Quality of life outcomes in a hospitalised sample of road users involved in crashes

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QUALITY OF LIFE OUTCOMES IN A HOSPITALISED SAMPLE OF ROAD USERS INVOLVED IN CRASHES

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ABSTRACT

A follow-up study of road injury survivors admitted to hospital was conducted in the UK. The outcomes of road injury and their impact on quality of life were assessed using the SF-36v2, EQ-5D and CES-D scales. Lower extremity injury predominated (73%) in the study. Furthermore, there was a substantial impact on physical activity, large injury costs and potentially high QALY losses. Analysis of psychological effects found that females had higher levels of depression compared to males. This study identifies the consequences of road injury on individuals, highlighting the effective use of health outcome scales to quantify the quality of life changes over a 1-year period.

ROAD CRASHES ARE SERIOUS EVENTS which often have devastating effects on survivors and their families. Individuals can be affected in many different ways and of particular importance are aspects such as physical impairment, socio-economic implications and mental health issues. There are relatively few studies which have specifically examined the physical and psychological outcomes of road injury and quality of life [Read, Kufera, Dischinger et al. 2004, Mayou and Bryant 2002]. In contrast there are a number of studies that have explored outcomes of 'trauma'; notably the Trauma Recovery Project led by Holbrook (1998, 1999) and more specifically the Lower Extremity Study by Jurkovich, Mock, MacKenzie et al. (1995). These two large studies have used the Quality of Well Being Scale (QWB) and the Sickness Impact Profile (SIP) to examine the outcomes as well as other measures. Read et al. (2004) used the SF-36 to determine the outcomes of road crash injury. The SF-36 is a widely used generic health outcome measure assessing the impact of health across 8 dimensions measuring general, physical and mental health [Ware, Kosinski and Dewey 2002]. Its strength is to provide an overall profile of the impact of health but it does not generate utility weights to assess the impact of health on societal burden. In addition to and
independent of the health outcome measure used it is obvious that trauma including road trauma has an effect on physical and psychological well being, but how these effects translate into everyday life has not been widely considered.

A series of studies have been undertaken to examine the outcomes of injury for varying injury severities in road crash survivors (Barnes 2006). The purpose of this specific study was to examine the outcomes of 'serious' injury sustained in road trauma in the UK and explore the effects on everyday life. Therefore the objectives of this study were as follows;

- To follow-up a group of road crash survivors for one year and assess the effects of injury outcomes on everyday life.
- To use existing health outcome measures and in-depth interviews to assess outcomes of road crash injury.
- To estimate the societal burden of road injury as a measure of quality of life and economic costs.

METHOD

To enable access to seriously injured road crash survivors immediately after their crash it was deemed necessary to recruit participants whilst they were an inpatient in hospital. Appropriate permission channels were followed and permission sought from all of the Orthopaedic Consultants at two trauma hospitals in the East Midlands of the UK and relevant applications to Local Research and Ethics Committees were made and approved to conduct this study.

Inclusion of subjects was based on the following criteria;

- The subject had been admitted following an injury sustained in a road traffic crash.
- The subject was aged between 18 and 70 years.
- The subject was conversant in English and had access to a telephone for follow-up interviews.

Due to the exploratory nature of the study no restriction was made on body region or severity of injury sustained. All subjects were admitted under the trauma team and the trauma co-ordinator informed of any RTA admissions, thus those subjects not necessarily with an orthopaedic injury were still identifiable through the trauma co-ordinators and approached for inclusion in the study. Admission details were obtained from the trauma co-ordinators and approaches to the patients on the ward were made through the nurse in charge. The study was explained to the subjects and a letter from the Heads of Trauma Services was given to the patients to introduce the research investigator. Informed consent was obtained and interviews took place at the participants' bed side and then at 3, 6 and 12 months post injury. Each interview lasted approximately 40 minutes and had several components.
a) a study questionnaire to obtain demographic details, health information, social and occupational details as well as the crash details;
b) an assessment of the impact of injury on general health (SF-36v2);
c) a second assessment of injury impact to obtain utility scores (EQ-5D) [Brooks, 1996];
d) an assessment of depression (CES-D) [Radloff, 1977].

The SF-36v2 assesses health across 8 dimensions namely, general health, physical role and functioning, social functioning, bodily pain, mental health, vitality and emotional role. The assessment incorporates the previous 4 weeks and not just a one off assessment. Scores are generated for each dimension ranging between 0-100 which are then used to generate two component scores, namely the physical component and mental component scores (PCS and MCS respectively).

The EQ-5D assesses health in 5 domains; mobility, self care, usual activity, pain, and anxiety and depression. For the purposes of this study cognition was added as a sixth dimension, which is only presented in the profile obtained and not used for deriving utility scores. Each domain has 3 levels of assessment;
1 = no problems
2 = some or moderate problems
3 = severe or extreme problems.

For example a profile score of 11233(1) would indicate that a person had no problems with mobility, no problems with self care, some problems with usual activities, extreme pain and extreme anxiety or depression and (no problems with cognition).

The benefit of using a utility measure enables the impact of road injury on societal burden to be assessed using quality adjusted life years (QALYs). QALYs have two basic components that of the quantity and quality of life, with quality being calculated from utility measures. A QALY is where one year of perfect health-life expectancy is worth 1, but one year of less than perfect life expectancy is worth less than 1. To generate the level of less than perfect life the utility score from such measures as the EQ-5D are used, thus a QALY = (1 - utility score). The QALYs are used to quantify the injury outcomes for this sample.

The CES-D includes a series of 20 questions asking about feelings and behaviour over the previous week, returning a score indicating the level of depression. Scores range between 0 and 60 with scores of 16 indicative of depression.

These outcome measures were selected as they were standard measures, concise, easy to administer and have been shown to be reliable and valid instruments in the medical literature (Jenkinson, Coulter and Wright (1993), Brazier, Jones
and Kind (1993), Roberts, Rhoades and Vernon (1990). Additional information was obtained from the medical notes to obtain a detailed description of the injuries sustained and any treatment. The injuries were coded to the Abbreviated Injury Scale (AIS 98) [AAAM 1998] and maximum AIS (MAIS) and injury severity scores (ISS) were calculated for each participant.

The data were analysed using descriptive statistics and non-parametric statistics of Wilcoxon's rank-sum test for skewed continuous data and Friedman analysis of variance for ranks. Due to the exploratory nature of this study a probability level below 0.05 was considered statistically significant (p ≤ 0.05). These statistical analyses addressed the following research questions;

1. What if any effect does the injury have on quality of life in a road injury population as measured by the health dimensions in health outcome measures.
2. Do those affected by road injury have a worse quality of life compared to existing population norms.
3. What if any effect does quality of life following road injury have on normal everyday activity.

RESULTS

Results for those subjects with complete data are presented below (n=38). The main characteristics of the sample are presented in table 1. The mean age was 37 years (range, 18-68) and 79% were male. All had senior school education at least to 16 years of age, 17 had attended college and 2 university.

Table 1 - Participant characteristics

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>30</td>
<td>79%</td>
</tr>
<tr>
<td>White</td>
<td>38</td>
<td>100%</td>
</tr>
<tr>
<td>Married</td>
<td>18</td>
<td>47%</td>
</tr>
<tr>
<td>Full time employment</td>
<td>25</td>
<td>66%</td>
</tr>
<tr>
<td>Pre injury medical condition</td>
<td>12</td>
<td>32%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior school (high school)</td>
<td>38</td>
<td>100%</td>
</tr>
<tr>
<td>College education</td>
<td>17</td>
<td>45%</td>
</tr>
<tr>
<td>University education</td>
<td>2</td>
<td>5%</td>
</tr>
</tbody>
</table>

Sixty six percent (n=25) of the participants were working full time prior to their crash of which 4 participants had not returned to any level of employment at 12 months. The remaining 34% worked part-time (n=2), were students (n=2), unemployed (n=5), retired (n=3) or were fulltime house makers.
prior to the crash. Of these the house maker was unable to perform her role; a further 2 had become unemployed as a result of their injuries. The median wage at baseline was between £16,000 and £20,999. This remained the same at 12 months however, 6 participants were not earning a wage at 12 months and a further 2 were on substantially less wages due to loss of commission or overtime payments. Six subjects were receiving incapacity benefit at 12 months to compensate for being unable to work due to their injuries.

Thirty two percent of the participants had a pre-injury medical condition the most common being asthma (n=3), depression (n=4) and epilepsy (n=2). Medication pre-injury was taken by 10 participants but only 1 person with a history of depression was on any medication at baseline. No participants reported having a physical or sensory impairment pre injury.

The crash characteristics are presented in table 2, with the majority of participants considered to be vulnerable road users (motorcycle driver, pillion passenger, cyclists and pedestrians). Of these 34% (n=13) considered they were at fault for the crash.

<table>
<thead>
<tr>
<th>Road user</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car Driver</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>Front seat passenger</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Motorcycle driver</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td>Motorcycle pillion-passenger</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Cyclist</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>8</td>
<td>21</td>
</tr>
</tbody>
</table>

The number of injuries sustained by this sample was 195 in total with a mean number of 5 injuries per person (range, 1-12). Injuries were categorised into the single main injury per participant based on the highest AIS severity. Where more than one injury had the same AIS severity the most 'problematic' injury, as defined by the participant, was considered the 'main' injury. The majority of the main injuries sustained were to the lower extremity (73%), table 3.

<table>
<thead>
<tr>
<th>Body region</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Thorax</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Pelvis</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>22</td>
<td>58</td>
</tr>
<tr>
<td>Spine</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

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The median MAIS was 3, (range 1-5) with a mean ISS of 13 (range 1-57), figure 1. The mean length of stay in hospital was 16 days, (range 1-81 days), with all participants eventually discharged home.

![Figure 1 - Distribution of MAIS scores](image)

**IMPAIRMENT** - At 12 months 18% of the sample (n=7) required the assistance of a walking aid. These included walking sticks (n=3), crutches (n=4) with some having a second aid such as a walking stick and / or crutches; 1 person still required the use of a wheelchair. Eighty four percent of the sample (n=32) required physiotherapy after discharge from hospital with 26% (n=10) still receiving therapy at 12 months. One participant at 12 months had been admitted to a rehabilitation unit for intensive therapy on an arm injury and anger management. He had received a head injury in the crash which had resulted in rapid mood swings resulting in work referring him for therapy. All subjects at baseline reported some degree of pain and at 12 months 63% (24) still reported having pain with 18% of these requiring regular analgesics.

**COMPENSATION** - At 12 months, 61% (n=23) were involved in compensation claims or court cases. One participant at 12 months had been paid £40,000 to complete a personal injury claim in an out-of-court settlement, he had received fractures to his femur, patella and fibula. A further 5 participants had received interim payments by 12 months ranging between £2000 and £10,000. The slow process of compensation was reported by many participants even when it was considered they were not at fault and their injuries were impairing. The main hold up in the process was the medical examination which usually occurred at 6 months but for many, a second medical was required at 1 year to ascertain the problems and to determine the level of impairment at this point.
All participants were asked whether the crash had left them with any financial burden for which they had not been compensated by insurance or compensation monies. Seventy six percent of the sample (n=29) stated they were still experiencing financial burden at 12 months. The mean loss was £5,712 (median £4,320) with a range between £300 and £17,600. On the whole these losses were as a result of loss of earnings, vehicle replacement and insurance losses.

IMPACT OF INJURY ON GENERAL HEALTH - The SF-36v2 was used to obtain a profile across 8 dimensions to assess the impact of injury. From figure 2 it can be seen that the health dimensions were lower at baseline compared to the UK population norms for physical functioning, role physical, bodily pain and social functioning. At 12 months all but the role emotional and vitality were below the UK population norms.

![Figure 2 - The SF-36v2 Health Dimension Scores](image)

PF-physical functioning; RP-role physical; BP-bodily pain; GH-general health; VT-vitality; SF-social functioning; RE-role emotional; MH-mental health

The 8 health dimensions on the SF-36 can be divided into two principal components those of mental health and physical health (mental component score, MCS, and physical component score, PCS). These are transformed normalised scores with a mean of 50 and standard deviation of 10. The PCS and MCS are presented in figure 3 and reflect the changes in the physical and mental health of the participants over the follow-up period. It can be seen that the mental health of this sample only dropped marginally below the norm at 3 months but for the PCS the norm was not achieved at any follow-up period. The Friedman analysis of variance by ranks was significant for the PCS score for all but the baseline to 12 month scores (p≤0.001).

It can further be seen that the PCS distinguishes between MAIS 2+ injuries, with worse PCS associated with higher MAIS injuries (figure 4).
The EQ-5D health dimensions in figure 5 show the difference between the baseline and 12 month assessment on this measure. At baseline the majority of this sample had severe problems with mobility and performing usual activities with at least half of the sample experiencing some level of problem in all of the domains apart from cognition. From figure 5 it can be seen that the baseline assessments on the EQ-5D appear worse than the assessment obtained from using the SF-36v2 (figure 3). The difference between the health outcome measures is noticeable at baseline because the EQ-5D assesses 'that day only' unlike the SF-36 which incorporates the previous 4 weeks in the assessment. Thus at baseline the SF-36 has an element of 'pre-injury' health assessment.
The benefit of using the EQ-5D is its ability to derive utility scores from the overall profile scores. At baseline the utility scores were low which was directly related to the high number of severe or extreme problems experienced by this sample at baseline (figure 6). The utility scores at all follow-up periods were significantly lower for this injured sample than the UK population norms for an age and gender matched sample (Kind, Dolan, Gudex et al. 1998) ($p=0.001$, Wilcoxon rank sum test). By 12 months there was an improvement in health status although for activities and pain, over half of the sample still recorded problems in those domains.

DEPRESSION - Depression was assessed using the CES-D where scores above 16 indicate depression. At baseline 32% of the sample were rated as depressed which had declined to 26% at 12 months (figure 7). It was noticeable that females had higher levels of depression compared to males at all follow-up periods;
however, there were only 8 females in total compared to 30 males of which 2 had a history of depression prior to their injury.

![Figure 7 - Percentage Depression by Gender](image)

RECOVERY - At 12 months 58% of the sample stated they had not recovered fully from the crash with the main reasons being pain, problems with healing and secondary health problems and loss of hobbies / activities; 10% stated they had almost recovered and 32% stated they had fully recovered.

BURDEN OF INJURY - Using the EQ-5D population norm of 0.93 the Quality Adjusted Life Year (QALY) losses for this sample were 0.21 at 12 months (i.e. 0.93 - 0.72 = 0.21). Arbitrarily assuming that the average life span is 80 years then it could be hypothesised that this sample group will lose 9 years of full quality of life; where the life expectancy is 43 years (i.e. average life span - mean age (80-37 = 43) and the QALY loss at 12 months is 0.21(43 x 0.21 = 9). This does not appear to be a large portion but this is only for a sample of 38 people. Serious casualty crashes in the UK amounted to 31130 [Department of Health 2005] in 2004 and assuming a mean QALY loss of .21 a total of 6537 QALY years would be lost. Whilst this is somewhat theoretical, it illustrates the impact of road injury on society generated from a subjective measure.

DISCUSSION

There are very few studies which examine the specific outcomes of road injury in the UK from the victims' perspective. This study has effectively used a combination of quantitative and qualitative data methods to assess outcomes in a specific road injury sample. The in-depth interviews add interpretative value to the quantitative data obtained from the health outcome measures. The following discussion incorporates the data from health outcomes measures and the interviews. This study looked at applying standard health outcome measures to a sample of
hospitalised road injury survivors to determine the outcomes of injury and their effects on quality of life.

Of note for this sample was the effect on physical health and the implications of this on work and social activities. The return to work rate was 90% at 12 months although some of those who had returned to work were on 'light' or 'restricted' duties. This was somewhat higher than other trauma studies which ranged between 55% and 82% [Read et al. 2004, Mock et al. 2000, Vles, Steyerberg, Essink-Bot et al. 2005, Michaels, Michaels, Smith et al. 2000, Glancy, Glancy, Lucke et al. 1992, Butcher, MacKenzie, Cushing et al. 1996]. For this sample the goal in recovery was to return to work and not necessarily the social activities which, although important were not considered a priority. The occupation of the participants appeared to be a factor in how soon they returned to work. For example there were 3 participants with similar fractures to their femurs, 2 had returned to their desk jobs at 3 months, despite one of these having secondary problems but the third did not return to his manual job until 6 months. This inability to work had further consequences on individual finances and for one participant he was concerned that he might lose his home due to the inability to pay his mortgage as a result of long term sickness. At 12 months financial burden was experienced by 76% of the sample with the majority of costs incurred from loss of wages and replacement of vehicles. The area of financial burden was not helped by the slow compensation process identified by many of the subjects. All of the participants in this study wanted to be recompensed for their losses rather than wanting money for the sake of it. Receiving compensation acted in two ways - to restore the financial losses accrued and also to prove innocence. Compensation payments in the UK are considered to be slow and modest and unfortunately can further exacerbate psychological and social problems [Mayou 1995]. In addition others have suggested that compensation acts to prevent recovery and return to work in combination with receiving workers compensation [Mock, Mackenzie, Jurkovitch et al. 2000, Mackenzie, Morris, Jurkovitch et al. 1998]. The anxiety reported by participants about money worries was evident in a number of cases as a direct result of the inability to work.

The high incidence of lower extremity injury was of interest suggesting that these injuries are a problem for road injury survivors and often associated with functional limitations [Dischinger, Read, Kufera et al. 2004, Mackenzie et al. 1998, Read et al. 2004]. At 12 months 18% of the sample still required the use of a walking aid, of which one subject had returned to part time work on very restricted duties. He was a maintenance engineer and had returned to work to process the orders in the office rather than undertake his normal manual work.
Pain was a notable factor in this study limiting normal functioning and was also reported as a reason for non-recovery at 12 months. At 12 months 63% of the sample still experienced pain from the original injury. Similar reports of pain were found by Read et al. (2004) and Anke and Fugl-Meyer (2003) following traumatic injury. Mayou (1995) suggests that the presence of chronic pain contributes to a circle of events contributing to poor health related quality of life which in turn exacerbates depression and further pain. He adds that as an outcome of injury pain ought to be considered and treated effectively in the recovery process. However pain is not considered to be a factor influencing functional outcome in the Functional Capacity Index (FCI) as it is a hindrance rather than an impairment per se [MacKenzie, Damiano, Miller et al. 1996], but findings from studies suggest that pain is an important factor in the recovery following traumatic injury and may be influential in the poor predictability of the FCI to date.

Previous studies have identified psychological problems including depression and PTSD in a number of survivors of trauma [Holbrook, Andersen, Sieber et al. 1998, Read et al. 2004, Blanchard and Hickling, Taylor et al. 2004]. As a group the mean scores for this sample did not identify depression to be a significant outcome, however there were a number of participants scoring above 16 on the CES-D. The higher percentage of females (26%) in this study with reported depression compared to the males is consistent with other studies although the reasons are not clear [Holbrook, Hoyt, Stein et al. 2002, Vles et al. 2005 and Meerding, Looman, Essink-Bot et al. 2004]. There were other psychological problems noted with some participants expressing the need to avoid the crash location. Others reported being nervous passengers if they were not in control of the vehicle and one participant had chosen never to drive again. These effects are not uncommon and have been found by Mayou and Bryant (1994). Conversely for two subjects the experience of the crash (including one individual who sustained life threatening injuries) had become a positive experience and reaffirmed the notion they were "living and should live life to the full".

Using a utility measure to assess health related quality of life comes into its fore when the results can be applied to assess the societal burden of injury using the QALY. Classically QALYs are used in cost utility analyses to determine the benefits of one treatment over another, however, this study used QALYs at a basic level to quantify societal burden from actual patient measurements using the EQ-5D. The utility scores obtained from the EQ-5D profiles are the 'quality' aspect of the QALY. Although this sample was small the associated societal burden appeared to be considerable if one were to extrapolate the results.
The health outcome measures identified that road injury survivors have a significantly lower quality of life compared to matched age and gender population norms. The suddenness of sustaining an injury may have some impact on these results because there is limited time to accept and adapt to the situation unlike chronic disease. To assess the impact of quality of life in relation to the 'sudden' impact of injury would however, require a larger sample from which to draw any general conclusions.

The use of patient derived data outcomes research is a new area in the UK when applied to road crash survivors. This study although limited by size has shown that the effect of injury lasts substantially longer than the initial crash event and immediate injury treatment. Interestingly many subjects stated they 'could not believe how long it has taken them to recover from their initial injury' and also what lifestyle changes had to be made in the recovery period. It is evident that injury sustained in road crashes has a considerable impact on everyday life for the victims and their family. Its impact is probably heightened by the fact that it is a sudden occurrence without pre-warning to develop coping mechanisms with the after effects. It is recognised that this study is limited, however, it is one of few studies which have attempted to address outcomes of road injury at the subjective level and would warrant further study.

The study is limited by the small sample size at 12 months and as such the results have to be interpreted with this in mind. This study is part of a larger follow up study of 120 participants and represents the more serious injuries sustained by road users (Barnes, 2006). The majority of injuries were orthopaedic and of these a large proportion were leg injuries which may be a result of over half of the sample being vulnerable road users. The small sample size does limit the ability to generalise the results to a wider population, however, similarities exist between results from other specific road injury studies (Read, et al and Mayou et al).

CONCLUSIONS

This study has explored the outcomes specific to road injury in a UK sample from the participants perspective which is an under researched area using a combination of qualitative and quantative methods. The use of health outcome measures applied to road injury survivors have identified particular physical and psychological problems post injury as well as being able to examine the societal burden. Thus suggesting there is potential to incorporate such measures in future larger follow-up studies.

The conclusions are based on data from 38 participants following in-depth interviews and health outcome measures and are as follows;
Road injury has an impact on everyday activities as a result of limited physical functioning beyond the initial crash and immediate treatment.

- Females appear to suffer more from psychological effects following road injury.
  - The rate of lower extremity injury was high (73%).
  - Pain was a major factor in the recovery process with 68% of participants still suffering at 12 months.
- The societal burden of road injury is potentially high using QALYs.
  - Return to work rate was 90% but occupation type may affect this.
- Apparent need to explore the interaction of road crash injury on quality of life in a larger sample using these methods.

REFERENCES


Mayou R and Bryant B. Outcome 3 years after a road traffic accident. *Psychological Medicine, 32*(4): 671-675; 2002


