

# Assessing and coping with the financial burden of Computed Tomography utilization in Limbe, Cameroon: a sequential explanatory mixed-methods study.

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## Research article

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# Abstract

**Background:** Out-of-pocket (OOP) payments for healthcare services leads to unequal access to care with many not able to seek care or suffer catastrophic health expenditure and impoverishment. The cost of healthcare is on the rise and technological innovations in medical imaging are partly responsible. In this study we assess the risk of financial hardship after Computed Tomography (CT) utilization in a health facility in Cameroon and elaborate on how users adapt and cope.

**Methods:** We carried out a sequential explanatory mixed methods study with a quantitative hospital-based survey of CT users followed by an in-depth interview of some purposively selected participants who reported risk of financial hardship after CT utilization. Data was summarized using frequencies, percentages and 95% confidence intervals. Logistic regression was used in multivariable analysis to determine predictors of risk of financial hardship. Identified themes from in-depth interviews were categorized. Quantitative and qualitative data were integrated.

**Results:** A total of 372 participants were surveyed with a male to female sex ratio of 1:1.2. The mean age (standard deviation) was 52(17) years. CT scans of the head and facial bones accounted for 63% (95%CI: 59%, 68%) and the top three indications were suspected stroke (27% [95%CI: 22%, 32%]), trauma (14% [95%CI: 10%, 18%]) and persistent headaches with blurred vision (14% [95%CI: 10%, 18%]). Seventy-two percent (95%CI: 67%, 76%) of respondents declared being at risk of financial hardship after CT utilization and predictors in the multivariable analysis were low socioeconomic status (aOR: 0.19 [95%CI: 0.10, 0.38];  $p < 0.001$ ) and not having any form of financial risk protection (aOR: 3.59 [95%CI: 1.31, 9.85];  $p = 0.013$ ). Coping strategies included relying on family members and friends for financial assistance, lobbying hospital administration, social services and healthcare staff for a reduction of the direct cost, and borrowing of money.

**Conclusion:** Lack of financial risk protection and a low socioeconomic status are associated with risk of financial hardship after CT utilization and diverse coping strategies are engaged to minimize the financial burden. Reducing OOP payments for CT scans and/or the direct cost will reduce this hardship and improve access to CT.

## Background

The utilization of healthcare services by everyone in need of them without risk of financial hardship or impoverishment is an ambition for every nation [1]. This key concept of universal health coverage seeks to counter the devastating effects of direct and immediate cash payments before using healthcare services [1]. Many countries are setting priorities in this direction but so far progress is slow especially in developing countries where healthcare is often accessed through out-of-pocket (OOP) payments [1]. However the burden of OOP payments for healthcare services is not only suffered in developing countries as some studies reported that in developed countries including the United States of America, about 13% of people spend more than 10% of their income in OOP payments with the poor and elderly being

particularly vulnerable [2–5]. There is sufficient evidence that OOP payments for healthcare services leads to unequal access to care with many not able to seek care or suffer catastrophic health expenditure and impoverishment [1, 2, 4, 6–8].

The cost of healthcare is on the rise and technological innovations are partly responsible [9, 10]. Medical imaging has particularly taken a major leap forward in terms of sophisticated technological advances in recent years [11–13]. The utilization of medical imaging has increased as a whole especially for the cross-sectional imaging modalities (computed tomography and magnetic resonance imaging) with a corresponding increase in the cost of services [12, 14, 15]. Computed tomography (CT) in particular has recorded an exponential increase in utilization in recent years [12]. CT utilization however faces a dual challenge; the increasing cost for advanced procedures and the high exposure to ionizing radiation [14, 16].

With the considerable burden of OOP payments for healthcare services and the rising cost of care, some studies have highlighted the role of socioeconomic status (SES) in the utilization of healthcare services [17–19]. Persons with high SES have been reported to use more specialized healthcare services and to benefit from sophisticated medical procedures unlike individuals with low SES [18–20]. Consequently, better health and longer life are associated with a high SES whilst increased disease prevalence and mortality are reportedly associated with a low SES [17, 21–25]. The main reasons advanced are that individuals with high SES can afford the cost of healthcare services even when these are not covered by a medical insurance scheme and are also more likely to engage in a healthy lifestyle [26]. Regarding the relationship between SES and CT utilization, some published studies have reported a low likelihood for individuals with a low SES to use CT whilst a few reported the contrary or no association between CT utilization and SES [20, 27–31]. Published literature from sub-Saharan Africa on the financial burden of CT utilization or the role of SES is scarce. One retrieved study reported on the appropriateness of CT utilization [32].

### *Context*

Public health facilities in Cameroon are stratified into tertiary, intermediate and peripheral levels based on the degree of sophistication of available technology and health services offered. The tertiary facilities (teaching and national referral hospitals) which are the most equipped in terms of equipment and medical specialists are found in the two chief towns of Yaoundé and Douala. Intermediate-level health facilities are termed Regional and District Hospitals and they serve as reference hospitals within administrative regions. In a bid to improve access to healthcare the government of Cameroon is face-lifting intermediate-level health facilities by creating specialized units such as hemodialysis and medical imaging centers that were previously only available in tertiary health facilities. Many medical specialists are being deployed to these hospitals which have mostly had general practitioners, obstetricians and general surgeons over the years.

The direct cost of CT scans in government-owned health facilities ranges from 42 to 175 US Dollars, slightly lower compared to private health facilities due to government subvention. According to a national

demographic and health survey close to 40% of the population live below the poverty line and 96-98% do not have any form of health insurance [33]. However there are insurance policies available to workers in particular sectors and also for private subscription.

Given the context, it can be expected that CT utilization will be a challenge for persons of low SES who are likely to suffer a heavier financial burden. Despite the expected challenges, CT scans are still being utilized as the need is ever-present. To understand how CT users find a balance between their financial capability and the cost of CT scans in the study setting, we designed this mixed-methods study with main objective to assess the financial burden of CT utilization using risk of financial hardship as a proxy and to elaborate on how users adapt and cope. We formulated the following research questions: What factors are associated with the risk of financial hardship after CT utilization? How do some user characteristics translate into risk of financial hardship after CT utilization? How do CT users adapt and cope with having to use CT? How well does the qualitative phase augment the findings from the quantitative phase?

## Methods

### Study design

We used a sequential explanatory mixed-methods design [34]. Basically this paradigm generates information first through a quantitative phase which will have to be explained in greater detail with a qualitative phase. It permits the explanation of unexpected findings and generates multiple perspectives giving a more complete understanding of the phenomenon being studied [35–37]. The sequential explanatory design allows researchers to study variables in breadth and depth and with regard to the research questions for this study, it enables the quantitative assessment of the risk of financial hardship after CT utilization and further probing through in-depth interviews to understand how users adapt and cope [34]. We also expect the findings of this study to have implications for policy and practice in the study setting thus providing more grounds for adopting this paradigm which is compatible with the philosophical stance of pragmatism and critical realism [34, 38, 39].

Theoretically, the sequential explanatory mixed-methods paradigm gives more priority to the quantitative phase. This type of sequential design denoted “QUAN→qual” begins with a strong and robust quantitative phase followed by a qualitative phase to augment the findings [34]. The first author who was the principal investigator has a quantitative background and this paradigm was suitable.

### Ethics

Administrative authorization for the study was given by the South West Regional Delegation for Public Health (R11/MINSANTE/SWR/RDPH/82/786) and ethical approval was obtained from the Institutional Ethics Committee of Regional Hospital Limbe (002-03/2018/IEC-RHL) and The University of Yaoundé 1 (108/UY1/FMSB/VDRC/CSD).

### Study setting

This study was carried out at Regional Hospital Limbe, a 200-bed capacity health facility in the South-West Region of Cameroon. This facility was selected because it is the main intermediate-level referral health facility for the region and the only one with a functional CT scanner at the time the study was conducted. The first author also works in this facility as a radiologist making it convenient for data collection. Besides the 16-slice CT scanner there are other equipment such as digital radiography, mammography and a modern ultrasound scanner. The hospital has a 24-hour emergency department, operation theatre, neonatology and pediatric units, antenatal clinic and maternity, medical and surgical wards for admission, and medical specialists across the main specialties.

## **Participants**

### *Quantitative phase*

Consenting patients 18 years old and above who utilized CT at the Medical Imaging Center of Regional Hospital Limbe were consecutively enrolled from March 2018 to February 2019. Written informed consent was obtained from either the patient or the caregiver.

### *Qualitative phase*

Participants were selected using a purposive random technique [40, 41]. These were patients who participated in the quantitative phase and reported having no health insurance and to be at risk of financial hardship after CT utilization. Participant selection was done after quantitative data collection and analysis by carefully going through each quantitative data item. The participants for this phase were therefore a subset of participants from the quantitative phase [34]. It is worthy of note that the caregivers of some CT users were interviewed because the clinical state of these users did not permit them to be able to commit to an interview.

## **Sample size**

### *Quantitative phase*

The minimum sample size was estimated using Cochran's method for surveys [42]. The risk of financial hardship after CT utilization was the primary outcome and expressed as a binary categorical variable. With an alpha level of 0.05, a 5% error margin and a population variance estimate of 0.25, the estimated sample size was 385 participants. For a population of 1,614 CT users (number of CT users during the first year of functioning), the sample size of 385 exceeds 5% of the population. Applying Cochran's correction formula [42], the minimum return sample size was 310 participants. We further hypothesized a non-response rate of 20% and estimated reaching out to a total of 372 participants.

### *Qualitative phase*

We invited 28 potential participants for in-depth interviews and 22 were actually interviewed. Two participants could not be reached by phone after several attempts, three others were not disposed for a

conversation at the appointed time (one in a public transport vehicle and two in meetings), and one had just died and so the caregiver could not commit to the interview. This sample size was deemed satisfactory to explore participants' experiences on CT utilization based on recommendations from Guest and Morse [43, 44]. According to these recommendations, 6 participants would be sufficient to explore experiences and 12 to obtain thematic saturation.

## **Data collection**

### *Quantitative phase*

Structured interviews with standardized forms were used to collect data. The construction of the questionnaire was based on the study objectives. Content validation was used to ascertain the usefulness of the included items. After initial drafting by the first author, three other authors (LM, GN and POZ) took turns to cross-check the items rephrasing some, discarding others and suggesting some be modified and others introduced. Revised drafts of the questionnaire were pre-tested on some CT users for a few weeks to assess validity and clear any ambiguity. The final version of the questionnaire was consensually agreed upon by the authors and drafted in English and French. The outline was structured as follows: demographic attributes (age and sex), socialization patterns (region of origin, educational achievement; marital, employment and socioeconomic status; health insurance subscription), the presence of chronic illnesses, anatomic region scanned and clinical indication, payment method for CT and the risk of financial hardship after CT utilization. Socioeconomic status was assessed using household amenities score with each participant assigned to the quintile corresponding to their score. This tool has already been used in a previous study carried out in a similar setting [45]. The risk of financial hardship was determined using a self-reported question: "Do you have enough money to meet your needs including food, clothing, and payment of bills after paying for CT?" The options were "more than enough", "just enough" and "less than enough" [46].

A trained research assistant with a degree in sociology and who is fluent in English, French and the local pidgin-English language collected all the data. The standardized forms were available in English and French. The items were interpreted into the local pidgin-English language for participants who could best express themselves using that language. The data collector wore an identification badge and consenting participants were interviewed after CT had been done in an office made available for this purpose within the health facility. The principal investigator (PI) cross-checked all the forms after interviews for consistency.

### *Qualitative phase*

A pre-established interview guide was used to collect qualitative data (Box 1). This guide summarized important quantitative results to explain and study objectives that could only be explored using this method. Five typical respondents who were not part of the final sample were invited and interviewed by the PI (JT) using a first draft interview guide. Modifications were made to this draft after each interview and the revision following the last interview was adopted.

The PI (JT) called up potential participants by phone to invite them for the interviews. Information shared during this first phone call included an overview of the talking points, the expected duration of the interview and subsequent appointment for a telephone interview at the convenience of the participant, should they consent to participate. All interviews were conducted by the PI in the preferred language of the participant. Whilst being open to a wide range of ideas during the interviews, the discussion was nevertheless kept in line with the study objectives. Permission to audio-tape the conversation was requested from the participants at the beginning of the interview.

## **Data analysis**

### *Quantitative phase*

The information on the data forms were transcribed onto a Microsoft Excel® spreadsheet and analyzed using STATA® 12 (StataCorp, Texas, USA). Continuous variables were summarized using the mean and standard deviation. Categorical variables were summarized using frequencies, percentages and 95% confidence intervals (CI). The risk of financial hardship after CT utilization was categorized as a binary variable with the options “just enough” and “less than enough” merged into one category representing “risk” of financial hardship, while the option “more than enough” represented “no risk” of financial hardship. Sociodemographic variables were compared between respondents who reported risk of financial hardship and those who did not using Fisher’s exact and *chi-squared* tests where appropriate. Univariate and multivariable logistic regression techniques were used to determine if any factors were associated with the risk of financial hardship after CT utilization. In the multivariable modelling the following covariates were entered as a block: age, sex, marital status, educational achievement, employment status, SES, health insurance ownership and the presence of chronic illnesses (binary variable). Statistical tests were two-tailed and p-values less than 0.05 were considered statistically significant. Model fit was assessed using R<sup>2</sup> statistic.

### *Qualitative phase*

Thematic analysis was used to analyze the qualitative data given that the authors are more familiar with this method which is a “foundational” qualitative analytic method and also because of its flexibility as it can be independent of theory and epistemology [47, 48]. The audio recordings were reviewed many times by the PI so as to be familiar with the data. Word repetitions and indigenous categories were used to develop an initial categorization of recurring ideas [49]. The audio data were transcribed into written texts in English by the PI.

A theoretically-driven thematic analysis was adopted and guided by a six-phase tool provided by Braun and Clarke [47]. Initial manual coding of the texts was done by the PI. Identified themes were compared with initial categories. After multiple reviews of the coded texts identified themes were revised, redefined and reorganized. To improve on credibility and trustworthiness two other investigators (GN and AE) independently reviewed the transcripts and audio-recordings for accuracy. The final list of categorized themes was consensually agreed by the authors.

## Data integration

The separately analyzed data from both strands of the study were integrated to gain a more complete understanding that is “greater than the sum of the parts” [35]. Triangulation was used for data integration [50]. Each finding of interest from either the quantitative or qualitative phase of the study was compared and contrasted with the findings of the other phase for convergence, complementarity, dissonance and “silence” [50]. “Silence” during data integration implied the particular finding could only be explored during a particular phase of the study.

## Results

### *Participant characteristics*

A total of 372 participants were surveyed of which 167 (45%) were females. The mean age (standard deviation) was 52 (17) years with age range 18 to 92 years. Table 1 summarizes participant characteristics.

### *Anatomic region scanned and clinical indications*

CT scans of the head and facial bones accounted for 236 out of 372 scans (63% [95%CI: 59%, 68%]) and the top three indications were suspected stroke, transient ischemic attack or hypertensive emergency (27% [95%CI: 22%, 32%]), trauma (14% [95%CI: 10%, 18%]) and persistent headaches, blurred vision or suspected space-occupying lesion (14% [95%CI: 10%, 18%]). Table 2 summarizes the anatomic regions scanned.

### *Risk of financial hardship after CT utilization*

Among study participants, 246 out of 344 (72% [95%CI: 67%, 76%]) declared having “just enough” or “less than enough” money to cater for their bills, food and clothing after paying for the scan, indicating risk of financial hardship. A hundred and two respondents out of 370 (28% [95%CI: 23, 32%]) reported to have negotiated for direct cost reduction, with 44 (43% [95%CI: 34%, 53%]) doing so formally through the hospital Social Services or the administration and 58 (57% [95%CI: 47%, 66%]) informally through healthcare staff directly related with service provision. Table 4 shows the relationship between some selected variables and risk of financial hardship on univariate and multivariable analyses.

### *Qualitative findings*

Table 5 summarizes the characteristics of the persons interviewed.

Three main themes related to CT utilization were identified: I) coping with CT utilization, II) CT utilization despite reported hardship and III) deterrents to CT utilization and missed opportunities. There were three and two subthemes for themes I and III respectively.

## Coping with CT use

### *Family solidarity*

Some respondents reported that close family relatives had to be called up for financial assistance. Persons called up were not limited to the nuclear family as they included other relatives and even close friends. In the study context regular use of the word “family” goes beyond blood ties. The excerpts below from three respondents illustrate:

“... my husband is a logger and works for himself ... since he has been down with sickness it is not easy so I have to support him financially ... I sell pea nuts” (P01; caregiver of 38-year old male patient)

“We had to pay for the scan. She is not working and the doctor had planned to operate her ... where was she supposed to get the money from?” (P08; caregiver of 28-year-old female patient)

“... we came prepared ... my mother paid for everything” (P09; caregiver of 56-year old male patient)

Despite many respondents’ acknowledgement of receiving help from family, some nevertheless stated they had to “dig deep” into their savings to pay for the cost of CT all by themselves. These persons also claimed in doing so they felt a “vacuum” in their reserves but considered it necessary so that they could be diagnosed and properly treated.

### *Exonerations*

Some respondents declared to have benefitted from some sort of fee-reduction scheme. This happened through mainly two pathways: fee reduction approved by hospital administration or Social Services, and through staff directly involved with the provision of services. The former was reported by persons who either claimed to personally know some members of the administration, belonged to the same ethnic group, attended same church, or upon recommendation from a political or local administrative figure. The benefits ranged from totally free direct cost to reductions of up to 75%. For fee reduction obtained through healthcare staff, beneficiaries hoped economic hardship would predispose them to strive for direct personal gain thus open for a bargain. Some clients would even pose as a staff relative so as to “soften” the negotiations. The accounts below from four respondents illustrates:

“I had to give part of the money for the scan to the “nurse” first ... I told him I cannot run away since my patient is admitted in the hospital” (P18; caregiver of 52-year old male patient)

“... pension is how much? The government doesn’t know what the people are going through ... as a senior citizen I had to ask the director for a reduction and he cut the cost by two” (P02; 61 years old, female)

“... I know the director personally ... so I went to him [director] for consultation and he prescribed the scan himself and asked me to pay 50% of the cost” (P10; 31 years old, male)

“I explained my situation [financial] to the person I met who offered to help me ... so I gave him what I had” (P11; 43 years old, female)

### *Borrowing of money*

Having to borrow money from neighbors, friends and small common interest groups was also reported as a means of raising money to pay for CT when the need arose.

“I was pushed to borrow money because I was not feeling fine at all” (P04; 42 years old, female)

“I had to stretch my hands to my neighbors ... I am on a loan” (P21; 56 years old, male)

### **CT utilization despite reported hardship**

Despite reporting risk of financial hardship after CT utilization, it is obvious that CT is still being utilized. One of the reasons why CT was promptly done was because of reported pain. Also, some respondents believed appropriate medical care would only be administered after CT scan was performed. Furthermore some CT users had the understanding that CT scanning was necessary to determine the cause of ill health and therefore guide treatment. To others still CT scan was considered to be a kind of “one-stop-shop” test for the entire body and was expected to “reveal any anomaly” besides the present complaint. The excerpts below from two respondents illustrate:

“My patient was feeling some “hot pains” so we had no choice but to run up and down to mobilize the funds to get the scan done” (P01; caregiver of 38-year old male patient).

“... I am feeling very bad ... cannot walk right now ... I had to do it [CT] so that my entire body could be properly checked” (P06; 66 years old, male)

### **Deterrents to CT use and missed opportunities**

#### *Fear*

Some respondents reported not showing up for CT scan despite having received a prescription from a healthcare provider (for clients who had to do a repeat CT) because of fear. The reasons were varied: no money as previous experience showed the cost was substantial, resentful attitude of hospital staff as clients feared being ridiculed should they show up with insufficient funds, the scare of the equipment as patients are left alone inside the room, and also the fact that the machine uses x-rays which should have a long term effect in “reducing the lifespan” according to some respondents.

“ ... money issues otherwise we were supposed to have done another CT scan following treatment ... ” (P01; caregiver of 38-year old male patient)

“If you dare go to hospital without money do you know what the staff can do to you?” (P03; 62 years old, female)

“The machine is scary ... didn't like being left alone in the room ... not my first time doing CT scan and I am already afraid of the effect of the rays on my body” (P17; 56 years old, male)

## *Ignorance*

Some respondents would not believe that CT services could be provided in emergency situations before the financial obligations are met. They remained adamant when this was explained and relied heavily on their past experiences with using health care services where pre-payment was mandatory. Also there was no knowledge of the Social Action Service, a department within the hospital facility that identifies paupers within the local community to offer them some fee reduction so that they can use needed healthcare services.

## **Discussion**

In the quantitative analysis a low socioeconomic status and not having any form of financial protection for health were associated with risk of financial hardship after CT utilization. The qualitative data revealed different coping strategies to reduce the burden of OOP payments for CT. These coping mechanisms have consequences for the health facility such as the loss of income through wanton exonerations and the encouragement of corrupt practices by some staff. In addition to coping with CT utilization, the qualitative phase further identified potential barriers to CT utilization that could be taken advantage of to improve upon the experience of having to use CT.

If a lower socioeconomic status would mean less financial viability, then both quantitative and qualitative strands of the study agree that persons with a low SES are at risk of financial hardship after CT utilization. This finding indicates an association between SES and CT utilization, similar to reports by some authors [27, 28]. Brown and colleagues reported an increased likelihood of economic insecurity among men getting towards retirement [51]. We did not find any association between risk of impoverishment and age in this study.

There was some dissonance with the findings as employment status was not associated with risk of financial hardship in the quantitative analysis but was a relevant factor in the qualitative analysis. Being unemployed, retired or temporarily out of work was linked with the inability to pay for the direct cost of CT. Bosch de Basea and colleagues reported an association between high unemployment and temporary work with low CT utilization [52].

In this study, the qualitative phase brings out additional information to complement the quantitative. Furthermore, there are areas of convergence and dissonance of findings, permitting a broader perspective that cuts across both strands of the study. This study gives insight into the financial barriers of CT utilization in the study setting and potential impact, reveals threats to the current organizational culture and suggests avenues for improvement.

The goal of universal health coverage (UHC) is to enable all persons use needed healthcare services without risk of financial hardship [1]. This is mainly through the protection of potential service users from the negative impact of unaffordable out-of-pocket payments for healthcare services. OOP payments for healthcare services cause financial hardship, deter people from seeking or continuing care, can push

entire households further below the poverty line (impoverishment) or require they forego other basic necessities [1, 53]. Improving access to healthcare services therefore remains an important step towards achieving UHC [54].

### *Strengths and limitations*

To improve upon the validity and credibility of the findings, content validation of data collection tools and pre-testing were done. Data collection was done by a single individual for each phase of the study to achieve consistency. Also, there was an independent review of data forms and transcripts by investigators with a different research background (social sciences and public health). Furthermore, triangulation of methods with the use of both quantitative and qualitative designs to study the same phenomenon consolidates the findings.

Some limitations to this study exist. Firstly, the main outcome of the quantitative phase was self-reported and so reporting bias may have occurred. There are also concerns of reflexivity and power as the qualitative in-depth interviews were conducted by the PI, whose worldview and intuition could have influenced the reporting. Nevertheless, the absence of physical contact during the interviews might have limited the power gradient to some extent. Also, some participants could not be reached by phone or were not disposed for an interview when calls were made. We further report that no software was used for qualitative data analysis given the diversity of languages used for the interviews and unavailability of appropriate software.

## **Conclusion**

The risk of financial hardship is a real threat to CT utilization for persons of low socioeconomic status without any form of financial risk protection. However, CT users in the study setting have had to adapt to cope with the financial burden of OOP payments for CT scans. It is our opinion that reducing OOP payments and/or the direct cost of CT will reduce unequal access and the negative consequences of the coping strategies.

## **Declarations**

### **Ethics approval and consent to participate**

Ethical approval for this study was obtained from The University of Yaoundé I Ethics Committee (108/UYI/FMSB/VDRC/CSD) and the Institutional Ethics Committee of Regional Hospital Limbe (002-03/2018/IEC-RHL). The study was conducted in accordance with the Helsinki Declaration. Participation was voluntary and participants were informed they could withdraw at any time should they choose to do so without any repercussion on their care. Informed consent was both oral and written. Participants were assured the information obtained from them was recorded anonymously and would be used confidentially, just for the purpose of the study.

## Consent for publication

Not applicable

## Availability of data and materials

The dataset supporting the conclusions of the quantitative phase of this article is available at Mendeley Data, <http://dx.doi.org/10.17632/r4dmt58v3r.1>. The qualitative data contains sensitive information and can be available from the corresponding author upon reasonable request.

## Competing interests

The authors declare that they have no competing interests

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None

## Authors' contributions

JT conceived the study and participated in study design, data collection, analysis and drafting of the manuscript. LM participated in study design, supervised data analysis and proof-reading of the manuscript. POZ participated in study design and corrected the final draft of the manuscript. GN and AE participated in data collection and analysis. VM and JZM provided advice during the study and corrected drafts of the manuscript. All authors approved the final version of the manuscript.

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## Abbreviations

CT: computed tomography; OOP: out-of-pocket; SES: socioeconomic status; PI: principal investigator; CI: confidence interval; UHC: universal health coverage

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## Tables

Table 1. Characteristics of study participants with comparison between those who reported risk of financial hardship and those who did not

Variables	Frequency (%)	P value*
Sex (N=372)		0.069
Female	167 (44.9)	
Male	205 (55.1)	
Marital status (N=372)		0.277
Married	232 (62.7)	
Single	83 (22.3)	
Widow(er)	42 (11.3)	
Divorced	11 (3.0)	
Living in union	4 (1.1)	
Educational achievement (N=347)		<0.001
<O level	158 (45.5)	
O level or equivalent	61 (17.6)	
A level or equivalent	64 (18.4)	
Degree or equivalent	45 (13.0)	
Master & above	19 (5.5)	
Employment status (N=294)		0.001
Employed, with contract	82 (27.9)	
Employed, with no contract	2 (0.7)	
Self-employed	115 (39.1)	
Unemployed	12 (4.1)	
Retired	83 (28.2)	
Socioeconomic status quintiles (N=370)		<0.001
SES quintile 1	74 (20.0)	
SES quintile 2	75 (20.3)	
SES quintile 3	75 (20.3)	
SES quintile 4	79 (21.4)	
SES quintile 5	67 (18.1)	
Health insurance ownership (N=370)		<0.001
Yes	38 (10.3)	
No	332 (89.7)	
Number of deponents (N=272)		0.425
0 to 3	117 (43.0)	
4 to 6	97 (35.7)	
7 and above	58 (21.4)	
Presence of chronic illnesses (N=369)		0.232
Yes†	130 (35.2)	

\*P values obtained using Fisher's exact and  $\chi^2$  tests

†Included in this category are hypertension, diabetes, peptic ulcer disease, cancer, chronic kidney disease, hyperprolactinemia

Table 2. Anatomic regions scanned.

Anatomic region scanned (N=372)	Frequency (%; 95%CI)
Head + facial bones	236 (63.4; 58.5, 68.3)
Abdomen	46 (12.4; 9.0, 15.7)
Spine	41 (11.0; 7.8, 14.2)
Chest + abdomen	14 (3.8; 1.8, 5.7)
Chest	10(2.69; 1.0, 4.3)
Angiograms	7 (1.88; 0.5, 3.3)
Neck region	4 (1.08; 0.0, 2.1)
Multiple regions	14 (3.77; 1.8, 5.7)

Table 3. Indications for scanning per anatomic region

Indications for CT scan*	Frequency (%; 95% CI)
Head & facial bones	
Suspected stroke/transient ischemic attack/hypertensive emergency	86 (27.0; 22.2, 31.9)
Trauma	45 (14.1; 10.3, 18.0)
Persistent headaches, blurred vision, suspected space-occupying lesion	44 (13.8; 10.0, 17.6)
Chest	
Suspected pulmonary embolism	7 (2.2; 0.6, 3.8)
Chronic cough	4 (1.2; 0.0, 2.5)
Tumor workup	2 (0.6; 0.0, 1.5)
Abdomen/Pelvis	
Pain, acute abdomen	18 (5.7; 3.1, 8.2)
Suspected tumor, mass	22 (6.9; 4.1, 9.7)
Urinary symptoms	15 (4.7; 2.4, 7.0)
Spine	
Back ache (severe, chronic, persistent)	28 (8.8; 5.7, 11.9)
Suspected cord compression	9 (2.8; 1.0, 4.6)
Trauma	6 (1.9; 0.4, 3.4)

\*Data available for 318 respondents



Table 4. Risk of financial hardship after CT utilization

Variables	Univariate		Multivariate	
	Odds ratio (95% CI)	P value	Adjusted Odds ratio (95% CI)	P value
Age (years; N=344)	1.00 (0.98, 1.01)	0.723	0.96 (0.94, 1.00)	0.067
Sex (N=344)				
Female	1.55 (0.96, 2.50)	0.070	1.37 (0.71, 2.65)	0.357
Male	ref		ref	
Marital status (N=344)				
Married/living in union	ref		ref	
Single/divorced/widow	1.36 (0.83, 2.24)	0.222	1.49 (0.69, 3.2)	0.309
Educational level (N=319)				
≤O level	2.42 (1.44, 4.06)	0.001	1.66 (0.78, 3.55)	0.187
>O level or equivalent	ref		ref	0.198
Employment status (N=266)		0.004		
Employed (formally, informally, self)	ref		ref	
Unemployed/Retired	1.05 (0.60, 1.86)	0.855	1.81 (0.66, 4.99)	0.253
SES (N=342)	0.20 (0.12, 0.34)	<0.001	0.19 (0.10, 0.38)	<0.001
Health insurance ownership (N=342)				
Yes	Ref		ref	
No	6.28 (2.73, 14.45)	<0.001	3.59 (1.31, 9.85)	0.013
Chronic illnesses (N=369)				
Yes	1.36 (0.82, 2.24)	0.233	1.37 (0.70, 2.68)	0.361
No	ref		ref	

Model  $R^2 = 0.1885$ ;  $p < 0.001$ .

Table 5. Characteristics of interviewees

Number of respondents	22
Male	9
Female	13
Mean age (SD), years	49.7 (9.9)
Duration of interviews (minutes: min; max)	10 ; 18
Employment status	
Self-employed	8
Retired	8
Unemployed	3
Employed with a formal contract	3
Person interviewed	
Patient	16
Patient's caregiver	6

## Figures

Study diagram

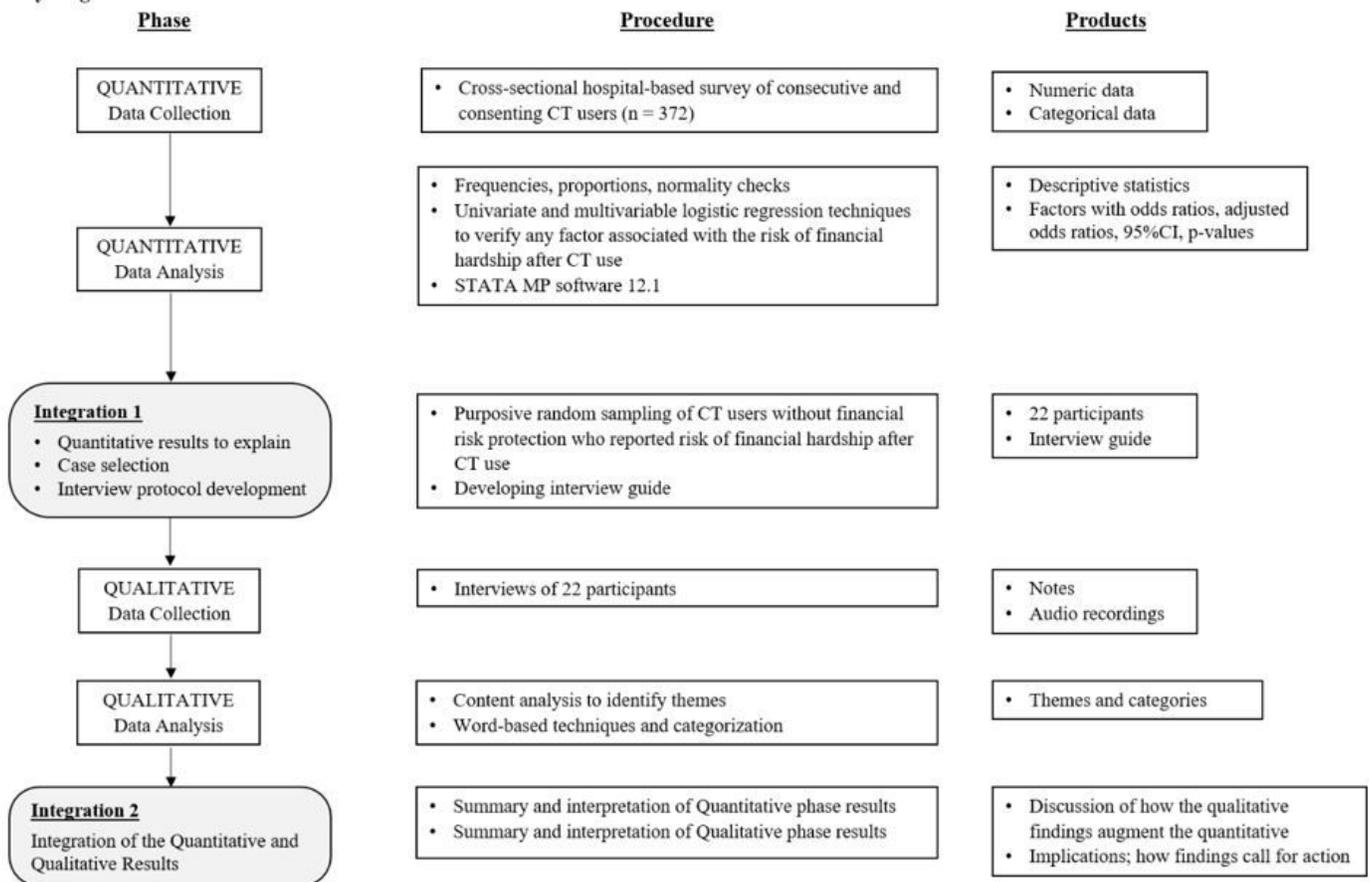


Figure 1

Study diagram.