A community based investigation of the association between cannabis use, injuries and accidents

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Abstract

Background: There are well documented acute and chronic effects of cannabis use. However, less is known about any effects on safety within the context of work and everyday life.

Aims: To examine any association between cannabis use and injuries and accidents.

Methods: A postal questionnaire survey was conducted among people selected at random from the electoral registers of Cardiff and Merthyr Tydfil.

Results: Cannabis use was associated with both minor injuries and accidents, particularly among those with high levels of other associated risk factors.

Conclusions: Cannabis use was associated with a significant detrimental impact on safety. It is possible that this is linked to an amplification of other risk factors associated with accidents and injuries. This has potentially wide reaching implications particularly in the context of other work and lifestyle characteristics.

Keywords

Cannabis, injuries, accidents

Introduction

After alcohol and tobacco, cannabis is the most popular drug of choice in Europe (Calafat, 1999). In the UK it has consistently been the most commonly used illicit drug: 11% reported using it in 2001/02 (Aust and Condon, 2003). British teenagers are more likely to have tried illicit drugs than their counterparts elsewhere in Europe (SCIAOD, 2000), and longitudinal work suggests that drug use is increasingly limited to cannabis as people move into adulthood (Williams and Parker, 2001). This suggests a pattern of increasingly long cannabis use careers among substantial numbers of people.

The sedative effects of cannabis use are well established, with users typically reporting mental slowness, tiredness, anxiety and paranoia as well as relaxation and euphoria (Parrott et al., 2004). Acute effects on cognition and performance, limited to periods of intoxication, have been well-documented (Parrott, 1987; Golding, 1992; Heishman et al., 1997; Solowij, 1998). Somewhat less research has focused on the long-term effects of chronic cannabis use on cognitive performance. However, the evidence suggests that long-term cannabis use leads to subtle and selective impairments of specific higher cognitive functions (Solowij, 1998). The results of a parallel part of this study investigating the impact of cannabis use on cognitive performance among workers are consistent with these findings and are reported elsewhere (Wadsworth et al., 2005).

In the light of these results a possible impact on safety seems intuitively likely. Laboratory studies show that cannabis impairs driving skills (Parrott, 1987), perhaps at a similar level to a blood alcohol concentration of between 0.07 and 0.10% (Hall et al., 1994). Furthermore, recent drug use has been associated both with traffic accidents (Ramaekers et al., 2004) and road accident culpability (Drummer et al., 2003). Accident and Emergency based studies also show a high prevalence of drug use among attendees (MacDonald et al., 1999). These studies (Seymour et al., 1999) and driving accidents studies (Kelly et al., 2004) also indicate increasingly prevalent polydrug use. Their focus is necessarily on more serious accidents and on incidents occurring while intoxicated.
The aim of this study was to examine any association between cannabis use and accidents, injuries and cognitive failures within the context of work and everyday life. Cognitive failures are problems of memory, attention or action (effectively human errors). Although under most circumstances they do not result in accident or injury, cognitive failures can lead to accidents and injuries (O’Hare et al., 1994; Larson et al., 1997). Each of these incident types is also associated with particular characteristics which may change with the circumstances in which the incident occurs. Within our recent work we have shown associations with demographic (age, gender, income, education), personality (neuroticism, risk taking), mental and physical health and lifestyle (smoking, alcohol use, stress) factors (see Wadsworth et al., 2003; Simpson et al., in press). Incidents at work may be associated with particular occupational characteristics in addition to these other factors (see Wadsworth et al., 2003; Simpson et al., in press). Furthermore, drug use itself also seems to be linked to many factors. These overlap with some of the same areas, such as risk taking, gender, age, smoking and alcohol use (Wadsworth et al., 2004b), though not necessarily in the same direction: for example, drug use is associated with males (Wadsworth et al., 2004b), as are accidents at work (Wadsworth et al., 2003; Simpson et al., in press), but cognitive failures at work are associated with females (Simpson et al., in press).

This study is an attempt to consider cannabis use and safety both at work and outside work within the context of these other factors and associations. Drug use is increasingly part of normal young adult life (Parker et al., 2002). There is also growing evidence of subtle cognitive effects of cannabis use linked to duration of cannabis use (Block and Ghoneim, 1993; Wadsworth et al., 2005) that may not recover with abstinence (Solowij, 1995). It is therefore increasingly important that research on the impact of cannabis on safety attempts to control for the potentially confounding influence of other factors associated with accidents and injuries (MacDonald et al., 2003).

Methods and Materials

A postal questionnaire survey was conducted among people selected at random from the electoral registers of Cardiff and Merthyr Tydfil. The questionnaire was based on that used in the Bristol Stress and Health Study (Smith et al., 2000), and included sections on demographics, health, accidents and injuries, health related behaviours and work. It has been described in detail elsewhere (Smith et al., 2004; Wadsworth et al., 2004a, 2004b), and details of the measures used in the analyses are given in Table 1.

Participants

Thirty thousand people were selected at random from the electoral registers for Cardiff and Merthyr Tydfil (22,500 and 7500, respectively). These areas were selected for their differing social and economic conditions. Employment rates and deprivation scores are different for the two areas, with Merthyr Tydfil experiencing, in general, higher unemployment and greater social and economic deprivation than Cardiff. Index of Multiple Deprivation scores, which combine the income, employment, health, education, housing and service access domains are 17.88 for Cardiff, 42.77 for Merthyr and 21.75 for Wales as a whole (National Assembly for Wales, 2000). Townsend scores (Townsend et al., 1988), which measure deprivation by area using census data about unemployment, overcrowding, non-car ownership and non-home ownership, for Cardiff and Merthyr Tydfil were 3.25 and 1.58, respectively (National Assembly for Wales, 2000). And Jarman scores (Jarman, 1984), which are an area-based measure of additional GP workload based on unemployment, overcrowding, lone pensioners, single parents, born in the New Commonwealth, children aged under 5, low social class and one year migrants, were 14.25 and 10.01 (National Assembly for Wales, 2000).

Procedure

Questionnaires and covering letters were posted in early May 2001. In an attempt to maximize frank reporting of drug use, no identifiers were attached, precluding any follow-up procedure. The questionnaire’s content has been described previously (Smith et al., 2004). The questions about recreational drug use were taken from the British Crime Survey (Ramsay and Partridge, 1998).

Outcome measures

Participants were asked about four incident types:

- accidents – during the previous year which required medical attention
- road traffic accidents – during the previous year where the respondent was the driver
- minor injuries – during the previous year which did not require medical attention (quite and very frequent minor injuries were compared with none, rare or occasional minor injuries)
- cognitive failures – problems of memory, attention or action (quite and very frequent cognitive failures were compared with none, rare or occasional cognitive failures)

They were asked about each incident type both outside work and at work (in the case of traffic accidents this included driving to and from work as well as driving as part of work).

Analyses

Analyses were carried out in two stages. First, logistic regression modelling was used to assess any association between drug use and accidents, minor injuries and cognitive failures. Each model also included the factors listed in Table 1. This allowed any association between cannabis use and the outcome measures to be assessed independent of these other factors. The other factors were chosen because of their association with accidents, injuries or cognitive failures established previously (see final column). Some of them are also associated with drug use (Wadsworth et al., 2004b), and these are also identified in the final column.

Second, those factors listed in Table 1 that were associated
with each incident type were established using backward stepwise logistic regression. Participants were then categorized according to whether they had high or low levels of these associated risk factors. Within each of these categories, participants were further divided into those who had used cannabis in the last year and those who had not used any drugs. The resulting four level variables (i.e., low level of other risk factors and no cannabis use; low level of other risk factors and cannabis use; high level of other risk factors and no cannabis use; high level of other risk factors and cannabis use) were then included in logistic regression analyses. This allowed the assessment of any association with cannabis use over and above that of the other associated risk factors among two groups of respondents: those with lower levels of other associated risk factors and those with higher levels of other associated risk factors.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Factors included in the logistic regression analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>Categorization</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>&gt;25, 25 &gt; 40, 40 &gt; 60, 60 +</td>
</tr>
<tr>
<td>Sex</td>
<td>Male, female</td>
</tr>
<tr>
<td>Income</td>
<td>&gt;£10k, £10k, £20k, £20k &gt; £30k, £30k &gt; £100k</td>
</tr>
<tr>
<td>Education</td>
<td>No qualifications, 0 level or equivalent, A level or equivalent, City &amp; Guilds, degree or high degree, professional qualification</td>
</tr>
<tr>
<td>Personality</td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td>Quartiles of EPI-N</td>
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<tr>
<td>Risk taking</td>
<td>None, rare, occasional compared with quite or very frequent</td>
</tr>
<tr>
<td>Mental health</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>Clinical cut-point of HADSa</td>
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<tr>
<td>Depression</td>
<td>Clinical cut-point of HADSD</td>
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<tr>
<td>Sleep problems</td>
<td>Difficulty sleeping in the last 14 days</td>
</tr>
<tr>
<td>Physical health</td>
<td></td>
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<tr>
<td>14-day symptoms</td>
<td>3 or more compared with fewer from checklist</td>
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<tr>
<td>12-month symptoms</td>
<td>2 or more compared with fewer from checklist</td>
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<tr>
<td>Chronic symptoms</td>
<td>1 or more compared with fewer from checklist</td>
</tr>
<tr>
<td>General health</td>
<td>Very good, good, moderate compared with bad or very bad</td>
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<tr>
<td>Lifestyle</td>
<td></td>
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<tr>
<td>Smoking</td>
<td>Current smokers compared with non-smokers</td>
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<tr>
<td>Alcohol</td>
<td>Those in the top 10% (calculated separately for men and women) compared with those below</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Work status*</td>
<td>Workers compared with non-workers</td>
</tr>
<tr>
<td>Combined incidents</td>
<td>Combinations of other accidents, injuries and cognitive failures reported at work or outside work as appropriate</td>
</tr>
<tr>
<td>Occupational**</td>
<td></td>
</tr>
<tr>
<td>Risk taking at work</td>
<td>None, rare, occasional compared with quite or very frequent</td>
</tr>
<tr>
<td>Work stress</td>
<td>None, mild, moderate compared with very or extreme</td>
</tr>
<tr>
<td>Total negative score</td>
<td>Quartiles of negative occupational characteristics (ref)</td>
</tr>
<tr>
<td>Social class</td>
<td>Manual compared with non-manual</td>
</tr>
<tr>
<td>Employment</td>
<td>Self-employed compared with others</td>
</tr>
<tr>
<td>Experience</td>
<td>Less than 6 months in post compared with longer</td>
</tr>
</tbody>
</table>

*Excluded from models for work-related outcomes. **Included only in models for work-related outcomes. ¹Wadsworth et al., 2003, ²Simpson et al. (in press), ³Wadsworth et al., 2004b.
Ethical approval

The study was approved by the Cardiff University School of Psychology Ethics Committee.

Results

Participants

In total 7979 people completed and returned a questionnaire. Respondents were predominantly female (n = 4601, 58%), their mean age was 45.61 (SD = 18.00, range 16–97), most were working (n = 4620, 58%), most were white (n = 7584, 97%) and 26% had a degree or higher educational qualification, while 18% had no educational qualifications.

Twelve per cent reported having used drugs in the last year, and 7% in the last month. Among those who had used drugs in the last year, 59% reported using only cannabis. Those who reported using other illicit drugs as well as cannabis in the previous year were excluded from the following analyses.

Overall 11% of respondents reported an accident, 2% a road traffic accident, 14% quite or very frequent minor injuries and 18% quite or very frequent cognitive failures.

Modelling all incidents together (i.e., any accident at work, outside work or rta) in the last year, or quite or very frequent minor injuries (at work or outside work) in the last year, or quite or very frequent cognitive failures (at work or outside work) 2661 (38%) respondents reported an incident.

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Table 2 shows first the adjusted odds ratio (i.e., the odds ratio after adjusting for all the factors listed in Table 1) for reporting an incident among cannabis users (OR = 1.41). This indicates that cannabis use was associated with reporting an incident independent of the other factors included in the model. Second, Table 2 shows the odds ratios for the grouped variable categorizing respondents according to both their level of other associated risk factors and their cannabis use. Comparing levels of risk among non-cannabis users (i.e., the non-bold lines) shows, as expected, an association between higher levels of associated risk factors and reporting an incident (OR = 2.60). Comparing cannabis use status within each level of risk (i.e., each bold line with the non-bold line below it) shows associations between cannabis use and reporting an incident both for those with lower levels of other associated risk factors (OR = 1.52) and for those with higher levels of other associated risk factors (OR = 3.84).

Similarly, analysing work and non-work incidents separately showed that for non-work-incidents there was an association with cannabis use, and this was also significant among those with high levels of other risk factors. For work incidents there was an association with cannabis use among those with high levels of other risk factors (the overall adjusted odds ratio also approached significance) (see Table 2).

Next each incident type was considered separately.

Cognitive failures

There were no significant association between cannabis use and cognitive failure (see Table 3).

Minor injuries

Cannabis use was associated with quite or very frequent minor injuries. This was significant among those with high levels of other risk factors. Restricting the analyses to minor injuries outside work and then at work also showed this pattern: cannabis use was associated with quite or very frequent minor injuries outside work – this was significant among those with high levels of other risk factors; cannabis use was also associated with minor injuries at work among those with high levels of other risk factors only (see Table 4).

Accidents

Considering all accidents together there was an association with
cannabis use among those with high levels of other risk factors only. This pattern was repeated when just accidents outside work were considered. There was no association between cannabis use and work accidents (see Table 5).

**Road traffic accidents**

Cannabis use was associated with all road traffic accidents (see Table 6). Those with low levels of other risk factors who used cannabis were more likely to report a traffic accident (see Table 6). Similarly, those with low levels of other risks who also used cannabis were more likely to report a work-related road traffic accident in the last year (the overall odds ratio for work-related road traffic accidents also approached significance) (see Table 6). There was no significant association between cannabis use and non-work-related road traffic accidents.

**Discussion**

Cannabis use was associated with self-reported accidents, road traffic accidents and minor injuries. Specifically, those who had higher levels of other risk factors associated with accidents and who also used cannabis were more likely to report an accident in the previous year. This pattern was repeated when accidents outside work were analysed separately, but was not apparent for accidents at work. Those who used cannabis were also more likely to report a road traffic accident in the previous year. This was also apparent among those with lower levels of other associated risk factors. Analysing work- and non-work related road accidents separately showed an association only for work-related accidents (i.e., while driving to or from work, or as part of work) among those who also reported lower levels of other associated risk factors. Cannabis users were also more likely to report quite or very frequent minor injuries. This too was apparent among those who had higher levels of other associated risk factors. The same pattern emerged when non-work related minor injuries were analysed separately, while for work-related minor injuries the only association was among those with higher levels of other associated risk factors.

However, there was no association between cannabis use and cognitive failure. This suggests that cannabis users may be unaware of any impact on their cognitive performance. This is consistent with recent parallel work which suggests measurable cognitive performance deficits among cannabis users but relatively little awareness by users of any detrimental performance effects at work (Wadsworth et al., 2005).
Some caution is needed interpreting these data. Timings of cannabis use in relation to accidents and injuries were not available, the data were entirely self-reported, and there was no information about amount, frequency or duration of cannabis use. However, they do suggest a possible impact of cannabis use on safety both in and out of the workplace. They are also consistent with laboratory findings suggesting that, for example, acute cannabis use affects the attention, tracking and psychomotor skills used in driving (Coombs and McAndrews, 1994). Similarly, they are consistent with the effects on psychomotor speed, information processing and memory among those associated with longer-term cannabis use (Solowij, 1998). This would be consistent with parallel work suggesting impairments of psychomotor speed, information processing and memory among those using cannabis for longer (Wadsworth et al., 2005).

The associations described may represent acute effects (i.e., accidents or injuries occurring while intoxicated). Drugs have been found in up to 25% of those involved in road accidents with cannabis generally the most commonly detected (Kelly et al., 2004). There is growing evidence that recent cannabis use (determined by detection of THC in the blood – rather than past use determined by detection of THC in the urine), particularly at higher concentrations, does increase traffic accident risk (Ramaekers et al., 2004).

In addition, recent studies of road traffic accidents have suggested that culpability increased with higher concentrations of blood THC (Drummer et al., 2003). However, it is also possible that they include an association with accidents or injuries while not intoxicated resulting from cognitive performance deficits associated with longer-term cannabis use (Solowij, 1998). This would be consistent with parallel work suggesting impairments of psychomotor speed, information processing and memory among those using cannabis for longer (Wadsworth et al., 2005).

Epidemiological studies, despite showing a correlation between cannabis use and injuries, cannot rule out alternative explanations, and have shown inconsistent results (MacDonald et al., 2003). For example, the association between cannabis use and traffic accidents in a population-based study in Canada may reflect risk-taking behaviour in general (Chipman, 1995). Risky driving behaviour is common among younger drivers, particularly males prone to externalizing behaviour (including substance abuse) (Fergusson et al., 2003b). Alternatively, the findings may represent injury as a result of detrimental effects of withdrawal such as restlessness and anxiety (Ashton, 2001). Indeed, there is some evid-
ence that information processing speeds among heavy cannabis users may be normalized when the drug is used (Kelleher et al., 2004).

This work represents an attempt to control for the potentially confounding influence of many other factors known to be associated with accidents and injuries as called for in a recent comprehensive review of the literature (MacDonald et al., 2003). However, the extent to which statistical adjustment overcomes potential confounding is dependent on the identification and measurement of those factors. Alternate explanations for the associations between cannabis use and accident and injury cannot be ruled out by this study. Despite this, the study suggests that there is an association between cannabis use and both accidents and injuries over and above that of the combined effect of higher levels of other factors associated with accident and injury. This points to the possibility of an independent association with cannabis use. It also implies that either cannabis use may amplify the risks associated with other influential factors, or that these other influential factors may amplify the risk associated with cannabis use. This has been suggested previously with reference to road traffic accidents where cannabis use may amplify the effects of alcohol (Hall et al., 1994). Similarly, the combination of problematic alcohol use and cannabis use in adolescence is more strongly associated with both adult alcohol and drug abuse than adolescent use of cannabis or alcohol alone (Stenbacka, 2003). Parallels with many other areas also exist. For example work characteristics, where the imbalance of effort and reward is a powerful predictor of coronary heart disease (Siegrist, 1996; Bosma et al., 1998), and hypertension where control is improved by the use of drug combinations (Borghi et al., 2004).

These results highlight the fact that cannabis use takes place within a wide range of other daily behaviours, influences, factors and contexts. Some of these other characteristics are also associated with an impact on safety. There may be some interaction between one or more of these factors and cannabis use that modifies their relationship with safety. Altering accident, injury and error rates is dependent on the identification of factors that are both associated with the outcomes and are modifiable. Research must therefore include the context and other associated factors to assess not only any independent effects of cannabis use, but also any interactive influence between cannabis use and other factors.

A further recent review has identified a consistent association between cannabis use and lower educational attainment (Macleod et al., 2004). Respondents in this study were more likely to have a higher educational qualification, as were those who had used other drugs as well as cannabis (Wadsworth et al., 2004b). Among those who took part in parallel laboratory-based work, however, fewer cannabis users than controls had a higher educational qualification (61% vs. 74%), though this difference was not significant (Wadsworth et al., 2005). These findings probably reflect the population sampled (Cardiff is a university city with a relatively young population), and some selection bias. As a cross-sectional study with a self-selected sample these data cannot infer causality. However, the implication is that some of the cognitive performance (Wadsworth et al., 2005) and safety problems associated with cannabis use are also apparent among cannabis users with relatively high educational attainment and were apparent when education was included in the analyses. This is consistent with the suggestion that the association between cannabis use and lower educational achievement may reflect the effects of the social context of cannabis use rather than any direct effect on ability or motivation (Fergusson et al., 2003a).

Similarly, alcohol use was controlled for in the analyses, suggesting that even though drug use and heavy drinking are strongly linked (Leitner et al., 1993; Goddard and Higgins, 2000; Wadsworth et al., 2004b), these findings may represent a cannabis effect rather than a more general substance use effect.

There is little work focusing on the use of only cannabis and accidents or injuries. However, research considering more general drug use suggests links with accidents and injuries outside the workplace (MacDonald et al., 1999; Seymour et al., 1999), which may well represent the more acute effects of drug use. There is little evidence, though, for any association between drug use and accidents at work (Normand et al., 1990; Dell and Berkhout, 1998), where being under the influence of drugs at the time is likely to be much less prevalent (Alleyne et al., 1991). Rather, research in this area often suggests that drug use is associated with higher absenteeism and employee turnover (Normand et al., 1990; Peat, 1995). There is also little research into those injuries that are much less serious (i.e., do not require medical attention). These are not reported and recorded in work, and by definition do not come into contact with the medical system. They are, however, more prevalent. It is also possible that epidemiological studies do not find a link between drug use and workplace accidents and injuries because there is an element of self-selection. Those who use cannabis may choose to do less inherently dangerous jobs, and those who do riskier jobs may choose not to use cannabis. Furthermore, cannabis use seems to produce subtle and selective cognitive impairments that may only become apparent after several years of use (Solowij, 1998) and may be linked to duration of use (Hall and Solowij, 1998; Solowij, 1998; Wadsworth et al., 2005).

Studies of road traffic accidents and drug use are increasingly focusing on culpability (e.g., Drummer et al., 2003). Research into other kinds of accidents and injuries also needs to find a way to include this concept. If cannabis use is involved in accidents or injuries any effect is due to the cognitive impairment associated with either acute or chronic use. As such research should focus on accidents and injuries that result from human error and on those who make such errors regardless of whether they are the ones injured as a result. To this end it could be argued that minor injuries (such as cuts and bruises), which were more strongly associated with cannabis use here than accidents, may be more likely to be sustained by an individual as a result of their own error.

As described above, there are limitations to the methodology used in this study. The results, however, suggest a detrimental impact of cannabis use on safety that is apparent both in and out of the workplace. In particular the associations were significant among those who also had higher levels of other risk factors. This not only emphasizes the importance of studying cannabis use in context, but also raises the possibility that, as with road traffic accidents (Hall et al., 1994) cannabis may amplify other risk factors.
Cannabis is the most widely used, and earliest first used, illicit drug in the UK (Aust et al., 2002), and it is the one most likely to be continued into adulthood (Williams and Parker, 2001). It is frequently used in combination with other illicit drugs and with alcohol and is increasingly part of young adult life (Parker et al., 2002) among otherwise conforming individuals (Williams and Parker, 2001). It is, therefore, increasingly important to understand not only any cognitive impact of cannabis use, but also any consequent safety implications within the context of other real world factors both as a result of acute intoxication and the longer-term sequelae of chronic use.

Acknowledgement
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References