

Increasing Motorcycle Taxi Driver Conspicuity in Tanzania

by

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Duke Global Health Institute
Duke University

Date: _____

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Catherine Lynch

Brian Pence

Thesis submitted in partial fulfillment of
the requirements for the degree of Master of Science
in the Duke Global Health Institute
in the Graduate School
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2014

ABSTRACT

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Abstract

Motorcycle crash related injuries and deaths are increasing rapidly in many African nations. Utilizing conspicuity measures, such as wearing reflective, fluorescent safety vests, are effective as crash prevention strategies. Furthermore, use of some conspicuity measures is mandated by law among motorcycle-taxi drivers in Tanzania. Nonetheless, uptake remains low. Locally appropriate strategies to improve crash preventative behaviors are needed.

To explore whether use of conspicuity measures could be improved through eliminating cost-barriers, we tested a distribution strategy involving the provision of free motorcycle safety vests among a population of motorcycle-taxi drivers in Moshi, Tanzania. We conducted a cluster randomized controlled trial among 180 motorcycle-taxi drivers in which half of the participants (90) were randomized to the intervention arm and received a free reflective vest. The other half of the participants (90) were randomized to the control arm and did not receive free vests. Whether motorcycle taxi drivers used the reflective vest was then unobtrusively observed on city streets over a period of three months.

Mixed-effects logistic regression was used to estimate differential uptake of the vests between trial arms. At baseline, 3.3% of individuals in both arms used a reflective vest. In three months of follow-up, 79 drivers in the intervention arm and 82 drivers in

the control arm were able to be observed. In the intervention arm the average proportion of observations during which drivers were observed to be using a reflective vest was 9.5%, compared to 2.0% in the control arm (odds ratio: 5.5, 95% confidence interval: 1.1-26.9, p-value: 0.04). Distribution of free reflective vests did lead to an increase in vest usage, however, the increase was minimal. Removing economic barriers alone appears insufficient to adequately improve adherence to conspicuity measures.

Dedication

This thesis is dedicated to Esther: Nakupenda mke wangu!

Contents

| | |
|---|----|
| Abstract | iv |
| List of Tables | ix |
| List of Figures | x |
| Acknowledgements | xi |
| 1. Introduction | 1 |
| 1.1 Burden of Road Traffic Injuries | 1 |
| 1.2 Conspicuity Measures..... | 2 |
| 1.3 Motorcycle Taxis..... | 2 |
| 1.4 Study Rationale, Aims, and Hypotheses..... | 3 |
| 2. Methods..... | 4 |
| 2.1 Study Area and Population..... | 4 |
| 2.2 Recruitment and Randomization | 4 |
| 2.3 Intervention..... | 6 |
| 2.4 Outcome Measurement | 7 |
| 2.5 Statistical Analyses..... | 8 |
| 3. Results..... | 10 |
| 3.1 Baseline Characteristics of Participants..... | 10 |
| 3.2 Conspicuity Measure Use..... | 13 |
| 3.3 Reasons for Non-use of Conspicuity Measures | 16 |
| 3.4 Cost Estimates..... | 18 |

| | |
|---|----|
| 4. Discussion | 19 |
| 4.1 Effectiveness of Intervention..... | 19 |
| 4.2 Understanding Non-Adherence..... | 20 |
| 4.3 Limitations..... | 21 |
| 4.4 Conclusion..... | 22 |
| Appendix A: Informed Consent Form..... | 23 |
| Appendix B: Study Enrollment Survey | 25 |
| Appendix C: Study Closure Survey | 30 |
| References | 36 |

List of Tables

| | |
|---|----|
| Table 1: Baseline Characteristics Motorcycle-Taxi Drivers by Treatment Arm | 12 |
| Table 2: Proportion of Time Motorcycle-taxi Drivers Followed Recommended Conspicuity Measures ^a | 15 |
| Table 3: Reasons Reported for Not Wearing Reflective Vest After the End of the Study | 17 |

List of Figures

| | |
|--|----|
| Figure 1: Reflective Vests Used in Study | 7 |
| Figure 2: Study Flow Diagram | 11 |

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1. Introduction

1.1 Burden of Road Traffic Injuries

Globally, road traffic injuries (RTIs) are the 2nd leading cause of death among males age 15 to 49, the economically productive age group [1]. Additionally, road traffic injuries have risen 47% from 1990 to 2010 [1] and are projected to continue to rise as a result of ongoing economic development and increased motorization [2]. The Africa region currently has some of the world's highest traffic injury rates. Road users such as motorcycle riders bear a disproportionate share of the injury burden. Moreover, these injuries are often underreported and underestimated from current data [3, 4].

Historically, pedestrians in Africa have borne the largest share of the mortality burden from RTIs [5]. However, recent research indicates that the burden of injury may be shifting to motorcyclists [6]. The increased availability of low cost motorcycles and rising household income levels have helped to promote motorcycles as a rapidly growing form of transport in many African nations [7]. We recently documented this transition in Tanzania, where motorcycle injuries comprised the largest segment of RTI victims among patients presenting to a zonal referral hospital [8].

1.2 Conspicuity Measures

One of the most effective strategies for the primary prevention of motorcycle crashes is to increase use of conspicuity measures by motorcycle riders. Conspicuity measures—factors that increase a motorcycle rider’s ability to be seen by other vehicles—are important as motorcyclists often are difficult to see and can be easily hit by larger vehicles, particularly in chaotic traffic patterns [9]. Wearing reflective or fluorescent clothing, continuously operating the motorcycle headlight (including during the daytime), and wearing a white colored helmet are estimated to be associated with a 37%, 27%, and 24% reduced risk of motorcycle crash, respectively [9]. Thus, large gains in primary prevention of motorcycle crashes can potentially be achieved from relatively simple interventions that make motorcycle riders more visible. Our study evaluated the uptake of the most protective conspicuity measure, the use of a reflective vest, following free distribution of vests among a high risk population of motorcycle-taxi drivers in Northern Tanzania.

1.3 Motorcycle Taxis

Motorcycle-taxi’s are a common form of transport in many developing nations and consist of a motorcycle driver who carries passengers on the back of the motorcycle for a fee. Motorcycle-taxi drivers are a particularly high risk population for motorcycle

crashes as they operate a motorcycle for several hours a day and are financially incentivized to provide as many rides as possible daily. The use of reflective/fluorescent vests is mandated by law for motorcycle-taxi drivers in Moshi, Tanzania; however, use of such vests and enforcement of the law is limited. Anecdotally, motorcycle-taxi drivers indicated that the major barrier to use of the vests in our region was cost.

1.4 Study Rationale, Aims, and Hypotheses

Provision of free health-related equipment in resource limited settings is a highly debated topic, with most of the current literature focusing on malaria bed net distribution [10-12]. Evidence from randomized controlled trial data testing the provision of free equipment for injury prevention campaigns in low-income nations is particularly limited. Our primary aim was to determine, in a cluster randomized controlled trial design, whether distribution of free reflective, fluorescent vests to participants in the intervention arm improved the frequency of use, compared to the control arm, in which no free vests were provided. Both groups also received brief education on all recommended conspicuity measures. As a secondary outcome, we monitored usage of white helmets and daytime running headlights after the provision of education, though no free equipment was provided for these outcomes.

2. Methods

2.1 Study Area and Population

Moshi is a city in the Kilimanjaro region of Northern Tanzania with a population of 184,292 in the most recent 2012 Tanzanian census [13]. Motorcycle-taxi drivers in Moshi wait for potential customers at motorcycle-taxi stands located along well-traveled roads. Each driver has a typical stand location that is usually shared with a varying number of other motorcycle-taxis.

2.2 Recruitment and Randomization

Motorcycle-taxi drivers were recruited in clusters from motorcycle-taxi stands with randomization to either intervention or control occurring at the stand level. To ensure roughly equal assignment of participants to intervention and control, motorcycle-taxi stands were classified into three strata based on size (1-3, 4-6, and 7 or more drivers). A block randomization sequence was prepared by a researcher not involved in this study using a commercial randomization provider with block sequence and size unknown to study investigators [14]. In the field, study staff first approached a motorcycle-taxi stand, identified the stratum based on number of drivers present, and then opened a sealed, opaque envelope for that stratum revealing the trial arm assignment.

Motorcycle-taxi drivers at the particular stand were then approached for enrollment. For inclusion into the study, drivers had to work at least 2 days per week, have a phone number for ride solicitation, have a license plate able to be recorded, be at least 18 years old, and be willing to be contacted in the future for repeat survey. Motorcycle riders were excluded if they did not meet the above criteria or did not consent to participate.

For sample size determinations, to account for the clustering at the taxi stand level we assumed a between-driver, within-taxi-stand, correlation equal to 0.1 and a 0.95 correlation between observations on the same driver over time. Assuming that 20% of the control group would wear reflective vests and allowing for a drop-out rate of 1 in 6 drivers, 90 drivers per arm (180 total) were required to produce an 80% power to detect a 25% or greater difference in vest utilization between arms for a two-tailed 5% significance level.

Ethical review board approval was provided by the Ethics Committee of the Kilimanjaro Christian Medical Centre, the Tanzanian National Institute of Medical Research, and the Duke University Institutional Review Board. This trial is registered with ClinicalTrials.gov as NCT01733537. The trial was conducted from February 2013 through June 2013.

2.3 Intervention

At the time of enrollment, all study participants were administered a baseline survey. After the survey, all participants also received a brief education session on conspicuity measures. The education session was led by a peer motorcycle-taxi driver who was trained to deliver a five minute educational message highlighting that wearing reflective/fluorescent clothing, using daytime running headlights, and wearing a white helmet were protective against crashes. The peer driver also communicated estimated risk reductions of the above conspicuity measures along with locations where such equipment could be purchased.

Each participant selected for the intervention group, however, additionally received a free reflective, fluorescent vest. All vests were identical in brand and style and similar to other vests locally available for purchase (see Figure 1). Participants were able to select their appropriate size.



Figure 1: Reflective Vests Used in Study

2.4 Outcome Measurement

The primary outcome was the proportion of drivers wearing a reflective, fluorescent vest in the intervention group compared to the control group over a three month time period. Secondary outcomes were the use of daytime running headlights and the wearing of a white colored helmet. Over the observation period, research assistants attempted to observe drivers at least once per month. To assess each participant's use of the recommended conspicuity measures we utilized a naturalistic observation strategy in which study staff unknown to the participants from the initial recruitment phase solicited rides from each taxi-driver during the daytime. During the ride the study staff would observe the participants use of a reflective vest, use of headlights, and presence and color

of a helmet. The use of this observation method helped to avoid a “Hawthorne effect,” in which participants may change their behavior simply because they know that their behavior is being observed [15].

The above ride-solicitation procedure was utilized for the first month of observation. However, interim analyses at this point revealed that the intervention had very low levels of uptake. Thus, for months two and three of observation, we transitioned to a less intensive and lower cost strategy in which study assistants unknown to the motorcycle-taxi drivers identified the drivers at their taxi stand or driving on the road based on their license plates and subsequently observed their use of conspicuity measures from a distance in an inconspicuous manner. At the close of the three months of observations, a second survey was performed to gauge participants’ opinions. At enrollment, study participants were asked if they always used the same motorcycle and at study closure participants reported whether they had changed motorcycles at any point in the study. For participants who had changed motorcycles during month two and three, when identification was based on license plate number, observations made after the date of the switching of their motorcycle were not used.

2.5 Statistical Analyses

As mentioned, the primary outcome of interest was the proportion of participants using a reflective, fluorescent vest. To determine the percentage of reflective vest usage in a particular trial arm over the study period, the average of each individual driver’s

observations over the study period was incorporated into a grand average of all participants in each trial arm. Secondary outcomes assessed were use of white helmets and daytime running headlights.

Outcomes were analyzed using mixed-effects logistic regression to account for the multilevel structure of the data which contained multiple observations per taxi driver and multiple taxi drivers clustered within taxi stands. In addition to taking into account the nested structure of the data, regression analyses adjusted for baseline conspicuity measure usage (for use of reflective vest and white helmet) and stratum of randomization. All analyses were performed according to the intention to treat principle. Analyses were performed in Stata 12.1 (StataCorp, College Station, TX).

3. Results

3.1 *Baseline Characteristics of Participants*

The study sample recruited included 180 motorcycle-taxi drivers; 17 clusters with 90 drivers were assigned to the intervention arm and 16 clusters with 90 drivers were assigned to the control arm (Figure 2). After three months of observations, 11 participants in the intervention group and 8 participants in the control arm were unable to be observed leaving 79 and 82 participants for analysis in the intervention and control groups, respectively (Table 1).

Baseline characteristics of participants recruited into both arms were comparable (Table 1). On average, the motorcycle-taxi drivers worked over 80 hours per week and provided approximately 20 rides to clients daily. Drivers reported just over one previous crash on average.

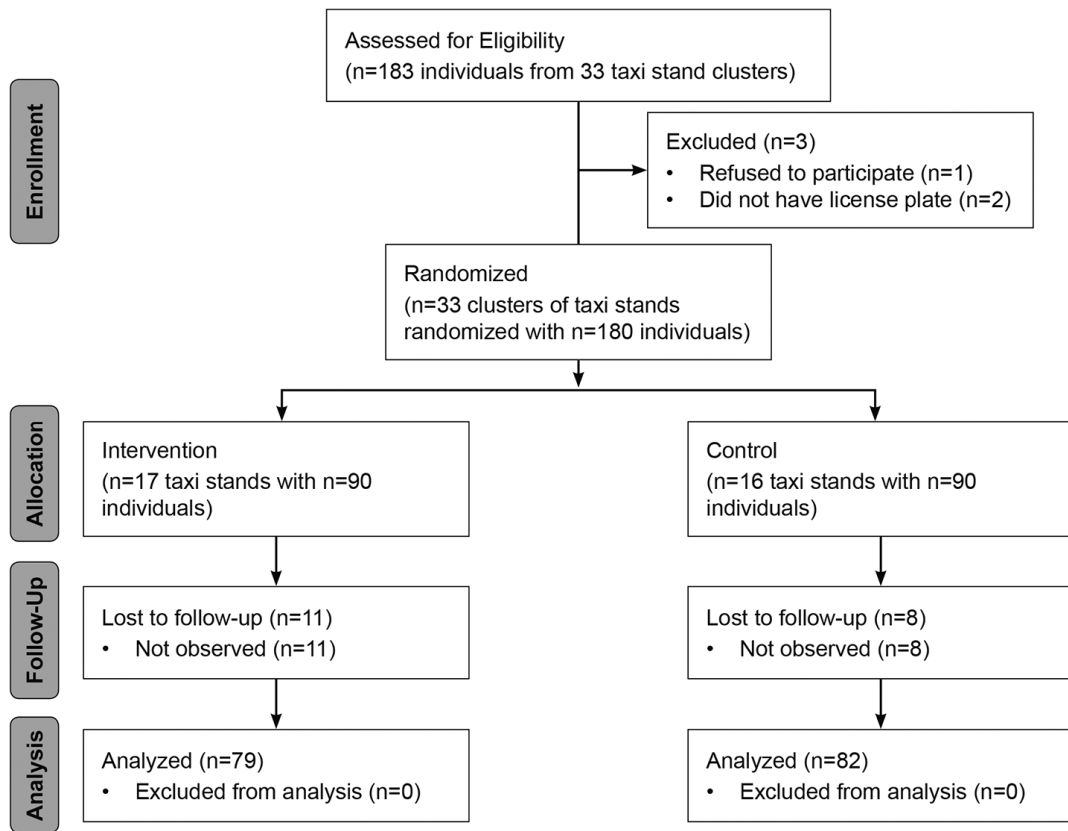


Figure 2: Study Flow Diagram

Table 1: Baseline Characteristics Motorcycle-Taxi Drivers by Treatment Arm

| | Intervention (N=79) | Control (N=82) |
|---|--------------------------------|---------------------------|
| Clusters | | |
| Number of taxi-stands by size: | | |
| 1-3 drivers | 7 | 7 |
| 4-6 drivers | 8 | 7 |
| 7 or more drivers | 2 | 2 |
| Individuals Observed | 79 (100%) | 82 (100%) |
| Male | | |
| Age in Years, Mean (SD) | 28.8 (6.5) | 28.8 (6.4) |
| Married | 54 (68.4%) | 52 (63.4%) |
| Number of Dependent Children, Mean (SD) | 1.4 (1.2) | 1.4 (1.3) |
| Highest Educational Level Attended | | |
| None | 1 (1.3%) | 0 (0%) |
| Primary | 55 (69.6%) | 56 (68.3%) |
| Secondary | 23 (29.1%) | 26 (31.7%) |
| Years of Experience Driving A Motorcycle, Mean (SD) | 5.9 (4.7) | 6.7 (5.1) |
| Years of Experience Working as a Motorcycle-taxi Driver, Mean (SD) | 2.3 (1.2) | 2.2 (1.1) |
| Hours Per Week Worked, Mean | 83.4 (14.7) | 86.4 (17.5) |
| Motorcycle-taxi Rides Per Day Given. Mean (SD) | 19.7 (8.0) | 21.4 (10.2) |
| Number of Previous Crashes, Mean (SD) | 1.4 (1.2) | 1.1 (1.9) |

Values are numbers (percentages) unless otherwise stated

3.2 Conspicuity Measure Use

Over the three month study follow-up, the mean number of observations made per participant was 3.7 and 3.1, in the control group and intervention groups, respectively. Over 3 months of follow-up, the average proportion of observations that motorcycle drivers used a reflective vest in the intervention group was 9.5% compared to 2.0% in the control group, with logistic regression model estimates indicating that participants in the intervention group were over 5 fold more likely to use a reflective vest (OR 5.5, 95%CI 1.1-26.9). Thus, provision of a free vest appeared to increase vest usage at a statistically significant level, but the absolute increase was modest.

For the secondary outcome of white helmet usage, at 3 months of follow-up there was no discernible difference between intervention and control groups (OR 0.7, 95%CI 0.03-17.4). Use of white helmets appeared to vary considerably from month to month. Discussions indicated that motorcycle-taxi drivers often share or switch helmets, consistent with these findings.

For the secondary outcome of daytime running headlight usage, there also was no detectable difference between intervention and control groups after 3 months of follow-up (OR 1.2, 95%CI 0.6-2.3). As with white helmet usage, daytime running headlight usage varied considerably. Anecdotally, rather than maintaining headlights

always on, many motorcycle driver use lights intermittently to signal to other vehicles or pedestrians, potentially explaining this variability.

Table 2: Proportion of Time Motorcycle-taxi Drivers Followed Recommended Conspicuity Measures^a

| Primary Outcome | Trial Arm | Baseline | Month 1 (N=139) ^b | Month 2 (N=111) | Month 3 (N=95) | Month 1-3 | Odds Ratio ^c (95% CI) | p-value |
|---------------------------------|--------------|----------|---------------------------------|--------------------|-------------------|------------------|-------------------------------------|---------|
| | | | | | | Total (N=161) | | |
| Reflective Vest Used | Intervention | 3.3% | 12.7% | 8.8% | 7.7% | 9.5% | 5.5 (1.1-26.9) | 0.04 |
| | Control | 3.3% | 4.4% | 1.7% | 2.4% | 2.0% | 1 (ref) | n/a |
| Secondary Outcomes | | | | | | | | |
| White Helmet Present | Intervention | 11.1% | 5.6% | 6.4% | 7.9% | 5.6% | 0.7 (0.03-17.4) | 0.84 |
| | Control | 6.7% | 4.4% | 0.9% | 5.5% | 3.4% | 1 (ref) | n/a |
| Daytime Running Headlights Used | Intervention | — | 17.4% | 3.0% | 9.3% | 11.3% | 1.2 (0.6-2.3) | 0.67 |
| | Control | — | 10.9% | 6.3% | 5.4% | 8.2% | 1 (ref) | n/a |

^a The reported measures represent the average percent of observations that drivers in each trial arm used a particular conspicuity measure.

^b N indicates the total number of individuals drivers observed during each time period.

^c The odds ratio reported compares the specified outcome in the intervention group vs the control over the entire 3 month follow-up period.

3.3 Reasons for Non-use of Conspicuity Measures

At the study closure survey, before participants were informed of the results of the trial and that their usage of conspicuity measures had been observed, participants reported on reasons for not using a reflective vest (Table 3). For participants in the intervention group, the most common reason cited for not wearing the vest was forgetting, listed by 51.2% of respondents. A lower percentage reported not being convinced that the vest was protective (18.6%) and not liking the look of the vest (11.6%). When asked in an open ended question for other reasons for not wearing the vest, 22.1% of respondents indicated that they still had the vest but were currently washing it.

Among the control group, the majority of respondents (32.6%) indicated that they had not acquired a vest since the start of the study because it was too expensive to buy. Other common reasons for not wearing a vest included forgetting that it was recommended and not being convinced that it is protective, indicated by 31.5% and 29.2% of respondents, respectively.

Table 3: Reasons Reported for Not Wearing Reflective Vest After the End of the Study

| Intervention Group (N=86)^a | | Control Group (N=89)^a | |
|--|----------------------------|---|----------------------------|
| Reason | Percent^b | Reason | Percent^b |
| Forgot to wear | 51.2 | Too expensive to buy | 32.6 |
| Not convinced vest is protective | 18.6 | Forgot it was recommended | 31.5 |
| Did not like look or design of vests | 11.6 | Not convinced vest is protective | 29.2 |
| Vest did not fit well | 8.1 | Money better spent elsewhere | 22.5 |
| Lost vest | 4.7 | Did not like look or design of vests | 19.1 |
| Sold Vest | 0 | Did not know where to buy vest | 18.0 |
| Other: | | Other: | |
| Vest being washed | 22.1 | Wears at night | 13.5 |
| Wears at night | 15.1 | Washing | 5.6 |
| Vest is worn out or dirty | 11.6 | Too hot | 5.6 |
| Too hot | 8.1 | Worn out | 3.4 |

^aThe N reported here includes all study participants located during the follow up survey

^bPercents do not sum to 100 as more than one reason could be chosen by respondents

3.4 Cost Estimates

Crude estimates of the cost effectiveness of this intervention can be calculated. Costs of purchasing and shipping reflective vests to Tanzania were 6.95 USD per vest. The cost of distribution of vests to drivers is estimated to be 0.57 USD per vest, including local staff salaries and transport costs (16). Thus, total vest acquisition and distribution cost is approximately 7.52 USD per vest.

From the baseline survey, our population reported 0.40 crashes per year of driving. Considering an estimated crash rate reduction of 37% attributed to wearing fluorescent/reflective clothing [9], vest usage would thereby decrease the crash rate among our population to an estimated 0.25 crashes per year. Assuming a maximum differential uptake of 7.5%, out of a hypothetical 1,000 taxi drivers treated annually this equates to approximately 11.25 fewer crashes. Assuming a vest lasts 6 months, distributing vests to 1,000 drivers for 1 year would cost 15,040 USD. Thus, cost of the intervention per crash prevented is estimated to be 1,337 USD.

4. Discussion

4.1 Effectiveness of Intervention

The primary purpose of this trial was to assess the effectiveness of a program of free equipment distribution to increase the use of conspicuity measures among motorcycle-taxi drivers, focusing on the use of fluorescent, reflective vests. Use of such vests is associated with a 37% lower risk of crash and is a low-cost, high-yield intervention [9]. Furthermore, use of reflective vests is mandated by law in Tanzania among motorcycle-taxi drivers.

Analysis of the primary outcome revealed that after 3 months of observations, provision of a free, reflective vest did lead to a statistically significant increase in reflective vest usage compared to not receiving a free vest, but the absolute difference between groups was relatively small at 7.5%. Prior to the start of the trial we hypothesized a minimum 25% difference between arms, indicating an observed lower level of effectiveness of the intervention relative to initial expectations. Noting no clear increase in reflective vest usage among participants in the control arm and no increase in use of white helmets or daytime running headlights over time, the brief education session given at study enrollment did not lead to any noticeable changes in behavior. Educational interventions of longer duration and greater complexity may be more effective [17].

4.2 Understanding Non-Adherence

Among participants who received a free vest, the majority indicated that the main reasons for not wearing the vest were forgetting to wear the vest or that it was currently being washed, suggesting a low priority for vest usage. Among the control group in which participants did not receive any free vest, the main reason listed for not acquiring a vest was that they were too expensive. However, the low utilization in the intervention arm, where vests were provided for free, suggests that cost is not the only reason for non-use, even among those citing cost as the primary barrier.

Although we can find no prior published literature elucidating rationale for non-adherence to conspicuity measures in developing nations, research on helmet use indicates that while cost is often cited by drivers as a major reason in helmet acquisition, there are a multitude of other influential factors [18]. One major factor appears to be enforcement of traffic safety laws [19].

Indeed, after the closure of the observation period and follow-up surveys were complete, the participants were revisited and results of this trial were shared with them. Motorcycle-taxi drivers reported candidly that uptake of vest usage would likely not occur unless enforcement of the law requiring their usage occurred. Interestingly, the percent of motorcycle-taxi drivers possessing a helmet (of any color) was exceptionally high, at 93%; drivers indicated that local police were enforcing helmet usage laws with

finest of approximately 20 USD per infraction but fines for not using reflective vests were not enforced.

4.3 Limitations

There exist some limitations to this study. Given its focused nature, our study provides insight mainly into economic incentives and safety behaviors; however, there remain many additional facets of shaping preventative behaviors yet to be explored. Nonetheless, this trial contributes significantly to the traffic injury prevention literature because provision of free equipment is a nuanced area in which quantification of benefit has not been rigorously assessed. Furthermore, because injury prevention campaigns often, appropriately, employ multifaceted strategies to attempt to affect behavioral change, the efficacy of specific components of such campaigns is difficult to assess; our study helps to contribute to such knowledge.

It should also be noted that the rollout of the intervention and distribution of vests was not able to be blinded. The degree to which motorcycle-taxi drivers in the city knew who received a free vest and the potential effects of this are not known. However, the unblinded nature of this trial mimics real-world program implementation. Additionally, the generalizability of these results remains unclear. Distribution of free health and safety-related equipment and its uptake among a given population is likely influenced by a host of local factors. Nevertheless, this trial provides useful insights for public health strategies that do involve distribution of free items.

4.4 Conclusion

The modest behavior change noted in this trial highlights the importance of understanding a wide range of other factors that may influence and improve injury prevention behaviors, such as social marketing or design considerations of safety equipment [20]. A continued factor to further investigate is the role of effective enforcement of road safety laws [19, 21]. The effectiveness of campaigns involving provision of free equipment or education in injury prevention work may be augmented significantly by multi-faceted approaches; the ideal composition of such strategies remains an area to be explored.

Appendix A: Informed Consent Form

Kilimanjaro Christian Medical Centre Consent To Participate In A Research Study

“Improving Commercial Motorcycle Driver Visibility in Tanzania—a Cluster Randomized Controlled Trial”

Verbal Consent Form:

Hello. My name is _____. I am an assistant working for the Kilimanjaro Christian Medical Center (KCMC). Doctors from the orthopedics, casualty, and internal medicine departments of KCMC and Duke University in the United States are interested in studying how to prevent motorcycle crashes. Specifically, they are interested in the clothing that motorcycle drivers wear to make themselves more visible to other vehicles, such as reflective vests.

We would like to talk with you about the clothing you wear and other aspects of your job. The main purpose of this study is to learn how to best help commercial motorcycle drivers to wear fluorescent or reflective clothing, which has been associated with a lower risk of crashing. There will be approximately 180 commercial motorcycle drivers from Moshi in this study. If you choose to join, your participation will start today with a survey. Then, taxi drivers will be randomly assigned (like the flip of a coin) to receive either a short teaching session on how to prevent motorcycle crashes plus a free cell phone airtime card or the teaching session plus a free fluorescent reflective vest. You will be asked to complete a follow-up survey in the future on your thoughts on the vest and/or teaching.

It is important that you know your participation is entirely voluntary and you may decide not to take part or to withdraw from the study at any time. You can refuse to answer any questions.

For your time, you will receive approximately 3500 Tanzanian Shillings for each survey completed. To contact you in the future we ask for your permission to call you in the future. Only individuals who are age 18 or over and who work as a commercial motorcycle driver at least 2 days a week can participant. Also, only individuals with a cell phone number and who have a motorcycle with a license plate can participate in this study because otherwise it would be too difficult to contact people in the future and make sure that it is the same person we are talking to.

May we contact you in the future? yes no

What is your Telephone Number(s)?:

The information collected from you in this survey will remain confidential and will only be used for the purposes of this study. The only risk to you for participating in this study is a loss of confidentiality, but your responses will be kept private. Your participation in this project will benefit all motorcycle riders if we can learn how to help prevent motorcycle crashes.

If you have any questions about this study, you can contact our office at KCMC at 255-_____ and ask to speak with Dr. Anthony Pallangyo or Steven Sumner of KCMC; or you may contact the chair of the KCMC Medical Research Coordinating Committee at telephone 255-272753909 or address PO Box 3010, Moshi, Tanzania; or you may call the Duke University Ethics Committee at 919-668-5111.

May I begin asking you questions? yes no

Name of interviewer: _____

Date: _____

Appendix B: Study Enrollment Survey

A. Demographic Information:

I'll begin the questionnaire by asking you some basic questions about yourself.

- A.1. Age: How old were you in years at your last birthday? _____ (years)
- A.2. Sex: male female
- A.3. Marital status: Are you currently married or living together with a woman (or man) as if married?
- yes, currently married yes, living with a woman (or man)
 no, widowed
 no, separated/divorced no, never married or lived with a woman (or man) as if married
- A.4. Children: Do you have children who are dependent on you financially?
- yes no **[skip to A.5.]**
- A.4.1. Number of children: How many children do you have who are dependent on you financially? _____ (number of children)
- A.5. Education: What is the highest level of school that you attended? (read responses)
- no formal education **[skip to B.1.]** primary school
 secondary school beyond secondary school
[skip to B.1.]
- A.5.1. Highest grade level: What is the highest grade/year that you completed?
_____ (grade/year)

B. Work Information:

- B.1. Years as taxi: How long have you worked as a motorcycle taxi driver?
_____ years and _____ months
- B.2. Years driving: How long have you been driving a motorcycle in total?
_____ years and _____ months

- B.3. Taxi stand: Is this where you typically wait for passengers?
 yes no
- B.4. Days per week worked: How many days per week do you work as a motorcycle taxi driver on average? _____ (days)
- B.5. Hours per day worked: How many hours per day do you work as a motorcycle taxi driver on average? _____ (hours)
- B.6. Rides per day: How many rides do you provide for passengers in a typical day?
 _____ (number of rides)
- B.7. Telephone number: What is your cell phone number to contact you in the future, the one that passengers use to call you for rides? (record all cell phone numbers participant has, and call each cell phone number to make sure it works)
 _____ (cell phone 1)
 _____ (cell phone 2)
- B.8. Time of day present: What time of day are you usually working here? (read responses)
 morning afternoon both morning and afternoon
- B.9. Days of week present: What days are you usually working here? (check all that apply)
 Monday Tuesday Wednesday
 Thursday
 Friday Saturday Sunday
- B.10. GPS coordinates: Record the GPS coordinates of the interview location.
 Latitude: _____ Longitude:

- B.11. Motorcycle use: Do you always use the same motorcycle when working as a taxi driver?
 yes no
- B.11. License plate number: Record license plate number.

C. Motorcycle Safety:

C.1. Helmet: Do you currently have a helmet with you that you wear? (verify presence of helmet)

yes no **[skip to C.2.]**

C.1.1. Color of helmet: What color is your helmet primarily? (verify color)

white black blue
 yellow
 red orange purple
 green
 silver/gray other _____ (record color)

C.1.2. Color choice: Why did you choose this particular color helmet? (choose best response)

I liked how it looked best
 This was the cheapest helmet
 This was the only available helmet in the store
 This helmet was free or a gift
 other

C.2. Paying for helmet: How much are you willing to pay for a helmet?
_____ (Tanzanian shillings)

C.3. Fluorescent or reflective clothing: Are you currently wearing any fluorescent or reflective clothing like a fluorescent or reflective vest, jacket, or shirt that you wear? (verify presence of fluorescent or reflective clothing)

yes no **[skip to C.4.]**

C.3.1. Location of clothing: Where on your body do you wearing the fluorescent or reflective clothing? shirt pants
 jacket/vest other

C.4. Vest cost: How much would you be willing to pay for a reflective vest?
_____ (Tanzanian shillings)

C.5. Daytime running headlights: How often do you run your motorcycle's headlight when you are driving during the daytime? (read responses, chose best reponse)

- never
- 25% of the time
- 50% of the time
- 75% of the time
- always

C.6. Safety course: Did you ever take formal driving lessons or driver's safety course?

- yes
- no **[skip to C.7.]**

C.6.1. Teacher: Who taught the course?

- government organization
- private company
- other _____
- don't know/no response

C.7. Motorcycle crash: Have you ever been involved in a motorcycle crash, such as crashing with another vehicle/motorcycle, crashing with an object, or losing control of the motorcycle on your own and crashing?

- yes
- no **[skip to C.8.]**

C.7.1. Number of crashes: How many crashes have you had since you first started driving a motorcycle? _____
(number of crashes)

C.7.2. Most recent crash: How long ago was your most recent crash?
_____ years and _____ months and _____ weeks

C.7.3. Injury: Were you injured in any of your crashes?

- yes
- no **[skip to C.8.]**

C.7.3.1. Serious Injury: Tell me about your worst crash, did you consider your injury serious?

- yes
- no

C.7.3.2. Treatment: Did you seek treatment at a hospital, clinic, or with a healthcare provider for this crash?

- yes

C.7.3.3. Injuries sustained: How were you hurt in this crash? (check all that apply, and ask about each item)

- bruises broken bone(s) skin cuts or abrasions
 head injury
 other
-

C.8. Near misses: In the past 3 months how many times have you almost had a crash but did not?

_____ (number of near misses)

C.9. Crash risk: How likely do you think it is that you will be in a crash in the next year? (read responses, choose best response)

- no chance very low chance some chance very high chance

D. Motorcycle characteristics:

D.1. Ownership: Is the motorcycle you are driving now owned by you or someone else?

- "owned by me" "owned by someone else"

D.2. CC rating: What is the size of the motorcycle engine? _____
(ask for cc rating)

D.3. Brand: What is the brand of the motorcycle? _____
(brand)

D.4. Familiarity: How long have you been driving this particular motorcycle?
_____ years and _____ months

D.5. Motorcycle color: What color is your motorcycle body primarily? (verify color)

- white black blue yellow
 red orange purple green
 silver/gray other _____ (record color)

Thank you for completing this survey. We hope your participation will help us improve safety for motorcycle drivers like yourself.

Appendix C: Study Closure Survey

A. Visibility recommendations:

I'll begin the questionnaire by asking you some basic questions about the recommendations talked about at the first survey.

- A.1. Fluorescent or reflective clothing: Are you currently wearing any fluorescent or reflective clothing like a fluorescent or reflective vest, jacket, or shirt that you wear? (verify presence of fluorescent or reflective clothing)

yes no [**skip to A.2.**]

- A.1.1. Location of clothing: Where on your body do you wear the fluorescent or reflective clothing? shirt pants
 jacket/vest other
-

- A.2. Fluorescent or reflective clothing: Since you were first surveyed, how often would you typically wear fluorescent or reflective clothing when driving your motorcycle? (read responses, choose the best response)

Never
 25% of the time
 50% of the time
 75% of the time
 Always [**skip to A.3**]

- A.2.1. Not wearing clothing recommendations: Why did you not wear fluorescent or reflective clothing more often? (read one response at a time and ask participant to answer "yes" or "no")

(for those in the **Control** group these responses are possible):

yes no

I was not convinced it would help me be protected from crashing

I wanted to buy some fluorescent or reflective clothing but it was too expensive

I forgot it was recommended to me to wear a reflective/fluorescent vest

I did not know where to buy fluorescent or reflective clothing

I felt my money was best spent elsewhere

I did not like the look or design of the fluorescent or reflective clothing I found

Other

(for those in the **Intervention** group these responses are possible):

yes no

I was not convinced it would help me be protected from crashing

I lost my reflective/fluorescent vest

I forgot to wear my reflective/fluorescent vest

I sold my reflective/fluorescent vest

My reflective/fluorescent vest did not fit well

I did not like the look or design of my reflective/fluorescent vest

Other

A.3. Helmet: Do you currently have a helmet with you that you wear? (verify presence of helmet)

yes [**skip to A.4.**] no

A.3.1. Reason for not wearing: Why did you not start wearing a helmet?
(read one response at a time and ask participant to answer “yes” or “no”)

yes no

I was not convinced it would help me be protected from crashing

I wanted to buy one but it was too expensive

I felt my money was best spent elsewhere

I did not know where to buy one

Other

I did start wearing a helmet but do not have it today

A.4. Helmet use: Since you were first surveyed how often would you typically wear a helmet when driving your motorcycle? (read responses, choose the best response)

Never **[skip to A.5.]**

25% of the time

50% of the time

75% of the time

Always

A.4.1 Color of helmet: What color is your helmet primarily?

white **[skip to A.5.]** black blue

yellow

red orange purple

green

silver/gray other _____ (record color)

A.4.1.1 Reason for not wearing white: Why did you not start wearing a white helmet? (read one response at a time and ask participant to answer “yes” or “no”)

yes no

I did not like the look or design of the white helmets

I was not convinced white color would help me be protected from crashing

I could not find a white helmet in the stores

Other

A.5. Daytime running headlights: Since you were first surveyed, how often would you run your headlights when driving your motorcycle during the daylight hours? (read responses, choose the best response)

Never

25% of the time

50% of the time

75% of the time

Always **[skip to B.1.]**

A.5.1. Not following headlight recommendations: Why did you not start running your headlights during the daylight hours? (read one response at a time and ask participant to answer "yes" or "no")

yes no

I was not convinced it would help me be protected from crashing

It depletes my motorcycle's battery or energy

It costs me extra petrol to run the headlights

It signals to others that I need help or have a problem

Other _____

B. Crash risks:

B.1. Crashes: Since the first survey have you been involved in any motorcycle crashes, such as crashing with another vehicle/motorcycle, crashing with an object, or losing control of the motorcycle on your own and crashing?

yes

no **[skip to B.2.]**

B.1.1. Number of crashes: How many crashes have you had since the first survey?

_____ (number of crashes)

B.1.2. Most recent crash: How long ago was your most recent crash?
_____ (weeks)

B.1.3. Injury: Were you injured in any of your crashes?
 yes no **[skip to B.2.]**

B.1.4. Serious Injury: Tell me about your worst crash since the first survey, did you consider your injury serious? yes

B.1.5. Treatment: Did you seek treatment at a hospital, clinic, or with a healthcare provider for this injury? yes

B.1.6. Injuries sustained: How were you hurt in this injury? (check all that apply, and ask about each item)
 bruises broken bone(s) skin cuts or abrasions head injury
 other

B.2. Near misses: Since the first survey how many times have you almost had a crash but did not?
_____ (number of near misses)

B.3. Speeding: In the past week, how many times have you driven over 20 km/hr above the speed limit? _____ (number of times speeding in past week)

B.4. Traffic tickets: In the past year how many traffic tickets or violations have you had?
_____(number of tickets in past year) **[if number of tickets is 0 skip to B.5.]**

B.4.1. Fines: What was the total amount you had to pay in fines for all of these tickets over the past year?
_____ (amount of fines in Tanzanian shillings)

B.5. Driving license: Do you have a license to drive a motorcycle?
 yes no

B.6. Taxi license: Do you have a license to work as a motorcycle taxi driver?
 yes no

- B.7. Total Salary: How much money do you earn as a motorcycle taxi driver in a typical day **not** subtracting any of your expenses like gasoline or paying the owner of the motorcycle?
 _____ (Tanzanian shillings)
- B.8. Salary: How much money do you earn as a motorcycle taxi driver in a typical day **after** subtracting all of your expenses like gasoline or paying the owner of the motorcycle?
 _____ (Tanzanian shillings)
- B.9. Alcohol: Do you drink alcohol? yes no [**skip to B.10.**]
- B.9.1. Alcohol in past week: In the past 7 days, how many days have you drunk alcohol?
 _____ (number of days in past 7 days)
- B.9.2. Number of drinks: On average, how many alcoholic drinks do you have per day when you drink?
 _____ (number drinks per day)
- B.9.3. Drinking and driving: In the past month, how many days have you had alcohol to drink within 12 hours of starting working as a motorcycle taxi driver?
 _____ (number days in past month)
- B.10. Job Satisfaction: How happy are you with your job working as a motorcycle taxi driver? (read responses)
 very unhappy unhappy neutral
 happy very happy
- B.11. Change: If you could change or improve one thing about your current work, what would that be?

Thank you for completing this survey.

References

1. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012 Dec 15;380(9859):2095-128.
2. Bliss T, Breen J. Implementing the Recommendations of the World Report on Road Traffic Injury Prevention Country Guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects. Washington, D.C: The World Bank Global Road Safety Facility; 2009.
3. Constant A, Lagarde E. Protecting vulnerable road users from injury. *PLoS medicine*. 2010 Mar;7(3):e1000228.
4. Salifu M, Ackaah W. Under-reporting of road traffic crash data in Ghana. *International journal of injury control and safety promotion*. 2012;19(4):331-9.
5. Naci H, Chisholm D, Baker TD. Distribution of road traffic deaths by road user group: a global comparison. *Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention*. 2009 Feb;15(1):55-9.
6. Labinjo M, Juillard C, Kobusingye OC, Hyder AA. The burden of road traffic injuries in Nigeria: results of a population-based survey. *Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention*. 2009 Jun;15(3):157-62.
7. Kumar A, Barrett F. Stuck in Traffic: Urban Transport in Africa. *Africa Infrastructure Country Diagnostic*. Washington, D.C.: The World Bank; 2008.
8. Casey ER, Muro F, Thielman NM, Maya E, Ossmann EW, Hocker MB, et al. Analysis of traumatic injuries presenting to a referral hospital emergency department in Moshi, Tanzania. *International journal of emergency medicine*. 2012;5(1):28.
9. Wells S, Mullin B, Norton R, Langley J, Connor J, Lay-Yee R, et al. Motorcycle rider conspicuity and crash related injury: case-control study. *BMJ*. 2004 Apr 10;328(7444):857.
10. De Allegri M, Marschall P, Flessa S, Tiendrebeogo J, Kouyate B, Jahn A, et al. Comparative cost analysis of insecticide-treated net delivery strategies: sales supported by social marketing and free distribution through antenatal care. *Health policy and planning*. 2010 Jan;25(1):28-38.

11. Becker-Dreps SI, Biddle AK, Pettifor A, Musuamba G, Imbie DN, Meshnick S, et al. Cost-effectiveness of adding bed net distribution for malaria prevention to antenatal services in Kinshasa, Democratic Republic of the Congo. *The American journal of tropical medicine and hygiene*. 2009 Sep;81(3):496-502.
12. Beer N, Ali AS, de Savigny D, Al-Mafazy AW, Ramsan M, Abass AK, et al. System effectiveness of a targeted free mass distribution of long lasting insecticidal nets in Zanzibar, Tanzania. *Malaria journal*. 2010;9:173.
13. United Republic of Tanzania 2012 Population and Housing Census. Dar Es Salaam, Tanzania: National Bureau of Statistics. The United Republic of Tanzania. Ministry of Finance; 2013.
14. London, UK Sealed Envelope Ltd; 2013 [updated 2013; cited 2013 Jan 2]; Available from: sealedenvelope.com.
15. Sedgwick P. The Hawthorne Effect. *BMJ*. 2012 Jan 4;344:d8262.
16. Currency Converter. OANDA Corporation; 2013 [updated 2013; cited 2013 Sep 28]; Available from: oanda.com.
17. Swaddiwudhipong W, Boonmak C, Nguntra P, Mahasakpan P. Effect of motorcycle rider education on changes in risk behaviours and motorcycle-related injuries in rural Thailand. *Tropical medicine & international health*. 1998 Oct;3(10):767-70.
18. Bachani AM, Tran NT, Sann S, Ballesteros MF, Gnim C, Ou A, et al. Helmet use among motorcyclists in Cambodia: a survey of use, knowledge, attitudes, and practices. *Traffic injury prevention*. 2012;13 Suppl 1:31-6.
19. Hung DV, Stevenson MR, Ivers RQ. Prevalence of helmet use among motorcycle riders in Vietnam. *Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention*. 2006 Dec;12(6):409-13.
20. Mock C, Quansah R, Krishnan R, Arreola-Risa C, Rivara F. Strengthening the prevention and care of injuries worldwide. *Lancet*. 2004 Jun 26;363(9427):2172-9.
21. Jiwattanakulpaisarn P, Kanitpong K, Ponboon S, Boontob N, Aniwattakulchai P, Samranjit S. Does law enforcement awareness affect motorcycle helmet use? Evidence from urban cities in Thailand. *Global health promotion*. 2013 Sep;20(3):14-24.