American University of Armenia

CS 108 Statistics A

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Final Project Report

«Առողջության պարտադիր ապահովագրությունն ու առողջապահական ծառայությունների հասանելիությունը Հայաստանում»

“Mandatory Health Insurance and Access to Healthcare Services in Armenia”

1. Introduction

Healthcare is something that affects every person, yet not everyone has equal access to it. When I first started thinking about this project, I came across studies showing how countries with mandatory health insurance (MHI) systems - like Georgia or many European countries - had better healthcare access for their populations. That made me wonder: *What about Armenia?*

With the development of voluntary health insurance started in 2005 (Okhikyan, 2016), the Armenian government has also approved the concept of Universal Health Insurance in 2023 with prospects of turning it into a Mandatory Healthcare Insurance system (Badalian, 2024), aiming to make healthcare more affordable and accessible. However, even after years of negotiations, the MHI systems haven't been fully integrated into the Armenian healthcare system and many people still lack access to healthcare. Therefore, I wanted to dig deeper and analyse: *What are the drawbacks of the current Armenian healthcare system? How to make people trust the healthcare system and how to make essential services available for the majority of people? Will people actually get better access to doctors and hospitals with MHI, or will there still be big gaps depending on where you live or how much you earn?*

Research Question: ***How does Armenia's healthcare system fail to protect low-income families from medical impoverishment, and could a subsidized mandatory model improve healthcare access and financial security?***

Preview: The analysis begins by exploring the data, then tests associations using chi-square and z-tests, concluding result analyses and possible solution suggestions

2. Data Description: Source & Collection Method

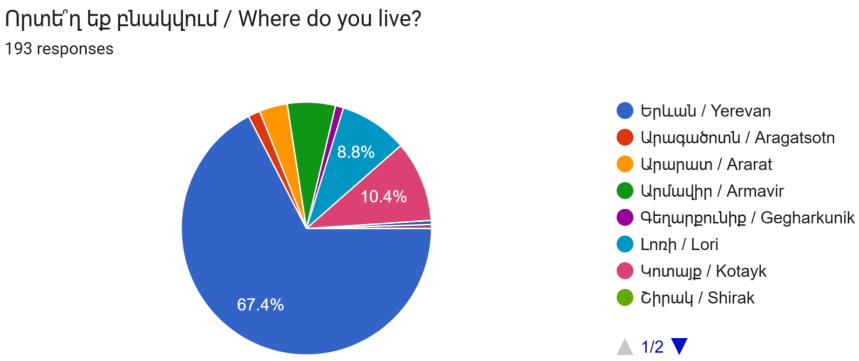
After analyzing multiple public databases *(Armstat, Statista, WHO, World Bank)* and research articles, I found no existing datasets that combined mandatory health insurance status with healthcare access metrics for Armenia. To address this gap, I decided to conduct an original survey, which was distributed through:

- Social media platforms *(Facebook, Instagram, Telegram)*
- Armenian university student groups
- Local NGO and Youth networks

The survey was open for 10 days (April 16-25, 2024) and collected responses from 193 participants. To ensure diversity:

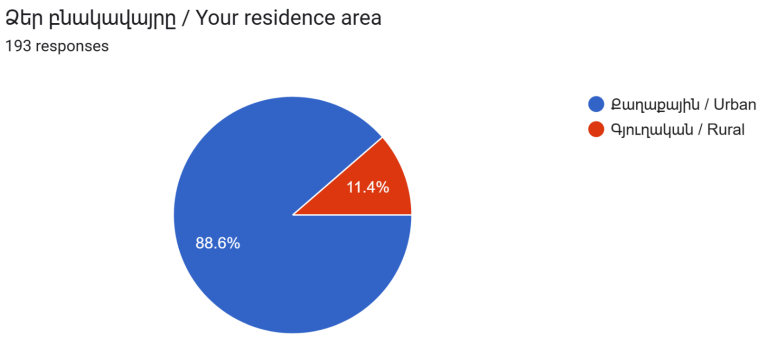
➢ 67.4% of responses came from Yerevan

➢ 32.6% from other regions



As well as:

- ➢ 88.6% of responses came from urban areas
- ➢ 11.4% from rural areas



Key Variables and Units:

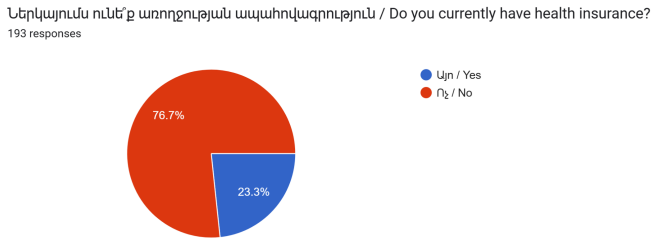
Key Column Names	Type	Description/Units
Age	Categorical (Age groups)	• 18-25 • 26-45 • 46-60 • 60+
ResidenceType	Binary	Urban/Rural
MonthlyIncome	Categorical (Ranges)	• < 100K AMD • 100 - 200K AMD • 200 - 300K AMD • 300 - 400K AMD • > 400K AMD • Currently Not Working
DelayedCare	Binary	Yes - Postponed medical care No - Did not postpone
HasInsurance	Binary	Yes/No
NoInsuranceReason	Categorical (Checkbox)	• High costs • Poor quality of care • Prefer to pay out of pocket when needed • Not familiar with options • Other (text entry)
SupportEssentials	Binary	Will support - when the insurance covers essential services like doctor visits, hospitalisations, and basic medications Will not support

3. Exploratory Data Analysis (EDA)

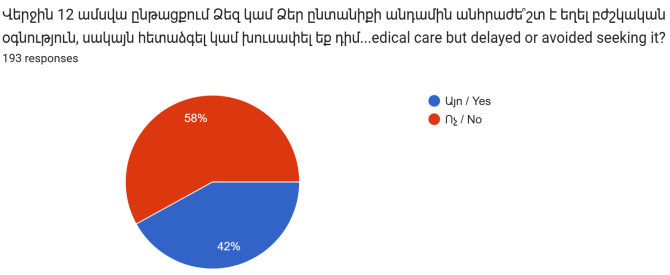
Before diving into complex models, I explored the data to understand its patterns and potential issues. Here's what stood out:

Key Statistics

- **Insurance Coverage:** Only 23.3% of respondents had medical insurance, while 76.7% did not. This pattern directly addresses my research question about **systemic failures**. Such low coverage suggests Armenia's current healthcare model leaves most vulnerable to out-of-pocket expenses, increasing impoverishment risk.

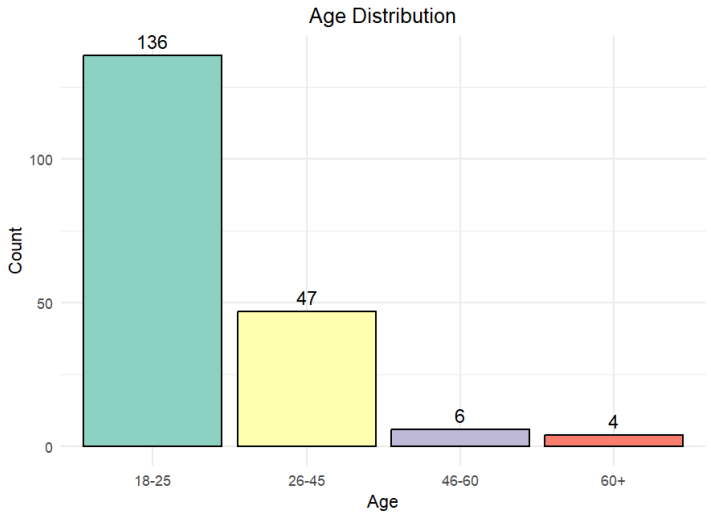


- **Delayed Care:** 42% reported delaying medical treatment, with lack of finances being the most common reason (47.4% of delays). The pattern is that nearly half of the respondents postponed care, primarily due to unaffordability. Clearly, delays of medical care worsen health outcomes, leading to even more expensive treatments later. That is why this pattern can support my hypothesis that financial protections (e.g., income-based subsidies) could reduce delays.

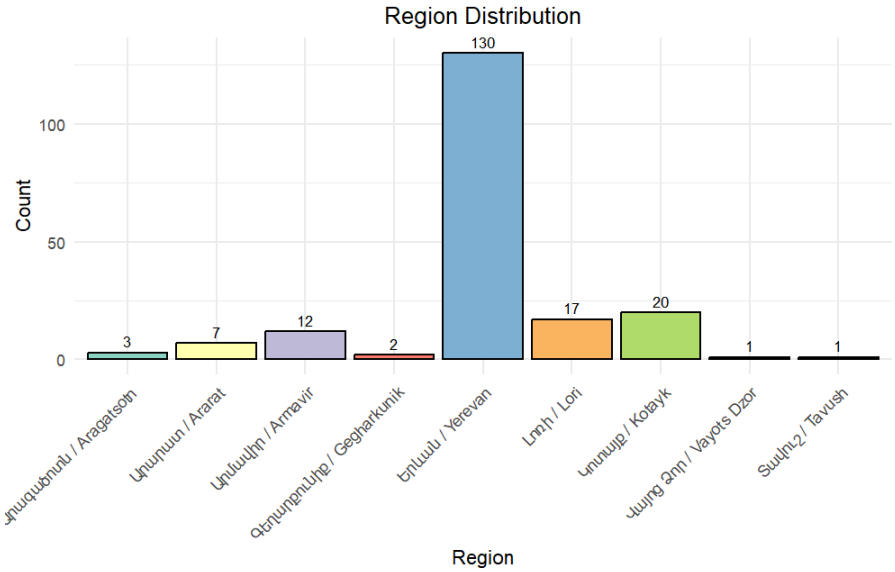


Visual trends

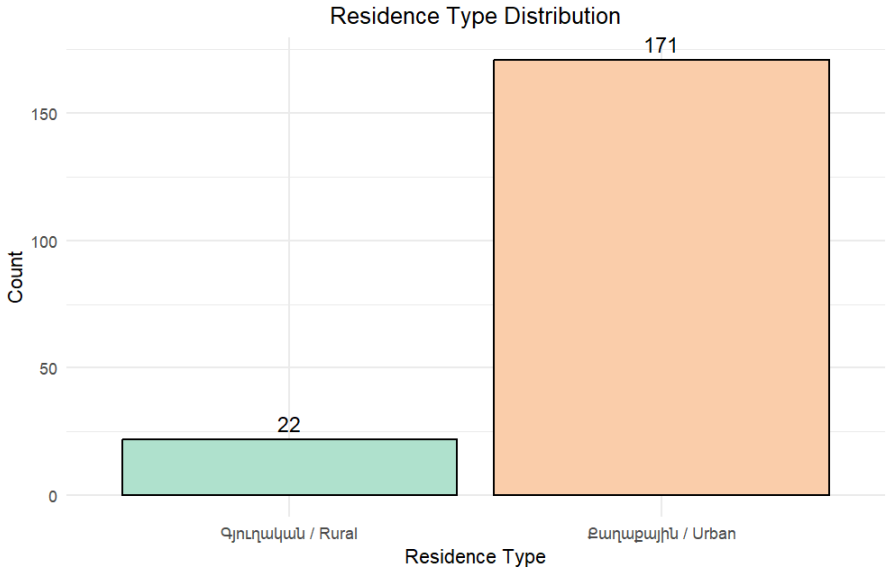
- Young adults (18-25) dominated responses, reflecting Armenia's digitally-engaged population but potentially underrepresenting elder care challenges.



- While Yerevan predominates, substantial participation from other regions ensures diverse perspectives.

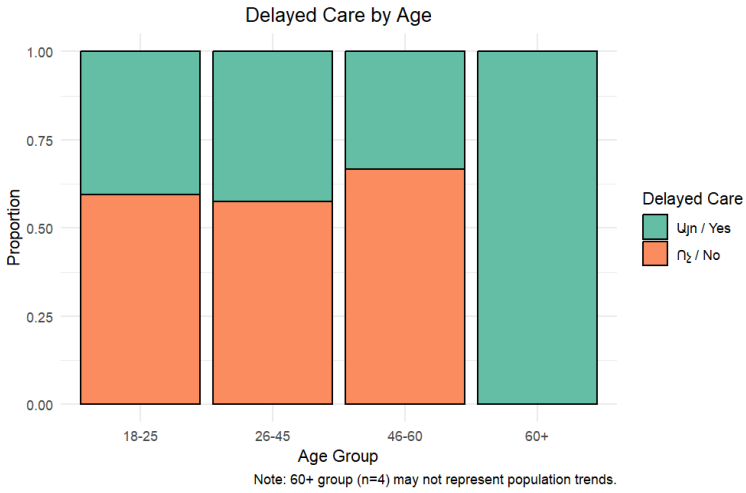


- While urban respondents predominated, the inclusion of rural perspectives (n=22) provides critical insights into geographic disparities in healthcare access.

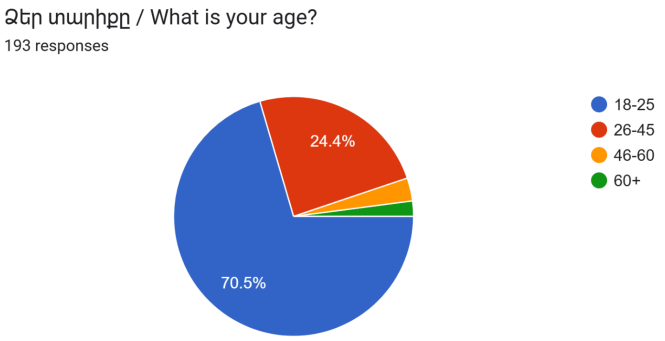


“Delayed Care by Age”

Through this barplot (screenshot from R), I wanted to figure out if there might be any trends between delaying care and the age. Although, it might visually seem that people aged 60+ appear to delay care more frequently, this observation lacks statistical reliability due to extremely limited data from this demographic. Only 4 survey participants (2.1% of total responses) belonged to the 60+ age group, making any age-specific conclusions about seniors unreliable.

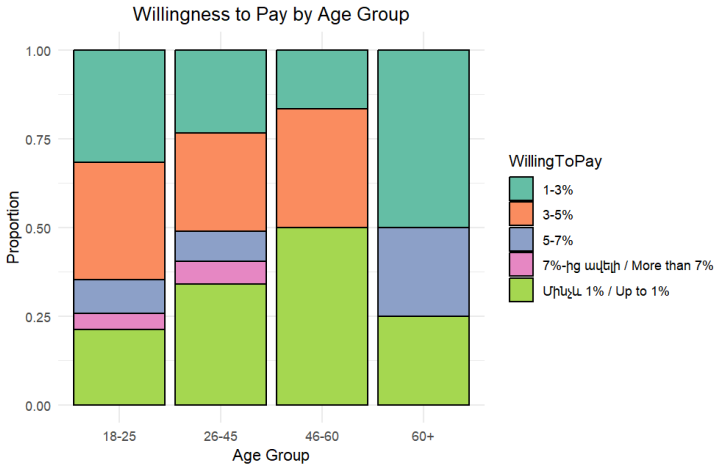


However, even if statistically unreliable, the trend aligns with global evidence that seniors face higher healthcare barriers. Therefore, larger studies should target this demographic to verify.

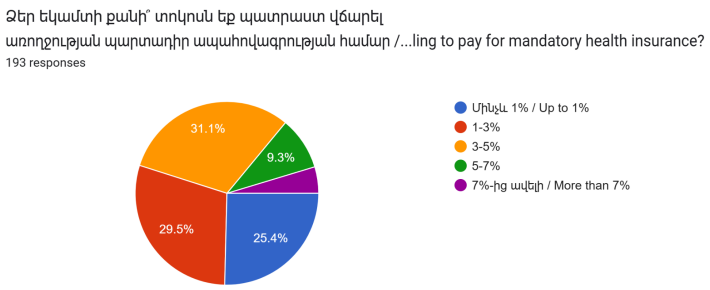


“Willing to Pay by Age Group”

Through this barplot (screenshot from R), I wanted to figure out if the willingness of paying some percentage from income for mandatory health insurance was somehow connected to age. Visually, we might think that the option “up to 1%” is dominating in the combined responses. Which might lead us to think that most people are not willing to pay more than 1% for their health services, therefore raising some questions starting with “WHY?”... However, looking at the auto-generated pie-charts by Google Forms, the actual dominating option is “3-5%” (31.1% of respondents). The actual preference for “3-5%” suggests some willingness to contribute, but affordability limits (low incomes) may cap this. Therefore,



just like in the case above, we cannot rely simply on eyeballing to get a full and correct statistical interpretation.



Handling Missing Data

Like most real-world surveys, my dataset isn't perfect - it has some missing values, mostly common in two places:

- First, in the open-ended questions like “HardshipStory”, where people could share personal experiences - not everyone chose to write something.
- Second, in those checkbox questions that had an “Other” option - some respondents would select “Other” but then leave the text box empty.

After thinking and considering several options for handling missing information, I decided not to do a massive cleanup, as that might accidentally delete useful information from other columns. That is why, I only cleaned up missing data when I actually needed to use that specific column for analysis. For example, when I performed hypothesis testing for reasons for not having health insurance, I removed NA values and empty strings from the NoInsuranceReason column.

4. **Methodology: Justification of the analytic choices**

To investigate disparities in healthcare access, insurance coverage, and public opinion in Armenia, I used Hypothesis Testings:

Two-Proportion Z-Test

Purpose: Test for significant differences in delayed care rates between urban and rural residents.

Justification: Appropriate for comparing proportions between two independent groups (Ross, 2010, chapter 10).

Assumptions:

- Independent samples (urban vs. rural)
- Sufficient sample size (urban: n=171, rural: n=22; both >10 successes/failures)

Two Chi-Square Tests of Independence

Purpose: Analyse associations between:

1) Insurance status and healthcare spending

   Assumptions: (Egbuchulam, 2024)

- Data Type: The contingency table contains frequency counts (not percentages) of respondents in each insurance-spending category

- Mutual Exclusivity:

  Each respondent is classified in only one insurance category (Yes/No)

  Each respondent falls in only one spending category (<100K AMD, 100-200K AMD, etc.)
- Independence:

  All observations are independent (no respondent contributes to multiple cells)

  Random sampling (ensured via survey distribution methods)
- Variable Type: Both variables are categorical

2) Age group and support for mandatory insurance

   Assumptions: (Egbuchulam, 2024)

- Data Type: The table contains counts of respondents in each age-support combination
- Mutual Exclusivity:

  Each respondent belongs to only one age category

  Each respondent selected only one support level
- Independence:

  No respondent is counted in multiple age groups

  Random sampling (ensured via survey distribution methods)
- Variable Type: Both variables are categorical

Justification: Standard for categorical-categorical relationships (Pearson, 1900).

One-Sample Proportion Test

Purpose: Analyse whether lack of awareness is the primary reason (> 50% of cases) for not having mandatory health insurance among uninsured Armenians.

Justification: The test evaluates deviation from a hypothesized proportion (50% threshold) (Hessing, 2020), appropriate for binary outcomes derived from survey data.

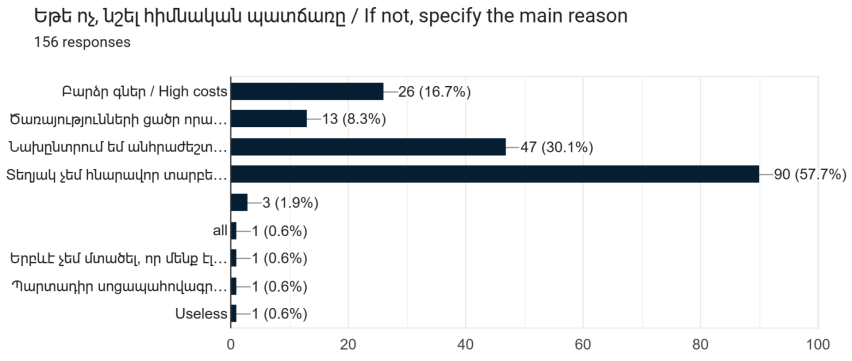
Assumptions:

- Binomial Distribution:

  Though the original question allowed multiple checkbox responses, those were categorized into two mutually exclusive groups to satisfy the binomial requirement. Group 1: “Not familiar with options” / Group 2: All other reasons combined.
- Normal Approximation Validity:

  Verified with: $n \times p = 153 \times 0.49 \approx 75 > 10$, $n \times (1-p) = 153 \times 0.51 \approx 78 > 10$.

  Thus, normal approximation to the binomial distribution is appropriate.
- Random sampling (ensured via survey distribution methods)



Software & Packages

R software along with with packages:

- stats (for Z-test, chi-square, proportion tests)
- dplyr (for data wrangling)
- ggplot2 (for visual diagnostics)

5. Results

5.1 Hypothesis Testing for Delayed Care Based on Residence Type (Urban vs Rural)

Null Hypothesis (H_0): There is no significant difference in the proportion of delayed care cases between urban and rural residents.

Alternative Hypothesis (H_1): There is a significant difference in the proportion of delayed care cases between urban and rural residents.

Before running the test, I suspected rural residents would face more delays in seeking care - likely due to accessibility barriers: fewer clinics, longer travel distances, and limited specialist access in villages. The data confirmed this hypothesis: *while 38% of urban respondents reported delaying medical treatment, that number nearly doubled to 68% in rural areas.* This 30-percentage-point gap wasn't just noticeable, it was statistically significant **(p-value = 0.0081)**.

The negative Z-score (-2.65) confirmed what the proportions suggested: rural Armenians are substantially more likely to postpone care. Besides that, I also calculated the 95% Confidence Interval which was **[-0.529, -0.062]**, indicating that urban residents had between 6.2% and 52.9% fewer delayed care cases than rural residents.

Therefore, the results supported the Alternate hypothesis, however, I would like to be transparent about the second part of my initial assumption regarding accessibility being the primary driver. Although that option was one of the answers for the question why respondents delayed care, and Armenia's uneven distribution of hospitals might support this interpretation, there might be other reasons as well, e.g. lack of financial resources, trust issues, or just simply being irresponsible, lazy, busy, etc.

5.2 Hypothesis Testing for Healthcare Spending Between Insured vs. Uninsured

Null Hypothesis (H_0): Insurance status and yearly healthcare spending level are independent

Alternative Hypothesis (H_1): Insurance status and healthcare spending level are associated

When I started this analysis, I expected insured Armenians to spend less on healthcare. But my data did not confirm my prediction, which is normal for real-life scenarios and a limited dataset. The chi-square test came back with a **p-value of 0.37 ($\chi^2 = 4.29$)**, meaning there's *no significant difference in spending patterns between insured and uninsured groups.*

	100.000-200.000 դրամ / 100.000-200.000 AMD
Այո / Yes	15
Ոչ / No	31
	100.000 դրամից պակաս / Less than 100,000 AMD
Այո / Yes	27
Ոչ / No	97
	200.000-300.000 դրամ / 200.000-300.000 AMD
Այո / Yes	2
Ոչ / No	9
	300.000-400.000 դրամ / 300.000-400.000 AMD
Այո / Yes	0
Ոչ / No	4
	400.000 դրամից ավելի / More than 400.000 AMD
Այո / Yes	1
Ոչ / No	7

The contingency table shows both groups clustered in the lowest spending tier *(<100K AMD)*. This suggests that: insurance might not be reducing costs as effectively as intended or uninsured Armenians aren't necessarily spending more - they might be avoiding care altogether.

Therefore, simply having insurance in Armenia doesn't necessarily lead to lower healthcare expenditures – at least not in ways this spending categorization could detect. This raises important questions about what exactly the current insurance covers and whether it's adequately protecting people from financial strain.

5.3 Hypothesis Testing for Reasons for Not Having Health Insurance

Null Hypothesis (H_0): More than half of the people who do not have health insurance are not primarily unaware of the available options.

Alternative Hypothesis (H_1): More than half of the people who do not have health insurance are primarily unaware of the available options.

Again, before conducting the hypothesis testing, I was expecting that lack of awareness would be the #1 reason Armenians don't have health insurance - after all, "not familiar with options" was the most selected response (90 mentions) among all options. But the statistics did not support my initial assumption. Firstly, even before applying the test, I had to clean the data I was working with. The survey allowed people to check multiple reasons for being uninsured, and many either skipped the question or clicked "Other" without explaining. Of the original 193 responses in the NoInsuranceReason column, only 153 gave usable answers after removing blanks and NAs. This was another good lesson from this project: real-world data is messy, and sometimes requires some important work even before starting the analysis.

Among the cleaned data, 49% cited lack of awareness as a factor (75 of 153 valid responses), the remaining 51% (78 of 153 valid responses) gave other reasons like high costs, poor quality, etc.

The statistical test confirmed what the proportions hinted at - with a **p-value of 0.56**, we can't confidently say that over half of uninsured Armenians lack awareness. However, the *49% unawareness rate is still concerning, even if it's not the dominant majority* I predicted

Therefore, based on the results of this test we can say that though awareness campaigns are crucial, they alone won't fix enrollment - we need to address cost, quality, trust, and other reasons, too.

5.4 Hypothesis Testing for Support for Mandatory Health Insurance vs Age Group

Null Hypothesis (H_0): Support for mandatory health insurance - based on coverage of essential services - is independent of age group.

Alternative Hypothesis (H_1): Support for mandatory health insurance - based on coverage of essential services - is associated with age group.

Going into this analysis, I suspected younger Armenians might be less supportive of mandatory health insurance. My reasoning was simple - when you're young and healthy, healthcare needs feel distant, while older generations facing more health issues would naturally value coverage. But the data told a different story: the chi-square test showed *no significant age pattern in support* **($\chi^2 = 1.179$, p-value = 0.758)**.

Looking at the numbers:

- Over 90% of every age group supported the insurance, including 91% of 18-25 year olds
- Even the small sample of seniors (60+) showed 100% support

	Կաջակցեմ	Չեմ աջակցի
18-25	124	12
26-45	44	3
46-60	6	0
60+	4	0

Several factors could explain this surprising consensus:

- ***Family structures:*** Younger adults may support it thinking of parents/grandparents or still being concerned about their own future
- ***Data scarcity:*** The amount of 46+ people is scarce in the dataset, which might lead to unreliable results.

Therefore, while my initial assumption proved wrong, this finding is actually encouraging - it suggests health insurance isn't seen as just for the old or sick. *The support across generations could provide strong public backing for improving the system.* However, for the future I believe we should:

- Study qualitative reasons behind support
- Observe larger groups of people
- Investigate why the few opponents were concentrated in younger groups

While statistics reveal important patterns, I would like to address the open-ended responses in my survey, too. Reading through the personal stories and opinions of respondents - many of which described impossible choices between health and financial survival - I realized the quantitative analysis only tells part of the story. Here are some of the most insightful responses, followed by what they can teach us about Armenia’s healthcare crisis.

To the question ***"Describe a situation when medical expenses caused financial difficulties for your family."***, respondents shared heartbreaking stories that statistics alone could never capture.

- «Մայրս քաղցկեղ է ունեցել, վարկով, պարտքով և տան բոլոր անդամների աշխատավարձերն իրար գումարած էինք վճարում դեղորայքի համար» (My mother had cancer - we paid for medications through loans, debts, and combining all family members' salaries)
- «Ուռուցքային հիվանդություններին ոչ մի տեսակ աջակցություն չի եղել» (There was absolutely no support for oncological diseases)
- «Ունեմ դեմքի անոթների խնդիր,և լիարժեք բուժման ավարտը թողել եմ կիսատ, քանի որ լազեռային միջամտության համար բավարար ֆինանսական միջոցներ չեմ կարող տրամադրել» (I have a facial vascular issue but had to abandon full treatment midway because I couldn't afford the laser procedure)
- «Երբ մի կոճակ հաբը արժի 1.000.000 դրամ, ստիպված գնում ես՝ ունենալով շատ ֆինանսական դժվարություններ» (When a single pill costs 1.000.000 AMD, you're forced to buy it despite severe financial hardship)
- «Այո, օրինակ աչքի լուրջ հետազոտությունը, ՄՌՏ հետազոտությունը անընդհատ հետաձգում եմ ֆինանսի պատճառով» (Yes, for example I constantly postpone serious eye examinations and MRI scans due to financial constraints)
- «Այո, հենց հիմա օրը 30 հազար կազմում է միայն պալատը , բայց անգամ դեռ հիվանդության պատճառը չեն պարզել» (Yes, right now just the hospital room costs 30.000 AMD daily, yet they still haven't even diagnosed the illness)

To the question ***"What changes would you like to see in Armenia's healthcare system?",*** respondents revealed both hope and deep skepticism.

- «Կոռուպցիայի վերացում, թափանցիկ աշխատառճ, հավասար պայմաններ բոլորի համար» (Eliminate corruption, transparent operations, equal conditions for all)
- «Անվճար բուժսպասարկում, հատկապես՝ տարեցների և թոշակառուների համար» (Free healthcare, especially for elderly and pensioners)
- «Ավելի մարդասեր և կամեցող լինեն, առաջնահերթության տակ դնելով մարդկային կյանքը» (More humane and willing [doctors], prioritizing human life)
- «Պարտադիր ապահովագրություն» (Mandatory insurance)
- «Ճկուն գնային քաղաքականություն ֆինանսապես ոչ ապահովված մարդկանց համար» (Flexible pricing policies for financially vulnerable groups)
- «Կարուկ դեմ եմ պարտադիր ապահովագրությանը, բանի որ համակարգը դրան բոլորովին պատրաստ չէ, ու սա էականորեն կվատացնի առողջապահության որակը՝ այդ թվում խոցելի խմբերի համար» (Strongly oppose mandatory insurance because the system is completely unprepared, and this will significantly worsen healthcare quality, including for vulnerable groups)
- «Մարզային բժշկությունը հատկապես խայ-սա-ռակ, անմխիթար, բարեբարյան վիճակում է ու սա վերանորոգման կամ սարքավորման մասին չէ, այլ կադրերի, մասնագետների անգրագիտության, տգիտության» (Regional healthcare is especially disastrous, deplorable, medieval - and this isn't about renovations or equipment, but staff incompetence and ignorance)
- «Որակ, և ինչն ամենակարևորն է բուժումը լիներ անվճար, ես ունեմ ապահովագրություն բայց երբ պետք է գալիս դրանից օգտվելը,պարզվում է որ դա չի մտնում ապահովագրության մեջ» (Quality and most importantly, treatment should be free, I have insurance but when I try to use it, turns out it's not covered)

Some painful, but still real concerns that arise based on these response are:

- **Healthcare costs drain family resources:** Multiple respondents described devastating financial challenges (taking loans, pooling entire households' incomes, or abandoning treatment altogether). The 30,000 AMD/day hospital costs reveal how hospitalization alone can bankrupt families before treatment even begins.
- **The abandonment crisis:** From cancer patients left without support to undiagnosed illnesses, the system fails at basic care continuity.
- **Diagnostic challenges:** Postponed MRIs and eye exams show how financial barriers create preventable health deterioration.
- **The Mandatory Insurance Debate:** Some people see it as a path to universal coverage, some argue it's premature due to systemic failures and may harm vulnerable groups.
- **The Quality Crisis:** Patients demand both competence, professionalism, and compassion from doctors, which is another strong concern. Besides that, even insured people usually face coverage gaps.

What This Means for Reform

These accounts reveal that *Armenia's healthcare system isn't just unaffordable - it's unsustainable*. While mandatory insurance is a step forward, it must be designed to address the specific crises people actually face. First, **flexible payment solutions** like income-based premiums and payment plans should be integrated into mandatory health insurance strategies. This will alleviate the burden of financially unstable people. Second, **investments in human capital** should be made. That is, educating doctors academically, as well as training them ethically is a must. As one respondent warned, without addressing core issues like corruption and

incompetence, even well-intentioned changes like mandatory insurance risk becoming a solution to the healthcare crisis. Therefore, true reform must start with the basics - doctors who listen, hospitals that don’t bankrupt families, and coverage that actually covers. Until then, Armenians will continue facing impossible choices - between debt and health, as well as, between hope and despair.

6. Discussion

Armenia's healthcare system is failing its most vulnerable citizens. The findings of this project confirm that low-income and rural families bear the heaviest burden - delaying care at alarming rates and facing financial challenges from catastrophic costs (e.g., loans for cancer treatment). While a subsidized mandatory health insurance (MHI) model could help, its success depends on addressing systemic gaps that lead to trust and access issues

"Will MHI Work?"

A subsidized model could reduce impoverishment if:

- Coverage is truly comprehensive, including diagnostics and chronic care, not just emergencies.
- Rural infrastructures improve, as insurance alone won't fix regional healthcare gaps.
- Premiums based on income: subsidies and support offered to the most vulnerable groups firstly.

Limitations & Potential Biases

While this study provides valuable insights into Armenia's healthcare challenges, several limitations must be acknowledged.

- **Small Sample Size (193 respondents):** While the findings are meaningful, a larger and more representative sample would improve accuracy, especially for subgroup analyses (e.g., elderly populations, rural vs. urban disparities).

- **Urban Overrepresentation:** The survey may not fully capture the extreme difficulties faced by rural communities, where healthcare access is often worse. The rural sample in my survey was limited, meaning their struggles (e.g., lack of specialists, long travel distances) might be underrepresented.
- **Data Constraints Restricting Analysis:** Due to missing responses and the small dataset, some advanced statistical models couldn't be performed.
- **Unmet Hypotheses & Unexpected Results:** Many of my initial predictions were not supported by the data. While frustrating, these "null findings" are still valuable. They suggest that Armenia's healthcare issues are more complex than simple insurance coverage, involving deeper systemic problems like distrust, corruption, and uneven service quality.
- **Sampling Considerations:** Since the survey relied on social media and student networks, it may overrepresent younger, tech-literate, or urban populations, skewing results.

7. Conclusion

Armenia's healthcare system disproportionately burdens low-income and rural families, forcing many into medical impoverishment - *a crisis that mandatory health insurance (MHI) alone cannot solve without addressing systemic corruption, geographic inequities, and distrust in care quality.*

Recommendations:

- ***Implement MHI with safety measures:*** Income-based premiums, explicit coverage of diagnostics and chronic care.
- ***Launch rural healthcare initiatives:*** Mobile clinics, mandatory doctor rotations, and telemedicine to bridge urban-rural gaps.
- ***Rebuild trust:*** Anti-corruption measures in insurance administration and patient feedback systems to hold providers accountable.

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