Using Technology to Address Falls & Risk Factors Impacting The Elderly in India

Author: Anya Sengupta

BACKGROUND

India has undergone a huge demographic change in the last 30 years, as the population of those over the age of 60 has almost tripled. The elderly population in India (those above 60) is projected to reach 158.7 million in 2025 and by 2050, it is expected to exceed the population of children below the age of 14. Among the elderly population, 23% of them live in rural areas and more than half are below the poverty line [3]. Unfortunately, many of them are dependents due to widowhood or separation and as high as 70% of them are women [3].

Percentage share of elderly in total population by place of residence

[1]
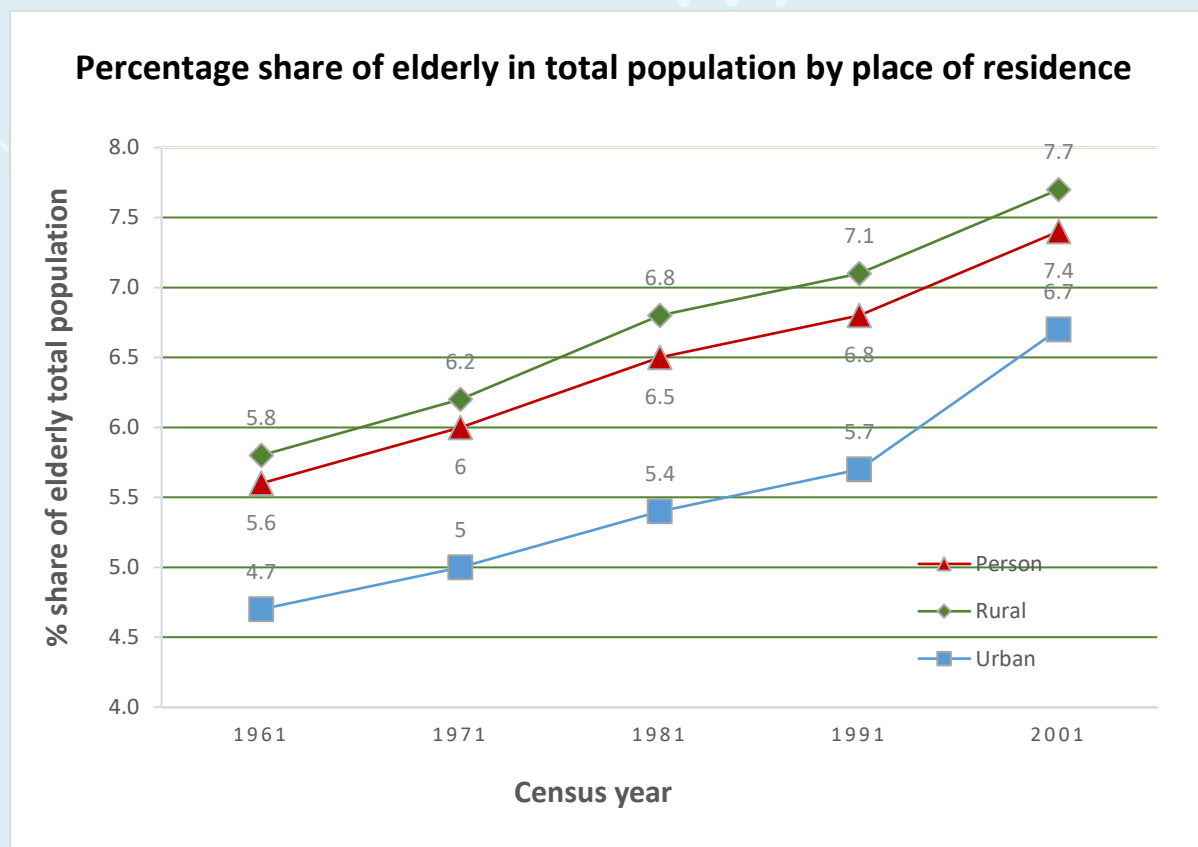
Objective

The objective of this paper is to undertake secondary review of the risk factors of falls among the elderly in India and initiate an innovative low-cost solution to allow caretakers to provide an urgent response.

Rationale

India has one of the largest elderly populations in the world due to India's overall population of over 1.3 billion and the rapid growth of the elderly population [3]. Fall related injuries make up 20-30% deaths among the elderly [14]. Low and middle-income countries like India have the most fall-related deaths as over 5 million die of fall-related injuries [16]. Due to these factors, falls impact India greater than most countries.

Materials and Methods

Firstly, the objective was determined for the secondary research, after understanding the magnitude of the problem and gaps related to it through initial review of literature, through media reports, academic publications, and data available from public health institutions.

A systematic literature search was done by using Google Scholar and PubMed.

This research paper and literature review was a result of several discussions with Jayeeta Chowdhury, the Program Director at India Health Fund (IHF) during the course of my summer research internship. India Health Fund is a collective initiation that combats infectious diseases like malaria and tuberculosis by creating possible solutions and investing in innovations. India Health Fund is seeded by Tata Trusts, one of India's oldest and largest philanthropic organizations that focuses on community development through innovations in areas of health, education, relief, habitation, innovations, and institutions.

Findings

Health Conditions

Many states in India are experiencing a growth and increase in aging like Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Haryana, Himachal Pradesh, Maharashtra, Odisha, and Punjab [3]. Most illnesses are related to the hazardous and risky behavior displayed by this demographic, as alcohol and tobacco usage and other diseases caused by physical inactivity. The elderly most frequently suffers from cardiovascular illness, circulatory diseases, and cancers [3].

The public health community needs to be more sensitive to the needs of the aging community. Sensory and cognitive changes, as well as weakness, are significant changes to the health among the elderly. They can experience falls, hearing, and vision loss which are common among this age group. In addition, there are other chronic conditions as the most common are cardiovascular disease, osteoporosis, dementia, osteoarthritis, and diabetes (Jaul and Barron, 2017) [5]. Among the elderly, Cardiovascular disease is the leading cause of death, which is caused by other chronic conditions. Those conditions include chronic bronchitis, anemia, high blood pressure, chest pain, diabetes, rheumatism, and depression [8]. As seen, there are many common illnesses that occur later in life that should be addressed. The population of the elderly has rapidly increased and will continue to increase at this rate, making these problems worse over time. It is best to address these problems now before it gets even worse as these illnesses are painful but inevitable for this population.

Traditionally the elderly would live with their family, but these days with the rise of nuclear families in urban areas the elderly are often living by themselves. According to Health of the Elderly in India: Challenges of Access and Affordability, "crimes against the elderly have risen in recent times, particularly related to material exploitation, financial deprivation, property grabbing, abandonment, verbal humiliation, and emotional and psychological trauma" [2]. On top of all the health issues like falls and other chronic conditions, the elderly are taken advantage of by society.

Falls

One of the major causes of death in the elderly are falls as 20%–30% of injuries among the elderly are caused by falls. Falls lead to 10%–15% of all emergency hospital visits among this age group Although falls can be prevented, 50% of injury related hospitalizations for elders (65 and older) are caused by falls as [14].

Falls and injuries have become a major public health concern. Globally, over 5 million people lose their lives due to injury yearly, especially in low and middle-income countries like India [16]. Falls are one of the leading causes for the increase in the morbidity and mortality rates. The article, Prevalence and correlates of fear of falling among elderly population in urban area of Karnataka, India, explains how the relationship between the elderly and their fear of fall. Due to the fear of fall (FOF), the elderly compromise their quality of life by limiting social interaction and mobility. The prevalence of FOF assessed objectively among all the elderly was 33.2%. Non-literates were found to have a significantly higher FOF (60%) as compared to literates (40%). Those belonging to joint families were found to have a higher FOF than the elderly from the nuclear family. This with pre-existing health problems had a higher FOF compared to the elderly with no health issues. The history of falls in the previous six months were revealed to be in significant relation to FOF for elders [10]. From researching factors associated with falls, it will reduce the occurrence of falls and improve the overall value of life among the geriatric population. There is a shortage of available information on falls, care, cost, and use of assistive devices, which is why more research is required to reveal the hidden strain of fall injuries in the elderly. The overall fear of falls among the elderly prevents them from living comfortably. Therefore, appropriate research into these health issues for the elderly is necessary.

According to Unintentional fall-related mortality in the elderly, Fall is defined as "inadvertently coming to rest on the ground, floor, or other lower level, excluding intentional change in position to rest" [9]. With age, many normal reactions of individuals start diminishing. Some of these reactions that are adversely impacted are the "vision, hearing, motor function, ability to respond, and natural reflex actions" [13]. It is time to recover and it is excessively slow in such frail individuals.

Risk Factors

For falls, the main risk factors "include muscle weakness, a history of falls, use of four or more prescription medications, use of an assistive device, arthritis, depression, age older than 80 years, and impairments in gait, balance, cognition, vision, and activities of daily living" [12]. Hip fractures and head injuries often occur as a result of falls. Regular exercise increases muscle strength, coordination and flexibility and reduces the tendency to fall [12].

Among the elderly, around 37.3 million falls require immediate medical care and 646,000 die of falls every year (WHO, 2018) [16]. They do not receive immediate medical attention due to the lack of help and emergency services, as those who live under the poverty line cannot afford nurses or caretakers. Many of them are also widowed or live alone, so when a fall occurs, there is no one in their home to help. When a treacherous fall occurs, they cannot use the phone or contact anyone since it is located far from them.

Per cent distribution of elderly persons of various age-groups by marital status
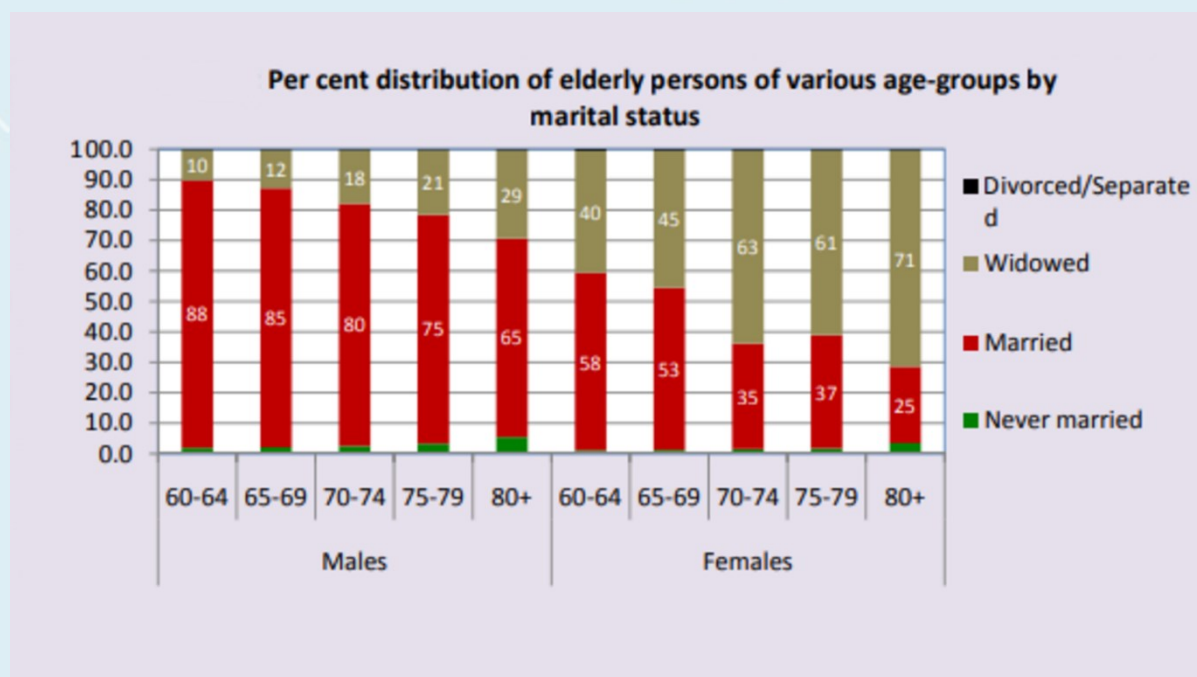
[1]

Technology Impact on Healthcare

Technology has impacted healthcare in many significant ways. It has allowed new medication and treatment by furthering research. Technology can predict and prevent outbreaks and diseases before it occurs. On the internet and through the media, it has spread medical information to prevent unnecessary

hospital visits and general awareness about health and conditions. Although there have been many advances in technology, there is no stable and affordable device for the elderly addressing falls.

Discussion

The elderly needs assistive technologies or home-based care, but only the privileged in India receive home based care as the rural population cannot afford such treatment. As shown earlier, more than half of the elderly population stands below the poverty line [3]. Therefore, a low-cost and affordable good quality and user-friendly solution is required. The innovation should always be easily accessible and uncomplicated for the elderly to use.

A recent innovation created to prevent falls was the "Safe-T-Mate Fall Prevention Monitor". This innovation is an alarm system which alerts when the elder has moved far away and out of the alarm system's vicinity. To be used, the user must constantly wear a bulky magnetic disk and a lengthy cord [11]. However, this is not the best solution as the elder cannot move smoothly since the device must always stay in the vicinity of the alarm. It can also be uncomfortable to use since it is inconvenient and takes up a large amount of space. This can be hard to use when sleeping, using the restroom, or other everyday activities. There needs to be a solution that allows the elderly to live unrestricted with no constraints.

Way Forward or Proposition

Today there is a serious problem that many elderly people are unable to obtain immediate help when experiencing a fall. I hypothesized that through a combination of heart rate and accelerometer sensors, a mobile application, and Wi-Fi technology, I could create a prototype of a wearable device that could autonomously determine a fall and send immediate alerts to caretakers. I decided to build a proof of concept and prototype based on such principles.

To build this project, I used Arduino micro-controller and Wi-Fi module. The Arduino will use the values from the connected heart rate sensor and accelerometer to send text or Push Notifications to the desired contacts if a fall

was detected. To set up the device, the caretaker would need to use the application to enter contact information and emergency contacts if a fall occurs. The elderly person would then wear the lightweight device throughout the day. If they ever need immediate help, they can also press the button located on the wearable to contact the caretaker (or other emergency contacts).

The proof of concept is depicted below through a graphic schema
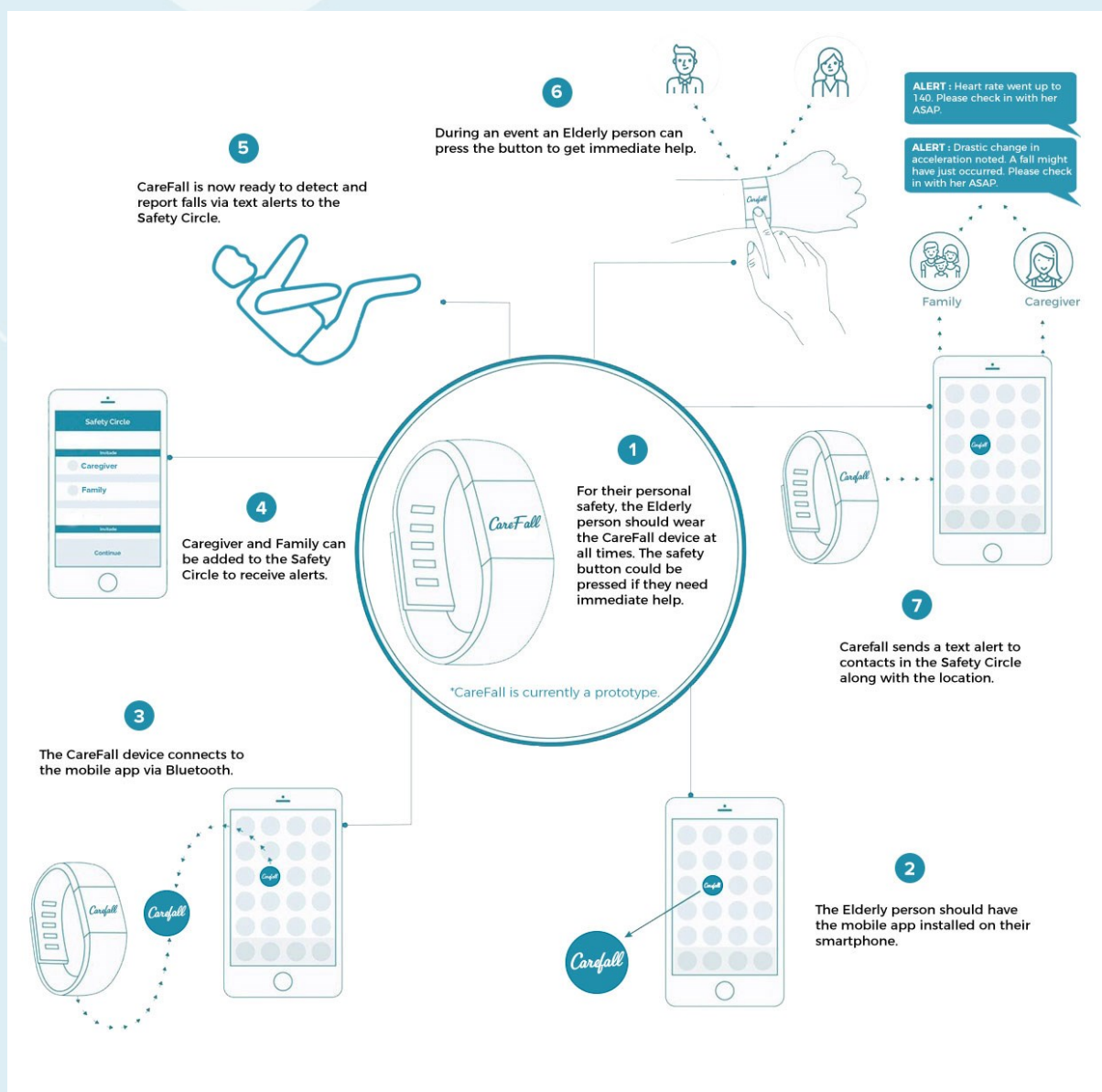
This prototype addresses the current gap in technologies as there are no accessible and affordable products for the elderly. CareFall is comfortable for elders to use and carry as it's particularly lightweight. As elders age, they become frail with many impairments in balance, gait, and vision so this lightweight device could be adjusted to their fragile bodies [14]. Another complication is that much of the elderly population does not receive immediate help when a fall occurs [10]. This device allows the elderly to receive immediate help after a fall, as the device sends a signal autonomously. In India, and other low and middle-income countries, the cost of the previous products for the elderly are highly expensive. It is especially costly when you consider other factors in health like the total expenses of conditions from other diseases and conditions [5]. Not only is this prototype affordable, but it is comfortable for the elderly to use.

I am currently implementing a new feature related to contact tracing. During the COVID 19 pandemic, senior centers have been the hotspot for multiple outbreaks. The elderly population is at greater risk of serious illness from this disease and it's even worse for them if they have conditions like asthma and heart disease. I will be using the stored historical sensor data to track other contacts who may have been within the vicinity of the patient. The application is being built using HTML/CSS/JavaScript and Python based APIs to store and retrieve the sensor data.

In the future, I plan to use more and improved sensors to create an accurate and precise wearable. Using the historical sensor data and it's patterns, I plan to build analytics and pro-active fault predictions.

Recommendation

The population of the elderly will continue to rapidly increase not only in India but all over the world. That means that there will be more lower-income families that will have to pay high expenses due to the medical conditions of the elderly. The expenses will be ongoing and costly, so this is necessary as it is an affordable solution to falls [14]. However, there are not enough resources for this age group. There is research into the common health problems among the elderly, but not enough research into the solutions. The elderly need attention from the government to invest in more research into solutions and innovations to prevent falls and other common geriatric syndromes. The families need more research and innovation to prevent falls and other conditions for their neglected loved ones. The elderly who live alone or in assisted living homes need awareness and involvement for their overall health. Researchers and innovators must work together to come up with an affordable way to prevent falls.

The lack of support for the elderly causes many common health issues, deadly or fatal issues. Falls are one of the leading causes of death in the elderly, and they prevent the elderly from living comfortably. As the population for the elderly increases, these health problems like falls will get even worse.

There is a limited awareness for elderly care who are being neglected from the care they need. There is more that needs to be fulfilled for the elderly care like more programs, technological development, and overall awareness for the elderly from families and the community. The members of society like researchers, law makers, innovators, and citizens need to be more involved in the care for the elderly.

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Graphs

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