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Factors Influencing Traffic Accidents Among the Elderly in Northern Iran: A Qualitative Content Analysis

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ABSTRACT

Objective: The study aimed to explore experts' perspectives on the factors contributing to accidents involving the elderly in Guilan, Iran.
Methods: This qualitative study employed conventional content analysis with an inductive approach in 2024. Fourteen experts from Guilan (Iran) were purposefully selected. Data were collected through individual face-to-face interviews using a semi-structured interview guide containing open-ended questions, which was developed through an expert panel discussion. All stages of data analysis were performed manually following the Graneheim and Lundman's approach.
Results: Three main categories, 10 subcategories, and 29 key codes were identified. The "Individual Factors" category had six subcategories: physical abilities, psychological factors, traffic literacy, cultural attitudes, and Individual needs. The "Environmental Factors" had two subcategories: road and traffic infrastructure, and weather conditions. The "Policy-making" category consisted of three sub-categories: transportation safety, healthcare system, and public education.
Conclusion: To reduce damages from elderly-related accidents, preventive measures should focus on improving health services, enhancing traffic education, and addressing specific behavioral and cultural factors. Additionally, enhancing infrastructure, designing age-appropriate vehicles, and implementing targeted policies could significantly mitigate accident risks among this population.

Keywords: Aged, Traffic accidents, Vulnerable populations.

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Introduction

Road traffic accidents pose a significant and disproportionate threat to the lives of vulnerable road users, particularly the elderly, who face higher risks of severe injuries and fatalities [1]. According to the World Health Organization, global road traffic fatalities exceeded 1,354,000 individuals in 2022 [2]. The growth rate of the elderly population is 1.9% in Iran, which is higher than the global growth rate of 1.2%. According to the statistics from the Statistical Center of Iran, the population of individuals over 65 years old in Iran in 2022 was approximately 7% of the total population, while in Guilan Province, it was about 10% [3]. A study indicated that road, vehicle, human, and environmental factors are critical to pedestrian safety in Guilan [4].

With rising societal age demographics, a growing proportion of elderly individuals are expected to use roads as drivers, pedestrians, and cyclists, thereby elevating the risks of traffic accidents [5]. A previous study in 2018 found that 23.6% of all injuries among the elderly were due to road traffic accidents [6]. The gradual aging of the population and the increasing importance of road traffic in our society make the relationship between the elderly population and road traffic a significant issue [5].

Challenging geographical conditions contribute to the increased accident risks among older adults [7]. In Guilan Province, motorcyclists account for the highest frequency of traffic-related injuries on urban roads, whereas vehicle occupants represent the majority of casualties on intercity roads [7, 8].

Unlike quantitative studies, qualitative research is better suited to explore experts' experiences and in-depth perspectives on roads and traffic-related issues. This study aimed to identify the factors contributing to the rising incidence of accidents among the elderly in Guilan Province. The results of this study might also be beneficial in planning and implementing measures to enhance the safety of the elderly population in Guilan Province, Iran, as well as in regions with comparable socioeconomic contexts.

Materials and Methods

This qualitative study was conducted using the conventional content analysis method with an inductive approach. Using purposeful sampling, eight safety and traffic experts were initially identified through researcher consensus. Additional participants were recruited using the snowball sampling method until data saturation was achieved, resulting in a final sample of 14 participants after removing duplicate referrals from the initial interviewee.

The interviews were conducted at locations chosen by participants (typically their workplaces) based on their preference and willingness. Participants were selected based on their (1) daily professional engagement with elderly safety and accident issues, (2) demonstrated expertise through active research or practical work in the field, and (3) Willingness to participate. To ensure maximum diversity, participants were purposively sampled to represent diverse educational backgrounds, occupational roles, and professional responsibilities (Table 1).

Table 1. Characteristics of the included participants with their related code

Related code	Sex	Interview Time (minutes)	Education	Role/ Responsibility	Age	Work Experience
1	Female	29	PhD in Nursing Education	Faculty Member	56 years	22 years
2	Female	53	Specialist in Social Medicine, Fellowship in Geriatric Medicine	Deputy at the Research Center	53 years	18 years
3	Female	44	Specialist in Emergency Medicine	Faculty Member	38 years	5 years
4	Male	70	General Practitioner	Deputy at the Research Center	45 years	15 years
5	Male	88	Mechanical Engineer	Head of Safety and Traffic Department	54 years	28 years
6	Male	26	Colonel	Deputy of the Traffic Police	48 years	20 years
7	Male	42	Colonel	Deputy of the Traffic Police	50 years	23 years
8	Male	33	Specialist in Emergency Medicine	Faculty Member	49 years	15 years
9	Male	38	MSc in Transportation	Expert in Road Maintenance and Transportation	44 years	18 years
10	Male	46	Civil Engineer	Head of NGO	80 years	54 years
11	Male	51	PhD in Psychology	Head of Psychology Department	40 years	16 years
12	Female	57	Specialist in Social Medicine	Head of Social Medicine Department	54 years	22 years
13	Male	38	MSc in Nursing	Inspection Expert, Emergency (115)	47 years	18 years
14	Male	45	MSc in Physiology	County Emergency Manager & ATLS Instructor	47 years	21 years

PhD: Doctor of Philosophy; MSc: Master of Science; ATLS: Advanced Trauma Life Support; NGO: Non-Governmental Organization

The inclusion criteria were: Iranian nationality, recognized expertise in elderly accident prevention (minimum 5 years' experience), willingness to participate in the study, and willingness to share knowledge. Participants could withdraw from the study at any time.

Data were collected using semi-structured interview techniques and based on an interview guide developed by the research team during multiple planning sessions. The open-ended question format allowed the interviewees to explore emerging themes in depth while maintaining focus on the study objectives. All interviews were conducted in Persian and in private settings selected by the participants, beginning with general open-ended questions and then delving into detailed discussion. The research team employed probing questions when necessary to clarify or expand upon responses (Supplementary file 1).

In addition to interviews, member checking and peer debriefing were employed as methodological triangulation techniques. All interviews were conducted by a physician-researcher from the Road Trauma Research Center, with audio recordings obtained after securing participant consent. In two instances where participants declined recording, comprehensive notes were taken instead. The research team meticulously transcribed each interview verbatim, assigning corresponding codes while repeatedly reviewing the audio material to ensure accuracy. In case of ambiguous points, these were resolved through follow-up phone consultations. Following initial category identification through this rigorous process, theoretical sampling was implemented to select additional participants to clarify and refine emerging concepts until reaching data saturation.

Data saturation was systematically assessed by continuing interviews until no new concepts or information emerged. Although saturation was initially achieved by the 11th interview, three additional interviews were conducted to confirm this finding. Furthermore, two follow-up interviews were conducted to resolve any ambiguities identified during transcript analysis. The interviews were performed between March and August 2024.

At the beginning, the interviewer introduced himself and explained the study objectives. If participants were willing to cooperate, they completed a written consent form. They were assured that all information would be confidential, participation would be anonymous, and they could withdraw from the study at any time without consequence.

The data analysis process was conducted using Graneheim and Lundman's method [9]. The initial coding framework was derived directly from participant terminology. Through an iterative analytical process and based on conceptual similarities, codes were systematically clustered into subcategories. These subcategories were then organized into broader categories, which were subsequently synthesized into overarching thematic categories. The research team maintained rigorous analytical standards by: (1) ensuring comprehensive representation of all subcategories within their respective categories, and (2) conducting repeated team discussions to verify and refine the coding framework until achieving full consensus.

To achieve reliability, four strategies proposed by Lincoln and Guba were used. To increase the validity of the study, all extracted categories and subcategories were independently reviewed by four accident experts [10]. To increase the reliability of the study results, two independent qualitative researchers analyzed the data to verify consistency in findings. The confirmability was established through comprehensive documentation of the research process, including audio recordings, verbatim transcripts, and systematic review of participant responses. To achieve high transferability of the results, the data were shared with three external experts for evaluation (Supplementary Table 1).

Results

The final study sample comprised 14 qualified participants, as two of the initially selected experts were unable to participate in the interviews due to professional commitments. The mean duration of the interviews was 47.14±15.86 minutes. The majority of the participants were men (10 individuals), aged over 40 years (n=12), with more than 15 years of work experience (11 individuals) (Table 1). Overall, three main categories, 10 subcategories, and 29 key codes were identified (Complete information on the categories, subcategories, codes, and the related data is presented in the Supplementary Table 2).

1. Individual Factors

These factors are categorized as "individual factors" since age-related physical and behavioral limitations play a significant role as a primary cause of accidents among them.

1.1. Decline in Physical Abilities

Participants identified age-related physical deterioration as a predominant accident determinant, with six specific key codes:

1.1.1. *Vision Problems:* Visual impairments include difficulties recognizing traffic signals, road signs, pedestrians, and vehicles.

"Visual impairment makes it difficult for elderly drivers and pedestrians to navigate, leading to road accidents" (P2).

1.1.2. *Hearing Problems:* Auditory deficits impair environmental awareness.

"...Failing to hear the noise of moving vehicles or the warning sound of car horns can lead to an accident. Recently, there have also been quiet cars and motorcycles on the market..." (P4).

1.1.3. *Underlying Medical Conditions:* Chronic comorbidities exacerbate mobility challenges:

"...Elderly people may suffer from chronic diseases, such as various spinal injuries, discopathies, osteoporosis*, knee osteoarthritis, joint problems, heart disease, or require the use of canes..."* (P3).

1.1.4. ***Medication Side Effects:*** Pharmacological impacts alter cognitive-motor function. *"The medications they use can also be a factor. For example, drug-induced parkinsonism, medications that cause drowsiness or low blood pressure..."* (P1).

1.1.5. ***Reduced Motor Abilities:*** Diminished physical responsiveness increases risk. *"... An elderly person takes longer to start moving due to a decline in agility and increased reaction time..."* (P5).

1.1.6. ***Slowed Learning:*** Cognitive adaptation barriers affect rule acquisition. *"Our elderly, due to their age and condition, struggle to learn new rules. ... There might even be some resistance to learning new things; it's not just that they cannot learn..."* (P7).

1.2. Psychological Factors

Psychological factors significantly influence accident risk among the elderly. These cognitive factors can increase the risk of accidents for elderly individuals.

1.2.1. ***Memory Problems:*** Neurocognitive disorders disrupt spatial orientation. *"Alzheimer's and dementia are prevalent among the elderly ... Even as pedestrians, they might enter dangerous areas and wander in circles, putting themselves at risk..."* (P8).

1.2.2. ***Impaired Decision-making:*** *"...Unlike younger people, elderly individuals cannot assess, for instance, whether an approaching vehicle is moving too fast…"* (P5).

1.2.3. ***Psychological Issues:*** Psychosocial factors could diminish safety awareness. *"...A very important issue among the elderly is their* depression *and low life expectancy, which may reduce their concern for their own safety..."* (P11).

1.3. Traffic Literacy

Participants identified gaps in traffic safety knowledge among older adults as a contributing factor to their increased accident vulnerability.

1.3.1. ***Risky Traffic Habits:*** *"…there are many examples- elderly people often walk along the roadside...[and] those who use motorcycles frequently without wearing helmets..."* (P9).

1.3.2. ***Lack of Familiarity and Use of Driving and Safety-Assistive Technologies:*** Unfamiliarity with modern transportation technologies places elderly individuals at risk.

"...For instance, some pedestrians now use headphones, and elderly drivers assume that honking will alert the pedestrian, increasing the risk of accidents..." (P14).

1.4. Cultural Attitudes

Participants highlighted the influence of cultural attitudes on road accidents among older adults.

1.4.1. ***Expectation of Yielding:*** *"... In our country, in our province, elderly pedestrians often tend to cross the street without checking for oncoming cars … They expect to be given the right of way, both as pedestrians and drivers"* (P5).

1.4.2. ***Poor Visibility of Pedestrian Clothing:*** Cultural clothing norms compromise nighttime safety.

"...One very important issue that needs attention is visibility. Due to cultural reasons, elderly people tend to wear darker clothing. This makes elderly individuals less visible to drivers, especially at night, which is dangerous..." (P4).

1.5. Individual Needs

The elderly population has certain needs that compel them to spend more time on the streets and in high-traffic areas.

1.5.1. ***Poor Economic Status:*** Financial pressures forcing high-risk occupations: *"...When a person retires, due to the lack of income, they often seek a second job, and one of the most common options is a high-risk occupation such as cab driving...."* (P4).

1.5.2. ***Risky Tendencies:*** Increased street exposure post-retirement

"...With retirement and increased free time, more elderly individuals tend to spend time out in the streets, and this can also create problems..." (P11).

1.5.3. ***Inadequate Family Support:*** *"...The elderly person's family needs to dedicate more time to them and help them in their daily routine, for example, to buy bread at a bakery across the road …."* (P5).

1.5.4. ***Inadequate Organizational Support:*** *"... The lack of organizational support for the elderly, increased risk of accidents. For example, there is no system where younger individuals take responsibility for helping them cross streets..."* (P11).

2. Environmental Factors

The second category, called "environmental factors," highlighted how environmental conditions such as specific weather patterns, day and night, and road conditions play a crucial role in accidents. This category was divided into two subcategories: "road and traffic infrastructure" and "weather conditions."

2.1. Road and Traffic Infrastructure

This subcategory consists of three key codes:

2.1.1. ***Poor Road and Sidewalk Conditions:*** Problems such as deteriorating asphalt, uneven surfaces, steep ramps, and excessive speed bumps pose significant safety risks, particularly for elderly pedestrians, increasing the likelihood of accidents.

"...Pedestrian bridges are ineffective for this group unless there's an elevator, which we either don't have or have very few of..." (P4).

2.1.2. ***Control Systems:*** *"...There are no signs for elderly pedestrians in high-traffic areas, similar to the school crossing signs for children..."* (P4).

2.1.3. ***Difficult and Dangerous Access to Services:*** *"...Our cities aren't elderly-friendly …Many* ***essential services are either out of their reach or located in crowded and hazardous areas…"*** *(P9)*

2.2. Weather Conditions

Adverse weather conditions—such as persistent rainfall and poor road visibility—heighten safety risks, particularly for elderly pedestrians.

2.1.1. ***Adverse Weather Conditions:*** *"...There are specific issues unique to the northern provinces. Unlike other parts of the country, the chances of fog, rain, and slippery roads are much higher here..."* (P2).

2.1.2. ***Road Lighting Conditions:*** Insufficient lighting on roads and vehicles significantly compromises visibility, increasing accident risks.

"...In our province, the workday for farmers starts in the dark... Besides, many elderly people go for walks early in the morning, before it's fully light..." (P12).

3. Policy-making

The third category, "policy-making", highlighted the critical role of regulations and strategic interventions in mitigating road accidents.

3.1. ***Transportation Safety***

Inadequate enforcement of driving regulations, poor traffic violation monitoring, and insufficient road and vehicle safety policies can significantly increase the risk of traffic accidents. This subcategory includes four key codes:

3.1.1. ***Deficiencies in License Renewal Regulations:*** *"... Up to what point should elderly individuals be permitted to drive? .... Renewal intervals of 10 or 5 years are inappropriate for older drivers...."* (P2).

3.1.2. ***Inadequate Handling of Violations:*** "Ineffective enforcement of traffic violations significantly raises the risk of road accidents". *"... The primary issue lies in the limited coverage of traffic enforcement cameras, frequent operational failures, and lack of proper oversight ..."* (P6).

3.1.3. ***Inappropriate Road Safety Policies:*** These deficiencies manifest in various ways, such asimproper determination of speed limits and permission for the construction of elongated roadside structures instead of establishing commercial complexes with safe access ramps. *".... In many developed countries, they additionally employ audible signals to alert pedestrians when to stop or proceed..."* (P2).

3.1.4. ***Low Vehicle Safety:*** *"...Unlike many other countries, our country's vehicles often fail to meet adequate safety standards, such as deficiencies in brake performance and structural durability..."* (P4).

3.2. Healthcare System

The healthcare system can have a significant impact on traffic accidents involving the elderly.

3.2.1. ***Weak Elderly Health Programs:*** *"...Our elderly people often lack adequate healthcare monitoring. ... Particularly in urban areas, people tend to go directly to specialists and skip general health centers...."* (P12).

3.2.2. ***Inadequate Staff Training:*** *"Healthcare staff demonstrate inadequate clinical knowledge and experience..... Despite mandatory courses on patient management, the necessary skill level remains absent in clinical practice...."* (P13).

3.2.3. ***Lack of Facilities:*** *"...Lack of medical infrastructure directly impacts both the frequency and outcomes of traffic accidents..."* (P13).

3.3. Public Education

Targeted traffic safety education for the elderly is essential for accident prevention.

3.3.1. ***Inadequate Traffic Behavior Education:*** Participants identified deficiencies in both traffic safety education and media shortcomings in teaching safe driving to the elderly. *As one noted: "... A critical skill for the elderly is learning to interact effectively with drivers when crossing the streets...."* (P4).

Discussion

The present study identified three main categories influencing traffic accidents among the elderly in northern Iran, including individual factors, environmental factors, and policies. The individual factors category had five key aspects: "decline in physical abilities", "psychological factors", "traffic literacy", "cultural attitudes", and " Individual Needs ". The environmental factors category included two subcategories: "road and traffic infrastructure" and "weather conditions ". The policy category consisted of three subcategories: "transportation safety", "healthcare system", "public education."

Consistent with our findings, numerous studies confirmed that as people age, their vision and hearing deteriorate, which could increase the risk of accidents [11, 12]. A previous study indicated that while dangerous diseases, such as angina, myocardial infarction, coronary artery disease, stroke, and glaucoma led to reduced travel and avoidance of driving, they failed to increase accident risks [13].

Age-related cognitive declines, particularly in memory, concentration, and executive decision-making functions, frequently result in delayed or inappropriate responses to hazardous road situations among elderly road users [14]. A study showed that cognitive impairment was directly associated with an increased chance of accidents [15].

Another significant factor highlighted by participants was traffic literacy. Risky traffic behaviors, such as abruptly stepping into the street while crossing, could increase the likelihood of accidents [16]. However, a study found that elderly pedestrians were less often at fault in accidents compared to other age groups [17].

Studies showed that although elderly pedestrians tended to be more cautious, they were more likely to be involved in accidents due to poor artificial lighting in small towns at night and their tendency to wear dark clothing [18, 19]. As mentioned by our participants, measures should be taken to enhance their visibility,

for example, using reflective materials on hats or wearing armbands to make them more noticeable.

Aligned with our findings, a study found that walking could be unsafe in low-income areas, where transportation options were limited [20]. Participants also highlighted insufficient family and organizational support as contributing factors to accidents among the elderly. The participants of the present study recommended that children, friends, or neighbors assist elderly individuals, for example, by helping them cross the street, whether by car or on foot.

Earlier research showed that urban environments not well-designed for elderly pedestrians could increase the risk of accidents [21]. A qualitative study in Iran identified the lack of adequate physical infrastructure for pedestrian safety as a significant challenge [22]. Furthermore, the absence of proper traffic signs and poor lighting at intersections and pedestrian crossings could contribute to accidents [23]. A Study indicated that the lack of facilities, such as public transportation, healthcare facilities, and welfare services, could increase the risk of accidents among the elderly [24].

Weather conditions, such as rain and dense fog, could reduce visibility for both drivers and elderly pedestrians while also making roads slippery, thereby increasing accident risks [25]. Several studies confirmed the impact of weather conditions and time of day on accident occurrence [25, 26]. However, some contradictory findings suggested that good weather conditions might increase the likelihood of pedestrian accidents [27].

In many U.S. states, driver's licenses for elderly individuals require renewal every one to two years with comprehensive vision checks [28]. However, a study by Grabowski *et al.,* indicated that vision tests, road tests, shorter renewal intervals, and in-person renewals for individuals aged 65-84 showed no independent association with mortality rates among older drivers [29]. Participants believed that inadequate enforcement of traffic laws might contribute to increased accidents. Supporting this, a study found that the severity of pedestrian accidents was lower on roads monitored by speed cameras [30]. Our Participants highlighted that higher maximum vehicle speed limits could increase the likelihood of accidents involving the elderly, consistent with previous studies, which underscored the need for rigorous, ongoing vehicle management [31-33]. Additionally, vehicle characteristics were identified as direct contributing factors in accidents involving the elderly [34, 35].

Studies identified inadequate training of pre-hospital service providers as a significant barrier to service quality [36]. Training programs should primarily focus on developing basic life-saving skills [37]. Supporting this concern, Arreola-Risa *et al.,* conducted a study in Mexico and found that many patients with respiratory distress failed to receive appropriate care due to insufficient ambulance equipment [38]. As stated by our participants, regular patient referrals to health centers with consistent medical record documentation would substantially improve outcomes.

While numerous studies indicated that education could have a positive impact on safety [39-41], contradictory findings have been reported. To date, active speed control measures yielded the greatest safety benefits, whereas educational programs targeting behavioral change show limited effectiveness [42]. Our participants specifically emphasized that elderly individuals require age-appropriate, skill-based education. Consequently, training programs should be customized to address their unique needs.

As a qualitative interview-based study, this research could have strengthened its conclusions by incorporating quantitative data, such as traffic accident statistics or medical records. Furthermore, since the study was conducted in a developing country context, both the identified problems and proposed solutions might have limited applicability to high-income countries with more advanced traffic safety infrastructure and measures. Further research is required to investigate how these findings might generalize across different economic and geographic contexts.

These findings provided valuable insights for both academic research and policy development. The study highlighted three critical areas requiring intervention: (1) elderly physical and mental health considerations, (2) inadequate road infrastructure, and (3) policy gaps in traffic safety measures. Targeted efforts addressing these interconnected challenges could significantly reduce accident risks among elderly pedestrians.

Declaration

Ethics approval and consent to participate: This study was approved by the Ethics Committee of Guilan University of Medical Sciences (IR.GUMS.REC.1403.068).

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