

1 **Health-related quality of life in motorcycle crash victims one year after injury: A longitudinal study in**

2 **Ho Chi Minh City, Vietnam**

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14

15 **Abstract**

16 Despite the burden of injury associated with motorcycle crashes and injuries in Vietnam, there are no studies  
17 investigating health-related quality of life following a non-fatal motorcycle crash in this country. Therefore, this  
18 study aimed to evaluate the change of health-related quality of life (HRQoL) pre-injury, and at 6, and 12 months  
19 post-injury motorcycle crash in Ho Chi Minh City, Vietnam. Outcome measures were Physical Component Scores  
20 (PCS) and Mental Component Scores (MCS) of the Short Form 12 version 2 and EQ-5D. Multilevel mixed models  
21 were undertaken. A total of 352 hospitalised motorcyclists were followed-up. Compared to pre-injury, the SF12  
22 PCS reduced by 6.61 points (95% CI: -8.21;-5.03) and 5.12 points (95% CI: -6.74;-3.51) at 12 months post-injury.  
23 MCS also reduced by 4.23 points (95% CI: -5.99;-2.47) at 6 months but increased by 1.29 point (95% CI: -0.49,  
24 3.08) at 12 months post-injury. The EQ-5D VAS score decreased by 10.41 points (95% CI: -11.49, -9.33) at 6  
25 months and 6.48 points (95% CI: -7.58, -5.38) at 12 months post-injury. The HRQoL among injured motorcycle  
26 riders improved between 6 and 12 months after injury but had not returned to the levels before injury.

27 **Keywords:** long-term outcomes, motorcycle injuries, health-related quality of life, motorcycle crashes,  
28 recovery, Vietnam.

29 What We Already Know

- 30 • The fatality rates from motorcycle crashes in Vietnam and low- and middle-income countries (LMICs)  
31 are high.
- 32 • There is a dearth of information about health-related quality of life for motorcyclists involved in crashes  
33 in Vietnam and LMICs.

34 What This Article Adds

- 35 • Health-related quality of life (HRQoL) of injured motorcyclists improved between 6 and 12 months post-  
36 injury.
  - 37 • HRQoL of motorcyclists had not returned to the levels pre-injury at 12 months post-injury.
  - 38 • Gender, increasing age, and length of stay in hospital were significantly associated with HRQoL.
  - 39 • These findings further understanding of the long-term HRQoL outcomes of motorcycle crashes.
- 40 Provides evidence to support better estimates of the burden of motorcycle injuries in Vietnam and other LMICs.

41 **Introduction**

42 Road traffic injuries (RTIs) are recognised as a major public health issue due to their substantial contribution to  
43 the burden of disease. Globally, RTIs are responsible for up to 78 million injuries and 1.35 million fatalities per  
44 year<sup>1,2</sup>. RTIs in low- and middle-income countries (LMICs) also result in significant burden of disease, accounting  
45 for more than 90% of global road traffic deaths<sup>2</sup>. While advances in trauma care have led to an increased likelihood  
46 of survival, the literature indicates that non-fatal RTIs are more likely to lead to long-term disability than  
47 premature death, with the long-term physical and mental health consequences<sup>3</sup>.

48 Health-related quality of life (HRQoL) is an excellent indicator of physical and mental health capturing self-  
49 perceived physical and mental health functioning and their impact on the individual's quality of life<sup>4</sup>. HRQoL has  
50 been found to be an important self-reported health outcome measure among injured people<sup>5</sup>, with previous studies  
51 finding that those injured in non-fatal RTIs report a significant reduction in HRQoL, including long-term  
52 psychological disorders and physical disability<sup>6-8</sup>. However, most of these studies examined all road users, rather  
53 than motorcycle crashes specifically.

54 There is a dearth of information about the long-term health outcomes for motorcyclists involved in crashes, with  
55 a limited number of studies having been conducted in high-income countries. A study based in Greece, Italy and  
56 Germany found that two-wheel users (motorcycles, scooters and bicycles) had residual physical deficits and  
57 psychological problems 12 months post-injury<sup>9</sup>. Studies conducted in United States and Australia, focusing on  
58 the effects of protective equipment including clothing and wearing helmets on health outcomes<sup>10,11</sup>, reported that  
59 over half of injured motorcycle riders continued to experience physical deficits one year after injury<sup>10</sup>. However,  
60 there is no research determining the change in HRQoL before injury and 12 months post-injury in motorcycle  
61 crashes, particularly in LMICs where motorcycles are the primary mode of transport<sup>2</sup>.

62 In many LMICs, the majority of road traffic deaths and injuries are attributed to motorcycle crashes<sup>2,12</sup>. Notably,  
63 motorcycle riders are more vulnerable, suffering more severe injuries than other groups of road users due to the  
64 lack of protective equipment compared to passenger cars<sup>13</sup>. Motorcycle riders are eight times more likely to be  
65 injured and 37 times more likely to die in a crash compared to vehicle occupants.

66 Vietnam is a LMIC located in Southeast Asia where motorcycles are the main mode of transport for commuting.  
67 The number of registered motorcycles has increased more than 20 fold in the last two decades, from 2.3 million  
68 in 2002 to more than 47 million in 2016<sup>14</sup>. The increase in the number of motorcycles in Vietnam has been  
69 accompanied by an increase in the number of motorcycle crashes and injuries, especially in Ho Chi Minh City

70 (HCMC) which has the highest population density and highest number of motorcycles in Vietnam. According to  
71 the World Health Organisation, there were 8,417 road traffic fatalities and 19,280 road traffic injuries in 2016 in  
72 Vietnam, of which 70% were motorcycle crashes<sup>2,14</sup>. HCMC accounted for the highest number of injuries as well  
73 as fatalities related to road traffic in Vietnam with 3,302 cases of injuries and 703 fatalities in 2015<sup>14</sup>. Despite the  
74 burden of injury associated with motorcycle crashes and injuries in Vietnam, there are no studies investigating  
75 health-related quality of life following a non-fatal motorcycle crash in this country. Therefore, this study aimed  
76 to evaluate the change of health-related quality of life before, 6, and 12 months after injury in a motorcycle crash  
77 in HCMC, Vietnam.

## 78 **Materials and Methods**

### 79 *Study design*

80 This is a prospective cohort study in the Gia Dinh hospital, one of the largest trauma hospitals in southern  
81 Vietnam, located in Binh Thanh district of HCMC.

82

### 83 *Participants*

84 Eligible participants were motorcycle riders aged 18 years and over on admission; and admitted to hospital for a  
85 period of at least 24 hours due to a motorcycle crash between 1 June 2017 to 31 January 2018.

86 Participants were excluded if any of the following were present: cognitive impairment due to the crash (physician-  
87 assessed); severe physical condition (e.g., serious traumatic brain injury or spinal cord injury); unable to provide  
88 informed consent; no memory of the crash; transferred to another hospital; did not speak Vietnamese; or the  
89 researcher was unable make contact with the patient at the hospital or at home.

90

### 91 *Data collection*

#### 92 *At baseline:*

93 Eligible participants were identified through Emergency Department (ED) admission lists based on the above  
94 inclusion criteria. The researcher approached eligible participants during their hospital stay, provided a Participant  
95 Information Sheet and consent form and extended an invitation to participate in the study. If eligible participants  
96 were discharged from hospital before being approached, they were contacted by mail for a follow-up telephone

97 interview within one week of discharge. All eligible participants were approached only when their physicians  
98 considered them fit to participate. Interviews did not proceed until written consent was obtained.

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100 *At 6 and 12 months post-injury:*

101 Two weeks prior to the interview, the participants or their relatives were contacted by telephone to remind them  
102 of the study and the purpose of the interview. Patients were considered unavailable for follow-up and excluded at  
103 6 and 12 months when one of the following criteria applied:

- 104 - Participant confirmed no interest in participating in the study;
- 105 - Participant did not respond to five consecutive telephone calls over two weeks.

106

### 107 ***Recruitment***

108 A total of 441 participants admitted to the ED of the Gia Dinh hospital due to a motorcycle crash were reviewed,  
109 with 378 (85.7%) meeting the study's inclusion criteria. All of the eligible injured riders were approached, and  
110 352 (93.1%) agreed to participate in the study. The researcher-administered questionnaire was completed by 330  
111 participants (93.8%) while in hospital, and by the remaining 22 participants (6%) by telephone after discharge. At  
112 6 months follow-up, 51 (14.5%) participants were lost to attrition. At 12 months follow up, 15 (4.3%) participants  
113 were lost to attrition. Data were collected for 286 (81.3%) participants at 12 months post-discharge.

### 114 ***Outcome measures***

115 The collection of baseline data via the researcher-administered questionnaire took approximately 20 minutes to  
116 complete. Follow up data collection occurred at 6 and 12 months post-injury either by telephone or face-to-face  
117 interview, depending on the participant's preference. The interview took approximately 10 to 15 minutes to  
118 complete.

119 Demographic data, including age, sex and education were collected during the baseline interviews. Length of stay  
120 in the hospital (LOS) and Injury Severity Score (ISS) were extracted from medical records at baseline.

121 The evaluation of the HRQoL was undertaken using the Short Form 12 Health Survey version 2 (SF-12 v2) and  
122 the five-level EuroQoL (EQ-5D-5L). These instruments have been translated into Vietnamese and have been used  
123 with the Vietnamese population<sup>15,16</sup>. Participants were questioned about their HRQoL in the month prior to the  
124 crash, at 6 months and 12 months post-injury.

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The SF-12 v2 (referred to as the SF-12 hereafter) comprises 12 questions. The SF-12 is reported as the Physical Component Scores (PCS) and the Mental Component Scores (MCS). Higher PCS and MCS indicate a better health status<sup>17</sup>.

The EQ-5D-5L describes participants' quality of life using five dimensions, namely mobility, self-care, usual activities, pain/comfort and anxiety/distress, and a score for overall self-rated health (Visual Analogue Scale-EQ-VAS)<sup>18</sup>. The EQ-VAS is used to assess self-rated health by using a 100mm scale with the score ranged from 0 (the worst health you can imagine) to 100 (the best health you can imagine)<sup>18</sup>. According to the EQ-5D-5L user guide, the EQ-5D-5L dimension can be categorised into either: no problems (level 1); and problems (levels 2 to 5)<sup>19</sup>.

### ***Statistical analysis***

Descriptive statistics were undertaken on demographic factors and HRQoL scores at baseline, 6 and 12 months post-injury. Chi-square tests and Mann-Whitney U tests were used to compare the age, gender and education of participants who completed the study and those lost to follow up. Wilcoxon pair tests were used to compare change in PCS, and MCS of the SF-12 and EQ-VAS scores relative to the previous time point.

Multilevel mixed effects regression models were undertaken to analyse the change in outcomes over time, and to explore predictors of these outcomes. We specified a two-level random coefficients model to account for the repeated measures of outcome (level 1) nested within different individuals (level 2). Each variable was added to the base model as a fixed effect to explain HRQoL variance between individuals and the change in such variables within each person over time. Explanatory variables included in the model at level 2 were age group, gender, ISS, LOS. Stata version 15 was used for the analyses.

### ***Ethics Approvals***

This study was approved by Curtin University (HRE2017-0010), the University of Medicine and Pharmacy at HCMC (UMP-40) and The Gia Dinh Hospital (KHTH-QLTSSL-04).

154 **Results**

155 *Overview of the participants*

156 Table 1 presents characteristics of participants at baseline, 6 and 12 months after motorcycle injury in HCMC. At  
157 baseline, the majority of participants were male (n=235, 66.8%). The largest number of injured motorcycle riders  
158 were aged 35 to 54 years (n=139, 39.5%), and one-third of participants (n=116, 33.0%) had vocational training or  
159 university degree. There were no statistically significant differences in gender, age group, and education over the  
160 three time points.

161 A total of 301 (85.5%) participants were followed up at 6 months post-injury, and 286 (81.3%) at 12 months post-  
162 injury. There were no significant differences in age, gender, education, ISS and LOS between participants studied  
163 and those lost to follow-up.

164 **Insert Table 1 here**

165 *Change in HRQoL scores of the study population relative to previous time point*

166 Changes in the mean PCS, MCS, EQ-VAS scores, and EQ domains are summarised in Table 2. The results of SF-  
167 12 indicated a significant decline in the mean PCS at 6 months (p<0.001), and at 12 months post-injury (p=0.03)  
168 compared to pre-injury. The mean MCS significantly decreased at 6 months post-injury compared with before  
169 injury (p<0.001). There was a non-significant increase in the MCS between pre-injury and 12 months post-injury  
170 (p=0.055).

171 There was a significant decline in the mean EQ-VAS scores at 6 (p<0.001) and 12 months (p<0.001) post-injury  
172 compared to pre-injury (Table 2). All dimensions of the EQ-5D showed significant improvement between 6 and  
173 12 months post-injury, except for the pain/discomfort dimension. However, none returned to pre-injury status.  
174 Before injury, pain/discomfort (n=90, 25.6%) was the dimension reported as causing problems in the highest  
175 proportion of participants, followed by anxiety/depression (n=86, 24.4%). At 6 months post-injury,  
176 pain/discomfort was still the dimension reported as problematic by the highest proportion of participants,  
177 increasing to 56.5% (n=170) of participants. Although the pain/discomfort dimension improved between 6 and 12  
178 months post-injury, this improvement was not significant (p=0.194). Anxiety/depression improved significantly  
179 by 7% between 6 and 12 months post-injury (p=0.025).

180 **Insert Table 2 here**



181 *Change in HRQoL scores of study population over time*

182 The results of the multilevel modelling examining the change in HRQoL scores over time are presented in Table  
183 3. After adjusting for covariates, the model analysing changes in HRQoL over time using the SF12 revealed that,  
184 compared to pre-injury, participants' PCS reduced significantly by 6.61 points (95% CI: -8.21, -5.03 ) at 6 months  
185 and by 5.12 points (95% CI: -6.74, -3.51) at 12 months post-injury. In addition, the MCS decreased significantly  
186 by 4.23 (CI: -5.99, -2.47) at 6 months post-injury, compared with before the motorcycle crash. The MCS increased  
187 by 1.29 points at 12 months but this increase was not statistically significant. Females had significantly lower PCS  
188 ( $\beta$ =-3.61; 95% CI: -5.16, -2.06) and MCS ( $\beta$ =-1.60; 95% CI: -3.56, -0.35) compared to males over time. Being  
189 aged over 55 years was associated with lower PCS ( $\beta$ =-9.38; 95% CI: -11.32, -7.44) and MCS ( $\beta$ =-2.92; 95% CI:  
190 -5.37, -0.46) compared to being aged between 18 and 34 years.

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192 The results of the mixed model modelling changes in the HRQoL using the EQ-5D indicated that the EQ-VAS  
193 score reduced significantly by 10.41 (95% CI: -11.49, -9.33) at 6 months and 6.48 (95%CI: -7.58, -5.38) at 12  
194 months post-injury, compared to pre-injury. After adjusting for covariates, females had significantly lower EQ-  
195 VAS scores ( $\beta$ =-2.87; 95% CI: -4.30, -4.15) compared to males over time. Being aged between 35 to 54 years  
196 ( $\beta$ =-6.7; 95% CI: -8.24, -5.18), and over 55 years ( $\beta$ =-14.10; 95% CI: -15.89, -12.31) were associated with lower  
197 EQ-VAS compared to the 18 to 34 year old age group.

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**Insert Table 3 here**

199 **Discussion**

200 This is the first longitudinal study to assess the change in health-related quality of life (HRQoL) of injured  
201 motorcycle riders due to a motorcycle crash from pre-injury to 12 months post-injury in Vietnam. The results  
202 found HRQoL scores increased between 6 and 12 months post-injury but they did not return to the baseline scores  
203 at the 12 month follow-up. Factors significantly associated with HRQoL were older age, gender, and length of  
204 stay in the hospital. Although there are no studies investigating the change in HRQoL over 12 months after  
205 motorcycle injury, limiting comparisons of the findings to other studies, the findings of this study were consistent  
206 with other studies that have found a reduction in HRQoL following a RTI<sup>3,20</sup>.

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208 This study found that motorcycle riders involved in a motorcycle crash experienced a significant decrease in the  
209 PCS at 6 months and 12 months post-injury compared to pre-injury. In contrast, the MCS reduced significantly at

210 6 months post-injury but improved at 12 months post-injury compared to pre-injury. This change over time was  
211 consistent with the findings of previous studies in the United States and European countries reporting changes in  
212 HRQoL over time after a RTI<sup>21-23</sup>. However, the size of the reduction in the PCS of HRQoL in our study was  
213 more pronounced than in the study by Alghnam and colleagues, which only showed a decline of 2.8 in the score  
214 <sup>21</sup>. However, the follow-up in the Alghnam et al. study was longer, up to 18 months, which may have resulted in  
215 a larger improvement of HRQoL due to the additional recovery time<sup>3</sup>. Another possible explanation for this is that  
216 injured patients in high-income countries may have better recovery post-injury due to earlier and better access to  
217 treatment and rehabilitation services<sup>24,25</sup>. In addition, the results of this study suggest motorcycle riders are likely  
218 to suffer more severe injuries than motor vehicle drivers due to the exposure to environmental conditions (such  
219 as wind, gravel and road surface damage) , and the absence of the physical protection provided by the external  
220 body of a motor vehicle<sup>13</sup>.

221

222 In contrast to our study, a recent study of 54 two-wheel users in three European countries of Greece, Italy and  
223 Germany found that reported levels of physical disability did not change between 6 and 12 months post-injury,  
224 although they were significantly higher than at one month post-injury. This study also found that psychological  
225 functioning was not significantly different at one, six and twelve months after injury<sup>9</sup>. These poor health outcomes  
226 may have been due to all participants in this study experiencing severe injury and being admitted to the Intensive  
227 Care Unit while our participants only included those with mild and moderate injuries. Therefore, the recovery of  
228 our participants may have been less protracted.

229 The study found the mean EQ-VAS score reduced significantly within 12 months post-injury compared to pre-  
230 injury, although there was an improvement between 6 and 12 months post-injury. This indicates that injuries from  
231 motorcycle crashes resulted in substantial long-term morbidity, consistent with the findings of previous research<sup>25</sup>.  
232 Furthermore, the changes in the mean EQ-VAS scores in our study support the hypothesis that crash injured  
233 motorcycle riders regain some lost HRQoL but do not achieve the pre-injury health status at 12 months post-injury  
234 <sup>3</sup>. Although there has been no previous research investigating changes in HRQoL using the EQ-5D-5L for injured  
235 motorcycle riders, our findings were consistent with previous studies conducted on populations with unintentional  
236 injuries that assessed the burden of injuries in high-income countries<sup>26,27</sup>. A recent cross-sectional study by Vu et  
237 al.<sup>28</sup> measured HRQoL using EQ-5D-5L among participants involved in road traffic crashes admitted to a hospital  
238 in Vietnam. This study found the EQ-VAS score among participants was 66. Our scores were higher at both 6  
239 months (75.12) and 12 months post-injury (79.96). The differences may be due to participants' HRQoL being

240 assessed at different times. While EQ-VAS score of this study was followed up following 6 and 12 months after  
241 injury, Vu et.al assessed the EQ-VAS score during hospital admission, which could have impact on the lower EQ-  
242 VAS score.

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244 This study found that injured female motorcycle riders had lower scores for both physical and mental health  
245 measures, which is similar to previous studies that have reported that females experience more long-term  
246 impairment and disability following traffic injuries than males<sup>3,27</sup>. However, the reasons for this disparity are  
247 unclear. It should be also noted that the majority of injured motorcycle riders in this study were young males  
248 reporting better outcomes. This study found that physical disability and psychological distress increased  
249 substantially with increasing age and increasing length of stay in the hospital, consistent with other studies on  
250 road traffic injuries in high-income countries<sup>29,30</sup>. This may be attributed to an increase in the healing time of  
251 older people<sup>3,30</sup>. In addition, the length of stay negatively affected interpersonal relationships, work status and  
252 social function, resulting in a HRQoL reduction<sup>6</sup>. Previous studies have found an association between injury  
253 severity and HRQoL<sup>3,27,30</sup>. However, our study did not find the association between ISS and HRQoL. A possible  
254 explanation is that most participants in this study suffered mild and moderate injury. The strengths of the study  
255 include the use of a longitudinal design allowing long-term changes in outcomes and baseline predictors to be  
256 analysed. Secondly, multilevel modelling enabled us to explain variation in outcomes by participant baseline  
257 characteristics, whilst taking into account the longitudinal data structure. However, the current study has a number  
258 of limitations that need to be acknowledged. First, only people with mild and moderate severity injuries were  
259 included in the study. This could lead to underestimation of the adverse physical and adverse psychological  
260 outcomes of those injured in motorcycle crashes. Future studies could include motorcyclists with more severe  
261 injuries and with longer follow-up, such as 24 months. Another limitation was it was not a population-based study.  
262 It was conducted at a single large tertiary hospital in a district of HCMC, potentially limiting citywide or national  
263 generalisability. However, changes in HRQoL in this study are consistent with previous studies on RTIs.

264

## 265 **Conclusions**

266 This is the first study to assess changes in HRQoL in mild and moderate motorcycle crash injured riders following  
267 injury in Vietnam. Twelve months after motorcycle injuries, the HRQoL had not returned to the levels before the  
268 crash. This was particularly noticeable when physical HRQoL was measured. These findings are important for  
269 furthering our understanding of the long-term HRQoL outcomes of motorcycle crashes, providing evidence to

270 support better estimates of the burden of motorcycle injuries in Vietnam and other LMICs and highlights the  
271 importance of screening and treating physical and psychological comorbidities as part of injury management in a  
272 timely manner.

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Table 1. Demographic and injury characteristics of motorcycle riders involving a motorcycle crash at baseline, 6 months and 12 months post-injury at HCMC, Vietnam in 2017 and 2018

Variables	Baseline (n=352)	6 months post-injury (n=301)	12 months post-injury (n=286)
	n (%)	n (%)	n (%)
<b>Gender</b>			
Male	235 (66.8)	206 (68.4)	195 (68.2)
Female	117 (33.2)	95 (31.6)	91 (31.8)
<b>Age</b>			
18-34	136 (38.6)	112 (37.2)	108 (37.8)
35-54	139 (39.5)	124 (41.2)	115 (40.2)
55+	77 (21.9)	65 (21.6)	63 (22)
<b>Education</b>			
No formal/Elementary school	57 (16.2)	49 (16.3)	45 (15.7)
Middle school	105 (29.8)	91 (30.2)	83 (29)
High school	74 (21)	66 (21.9)	62 (21.7)
Vocational/University	116 (33)	95 (31.6)	96 (33.6)
<b>Injury Severity Score</b>			
	7.3 (4.1) <sup>a</sup>	7.4 (4.2)	7.4 (4.0)
	8.5 [4-9] <sup>b</sup>	9 [4-9]	9 [4-9]
<b>Length of stay in hospital</b>			
	8.1 (6.3) <sup>a</sup>	8.3 (6.6)	8.4 (6.6)
	7 [4-10] <sup>b</sup>	7 [4-10]	7 [4-10]

350 <sup>a</sup> mean (SD)

<sup>b</sup> median [Inter Quatile Range]



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Table 2. Change in Health-related Quality of Life of motorcycle riders involving a motorcycle crash relative to previous time point at HCMC, Vietnam in 2017 and 2018

Variables	Pre-injury (n=352)	6 months post- injury (n=301)	12 months post- injury (n=286)	<i>p</i> -value Pre-injury vs 6 months	<i>p</i> -value Pre-injury vs 12 months	<i>p</i> -value 6 vs 12 months
	Mean±SD	Mean±SD	Mean±SD			
<b>SF-12</b>						
PCS <sup>a</sup>	51.78 ±9.71	45.19±13.73	46.62±10.78	0.000	0.000	0.029
MCS <sup>b</sup>	46.83±11.99	42.56±13.94	48.14±11.52	0.000	0.055	0.000
<b>The EQ-5D</b>						
EQ-VAS <sup>c</sup>	85.60±10.99	75.12±12.05	79.96±12.25	0.000	0.000	0.000
<b>EQ-5D domains</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>			
<b>Mobility</b>						
No problems	340 (96.6)	211 (70.1)	219 (76.6)	0.000	0.000	0.000
Problems	12 (3.4)	90 (29.9)	67 (23.4)			
<b>Self-care</b>						
No problems	347 (98.6)	232 (77.1)	242 (84.6)	0.000	0.000	0.015
Problems	5 (1.4)	69 (22.9)	44 (15.4)			
<b>Usual activities</b>						
No problems	325 (92.3)	191 (63.5)	207 (73.4)	0.000	0.000	0.035
Problems	27 (7.7)	110 (36.5)	79 (27.6)			
<b>Pain/discomfort</b>						
No problems	262 (74.4)	131 (43.5)	143 (50.0)	0.000	0.000	0.194
Problems	90 (25.6)	170 (56.5)	143 (50.0)			
<b>Anxiety/depression</b>						
No problems	266 (75.6)	169 (56.2)	185 (64.7)	0.000	0.000	0.025
Problems	86 (24.4)	432 (43.8)	101 (35.5)			

353 <sup>a</sup>PCS: Physical Component Score <sup>b</sup>MCS: Mental Component Score  
354 <sup>c</sup>EQ-VAS: The European Visual Analogue Scale  
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Table 3. Multilevel modeling assessing the change of HRQoL of a sample of hospitalised motorcycle riders involving a motorcycle crash in HCMC, Vietnam in 2017 and 2018

Variables	SF-12		The EQ-5D			
	PCS <sup>a</sup> Coefficient (SE)	95% CI	MCS <sup>b</sup> Coefficient (SE)	95% CI	EQ-VAS <sup>c</sup> Coefficient (SE)	95% CI
<b>Time assessment</b>						
Pre-injury	Ref					
Six months post-injury	-6.61 (0.81)	(-8.21 -5.03)	-4.23 (0.89)	(-5.99 - 2.47)	-10.41 (0.55)	(-11.49 -9.33)
Twelve months post-injury	-5.12 (0.82)	(-6.74 -3.51)	1.29 (0.91)	(-0.49 3.08)	-6.48 (0.56)	(-7.58 -5.38)
<b>Gender</b>						
Male	Ref					
Female	-3.61 (0.79)	(-5.16 -2.06)	-1.60 (0.99)	(-3.56 -0.35)	-2.87 (0.73)	(-4.30 -1.45)
<b>Age</b>						
18-34	Ref					
35-54	-2.26 (0.84)	(-3.91 -0.61)	-1.94 (1.06)	(-3.56 0.35)	-6.70 (0.78)	(-8.24 -5.18)
55+	-9.38 (0.99)	(-11.32 -7.44)	-2.92 (1.25)	(-5.37 -0.46)	-14.10 (0.91)	(-15.89 -12.31)
ISS <sup>d</sup>	-0.11 (0.09)	(-0.29 0.71)	-0.11 (0.16)	(-0.34 0.12)	-0.25 (0.09)	(-0.41 -0.078)
LOS <sup>e</sup>	-0.14 (0.06)	(-0.25 -0.03)	-0.05 (0.07)	(-0.19 0.93)	-0.13(0.05)	(-0.24 -0.021)
<b>Constant</b>	61.5 (1.35)					
<b>Random effect</b>	<b>Estimate</b>	<b>95% CI</b>	<b>Estimate</b>	<b>95% CI</b>	<b>Estimate</b>	<b>95% CI</b>
Between-person effect	5.64 (3.97)	1.41- 22.47	23.82 (5.95)	14.58-38.89	20.34(3.11)	15.07-17.46
Within-person effect	106.14 (6.09)	94.84- 118.78	129.26 (7.42)	115.49 - 144.65	48.6 (2.82)	43.36-54.45

365 <sup>a</sup>PCS: Physical Component Score    <sup>b</sup>MCS: Mental Component Score  
366 <sup>c</sup>EQ-VAS: The European Visual Analogue Scale  
367 <sup>d</sup>ISS: Injury Severity Score                      <sup>e</sup>LOS: Length of Stay in hospital (days)