Injured and broke: The impacts of the Ghana National Health Insurance Scheme (NHIS) on service delivery and catastrophic health expenditure among seriously injured children

Barclay T. Stewart\textsuperscript{a,b,*}, Adam Gyedu\textsuperscript{c,d}, Stephanie K. Goodman\textsuperscript{e}, Godfred Boakye\textsuperscript{f}, John W. Scott\textsuperscript{g}, Peter Donkor\textsuperscript{c}, Charles Mock\textsuperscript{a,b}

\textsuperscript{a} Department of Surgery, University of Washington, Seattle, WA, USA, Global Injury Control Section, Harborview Injury Prevention and Research Center
\textsuperscript{b} Global Injury Control Section, Harborview Injury Prevention and Research Center, USA
\textsuperscript{c} Department of Surgery, School of Medicine and Dentistry, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
\textsuperscript{d} University Hospital, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
\textsuperscript{e} Stanford Children’s Health, Palo Alto, CA, USA
\textsuperscript{f} Ghana Armed Forces, Accra, Ghana
\textsuperscript{g} Division of Acute Care Surgery, University of Michigan, Ann Arbor, MI, USA

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\textbf{ABSTRACT}

Introduction: Ghana implemented a National Health Insurance Scheme (NHIS) in 2003 as a step toward universal health coverage. We aimed to determine the effect of the NHIS on timeliness of care, mortality, and catastrophic health expenditure (CHE) among children with serious injuries at a trauma center in Ghana.

Methods: We performed a retrospective cohort study of injured children aged <18 years who required surgery (i.e., proxy for serious injury) at Komfo Anokye Teaching Hospital from 2015 to 2016. Household income data was obtained from the Ghana Statistical Service. CHE was defined as out-of-pocket payments to annual household income ≥10%. Differences in insured and uninsured children were described. Multivariable regression was used to assess the effect of NHIS on time to surgery, length of stay, in-hospital mortality, out-of-pocket expenditure and CHE.

Results: Of the 263 children who met inclusion criteria, 70% were insured. Mechanism of injury, triage scores and Kampala Trauma Score II were similar in both groups (all \(p > 0.10\)). Uninsured children were more likely to have a delay in care for financial reasons (17.3 vs 6.4%, \(p < 0.001\)) than insured children, and the families of uninsured children paid a median of 1.7 times more out-of-pocket costs than families with insured children (p < 0.001). Eighty-six percent of families of uninsured children experienced CHE compared to 54% of families of insured children (p < 0.001); however, 64% of all families experienced CHE. Insurance was protective against CHE (aOR 0.21, 95%CI 0.08–0.55).

Conclusions: NHIS did not improve timeliness of care, length of stay or mortality. Although NHIS did provide some financial risk protection for families, it did not eliminate out-of-pocket payments. The families of most seriously injured children experienced CHE, regardless of insurance status. NHIS and similar financial risk pooling schemes could be strengthened to better provide financial risk protection and promote quality of care for injured children.
African relevance

- Despite strides toward universal health coverage with the National Health Insurance Scheme (NHIS) in Ghana, nearly one third of seriously injured children did not have health insurance.
- Families on uninsured injured children pay markedly more out-of-pocket costs than families of insured children.
- Although families of uninsured children were more likely to experience catastrophic health expenditure (CHE) at all thresholds, CHE was commonly experienced regardless of insurance status.
- These findings have potentially useful implications for the NHIS, other agencies working toward universal health coverage, and trauma care systems generally.

Introduction

Injury is a leading cause of preventable death and disability globally, and disproportionately impacts children, young people and their families [1,2]. More than 90% of the injury burden is incurred in low- and middle-income countries (LMICs), which are least prepared to provide timely, effective and affordable care for the injured [3–8]. Efforts in LMICs to improve the accessibility and capacity of organized trauma care can dramatically reduce preventable deaths and disabilities, and increase productivity of individuals, families, and societies [9–11]. However, building capacity to care for the injured is not enough; trauma care must be affordable.

Injuries are unexpected emergencies; therefore, families do not have the opportunity to plan for the financial expenditures associated with trauma care. Although trauma care has repeatedly been demonstrated to be highly cost-effective in the long-run, the costs of diagnostic tests, surgery, critical care, involvement of multiple specialist teams, and rehabilitation needs may result in substantial costs in the short-run [12,13]. Healthcare systems and hospitals that require cost-sharing for emergency and trauma care have less efficient service delivery, delays in surgical and critical care interventions (e.g., resuscitation, hemorrhage control), and experience higher rates of preventable deaths and disability [14–16].

Although financial risk protection can result in improved care by reducing delays in service delivery, healthcare systems must also consider the effects of costs of care on families [7,8,17]. Financial risk protection schemes (e.g., health insurance) are intended to facilitate access to care, promote universal health coverage (UHC) and limit catastrophic health expenditure (CHE) [12,18–20]. CHE is a metric to assess the financial impact of medical costs on individuals and families [7]. The United Nations has implored that Sustainable Development Goal 3 – Good Health and Well-Being will not be achieved without 100% financial protection from CHE by 2030 [20,21].

In an effort toward universal health coverage, Ghana established the National Health Insurance Scheme (NHIS) in 2003, which aimed to cover 95% of conditions that affect Ghanaians [19,22]. As of 2015, the NHIS covered 10.5 million people, or 40% of Ghana’s population [23]. The total number of health facility encounters rose from just under 0.5 per capita in 2005 to almost 3 per capita in 2015. The NHIS covers all emergencies and much of trauma care [24,25]. However, some aspects of trauma care are not covered (e.g., many medications, advanced diagnostic imaging, prosthetics and rehabilitation, mortuary services).

Despite the government’s efforts, ensuring the NHIS’s financial sustainability now poses a serious challenge. Total claims payments rose from just GHS 7.6 million in 2005 to over GHS 1.07 billion in 2015 [23]. Meanwhile, the NHIS’s annual deficit has reached GHS 300 million. Initially touted as an unfragmented example of nationalized financial risk protection in sub-Saharan Africa and a model for other LMICs, there has been a decline in both reimbursement rates and timeliness of payments to hospitals by the NHIS due to over-reliance on a narrow tax base, a large informal work sector, and a greater than expected utilization of healthcare services [19,26,27]. As a result, the resources (e.g., trained staff, equipment, supplies, functional infrastructure) and incentives (e.g., timely reimbursements and salaries) necessary for essential service delivery have become unavailable at many health facilities [19,24,26]. Resultantly, the lack of timely reimbursements and availability of essential resources cause many hospitals transfer the costs of essential and emergency care to patients, often regardless of insurance status [4].

Less than half of children aged <18 years in Ghana are enrolled in the NHIS [23,28]. Given that emergencies, including pediatric emergencies and injuries, are covered by the NHIS benefits package, the high proportion of children and their families without NHIS may be associated with worse service delivery, outcomes, and risk of CHE after injury compared to those with NHIS plans. However, with a faltering NHIS and a healthcare system unable to meet the needs of its injured population, the intended effects of NHIS may not be realized [3,4,29].

Therefore, we aimed to determine the effect of the NHIS on timeliness of care, outcomes, and household catastrophic health expenditure (CHE) of seriously injured children at a tertiary hospital in Ghana. The findings might be used to advocate for efforts to strengthen NHIS trauma care coverage and activities to increase the proportion of enrolled children in Ghana.

Methods

Setting

Ghana is a lower middle-income country with a population of 29 million people [30]. Komfo Anokye Teaching Hospital (KATH) is the second largest among five teaching hospitals in Ghana, and is a major referral center for district and regional hospitals in the middle third of the country [31]. KATH is a major trauma center and offers the breadth of trauma care from emergency, critical and acute care, surgery, reconstruction, and rehabilitation [32].

Study design

We performed a retrospective cohort study of patients who presented to the KATH Accident and Emergency Center (A&E) with a serious injury. All such patients who presented from 1st January 2015 to 31st December 2016 were reviewed. Children were identified by the KATH A&E registry and the respective medical records were identified and reviewed. Data regarding patient age, sex, mechanism of injury, injury severity, vital signs at presentation, NHIS status, surgery, disposition, hospital charges, and out-of-pocket payments made were extracted. Patients’ acuity at presentation was determined using the South African Triage Scale (SATS) or pediatric SATS for patients aged <12 years or shorter than 150 cm [33]. The Kampala Trauma Score II (KTS II) was used to define injury severity retrospectively [34]. In the absence of a prospectively collected injury severity score, we also considered the need for surgery at presentation as a proxy for serious injury [35]. Time to surgery and length of hospital stay were determined from date and time stamps. We determined whether the child experienced financial delay if there was explicit information in the chart noting that surgery was delayed because the patient could not promptly make out-of-pocket payments for certain services (e.g., laboratory test, diagnostic imaging, blood products, medications, surgery).

Data analysis

Children missing variables central to the analysis were excluded by list-wise deletion. Child and injury characteristics, outcomes, total hospital charges and out-of-pocket payments were described. Given a lack of data regarding household income of children in the medical record, we assigned to each child’s family the median annual household income provided by the Ghana Statistical Service from the Ghana Living Standards Survey in 2016–2017. The proportion of children and their families who experienced CHE was calculated using previously published thresholds of 5%, 10%, 15%, and 20% (i.e., percentage of out-of-pocket payments to annual household income) [36–39]. We used a 10%
threshold at the household level (i.e., the most commonly used threshold for estimating CHE) as the outcome variable for regression models. We then performed a sensitivity analysis using cost and payment data from a sample of 1132 adults who were injured and required surgery at presentation at KATH with occupation and household income data. The incomes were best fit with a gamma distribution with the following parameters: mean US$ 1215.95, variance 11,000, skewness –0.019 and kurtosis 2.98. We used this curve to randomly generate and apply annual household incomes to each child using bootstrap technique [40]. Examination of the fitted annual household incomes to those from the sample demonstrated no differences in the means (t-test p = 0.49) or variances (F test p = 0.98) between the distributions.

We performed bivariate linear regression and logistic regression analyses to assess relationships between our primary outcome variables (i.e., time to surgery, in-hospital mortality, CHE) and other covariates. Multivariable regression models incorporated covariates independently significant in the bivariate analysis (p-value ≤ 0.05) as well as variables that were felt to be important or confounding (e.g. age of the child, injury severity, need for emergency versus urgent surgical procedure). Multicollinearity among covariates was assessed with tolerance and variance inflation factors. Collinear covariates were excluded. The remaining covariates were selected using backward elimination. The fitted models were assessed using Hosmer and Lemeshow’s goodness-of-fit test (p < 0.10) and Akaike information criterion (AIC). The models to predict each outcome with the best fit and lowest AIC were selected. Analyses were conducted with Stata v14 (StataCorp, USA).

**Ethics**

The study was approved by Kwame Nkrumah University of Science and Technology Committee for Human Research and Publication Ethics. No identifiable data were collected.

**Results**

**Children and injuries**

Two-hundred and sixty-three children presented with serious injuries and had complete data for analysis (Table 1). Eleven children were excluded due to missing key variables (4% of eligible children). About two thirds of children were male (68% of children). The median age was 10 years (interquartile range 6–15, range 4 months to 17 years). There were 42 children aged <5 years (16% of children). Seventy percent of children were NHIS-insured; no children were privately insured.

There was no evidence for significant differences between insured and uninsured children with regard to age, mechanisms of injury, SATS or pediatric SATS triage color, or KTS II (Table 1). Half of the injuries were the result of road traffic incidents (50%) and 26.9% of injuries were from falls. Most children were triaged yellow (59.5%) or orange (33.2%). Seventy-six percent of children had a mild KTS II (i.e., KTS II of 9 or 10), 21% had a hemorrhage control, laparotomy for peritonitis, intracranial decompression, fasciotomy) was similar in both groups (90.5 vs 87.2% of children; p = 0.55), as was total length of hospital stay (12 vs 13 days, IQR 7.0–22.5 vs 7.0–23.0 days among insured and uninsured children, respectively).

However, uninsured children more frequently experienced a financial delay for surgery (17.3%) compared to insured children (6.4%, p < 0.001) (Table 2). There were only three in-hospital deaths; all occurred among insured children.

**Out-of-pocket costs and catastrophic health expenditure**

The median out-of-pocket payment was nearly 1.7 times higher for the families of uninsured children (US$ 388.32, IQR US$ 274.70–588.63) compared to those of insured children (US$ 229.26, IQR US$ 130.74–345.93; p < 0.001). For reference, US$ 1.00 was equal to GHS 2.99 at the time of patient visits. Using a CHE threshold of 10%, 63.5% (95%CI 62.1–64.9%) of all families of severely injured children experienced CHE (Table 3). However, families of uninsured children more frequently experienced CHE (84.8%, 95%CI 75.1–91.2%) than families of insured children (53.4%, 95%CI 47.2–61.3%, p < 0.001). Additionally, proportionally more families of uninsured children experienced CHE than families of insured children when the CHE threshold was increased to 15% and 20%. At a CHE threshold of 20%, nearly half of families of uninsured children experienced CHE (44.3%, 95%CI 33.9–55.2%) compared to only 16.3% (95%CI 11.7–22.2%) of families with insured children (p < 0.001) (Fig. 3).

A similar pattern was evident when the household income was randomly generated from the distribution of household incomes from injured adults. However, the national median household income was 1.8 times higher than the median household income of insured adults at KATH. Therefore, the percent of families of injured children that experienced CHE was higher at all thresholds (Fig. 1). As example, at a CHE threshold of 10%, 93.7% (95%CI 93.3–93.9%) of families with uninsured children experienced CHE and 76.6% (95%CI 76.2–77.1%) of families of insured children experienced CHE (p = 0.001).

**Effect of insurance on timeliness of care and catastrophic health expenditure**

After adjusting for covariables age, sex, injury severity and emergency procedure with multivariable analysis, there was no evidence of correlation

**Table 1**

| All children | Insured | Uninsured | p value |
|--------------|---------|-----------|---------|
| N % | n % | n % |
| **General characteristics** | | | |
| Number of children | 263 – | 184 | 70.0 | 79 | 30.0 | <0.01 |
| Male, n (%) | 174 66.2 | 126 68.5 | 48 60.8 | 0.23 |
| Age, years | | | |
| Median, IQR | 10 6–15 | 9.5 6–14 | 10 7–15 | 0.52 |
| <5 | 42 16 | 30 16.3 | 12 15.2 | 0.77 |
| 5–9 | 84 31.9 | 62 33.7 | 22 27.9 |
| 10–14 | 70 26.6 | 47 25.5 | 23 29.1 |
| 15–17 | 67 25.5 | 45 24.5 | 22 27.9 |
| **Mechanism of injury** | | | |
| Road traffic incident | 130 50.0 | 90 49.2 | 40 52.0 | 0.96 |
| Fall | 70 26.9 | 50 27.3 | 20 26.0 | |
| Other blunt | 29 11.2 | 21 11.5 | 8 10.4 | |
| Gunshot wound or blast | 14 5.4 | 11 6.0 | 3 3.9 | |
| Burn | 3 1.2 | 1 1.1 | 1 1.3 | |
| Other mechanism | 4 1.5 | 2 1.1 | 2 2.6 | |
| **SATS and pSATS acuity level at triage** | | | |
| Green | 9 3.6 | 7 4.0 | 2 2.7 | 0.13 |
| Yellow | 147 59.5 | 111 63.8 | 36 49.3 | |
| Orange | 82 33.2 | 51 29.3 | 31 42.5 | |
| Red | 9 3.6 | 5 2.9 | 4 5.5 | |
| **Kampala Trauma Score** | | | |
| Mild (9/10) | 109 76.2 | 76 80.8 | 33 67.4 | 0.12 |
| Moderate (7/8) | 30 21.0 | 15 16.0 | 15 30.6 | |
| Severe (>6) | 4 2.6 | 3 3.2 | 1 2.0 | |
between insurance status and timeliness of care (i.e., time to surgery, \( p = 0.66 \); length of stay, \( p = 0.52 \)) (Fig. 2). Similarly, experiencing a financial delay was not associated with being insured (aOR 0.53, 95% CI 0.19–1.47).

Having insurance was protective against CHE at a 10% threshold compared to not having insurance regardless of whether the national median household income was applied to all families (aOR 0.21, 95% CI 0.08–0.56) or the fitted sample annual household income was used for families (aOR 0.06, 95% CI 0.01–0.47). Families of children with more severe injuries (i.e., KTS II ≤ 8) had markedly greater odds of experiencing CHE (aOR 5.74, 95% CI 1.73–19.00) than families of children with less severe injuries (i.e., KTS II > 9) when the median national household expenditure was applied. This association was similar, although with somewhat lower evidence for association when the fitted sample household income was used (aOR 4.37, 95%CI 0.91–21.56) (Fig. 4).

**Discussion**

This study was performed to determine the effect of the NHIS on timeliness of care, outcomes, and CHE of seriously injured children in Ghana. The results provide several important findings. First, nearly one third of seriously injured children did not have health insurance. Second, the timeliness of service delivery was poor and not associated with insurance status. Next, families of uninsured children paid markedly more out-of-pocket costs than families of insured children. Lastly, although families of uninsured children were more likely to experience CHE at all thresholds, CHE was commonly experienced regardless of insurance status.

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**Table 2**

|                         | Insured | Uninsured | \( p \) value |
|-------------------------|---------|-----------|---------------|
| n = 184                 |         | n = 79    |               |
| Median hours to surgery (IQR) | 45      | 21.1–133.7 |               |
| Delay in emergency surgery >8 h | 95      | 90.5      | 0.85          |
| Experienced financial delay | 53      | 6.4       | <0.001        |
| Length of stay, (median, IQR), days | 12      | 7.0–22.5  | 0.38          |
| In-hospital mortality | 3       | 1.6       | 0.25          |
| Out of pocket payment (US$), median (IQR) | 229.26  | 130.74–345.93 | <0.001 |

Insured – children insured by National Health Insurance Scheme; IQR – interquartile range; Emergency surgery delay – time between admission and emergency operation (e.g., hemorrhage control, laparotomy for peritonitis, intracranial decompression, fasciotomy); GHS – Ghana Cedis.

**Table 3**

Catastrophic health expenditure (CHE) among families of seriously injured children by insurance status at Komfo Anokye Teaching Hospital in Ghana.

|                         | 5% | 10% | 15% | 20% |
|-------------------------|----|-----|-----|-----|
|                         | %  | %   | %   | %   |
| National median household income |    |     |     |     |
| All families            | 86.3 | 85.3–87.3 | 63.5 | 62.1–64.9 |
| Families of insured children | 82.1 | 75.5–87.0 | 53.4 | 47.2–61.3 |
| Families of uninsured children | 96.2 | 88.9–98.8 | 84.8 | 75.1–91.2 |
| \( p \) value           | 0.003 | <0.001 | <0.001 | <0.001 |
| Sample household income |    |     |     |     |
| All families            | 92.4 | 88.4–95.1 | 81.7 | 76.4–86.1 |
| Families of insured children | 90.1 | 90.0–90.4 | 76.6 | 76.2–77.1 |
| Families of uninsured children | 97.5 | 97.3–97.8 | 93.7 | 93.3–93.9 |
| \( p \) value           | 0.04 | 0.001 | <0.001 | 0.002 |

Fig. 1. Catastrophic health expenditure (CHE) among families of seriously injured children by insurance status using two estimations of household income at Komfo Anokye Teaching Hospital in Ghana.
insurance status. These findings have potentially useful implications for the NHIS, other agencies working toward universal health coverage, and the trauma care system generally.

Nearly one third of seriously injured children did not have health insurance. The NHIS was designed to promote coverage of children by offering low or no premiums for this age group. All children below 18 years old with parents or guardians covered under the NHIS can receive insured services for free after enrolling into a scheme and paying about US$ 2 for an insurance card. Once enrolled, children and their families do not pay an insurance premium. Further, the NHIS explicitly provides risk protection for all emergencies, and specifically those that involve children. However, there has been a consistent decrease in the rate of enrollment in NHIS over the past decade (13.2% in 2013, 7.1% in 2017) and a decrease in the proportion of the population covered (41% in 2010, 35% in 2017) [28]. Although the proportion of children aged <18 years has remained relatively constant over time, this group represents that largest proportion of annual enrollees, suggesting that NHIS efforts to ensure children and their families have financial risk protection are relatively effective. It should be noted that the next largest groups of enrollees are workers in the informal sector and indigent persons. Although this trend is good for achieving UHC, it is a threat to NHIS sustainability given a relatively low proportion of members contributing higher premiums (e.g., salaried workers) who are low utilizers of healthcare services [28,41–43]. Thus, there must be additional efforts to achieve universal coverage of children and contributing adults in the short run. There are numerous examples of increased enrollment in insurance programs at all national income levels through the use of opt-out schemes, school systems, healthcare encounters, and community health workers [44–47]. These data suggest that such efforts should be redoubled to register children with the NHIS to minimize the chances that families experience CHE after injury or illness.

Timeliness of care is an important feature of service delivery and central to quality improvement in emergency and trauma care [48]. Delays in access to care for the injured at the health facility level can occur at multiple care-points (e.g., triage, assessment and resuscitation, performance of diagnostic testing, surgical intervention). Oteng et al. recently performed a preventable death panel review at KATH A&E and determined that 50% of injury deaths were either definitely preventable or possibly preventable [15]. Further, delays in surgery were responsible for nearly 25% of inappropriate care episodes that led to preventable deaths. The data presented here did not demonstrate that insurance status was associated with delays in surgery. Two inferences are reasonable: i) the lack of difference might demonstrate that care was appropriate for everyone; or ii) that care was not appropriate for everyone but was similarly distributed across children with and without insurance. Given that emergency procedures did not start within 8 h of presentation for 91% of insured children and 87% of uninsured children (p = 0.55), we can assume that care was inappropriate for most children regardless of insurance status. Therefore, other, non-financial causes of delays in service delivery must be investigated to improve the quality of care for injured children (e.g., insufficiencies in human or physical resources, lack of protocols, ineffective communication strategies). Prior work in Ghana has demonstrated a number of opportunities to strengthen trauma care, including care for children [4,29,33,49–55]. As example, a nationwide assessment of pediatric trauma care resources and services at first-, referral-, and tertiary-level hospitals in Ghana (including KATH) demonstrated marked deficiencies for a number of essential resources and services (e.g. basic airway management, chest decompression, hemodynamic monitoring, electrolyte determination capabilities, X-ray) [3]. Lack of pediatric-sized items commonly resulted from no procurement strategy, lack of training, frequent stock-outs and technology breakage. Pediatric items were consistently less available than adult-sized items at each hospital level assessed. Similar gaps in pediatric-specific trauma care have been demonstrated worldwide,
including in high-income countries with mature trauma systems [56–58]. Improvements in these areas may unmask an effect of the NHIS on timeliness of care for injured patients and outcomes; this unmasking has been demonstrated in high-quality trauma care systems [59].

The data presented here suggest that the NHIS did provide some financial risk protection to families of injured children. For example, families of insured children paid markedly less out-of-pocket payments than families of uninsured children. Previous reports have affirmed the protective effect of NHIS in patients who incurred medical expenses or expenses from surgery generally [60–63]. However, more than 60% of all families of seriously injured children experienced CHE, and only four families did not pay out-of-pocket expenses (1.5% of families of seriously injured children). There is concern that even small amounts of cost-sharing for essential or high-acuity conditions serves as a financial

Fig. 3. Multivariable regression of out-of-pocket costs among seriously injured children at Komfo Anokye Teaching Hospital in Ghana.

Fig. 4. Multivariable regression of catastrophic health expenditure at a 10% threshold among seriously injured children using two estimations of household income at Komfo Anokye Teaching Hospital in Ghana.
disincentive for people to access care when needed and not only leads to less care utilization, but worse outcomes, particularly for those most vulnerable [64,67]. Although this has been well described for preventative services and primary care, this question remains unanswered for emergency and trauma care, particularly in LMICs [65]. To address this question in the United States, Scott et al. used a nationwide database of inpatient charges to assess changes in insurance coverage and perforation rates among young adults with acute appendicitis (i.e., a metric for population-level healthcare access) [16]. The study used data from before and after the 2010 Dependent Coverage Provision (DCP) of the Affordable Care Act, which allowed young adults to remain on their parents’ health insurance plans until age 26 years. They reported significant reductions in uninsured rates among young adults after the DCP, which were associated with significant reductions in perforated appendix rates. Further, there was greater relative decreases in perforation rates among the most at-risk subpopulations (e.g., lower socioeconomic status, racial and ethnic minorities); this finding implies that expanding insurance coverage and reducing or eliminating cost-sharing may mitigate disparities in access to care. Although the current study does not allow us to draw conclusions regarding the impacts of insurance on care delays, previous work in Ghana has clearly demonstrated that direct and indirect costs limit health seeking behaviors and care affordability [66,67]. Therefore, insurance expansion and higher coverage rates could lead to fewer delays in seeking and accessing care for emergency conditions.

Several limitations are worth mention before interpreting the results. First, this was a retrospective study without access to some potentially useful data, such as time from injury to presentation, household income, and morbidity outcomes. Therefore, this study was narrow in scope. Additionally, we had to use national median household expenditure to estimate CHE, which may have not accurately reflected the median annual household income of the parents of injured children. As a sensitivity analysis, we also randomly assigned annual household income to our population of children using the distribution of annual household income of seriously injured adults at KATH. However, random assignment of annual household incomes, while hopefully reducing some of the confounders of using the national median income, do not take into account potential income differences between children from insured versus uninsured families. The findings demonstrated that the national median annual household income was markedly higher than the median income from the adult sample, suggesting that our findings represent a significant underestimation of CHE. Further, this study did not follow children longitudinally and reports only a single encounter. Given that many seriously injured children require numerous healthcare encounters, each with out-of-pocket costs, the estimates presented are particularly conservative. Second, this sample from a large teaching hospital is not representative of all children in Ghana, particularly those who sustain only minor injuries. However, most operations for seriously injured children occur at one of the trauma centers in Ghana regardless of their family’s household income or urban-rural living location [29,53]. Therefore, these findings are likely fair estimations for this subgroup of injured children in Ghana. NHIS did not improve timeliness of care, length of stay or mortality. Although NHIS did provide some financial risk protection for families, it did not eliminate out-of-pocket payments. The families of most children who presented with a serious injury experienced CHE, regardless of insurance status. NHIS and similar financial risk pooling schemes could be strengthened to better provide financial risk protection and promote quality of care for injured children.

Dissemination of results

The results were informally shared with the stakeholders of the Komfo Anokye Teaching Hospital Accident and Emergency Unit. The results will be presented at a locoregional meeting and shared via social media.

Authors’ contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: BTS, AG, SKG and CM contributed 20%; PD 10%; and GB and JWS 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

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Declaration of competing interest

The authors declared no conflict of interest.

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