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Developing effective earthquake risk reduction strategies: The potential role of academic institutions in Lebanon

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Abstract Lebanon faces the risk of powerful earthquakes with potentially devastating effects. However, the Lebanese people in general have not yet recognized this risk, as current educational programs and government officials have failed to inform them about it. This article discusses the essential role that Lebanese institutions of higher education should play in educating the public about this risk and in preparing the public to take risk reduction measures. It calls for efforts to integrate earthquake risk education into academic programs and to establish research facilities and student volunteer programs on university campuses across Lebanon to reduce the impact of future earthquake disasters and to make Lebanese communities more resilient to future crises. Without the engagement of higher education institutions in disaster prevention and mitigation, Lebanese communities will remain vulnerable to massively destructive earthquakes.

Keywords Earthquake · Academic institutions · Lebanon · Disaster risk reduction · Seismic resilience · Curriculum

Earthquakes are considered to be amongst the most destructive and costly disasters, posing a serious threat to a country's infrastructure, population, economy, and social structure. These natural hazards have the potential to knock down buildings, wreck cities, and wipe out communities in a matter of seconds. The effects of recent earthquakes on ill-prepared communities have proven to be devastating and long lasting. These effects can often deplete a nation's limited resources and divert its budget and essential financial assets away from development initiatives and toward post-disaster recovery and reconstruction. Earthquakes also disrupt fundamental services that local populations rely on for daily

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necessities. As a result, earthquake disasters can hinder economic growth and sustainability, which in turn affect quality of life.

Earthquakes kill tens of thousands of people every year. The tragic 7.0 moment magnitude earthquake in Haiti in 2010 claimed the lives of over 200,000 people and proved once again that poor and developing countries are highly vulnerable to earthquake hazards. The 8.0 moment magnitude 2008 Sichuan earthquake in China killed over 80,000 people and destroyed thousands of buildings, including schools and hospitals. The 6.3 moment magnitude earthquake in Bam, Iran, in 2003 resulted in the loss of 30,000 lives, and the 1999 Marmara earthquake in Turkey resulted in over 19,000 lives lost (Anbarci, Escaleras, and Register 2005). According to the Organisation for Economic Cooperation and Development (OECD 2008), approximately 90% of earthquake fatalities occur in developing countries due to a lack of awareness and preparedness initiatives, poor building design, and corrupt construction practices (Escaleras, Anbarci, and Register 2007). Therefore, such countries are desperately in need of immediate initiatives to improve the resilience of vulnerable and exposed communities.

Earthquake hazard and preparedness status in Lebanon

Seismic activity in Lebanon and along the Dead Sea fault has been observed and documented for more than 2,000 years. During that time, this activity has triggered several earthquakes in Lebanon, ruining cities and towns in the region, felling thousands of buildings into rubble, and leaving hundreds of thousands of casualties. Of these, the most notable and prominent have been the earthquakes of 551 AD, 1202 AD, and 1759 AD, which reached estimated magnitudes of 7.5 and caused tremendous destruction in the country's major coastal cities.

Geologists have shown that Lebanon is covered by seismic fault systems. For example, the Dead Sea Transform (DST) has been responsible for the bulk of the seismic activity in the Eastern Mediterranean. The DST originated from interactions and collisions between African and Arabian plates and is the deepest and most deadly fault system in the eastern Mediterranean region, stretching from Ethiopia through Aqaba, Jordan, Lebanon, and Syria and continuing north to join the East Anatolian fault in Turkey. This fault system has proven to be the origin of several catastrophic earthquakes throughout the history of Lebanon (Harajli, Sadek, and Asbahan 2002). The Mount Lebanon Thrust (MLT) is another major active fault that was recently discovered along the coast between Beirut and Enfeh (Elias et al. 2007). A disastrous 7.5 moment magnitude earthquake occurred on this fault on 9 July 551 AD, destroying most of the coastal cities in Lebanon. Scientists have suggested that similar earthquakes occurred along the same fault over the past 1,500 to 1,750 years. The least three documented earthquakes that occurred in Lebanon over the past 1,500 years had magnitudes exceeding 7.0 on the Richter scale. The last major earthquake, which occurred in 1759 along the DST fault system, measured 7+ on the Richter scale and killed 40,000 people in Beirut and Damascus. Experts forecast that major earthquakes on this fault system occur every 250 to 300 years.

Ninety percent of Lebanon's population of four million is well distributed in a band approximately 20 km wide and 200 km long that extends along the coast of the Eastern Mediterranean Sea, while two thirds of the population is concentrated within 10 km of the coast (Huijer, Harajli, and Sadek 2011; Naja and Baytiyeh 2014). The Peak Ground Acceleration (PGA) associated with the severity of ground shaking during an earthquake can be used as a quantitative indicator of the existing seismic hazard and the expected level of damage and destruction. Serious damage and losses occur in events characterized by a

PGA of 0.2g and above and a 0.3g earthquake can be labeled as "destructive". Taking into consideration the seismic activity within Lebanon and in its neighbouring countries along the Eastern Mediterranean, geologists and engineers have estimated that the PGA of the Lebanese territories varies between 0.2g in the eastern part of the country to 0.3g in the highly populated western part nearer the coast (Huijer, Harajli, and Sadek 2011). Thus, they recommend that a PGA of 0.25g be used for most of Lebanon's construction design. However, due to the recently discovered offshore MLT fault system, a PGA of 0.3g is recommended for building design to resist earthquake forces in coastal areas where most of Lebanon's population, infrastructure, lifeline facilities, and capital investments are located (Huijer, Harajli, and Sadek 2011).This existing seismic hazard has become a reliable scientific indicator of earthquake activity; reducing these known risks requires the involvement and collaboration of government agencies and academic institutions, a policy that is widely practiced in seismically active regions around the world.

While there is no doubt that future earthquakes pose a threat in Lebanon, internal political conflict and wars in the country over recent decades have exhausted the country's resources and delayed its efforts to prepare for an earthquake disaster. United Nations resident coordinator Robert Watkins estimates that, in the event of an earthquake in Lebanon, up to 30% of the population could die (Taylor 2012). There is good reason to believe that Lebanon is on the brink of a major catastrophe, and therefore the country should be on a higher level of alert.

The importance and objectives of the study

The slow-developing efforts and limited commitment of the Lebanese government's disaster risk reduction cannot lead to desirable outcomes. In May 2009, the Lebanese prime minister signed a three-year project with the United Nations Development Programme (UNDP), called Strengthening Disaster Risk Management Capacities in Lebanon, to help the Lebanese government develop an effective strategy for disaster management and risk reduction. Unfortunately, this project does not address the enforcement of seismic building codes or regulation of land use, nor does it engage the education sector in promoting disaster awareness and safety procedures. The country has insufficient infrastructure to resist such a natural hazard, and there is only limited disaster planning at both the government and local community levels. Furthermore, the country lacks policies and institutions designed for earthquake hazard preparedness and prevention (Baytiyeh and Naja 2013). According to a recent World Bank report (Kenny 2009), Lebanon is ranked fourth after India, Cameroon, and Guatemala in corruption linked to construction permits. Ambraseys and Bilham (2011) estimated that 83% of all deaths from building collapses during earthquakes over the past 30 years occurred in countries that are anomalously corrupt.

Despite these statistics, the Lebanese people have little perception about earthquake risk or adaptation to earthquake disaster impacts. Therefore, this paper aims to lay the foundation for a paradigm shift in the vision of Lebanese universities and policies regarding disaster risk reduction. By providing these suggestions, this paper seeks to motivate government leaders, policy makers, and university administrators in Lebanon to act on this issue in order to reduce its associated risks. This article urges higher education institutions in Lebanon to work toward greater safety and social prosperity by promoting earthquake disaster awareness, preparedness, and mitigation planning. The Lebanese people must be educated and prepared to take immediate action in the event of a disaster, as well as to be responsible for themselves and their families following an earthquake. Led by universities, educational institutions can actively engage in disaster prevention measures to respond in the event of an earthquake (Baytiyeh and Naja 2013). Thus, this article urges universities and colleges in Lebanon to adjust their academic curricula to cover earthquake disaster risk education, engage in research activities and projects, promote community awareness, launch earthquake volunteer programs, advance partnerships with public and private sectors, collaborate with international relief agencies, and exert increased effort to ensure that students and staff are aware of safety precautions for more efficient humanitarian disaster relief.

Higher education institutions in Lebanon not only possess the structures, facilities, and resources for emerging leadership with regard to disaster relief, but also hold high reputations amongst the public, government, and businesses (Baytiyeh and Naja 2013). Given their influential roles within society, it is crucial that universities participate in future disaster risk reduction and relief efforts.

The role of universities in disaster risk reduction

The vital role that academic institutions can play in shaping social values, advancing thinking, and affecting the attitudes of people in their surrounding communities should not be underestimated. Empirical studies conducted in diverse geographic, socioeconomic, cultural, and hazard contexts offer strong and consistent evidence on the positive impact that formal education can have on reducing vulnerability (Muttarak and Lutz 2014). Aside from being responsible for creating a learning environment conducive for students to develop their knowledge and interpersonal skills, society relies on universities as primary institutions to build and broaden a culture of safety amongst communities.

Drawing on the conclusions from the review of the Yokohama Strategy, the World Conference on Disaster Reduction established five priorities for action under the Hyogo Framework 2005–2015 (Hyogo Framework 2005), the third of which is “Use knowledge, innovation and education to build a culture of safety and resilience at all levels”. At all levels, the educational system can play a substantial role both in increasing the public’s ability to respond to disasters and in strengthening community resilience. And while the integration of disaster risk education in schools has positive outcomes, the leadership of universities is essential to develop a strong communal culture of safety. However, the current curricula of Lebanese schools do not incorporate earthquake disaster into the core subject matter required for the national examinations (sciences, math, and languages). Moreover, 10 out of 42 universities in Lebanon offer engineering programs but none of them has established an earthquake engineering program or research-related facilities. Table 1 gives examples of academic institutions that offer courses or programs in earthquake engineering from developed and developing countries.

In order to link research to practice, several universities in the United States have established the Consortium of Universities for Research in Earthquake Engineering (CUREE). The main purpose of CUREE is to advance earthquake engineering research, education, and implementation. Its 22 participating universities provide an administrative and management structure for efficient academic coordination on large projects. For example, investigations of buildings damaged by the 1994 Northridge earthquake revealed that a number of steel-moment-frame buildings had experienced fractures at the beam-to-column connections. When studies of ground movements were combined with data assessing the damage to various building types, damaged steel-moment-frame buildings were found over a large geographical area, including sites that experienced only moderate levels of ground shaking. The steel-building construction industry was greatly concerned

Table 1 Examples of engagement in earthquake risk education in academic institutions in some developed and developing countries

Institution, country	Availability of earthquake engineering programs/research center at the institutions
United States	Various universities in the United States provide earthquake engineering programs and have established earthquake research centers, including MCEER at the University of Buffalo, PEER at UC-Berkeley, and MAE at the University of Illinois.
Japan	Several universities provide earthquake engineering programs and have established earthquake research centers. Tokyo Institute of Technology provides an international program on earthquake engineering and has established a center for urban earthquake engineering, collaborating with PEER at UC-Berkeley. Also, the Graduate School of Science at Tohoku University has established a research center for prediction of earthquakes and volcanic eruptions.
New Zealand	A number of universities offer earthquake engineering programs and have established earthquake research centers, including Massey University, Oakland University, and Canterbury University.
Turkey	A number of universities offer earthquake engineering programs and have established earthquake research centers, including Kandilli Observatory and Earthquake Research Institute at Bogazici University in Istanbul and the Earthquake Engineering Center at Middle East Technical University in Ankara.
Israel	Several universities offer courses in earthquake engineering, including Technion–Israel Institute of Technology and Ben-Gurion University of the Negev.
Lebanon	No university is engaged with earthquake-related programs. The only such programme is the Earthquake Preparedness Initiative (EPI), launched on 19 March 2014 at the American University of Beirut, to activate available Lebanese resources to improve community resilience vis-à-vis earthquake disasters.
Iran	Several universities offer earthquake engineering programs, including Amirkabir University of Technology, Tehran Polytechnic, and Sharif University of Technology.
Pakistan	Two universities offer earthquake engineering programs: NED University of Engineering and Technology in Karachi and the University of Engineering and Technology in Peshawar.

about this flaw, and the discovery generated research into the problem. Within months after the earthquake, the Structural Engineers Association of California (SEAOC), the Applied Technology Council (ATC), and CUREE formed SAC Joint Venture to investigate damage to welded steel-moment-frame buildings and develop repair techniques and new design approaches that would minimize damage to similar construction from future earthquakes (O’Rourke, Holzer, Rojahn, and Tierney 2008).

Given all these threats from and risks of earthquakes, universities in Lebanon can play an essential role through several components: academic curricula, research facilities and testing laboratories, and community engagement. In the following sections the importance of each component is discussed.

Academic curricula

As disaster risk reduction must begin with education, universities can play an essential role in educating vulnerable communities about these risks and may influence community attitudes toward earthquake hazards as well as improve community members’ preparedness and survival skills (Shaw, Kobayashi, Shiwaku, and Kobayashi 2004). Despite the fact that mitigation education and risk awareness can reduce damages and fatalities (Soffer et al.

2011), universities in Lebanon lack disaster risk curricula. Highly educated persons and societies are reported to practice better preparedness and responsiveness to natural hazards, to suffer fewer losses, and to recover more quickly from such hazards (Muttarak and Lutz 2014). This suggests that empowering people and enhancing human resilience to disasters through education make them less vulnerable to future disasters.

Student enrolment across the majority of universities in Lebanon has recently increased dramatically. Therefore, this is a fitting time to restructure and revolutionize earthquake disaster education by including specific courses on earthquake disaster mitigation and by infusing informal mitigation education into projects and presentations. To be more effectively supportive, universities across Lebanon should implement a general disaster risk education course on the dangers of natural hazards. Such a course should also emphasize not only the importance of graduates engaging in community preparedness—and the vital role of their knowledge and skills in this regard—but also the contribution all stakeholders can make in the response and recovery phases of a destructive earthquake event. In addition, colleges and departments of education should include disaster risk education so that future teachers will be prepared for such disasters if they occur during school hours.

As disaster risk mitigation would be a new field at the third level, Lebanese academic institutions should consider creating a capacity-building initiative by mobilizing international links and collaborative infrastructures. For example, the National Disaster Preparedness Training Center at the University of Hawaii has become the main academic member of the Asia-Pacific Disaster Risk Reduction and Resilience Network, where professors from the United States, Japan, and Indonesia are creating an academic collaboration that they have dubbed "Disaster University". Moreover, the Islamic University of Indonesia and the University of Hawaii are currently collaborating to integrate their curricula on civil engineering, urban planning, community resilience, and economics. These universities are also working with Gadjah Mada University in Indonesia and Tohoku University in Japan to develop early-warning systems for landslides, which will operate by linking Indonesian communities to US databases via the Pacific Disaster Center in Hawaii. In addition, Tohoku University of Japan, which does not have courses covering the psychological and behavioral management side of disaster response, is working with the University of Hawaii to integrate these subjects into its curricula (Cochrane 2013). Another example of university collaboration is the MEEES (Masters in Earthquake Engineering and Engineering Seismology), a joint program amongst four institutions: the ROSE School of the Institute for Advanced Study, in Pavia, Italy; the University Joseph Fourier, in Grenoble, France; the University of Patras, in Greece; and the Middle East Technical University, in Turkey. A similar project is EU-NICE, funded by the European Commission for the period of 2010–2014, in which several researchers and practitioners at institutions located in seismic Asian countries are collaborating on scientific activities at the undergraduate, master, Ph.D., and postdoctoral levels to develop curricula in the fields of earthquake engineering, seismology, disaster risk management, and urban planning (Faggella et al. 2012). A final example of collaboration between academic institutions and international agencies is the partnership between Geohazards International and the NED University of Engineering and Technology in Karachi, Pakistan, and other universities to help prevent devastating losses in future earthquakes. The three-year project, funded by the U.S. Agency for International Development (USAID), was launched in 2007, to help strengthen curricula for both practicing engineers and students (Geohazards 2013).

Moreover, in 2003, the Ministry of Civil Defence and Emergency Management in New Zealand developed a national emergency management strategy that is tied to the country's higher education sector. In fact, most of New Zealand's public universities provide risk-, hazard-, or disaster-related courses as part of their under- and postgraduate programs (Britton 2004). Massey University, New Zealand's second-largest university, has offered a postgraduate Emergency Services Management program since 1991 in collaborative efforts across several departments, such as geography, management, planning, psychology, and sociology. Canterbury University has also developed a one-year master of science program in hazard and disaster management that enables science graduate students to hold a professional position in disaster management.

The government of Japan has been more reliant on technical applications and has invested a considerable amount of financial resources to develop new technologies, such as hazard-specific monitoring systems for early-warning detection and impact-location identification. In 2002, after the Hanshin-Awaji earthquake, the government of Japan established the Disaster Reduction and Human Renovation Institution, the first of its kind in Japan. One of its objectives is to train officials in disaster management and reduction. Another initiative involved the launch of an undergraduate program on emergency management at Fuji Tokoha University in 2003 within the university's Environment and Disaster Prevention Department. This program takes place in a web-based learning environment and is designed to interact with the local community to improve community resilience (Britton 2004).

Lebanese universities should be aware of these examples so they can integrate earthquake disaster education and mitigation into university and college curricula nationwide.

Research facilities and testing laboratories

Universities in Lebanon can play a vital role in earthquake risk mitigation by devoting more resources to multidisciplinary research on reducing the country's disaster risks. To overcome a common challenge, research in disaster risk reduction requires the involvement of scholars from a wide range of disciplines, including medicine, management, nursing, engineering, sciences, psychology, and sociology. For instance, psychological recovery is an essential component of restoring individuals' and communities' well-being. Research in psychology touching on disaster relief aims to promote disaster resilience and coping and to mitigate traumatic stress. Research can help to evaluate organisations' coordination capabilities and to model team-level thinking by developing measures of teamwork following natural disasters, as well as developing steps to promote community-level social well-being, solidarity, and capacity. In addition, research in sociology addressing social disruption is essential in gauging social norms after the destruction of neighbourhoods and the interruption of customary daily activities. Because earthquakes are unpredictable, research in disaster management is key to evaluating risk and exposure, creating response plans, and ensuring response capacity after an event. For this reason, researchers should work closely with organisations and local governments to determine what areas need to be evacuated as well as which buildings and neighborhoods are more likely to suffer severe damage should an earthquake strike. It is also important to determine which roads should be closed and where shelters should be set up—measures that help to mitigate the effects of an earthquake disaster.

Researchers have shown that managing and reducing seismic risk depends on policies, technology, and research implementation (Faggella et al. 2012). In New Zealand, Massey University has cooperated with the Earthquake Commission to initiate a chair in natural hazards planning within the Resource and Environmental Planning program. This chair plays a vital role in advancing hazards research, curriculum development, and teaching in planning and the social sciences. The objective of this collaboration is to integrate specific hazards courses into planning and social science curricula at the undergraduate and postgraduate levels, as well as to advocate for further multidisciplinary disaster risk reduction research, community outreach, and education (Britton 2004).

Universities should increase their investment in research on ways to develop earthquake disaster mitigation plans. For example, engineering and geophysical science faculties can generate seismic-hazard maps that include earthquake sources and dynamic soil characteristics and can overlay these maps on the infrastructure locations of schools, hospitals, and other essential facilities. Once such maps are completed, professional engineering committees from local universities can then identify the seismic vulnerability of various lifeline facilities and define a retrofitting strategy for government authorities to implement. Such a screening procedure is crucial for determining the seismic risk that critical facilities may face during a major earthquake. Professionals can then assess the maximum level of transmitted forces resulting from the specific ground-shaking characteristics of a given facility and the possible structural damage from such forces; this will allow them to evaluate buildings' structural types and construction and thus determine their seismic risks. Such assessments would provide better information to the government about potential seismic risks and officials could then prioritize facilities with the highest risk for seismic retrofitting operations (Baytiyeh and Naja 2014).

Unfortunately, researchers are doing very little research in Lebanon on disaster risk reduction—in any related field. For example, universities have no structural (or structural resilience) testing facilities to perform blast simulations of various types of disasters that can be used as multi-risk strategy. This is why Lebanese universities should seek greater research resources related to earthquake disasters—engineering, management, medicine, psychology, and others—through transnational access to foreign testing facilities and international cooperation. For instance, the National Science Foundation created the George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) to serve researchers on 15 experimental sites by providing them with facilities to learn how earthquakes and tsunamis impact buildings, bridges, and utility systems. One objective of the NEES is to lead training, education, and outreach activities on such issues, as well as to establish ties with US and international partners.

Universities in Lebanon have particular capabilities and assets that are suited for leading and assisting with earthquake disasters, including the ability to gather information, work on disaster assessment reports, support recovery efforts and strategies, and organize disaster management updates and briefings.

Community engagement

The role of universities is no longer limited to teaching, learning, and research activities; it has expanded to involve community engagement. Community engagement can create unique opportunities for universities and communities to work together not only to promote economic growth and social advancement, but also to minimize the hazards associated with disasters through disaster awareness campaigns, disaster volunteer programs, and disaster response and relief.

Awareness campaigns

Lebanon faces a chronic lack of awareness with regard to earthquake risks. Lebanese universities and local governments, together, should address these risks in order to plan for future earthquake risk reduction.

Increasing public awareness about earthquake risk is an essential step in reducing the effects of such a disaster (ISDR 2004). Evidence shows that communities with sufficient earthquake risk awareness and basic preparedness levels suffer significantly fewer casualties and losses in sudden catastrophic earthquakes. It has been argued that only through education and knowledge (Shaw, Kobayashi, and Kobayashi 2004) can communities minimize the suffering and losses caused by earthquakes. Studies have found that predisaster planning can save lives, prevent injuries, limit property damage, and minimize disruptions, enabling communities to recover more quickly (MCEER 2000).

To improve community awareness, universities in Lebanon can play a key role in educational efforts by launching national awareness campaigns that engage students, small communities, and organisations in activities to ensure widespread awareness. Such campaigns should use lectures, presentations, workshops, movies, posters, websites, and promotional advertisements. They should also prioritize schools and public institutions, professional organisations, and local government offices in both urban and rural areas throughout the Lebanese territories, and include information about seismic regulations for new-building construction. Learning modules, along with their guides, can be designed using technological tools for school workshops. All academic institutions can designate an "earthquake awareness day" during which students can become motivated to learn about and engage in earthquake awareness and preparedness activities.

Both individuals and communities must understand the risks involved in the event of an earthquake and how to prepare for its potential consequences. Thus, engaging local schools and communities in earthquake disaster reduction represents the first step toward creating a society resilient to earthquakes. However, an awareness and preparedness campaign initiated and led by Lebanese universities, with the support of the Lebanese government, will not become a reality until the nation's leading universities commit themselves to the mission of saving the country and its future generations from devastating earthquakes.

Volunteer programs

In the event of a major earthquake disaster, the knowledge and skills of organized volunteers are extremely beneficial to an effective and productive response. Therefore, student volunteers should be recruited and trained on campuses on a routine basis. Evidence confirms that volunteers can play an important role in developing and achieving emergency management goals related to mitigation, preparedness, response, and recovery (Manning and Goldfrank 2002).

Certain colleges and universities have taken the initiative to better understand how volunteers can help during disasters and other emergencies. For example, the Organization-Based Incident Management (OBIM) project was developed at New York University because its founders strongly believed that faculty, staff, and students confronted with a crisis would be ready and able to offer assistance to the university community and surrounding communities given sufficient information, guidance, and training (Fulmer et al. 2007). The Ready Campus project—developed by the Pennsylvania Campus Compact, College Misericordia, the Pennsylvania Office of Homeland Security, the American Red Cross, the Pennsylvania Association of Colleges and Universities, and the Association of Independent Colleges and Universities of Pennsylvania—is a collaborative effort that aims to connect colleges and students with their communities to prepare for unexpected future disasters. It conducts a series of workshops, drills, and training and planning sessions to identify the role of volunteers in affected communities, to assist Red Cross efforts (Smartt

2004). The results of such projects may motivate other universities around the world to consider using volunteers.

Universities are great settings for recruiting volunteers, as students with different backgrounds, interests, and expertise can enrich a volunteer program. A small country such as Lebanon, with a population of roughly 4 million, has more than 180,000 students enrolled in its 42 private and public institutions of higher education. University leaders in Lebanon can establish campus programs to motivate students to join volunteer activities that make their communities more resilient to sudden disasters. Such involvement can create opportunities for Lebanese college students who have never had experience with natural hazards to learn more, build basic skills, and be prepared to participate in humanitarian rescue and relief efforts. Volunteers trained by university programs can become valuable assets in the recovery stage after an earthquake disaster.

Response and relief

The leadership role of universities during times of disaster is indispensable in addressing the pressing safety and survival needs of communities. As academic institutions have participated in community disaster responses, they have increased community resilience and helped achieve specific dimensions of greater disaster preparedness and responses (Dunlop 2011). For example, in 2005, Hurricane Katrina affected 31 colleges and universities, of which the majority played a significant role in providing response-and-rescue resources to disaster victims (Kapucu and Khosa 2013).

Since 2004, the Large-Scale Emergency Readiness (LaSER) project at New York University, funded by the Department of Homeland Security and representing an ongoing program within the school's Center for Catastrophe, Preparedness, and Response, is charged with ensuring that the nation is prepared for public health issues due to large-scale emergencies (Fulmer et al. 2007). Other universities, such as Vanderbilt, are undertaking focused, threat-responsive, long-term local and national efforts toward comprehensive and coordinated mass-casualty healthcare training, which ultimately will increase the emergency-response capabilities of local, state, and federal response agencies (Weiner 2006). The development of such training within an academic organisation can supplement, support, and improve the efficacy of national and local emergency responses.

To ensure that trapped and injured earthquake victims can be saved, the Lebanese government must respond efficiently, coordinated with other organisations that include university-trained volunteers and expert teams. Response efforts should begin with search-and-rescue activities but be quickly directed to addressing the humanitarian needs of impacted communities. After search-and-rescue missions are completed, relief efforts should converge to support survivors in rebuilding their lives through assisted reconstruction, restoration, and rehabilitation programs. This process is necessary to ensure that affected communities can build a safer, stronger, and more resilient environment for the future. Recovery from an earthquake is a multifaceted, collaborative process that should involve communication and coordination from all major areas of society, including academic institutions, and should be planned *before* an earthquake occurs (Becker, Saunders, Hopkins, Wright and Johnston 2010; Norman 2006).

Following an earthquake disaster, medical assistance is essential, as hospitals and medical care teams are typically strained during such periods. During such an event, nurses are in great demand and critical care nurses are particularly helpful in situations with mass casualties. The shortage of qualified healthcare experts trained to offer the necessary aid to injured survivors immediately following a disaster is a significant challenge in Lebanon.

Lebanon has over 15 nursing programs and more than 6 medical schools—but none has implemented an emergency-and-disaster nursing program or a disaster-medicine specialization. Knowledge of emergency medicine is essential for search-and-rescue operations, the evacuation of the injured, forensic identification, response to emergency heart conditions, assistance to the elderly, air-ambulance efficiency, and more. Therefore, universities in Lebanon should expand their medical and nursing programs to include specialties necessary for disaster response emergencies.

Mitroff, Diamond, and Alpaslan (2006) list the four main features of an effective disaster response program at a well-prepared university: it is prepared for a variety of types of disasters and crises; it has the resources to forecast possible warnings for potential crises; it has inter-, multi-, and cross-disciplinary disaster response teams; and it partners with a number of internal and external stakeholders. With these four features, multidepartmental disaster response teams—which seek to ensure that schools address their own capacity to respond to emergencies—can spread a culture of awareness and preparedness throughout campus. While we must address the impact of crises on the ability of facilities and institutions to accomplish their educational missions, it is the human side of the equation that begs for our attention as educators committed to serving our communities.

Universities have been affected by many disasters over the last decade (FEMA 2003). Recent research suggests that while universities are paying increased attention to crisis preparation in the wake of high-profile events such as the Virginia Tech massacre, they still may not be able to handle such an event (June 2007). Certain universities have published emergency-management plans online, specifically for physical disasters, but evidence shows that a great number of colleges and universities may not be fully prepared for a wide range of events. A survey of 22 universities in Canada found less than half (45%) to be prepared to deal with the impacts of a disaster (Friesen and Bell 2006). Similarly, a 2004 survey of US colleges and universities found that schools were generally only prepared for the kinds of events they had experienced in the past (Mitroff, Diamond, and Alpaslan 2006).

The recovery phase involves not only repairing or replacing damaged physical infrastructures but also rebuilding the economic strength and social stability of a community through government-supported programs. Such recovery appears to be most effective when community organisations, supplemented by technical and financial assistance from local governments, assume principal responsibility (Mileti 1999). Universities in Lebanon, including their alumni and community volunteer programs, can greatly assist with home and building inspections by providing trained volunteer teams of professionals and engineering students for such tasks. Recovery from earthquake disasters should also cover the psychological and social dimensions of community revival (Paton, Johnston, and Johal 2011). For example, Lebanese response teams consisting of students, faculty, and staff from local universities could operate as the front line in future earthquake disaster responses by providing crisis counseling to victims in affected areas, particularly to residents and children who are struggling to cope with loss and emotional trauma.

The Lebanese public expects its government, health organisations, and the volunteer communities to organize and execute a prompt, efficient response when an earthquake strikes. In this effort, a major challenge facing Lebanese government responders during the immediate post-impact stage of an earthquake is to be able to accurately assess the situation and decide what type of response will be most efficient. The most important task that universities can take on in this effort is coordinating humanitarian relief efforts—serving as well-organized sites for storing and dispatching donated relief supplies for disaster victims. Therefore, international relief agencies should work closely with Lebanese universities to gain a reliable, long-term, and trustworthy partner that can ensure rapid and efficient relief support for homeless survivors and needy victims.

Conclusions

In light of the current threats of earthquakes in Lebanon, I have discussed the potential role that universities can play in disaster risk reduction. My research leads me to urge universities in Lebanon to integrate disaster risk education into their academic curricula to improve community preparedness and survival skills concerning earthquake hazards; I call on them to devote more resources to research facilities and testing laboratories in such disaster-related fields as geology, engineering, medicine, nursing, management, and psychology. I also discussed the importance of collaborative work between universities and communities to minimize the risks associated with disasters through disaster awareness campaigns, disaster volunteer programs, and disaster response and relief.

Further—again, based on my findings—I exhort universities to prepare for disasters by integrating such topics into their academic curricula, encouraging multidisciplinary research, developing centers for community engagement, establishing partnerships with the Lebanese Red Cross as well as faith-based and community organisations, keeping in contact with local alumni, training student response teams, and focusing on strategies and policies to ensure safe and prompt responses. Establishing international collaboration in earthquake-related education represents a major step toward engaging academic institutions in the country in disaster mitigation efforts.

The role of Lebanese universities in future earthquake disaster prevention is crucial. Universities should take a leading role in the pre-phases of disaster awareness and preparedness, and a supportive role in aiding the government during the post-disaster phases of response and recovery. To prevent future disasters caused by earthquakes in Lebanon, the country's government and universities should work together proactively to handle such challenging crises by executing preventive strategies. There is a pressing need for mutual understanding and collaboration between these institutions to reduce the effects of inevitable disastrous earthquakes in the future. Without earthquake awareness, preparedness, and effective response programs that include university involvement, government support, and community engagement, future earthquake events in Lebanon will no doubt have cataclysmic consequences.

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