about earthquakes by interacting with paddles (top) and breaking the ice with attendees (bottom)

4.3 Dialogue of Knowledge and Know-how

Dialogue under conditions of equity, respect and appreciation of differences favors learning, capacity building and the construction of new relationships between actors, knowledge and know-how. In the case of the workshop, the dialogue takes place around the affirmations and concerns expressed by the attendees in the participation space and during the activities that are developed (e.g. *Ensoñación* - daydream); therefore, the workshop is dynamic and always evolves according to the questions and the background of the participants (see Table 4). To guide the dialogues the moderator or expert must be able to accurately resolve the doubts expressed by the participants during the workshop, always trying to maintain a conversational environment between him/her and the participants and, therefore, must have adequate training in the seismic risk concepts addressed in the workshop or have a background related to risk topics (e.g. earth science, geology, civil engineering). The moderator can use resources such as the video generated for the workshop and the support material provided in the guide. We have noticed that the video is a key resource that facilitates the response to most of the participants' questions and to concisely and consistently convey a clear message of the phenomenon and its potential impact on society. Figure 6 shows photographic memories that show the dialogue spaces and some of the support material used by the moderators to answer the workshop questions and guide the different activities.

Figure 6. Dialogue spaces in the workshop and support material for the moderator to help participants identify structural typologies (left)

The skills of the moderator play a crucial role in creating a positive and engaging environment that promotes open discussions and trust among participants. An effective moderator ensures that the session is welcoming and non-judgmental, allowing attendees to feel comfortable asking questions, even about apparently "obvious" concepts, without hesitation. By facilitating dynamic and inclusive conversations, the moderator helps participants connect the discussions to their personal experiences, community actions, and, where relevant, their professional responsibilities. The discussions during the workshop should not only promote engagement during the session but also reach the interest of the participants for them to share the insights with colleagues, relatives, and friends, further amplifying the impact of seismic risk awareness and preparedness.

4.4 Transformation

The purpose of transformation is to achieve a process of change, resulting from participation, dialogue and encounter with others. This process is the goal of knowledge transferring, as it allows the attendees to walk the path that leads to a higher level of understanding: wisdom (Weichselgartner & Pigeon, 2015). The transformation process is evident throughout the workshop. In the different sessions, a very clear pattern has been evidenced in which the participants build knowledge in an incremental way, connecting the concepts acquired in the different activities that are carried out. Thanks to this new level of understanding, attendees generate their own conclusions, which are usually expressed and shared with the rest of the group in the last moments of the workshop.

4.5 Critical Reflection

Critical reflection refers to the continuous analysis that citizens make of the daily practices, situations and experiences in which they participate. In the final part of the workshop, the participants already recognize earthquakes as an event that can occur, and indicator that seismic risk perception has been achieved. An important part of this reflection is framed in

the continuation of the *Ensoñación* (daydream) exercise, in which each participant, with the help and dialogue with the moderator, carries out an activity to identify the structural system of their home. At this point, the participants are encouraged to evaluate the conditions of their homes and their surroundings, and to discuss how to act when an earthquake occurs according to their own context. They are also encouraged to reflect on their homes and try to identify simple actions that they can carry out based on the *Ensoñación* exercise, such as removing objects from the evacuation routes of their homes and anchoring heavy objects to the walls. Attention is raised to the preparedness measures that attendees have for an emergency: do they have an emergency kit? Do they have a family emergency plan? Do they know the meeting points in their neighborhood? Do they know whom to contact in case of a catastrophic event? Finally, it is suggested to the attendees that they can transfer the knowledge acquired in the workshop to their community and people close to them. Figure 7 shows examples of the type of analysis made by the participants based on the *Ensoñación* (daydream) exercise.

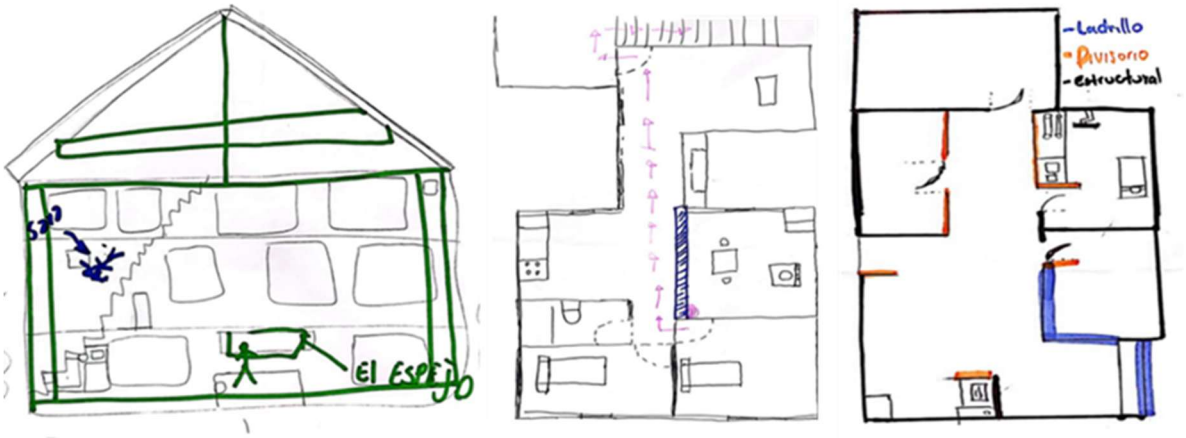

Figure 7. Reflection of the environment: identification of dangerous objects (left), evacuation routes (center), structural and partition walls in the house (right)

Once individuals understand the critical role of adequate construction practices in preventing severe damage to their homes, workplaces, and the infrastructure they rely on, effective risk reduction strategies can be implemented. One of the most common drivers of seismic risk is the construction of residential housing without adhering to proper building code standards (Calderón & Silva, 2022). In the Aburrá Valley, for example, 70% of residential houses are unreinforced masonry built with poor standards, making them highly vulnerable to earthquakes (Acevedo et al., 2017). When individuals truly understand the importance of safe construction, they become more likely to question the quality of their homes and seek ways to improve structural safety, avoiding common construction mistakes in future projects, considering safety measures when adding new floors to their homes or purchasing new properties. In this way the culture of risk reduction is built at the individual and at the household level. However, risk perception and reduction efforts cannot be limited to the household; they must be framed within a broader local context. It is essential that workshop attendees recognize the institutions responsible for emergency response in their territory and develop a multi-scale understanding of risk management. This means not only

knowing how to reduce vulnerability in their own homes but also understanding the role of communities in collective preparedness and identifying which institutions they can turn to in the event of an emergency. By integrating knowledge at these different levels, individuals are better equipped to contribute to resilience efforts, strengthening both personal and collective disaster preparedness.

5. CONCLUSIONS AND RECOMMENDATIONS

The execution of the seismic risk awareness workshop has proven to increase the seismic risk perception of the community: regardless of attendees' backgrounds and previous experience, during the two-hour workshop they show interest in the activities and use the session to increase their knowledge on topics related to earthquakes and their associated risk. The authors consider that these topics, which are usually not discussed with the community due to both their scientific complexity and the fact that a significant amount of the country's infrastructure is vulnerable, should be addressed in a clear and unrestricted manner. The workshop attendees have proven to be individuals who quickly grasp the concepts related to risk and who, at the end of the workshop, understand that they have an important role to play in risk management. At the end of the activity, it is common to find people who have been able to identify actions that they can perform, both at the individual and societal levels, that increase their resilience to earthquakes.

A key aspect of the workshop's content is the integration of audiovisual materials that reflect the local context and showcase the institutions responsible for emergency response in case of an earthquake. We encourage potential users of the workshop to adapt the video to the specific location where the workshop will be conducted (as was the case of Santiago de Cali, Colombia). If the adaptation of the video is not feasible, additional existing resources can complement the workshop, such as materials related to seismic risk knowledge and management developed by local, regional and national agencies related to DRR. Additionally, workshops benefit when representatives of DRR agencies actively participate in the session, as was the case of the workshops conducted at Tijuana, Mexico, where representatives of the Civil Defense of the city provided oral and written information that enriched the topics addressed in the workshop. The presence of representatives of DRR institutions generates trust in the attendees, making risk communication more effective.

Knowledge transferring is a process that requires the commitment of different professionals and, to achieve an effective transfer, it is essential to carry out a co-creation process where different points of view are considered, so that synergy is generated to effectively transmit knowledge to achieve transformation in the people receiving the information. We consider that the acceptance of the workshop is the result of a collaborative effort in which, from the initial stages of creation, the expertise of people from different areas of knowledge and with different roles in disaster risk management was included, always bearing in mind the type of public for whom the workshop was developed. We are aware of the limitations of the workshop such as the limited number of participants in each session. To

expand the coverage of the workshop, future efforts should concentrate on increasing the number of trainers, generating partnerships with researchers and risk managers outside the metropolitan area of Medellín, creating virtual resources for social media, and generating complementary activities related to topics such as seismic earthquake behavior, among others.

Implementing this workshop across the city for various stakeholders has facilitated valuable interactions and discussions between different groups, promoting a deeper exchange of knowledge and perspectives on seismic risk. In particular, the firefighters of the Aburrá Valley expressed a strong interest in further exploring the implications of seismic risk on rescue operations and enhancing their preparedness for earthquake-related emergencies. As a result, a follow-up workshop was developed (EAFIT-AMVA-GEM-USAID, 2023), building upon the foundational knowledge from the initial session. This second workshop focuses into more specific details on the effects of strong earthquakes on the built environment and how this understanding can be integrated into rescue strategies, ultimately strengthening response capabilities.

Despite the workshop's positive reception, several challenges will need to be addressed in the future, including the development of tools or procedures to assess the capacity of future moderators, questionnaires to qualitatively measure the workshop's effectiveness, and a review of the follow-up of actions promoted by workshop attendance. Furthermore, despite the decision not to address the dissemination of the results of technical studies to the general public, we have observed the importance of communication the risk results, when available, to the community. In this regard, an important aspect to consider is that communicating seismic risk to people is not an easy task as it "involves providing technical and scientific information, including the low probability of an adverse event, that is not always easy to understand" (Savadori et al., 2022). As suggested by Savadori et al. (2022), the use of comparisons can improve risk communication, which will be used in the development of future workshops where risk results are available. Furthermore, it is important to note that there are several factors that influence risk perception, such as gender, culture, individual perception, experience, awareness, preparedness, exposure, responsibility/accountability, response and trust in official sources of information (Hernández-Moreno & Alcántara-Ayala, 2017). We believe that, given that the workshop begins by gathering the audience's questions and concerns regarding seismic hazard and risk, each workshop addresses several factors listed by Hernández-Moreno & Alcántara-Ayala (2017), which encourages participation and interest among attendees.

The effectiveness of workshops can be increased if assessments of the public's perception of risk are available. We encourage the development of such assessments, focusing on issues such as previous experiences with earthquakes, perception of hazard and vulnerability, and preparedness planning. These issues have been studied in other regions such as Central America (Orihuela et al, 2023), where topics were included to assess participants' perceptions of earthquake-related factors as well as their perceptions of earthquake early warning systems.

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