Functional status, pain and return to work of injured motorcyclists involved in a motorcycle crash over one-year post-injury in Vietnam

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Abstract

Objective: This study aimed to determine changes in functional status, pain, and return to work/study (RTW/study) over 12 months post-injury in motorcyclists admitted to a large hospital in Ho Chi Minh City (HCMC), Vietnam.

Methods: A prospective study was undertaken with adult motorcyclists who were injured due to a crash and were admitted to hospital for more than 24 hours. Pain and functional status data were collected at baseline (time of injury), and follow-up at 6 and 12 months post-injury. RTW/study was collected at 6 and 12 months post-injury. Multilevel mixed models and multiple logistic regression models were used to determine the changes in outcomes and predictors of outcomes including age, sex, education, Injury Severity Score, length of stay in the hospital and health-related quality of life.

Results: A total of 352 hospitalised motorcyclists were followed-up. The proportion of motorcyclist RTW/study was 60% (n=165) at 6 months and 82% (n=210) at 12 months post-injury. After adjusting for covariates, pain scores improved significantly at 6 months (β=-3.31, 95% CI: -3.61, -3.01) and 12 months post-injury (β=-3.62, 95% CI: -3.92, -3.32) compared to baseline. Functional status increased significantly by 2.89 points (95% CI: 2.64, 3.13) at 6 months and by 3.51 points (95% CI: 3.27, 3.75) at 12 months compared to baseline.

Conclusions: The study found improvements in outcomes over the study period, although there was ongoing disability at 12 months post-injury (18% had not RTW/study). This study provides further evidence on the burden of motorcycle injuries in Vietnam and priorities for research, and further informs treatment and rehabilitation service planning.

Keywords: long-term outcomes, motorcycle injuries, functional status, pain, return to work, motorcycle crashes, Vietnam

Highlights

- Return to work/study of injured motorcyclists in Vietnam at 6 and 12 months months post-injury is low (60%)
- Despite significant improvement in pain and functional status of injured motorcyclists over 12 months post-injury, injured motorcycle continued to experience chronic pain and functional limitation at 12 months post-injury.
- Lower education, older age, longer length of stay in the hospital and worse health-related quality of life are significantly associated with reduction in functional status, pain, and return to work/study over 12 months post-injury.
- Injury management programs including early access and low cost rehabilitation services should be established in Vietnam to support motorcycle crash patients after discharge.

Introduction

Road injuries and fatalities are a global public health issue with more than 50 million injured persons and 1.35 million killed every year [1]. Improvements in trauma care have led to an increased likelihood of survival after road injuries [2]. As a result, a greater emphasis has been placed on investigating the disabilities associated with road crash injuries to improve quality of survival and reduce the burden of non-fatal injury [3, 4]. Previous research assessing long-term outcomes post road traffic injury found that a high proportion of trauma survivors experience chronic pain and long-term reduction in work capacity and functional status [5-8]. Most of these studies have focused on the long-term outcomes (from 6 months to 3 years post-injury) of road crashes involving all road users in high-income countries (HICs), rather than focusing on motorcycle crashes in a low and middle income setting.

Motorcycle injuries are a major public health issue in many low-and middle-income countries (LMICs) as they comprise up to 70% of road traffic fatalities [9]. According to World Health Organization (WHO), for every person that dies in a road traffic crash, at least 20 others sustain non-fatal injuries, often resulting in long-term disability [9]. In Vietnam, motorcycles accounted for approximately 95% of the nearly 50 million motorised vehicles in 2017 and motorcycle injuries constituted two-thirds of road traffic injuries and fatalities [10].

Currently, there is little evidence about long-term outcomes, such as chronic pain, reduced function and return to work for motorcyclists involved in a crash with available data mainly coming from HICs [11-13]. A prospective study that followed-up 45 injured motorcyclists in Florida, United States found that at 12 months post-injury, one in five motorcyclists were still experiencing pain, with 86% of the study participants able to return to work [11]. A prospective cohort of 212 motorcyclists in Australia found that more than half of the injured motorcyclists were still experiencing pain, and 13% had not returned to their pre-crash work role six months post-crash [13]. There has been no investigations into the long-term effects of motorcycle-related injuries in LMICs, including Vietnam.

Determining long-term outcomes of motorcycle injuries in Vietnam is important as it informs the burden of injury to society, the effectiveness of systems of care for the injured, and research priorities. Therefore, this study aimed to determine changes in pain, functional status, and return to work/study over 12 months post-injury for motorcyclists admitted to a

large hospital in Ho Chi Minh City (HCMC), Vietnam following a motorcycle crash. This study was approved by the Human Research Ethics Committees at Curtin University, the University of Medicine and Pharmacy at HCMC and the Gia Dinh Hospital.

Methodology

Study design and setting

A prospective cohort study was undertaken with patients admitted to the Gia Dinh hospital, one of the largest trauma hospitals in southern Vietnam, located in Binh Thanh district of HCMC.

Participants

Eligible participants were: motorcyclists aged 18 years and over on admission; admitted to hospital for a period of at least 24 hours due to a motorcycle crash between 1 June 2017 and 31 January 2018. Participants were excluded if they were transferred to other hospitals; diagnosed with cognitive impairment due to the crash (assessed by physicians); in a severe physical condition (e.g., serious traumatic brain injury or spinal cord injury); unable to provide informed consent; had no memory of the crash; could not speak Vietnamese; or the researcher was unable to make contact with the patient at the hospital and at home (e.g., telephone calls not answered after discharge , or not correct address), and asleep when visited at the hospital.

Data collection

The researcher identified eligible participants through Emergency Department (ED) admission lists. The researcher entered the potential participant's hospital room, explained the study procedures and invited them to participate. If the eligible participants consented to participate, written informed consent was obtained. Those discharged from hospital before being approached were contacted by telephone within one week of discharge. Collection of baseline data from researcher-administered questionnaires took approximately 20 minutes.

Six and 12 months post-injury, the participants were contacted by telephone. If participants indicated they preferred face-to-face interviews at the initial interview, the researcher visited their home. Participants were considered lost to follow-up at 6 and 12 months when one of

the following criteria applied: participants stated that they did not wish to complete the study; or participants did not respond to five ~~consecutive~~ telephone calls over a two-week period.

Assessment and Outcome measures

At the baseline interview, demographic characteristics, and health outcomes including health-related quality of life, pain and functional status were collected. The questionnaires on health outcomes were repeated at the two follow-up interviews. Length of stay in the hospital (LoS) and Injury Severity Score (ISS) were extracted from medical records. A comorbid condition was defined as a previous disease at the time of injury.

Pain intensity was assessed using the Numeric Rating Scale (NRS). Participants were asked to report their level of pain over the past 24 hours from no pain (score=0) to the worst pain imaginable (score=10) [14]. This scale is a valid, reliable and appropriate measure of pain [15]. This scale has been previously used in Asian countries including Vietnam [16].

Functional status was assessed using the Lawton Instrumental Activities of Daily Living scale (LADL) [17], a scale used to measure the changing functional status of a person over time. It includes eight domains of daily activities such as the ability to use a telephone, undertake shopping, food preparation, housekeeping, laundry, manage finances and medications and mode of transportation. A summary score ranges from 0 (low function, dependent) to 8 (high function, independent). The validity and reliability of this instrument has been reported [18] and has been used in a Vietnamese population previously to study home care needs among the elderly [19].

Health-related quality of life was assessed using the 12-item Short Form Health Survey version 2 (SF-12 v2) [20]. It was used to measure physical and mental health across eight health domains: physical functioning, role limitations due to physical problems, bodily pain, general health perception, vitality, social functioning, role limitation due to mental problems and mental health. Each domain was scored from 0 to 100, totalled and reported as the Physical Component Score (PCS) and Mental Component Score (MCS). Higher PCS and MCS scores indicate a better health status.

Return to work or study (RTW/study) data was collected at 6 and 12 months post-injury when the participant reported working (for income) or studying before the injury.

Statistical analysis

Descriptive statistics described demographics, the ISS and LoS. Comparisons of participants' baseline characteristics such as sex, age group, and education between participants who completed the study and those lost to follow up were performed using Chi-square tests. The distribution of ISS and LoS in the hospital were skewed so Mann-Whitney tests were used to compare these variables among participants who completed the study and those lost to follow up.

Potential predictors including sex, age, education, ISS, LoS, comorbidity, previous history of injury, PCS and MCS were selected based on previous studies [11-13]. Univariate tests were conducted to identify variables for inclusion in the final models. If the p-value <0.25 in the univariate analysis, the potential predictors were included in the multivariate regression. Multilevel mixed effects modelling (MLM) was undertaken to analyse the changes in pain score, and functional score over time, and to explore predictors of these outcomes. MLM models are well suited to analysing clustered and longitudinal data. This modelling also allows for the use of unbalanced data [21]. Multiple logistic regression analyses were used to analyse predictors of RTW/study (yes/no) at 6 and 12 months post-injury. Variables were considered significant level if the p-value was <0.05. All statistical analyses were performed using Stata version 15.

Results

Overview of the participants

A total of 378 potential participants were initially identified for inclusion in the study. Twenty-one (5.6%) declined to participate and five (1.3%) could not be contacted following hospital discharge. Of the remaining 352 agreed to participate in the baseline study, representing a response rate of 93.1%. There were no significant differences in age (p=0.723) and sex (p=0.665) between those who participated in the study and those who declined. The mean [standard deviation (SD)] age of the participants was 40.9 (15.3) years and 66.8% (n=235) were male. The median LoS was 7 days, Inter quartile range (IQR) = 4-36. The median ISS was 8.5, IQR = 1-22.

Follow- up and loss to follow-up

A total of 301 (85.5%) participants were followed-up at 6 months, and 286 (81.3%) at 12 months post-injury (Figure 1).There was no significant differences in age, sex, education level, ISS and LoS between participants studied and those lost to follow-up (Table 1).

Insert Figure 1 here

Insert Table 1 here

RTW/study

Of the 352 participants in the study, 318 (90.3%) were working or studying before they were injured. The proportion of participants who were able to RTW/study was 59.6% (n=165) at 6 months, and 81.7% (n=210) at 12 months post-injury.

A multiple logistic regression model found that at 6 months post-injury, there were significantly lower odds of RTW/study for greater length of stay in the hospital (OR=0.95, 95% CI: 0.91-0.98). Those with lower education levels had significantly lower odds of RTW/study (OR=0.51; 95% CI: 0.31, 0.85) after adjusting for covariates (Table 1). At 12 months post-injury there were significantly lower odds of participants RTW/study among those aged between 35 and 54 (OR=0.21; 95% CI: 0.06, 0.72) and with a higher ISS (OR=0.85; 95% CI: 0.77, 0.93). Participants with higher PCS and MCS had significantly higher odds of RTW/study (OR=1.14; 95% CI: 1.09, 1.20 and OR=1.04; 95% CI: 1.00, 1.09, respectively. Comorbidity, previous history of crash were not significantly associated with RTW/study both at 6 and 12 months post-injury.

Insert Table 2 here

Changes in pain and functional status over time

The results of the multilevel mixed model examining change in pain and functional status are summarised in Table 2. Overall, pain and functional status improved at 6 and 12 months post injury. After adjusting for covariates, the model showed that the pain score decreased significantly by 3.31 points (95% CI: -3.61, -3.01) at 6 months and 3.62 points (95% CI: -3.92, -3.32) at 12 months post-injury, indicating less pain compared to immediately following the injury. Compared to males, females experienced more pain (β=0.52, 95% CI: 0.18, 0.87) and participants aged over 55 years had significantly higher pain scores than those aged 18-

34 years (β=0.45, 95% CI: 0.38, 0.89). Participants with higher PCS (β =-0.03, 95% CI:-0.04, -0.02) and MCS (β=-0.02, 95% CI:-0.03, -0.01) had significantly lower pain scores. Comorbidity and previous history of crash were not significantly associated with pain intensity and functional scores.

After adjusting for covariates, participants' functional scores increased by 2.89 points (95% CI: 2.64, 3.13) at 6 months and by 3.51 points (95% CI: 3.27, 3.75) at 12 months post-injury, indicating improved levels of function compared to immediately after the injury. Participants aged over 55 years (β=-0.59, 95% CI: -0.93, -0.24) and with higher ISS (β=-0.05, 95% CI: -0.08, -0.02) had significantly lower functional status scores. Participants with higher PCS (β=0.02, 95% CI: 0.01, 0.03) and MCS (β=0.02, 95% CI: 0.01, -0.03) had significantly higher functional status scores.

Insert Table 3 here

Discussion

This study is one of the few studies exploring changes in pain intensity, functional status and return to work/study of motorcyclists injured in a motorcycle crash. The study is particularly important as it was undertaken in a LMIC in Southeast Asia, a region with the highest number of motorcycle deaths and injuries worldwide [1]. The study revealed that pain and functional status of injured motorcycle riders due to a motorcycle crash improved significantly within 12 months of the injury. However, nearly one in five of those working or studying previously had not RTW/study 12 months post injury. These findings provide insight into the burden of motorcycle injury to the individual and society in Vietnam.

The proportion of participants who RTW/study post-injury was 60% at 6 months, and 82% at 12 months, which is considerably less at 6 months and somewhat less at 12 months compared to previous studies conducted in the HICs of Australia (87% at 6 months post-crash) [13] and the US (86% at 12 months post-injury) [11]. There could be several explanations for the differences, particularly at 6 months. Firstly, participants in HICs may have the financial capacity to access treatment and rehabilitation services [22]. In Vietnam, the health care system is under-resourced [23]. This lack of resources is likely to reduce access to post-injury care and rehabilitation services, potentially hindering recovery. While 77% of Vietnamese people have health insurance, this does not cover motor vehicle injuries when a positive

blood alcohol concentration (BAC) is found [24]. The baseline data collection in this study revealed that 19% of those tested for BAC were over the legal limit but due to a large amount of missing data, this variable did not include in the models [25]. Secondly, the study in Australia included motorcycle riders who were not admitted to hospital, so were less seriously injured and were probably more likely to return to work sooner [13].

Few studies have assessed the changes in functional status outcomes of injured motorcycle riders up to 12 months post injury [12, 26]. The findings of a study by Papadakaki et al. [12] reported no change in physical function between 6 and 12 months post-injury but better physical function compared to the time of injury. In contrast, in this study, physical function improved significantly up to 12 months post-injury. Notably, previous studies were conducted in HICs where motorcycles have larger engine capacities (>250cc) and are primarily used for recreation or sport while the majority of motorcycle in LMICs likes Vietnam are light motorcycles with cylinder capacities between 50cc to 250cc and are mainly used for the daily commute [27, 28]. These differences could partly explain differences in injury severity and recovery after injury of motorcyle riders who are involved in a motorcycle crash between HICs and LMICs. Differences in tools assessing functional status across studies may lead to differences in the findings across studies. However, the finding of the present study is concur with previuos study that measured physical functional status using the short form 12 among the injured motorclists in Vietnam (accepted but not yet published article).

In this study, participants with lower education levels and a longer length of stay in the hospital had lower odds of RTW/study 6 months post injury. This is consistent with other research reporting injured riders with lower educational levels, and those spending a longer time in hospital reporting a delayed RTW/study [29, 30]. This may in part be explained by the less educated having lower incomes and being employed in physically demanding jobs, preventing an early RTW. In addition, a lower earning capacity may increase the difficulty in accessing comprehensive and/or expensive treatment, rehabilitation services, and ultimately increasing time to recovery and RTW/study [31]. In contrast, people with a higher education level may be employed in less physically demanding jobs and may have access to more flexible return to work options [32].

Participants aged 35 to 54 years had lower odds of RTW/study compared with younger participants (18-34 years) at 12 months post-injury. A middle-aged person may have more difficulty securing a job when they have recovered from their injury as either employers may have found alternative employees or the physically demanding nature of certain jobs may make finding employment more difficult for older people [33]. Consistent with other research [33-35] this study found lower functional status among those aged over 55 years, and those with a higher ISS. This could be due to natural physical decline related to advancing age, which impacts on recovery time [36]. However, this needs to be investigated further [33].

This study also found that better physical and mental well-being and lower ISS were important predictors of RTW/study at 12 months post injury. It seems plausible that more severe injuries require longer periods of treatment and rehabilitation, thus increasing time to RTW/study [37]. Furthermore, persisting disability due to injury severity has a direct effect on the likelihood of returning to work [32]. The *World Report on Disability* [32] indicated that only 44% of people of working age with disabilities had a job compared to 75% of people without disabilities. Of interest, our study also showed that better physical and mental well-being, measured by the SF-12 were associated with increased improvements in pain over time, which concurs with research showing that an inability to exercise and depressing can exacerbate pain [39]. Overall, better physical and mental well-being are associated with higher functioning over time [33, 35]. This reinforces the need for easy access to cost-neutral or low cost rehabilitation programs as part of the comprehensive discharge plan to improve physical and mental health outcomes [38].

There are few studies examining changes in pain of injured motorcycle riders over a 12 month period [11, 13]. This study found that, although pain improved significantly over study period time, there was residual pain due to motorcycle injuries at 12 months post-injury (about 23%). This suggests the injuries sustained from the motorcycle crash result in long-term morbidity. One suggestion to address this is targeted early interventions, such as pain management to improve long-term outcomes. In addition, as with previous research on road traffic injuries, this study found that older age was associated with higher pain levels compared to those of younger ages [8, 39]. This could be due to a greater susceptibility to pain related to aging [36].

The strengths of this study are that it is a longitudinal study collecting outcomes data at three time points. To our knowledge, no similar studies have followed up injured motorcycle riders in Vietnam or other parts of Southeast Asia. Moreover, this study had a high follow-up rate of more than 80% at each time point. The current study has certain limitations, such as: only mild and moderately injured participants were included in the study because participants needed cognitive capacity to participate. This could lead to an underestimation of the adverse health outcomes related of motorcycle crash injured riders. In addition, the study was not population-based. It was conducted at one large tertiary hospital in a district of HCMC, preventing national generalisability. However, the study provides unique data in an under-reported area of road safety.

Conclusions

This is the first study to examine changes in pain, functional status and RTW/study outcomes of injured motorcycle riders due to a motorcycle crash up to 12 months post-injury in Vietnam or any LMICs. The study demonstrated that these outcomes improved over time but that a substantial proportion of injured motorcycle riders were yet to RTW /study at 12 months post- injury. In addition, being aged 55 years and over, a lower health-related quality of life, lower education level and increasing ISS were significantly associated with poorer health outcomes up to 12 months post motorcycle injury. Failures to RTW/study and poor health outcomes have adverse social and economic consequences for the individual and society. These findings highlight the need for planning and implementing of injury management programs that include early access, low cost rehabilitation services to support motorcycle crash patients after discharge in Vietnam.

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Table

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Table 1. Comparison of Participants follow-up and those lost to follow-up at 12 months post-injury

Variables	**Follow-up (n=286)**	**Lost to follow-up (n=66)**	**p-value**
	n (%)	n (%)	
Sex			
Male	195 (68.2)	30 (60.6)	0.24
Female	91 (31.8)	26 (39.4)	
Age			
18-34	108 (37.8)	28 (42.4)	0.77
35-54	115 (40.2)	24 (36.4)	
55+	63 (22)	14 (21.2)	
Education			
Secondary school and under	128 (44.7)	34 (51.5)	0.32
High school and over	158 (55.3)	32 (48.5)	
	Median [IQR] [c]		
ISS [a]	9 [4-9]	4 [4-9]	0.11 [d]
LOS [b]	7 [4-10]	6 [4-8]	0.18 [d]

[a] ISS: Injury Severity Score

[b] LOS: Length of Stay in hospital (days)

[c] IQR: Inter quartile range

[d] **M**ann-Whitney test

Table 2. Multiple logistic regression for RTW/study among injured motorcyclists at 6 months and 12 months post-injury at HCMC, Vietnam in 2017 and 2018[a]

Variables	**Return to work/study at 6 months post-injury (n=277)**	**Return to work/study at 12 months post-injury (n=257)**
	OR (95% CI)[b]	**OR (95% CI)**
Sex		
Male	Reference	Reference
Female	0.82 (0.47 1.41)	0.90 (0.41 2.02)
Age (years)		
18-34	Reference	Reference
35-54	0.57 (0.32 1.04)	0.21 (0.06 0.72)
55+	0.52 (0.26 1.04)	0.36 (0.12 1.29)
Education		
Secondary school and under	Reference	Reference
High education and over	2.10 (1.23 3.58)	1.01 (0.45 2.28)
Injury Severity Score	0.95 (0.89 1.00)	0.85 (0.77 0.93)
Length of stay in hospital (days)	0.95 (0.91 0.98)	0.96 (0.45 1.20)
SF-12		
Physical Component Score	1.02 (0.99-1.04)	1.14(1.09 1.20)
Mental Component Score	1.01(0.99 1.03)	1.04 (1.00 1.09)

[a] Return to work if working/study prior to injury (n=318)
[b] OR indicates Odds Ratio, 95% CI indicates 95% Confidence Interval

Table 3. Multilevel mixed model of pain and functional status among injured motorcyclists at 6 and 12 months post injury in HCMC, Vietnam in 2017 and 2018

Variables	**Pain score**	**LADL**[a]
Time assessment	**β (95% CI)**[b]	**β (95% CI)**[b]
Baseline	Reference	Reference
6 months post-injury	-3.31 (-3.61, -3.01)	2.89 (2.64, 3.13)
12 months post- injury	-3.62 (-3.92, -3.32)	3.51 (3.27, 3.75)
Sex		
Male	Reference	Reference
Female	0.52 (0.18, 0.87)	0.06 (-0.20, 0.33)
Age		
18-34	Reference	Reference
35-54	0.19 (-0.18, 0.56)	-0.14 (-0.43, 0.15)
55+	0.45 (0.38, 0.89)	-0.59 (-0.93, -0.24)
Education		
Secondary school and under	Reference	Reference
High school and over	-0.20 (-0.52, 0.12)	0.25 (0.21, 0.49)
Injury Severity Score	0.01 (-0.02, 0.06)	-0.05 (-0.08, -0.02)
Length of stay in hospital (days)	0.05 (0.03, 0.08)	-0.02 (-0.04, 0.01)
SF-12		
Physical Component Score	-0.03 (-0.04, -0.02)	0.02 (0.01, 0.03)
Mental Component Score	-0.02 (-0.03, -0.01)	0.02 (0.01, 0.03)

[a]LADL: Lawton Instrumental Activities of Daily Living

[b] **β** indicates coefficient, 95% CI indicates 95% Confidence Interval

Figure

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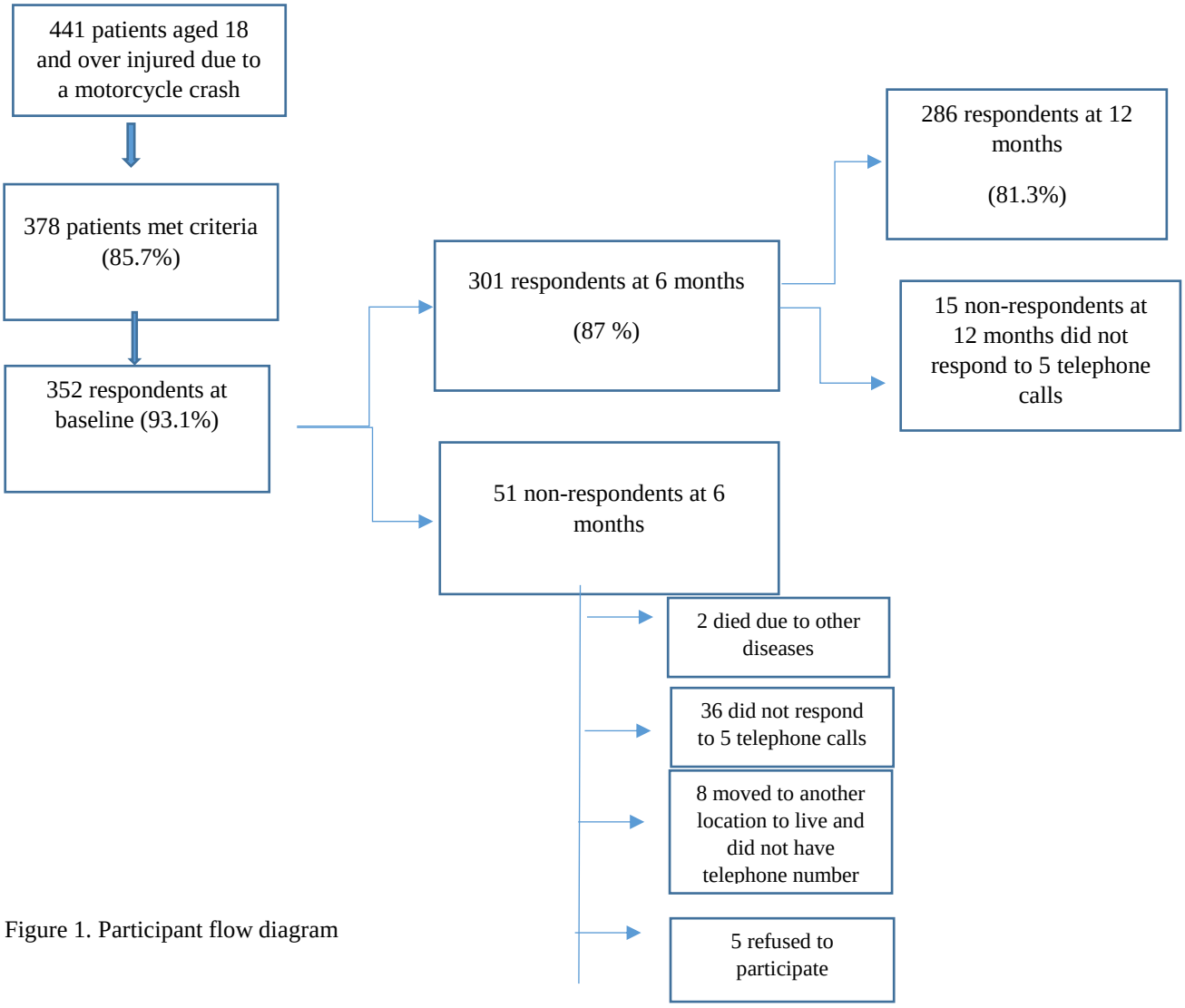

Figure 1. Participant flow diagram

Conflict of interest

The authors declare no conflicts of interest.