

# **PATTERNS OF ALCOHOL CONSUMPTION AND ROAD SAFETY AWARENESS – AN EXPLORATORY STUDY AMONG YOUNG PEOPLE IN TWO SOUTH AFRICAN COMMUNITIES.**

**M SINCLAIR, D SKINNER and Y TOEFY\***

Department of Civil Engineering, Stellenbosch University  
Private Bag X1, Matieland 7602

\*Tel: +27(0)21 808 3838; Email: msinclair@sun.ac.za

## **ABSTRACT**

This project examines the patterns of alcohol consumption and road safety risks facing young people in two South African communities. The research indicates that levels of consumption in both communities are higher than national averages, with young females consuming comparable amounts and with comparable frequency than males. Hand in hand with high consumption rates is an elevated exposure to actual and potential collision risk – one in nine youngsters have already been involved in a collision of some sort (most commonly as pedestrians) and many are exposed to the dangers of drunk drivers both as pedestrians and as passengers. The level of real understanding about the dangers of drinking and mobility are, however, extremely low – in almost all cases the physiological impact of alcohol was poorly comprehended and even basic knowledge such as national Blood Alcohol Concentration limits are simply not known or understood.

## **1. INTRODUCTION**

The World Health Organization's estimate that approximately 1.2 million people are killed in traffic collisions each year is well known. Less accurate estimates of serious injuries are available but it is understood that millions of serious, often life changing, injuries, are sustained as a consequence of traffic collisions annually. Within these overall statistics young people, and young males, are over represented – road traffic injuries are the leading cause of premature mortality for the age group 15-29 years (WHO, 2009). Globally, approximately 70-75% of these are male. A further important sub statistic is the fact that alcohol plays a role not only in a significant number of all fatal collisions, but noticeably so in collisions in which young people die. The extent of this varies from country to country. In France, for example, 31.5% of traffic fatalities are alcohol related (Reynaud, Le Breton, Gilot, Vervialle & Falissard, 2002:1833) compared with 15% in the United Kingdom (RRCGB, 2011). In the United States, 22% of drivers aged 16-20 involved in fatal collisions had been drinking alcohol and 17% had BAC levels in excess of the legal limit of 0.08 (NHTSA, 2006). In South Africa the MRC has estimated that around 57% of drivers and 58% of pedestrians fatally injured in road traffic collisions have some level of alcohol in their blood, with an average BAC of 0.17 for drivers and 0.21 for pedestrian. Both levels are greatly in excess of the BAC limit of 0.05.

Alcohol is clearly a major causative factor in traffic collisions and in serious/fatal collisions in particular. It plays a key role in other health issues – in homicide, inter-personal violence and suicide alcohol has been found to be a major contributory factor. The WHO studies into burden of disease at a global level confirm growing levels of alcohol related disease and injury in many developing counties. In October 2006 the International Conference on Alcohol and Harm reduction was held in Cape Town with the theme "Creating realistic and concrete solutions, especially in the context of developing countries". Understanding local conditions emerged as a crucial precondition for developing successful interventions.

Solutions developed in the developed world cannot always be imported successfully into developing countries. The key to finding effective and enduring solutions is to understand the problem in the local context.

This paper outlines some of the findings of an action research project which compares the patterns of alcohol consumption among young people and its correlation with road safety in three countries, namely South Africa, Argentina and Vietnam under the banner of “Safer Roads 4 Youth”. In South Africa the project is implemented by GRSP with the collaboration of Red Cross South Africa. Drinking among young people is emerging as a health concern all three countries. Of course, not all young people drink alcohol and among those that do not all drink in a way that is detrimental to their health or others. However, risk taking among the young is an age-related behaviour that is well documented. This combined with lack of experience and often lack of knowledge about sensible consumption patterns can place young people at high levels of potential harm.

While the international analysis and comparison of the three countries’ data is as yet incomplete it is useful to examine the results for the South African case study. This paper looks at some of the patterns of alcohol consumption that have been identified among young people in the neighborhood of Belhar/Kuils River (Western Cape) and Lekazi, Mbombela (Mpumalanga), and at the relative exposure of these youngsters to traffic injury risks, estimated fairly simply as a factor of the frequency with which they engage in unsafe road user behaviour as a consequence of alcohol consumption. Understanding why and where young people consume alcohol, how much they drink and with whom and how often excessive (binge) drinking occurs, and relating these to patterns of road user behaviour allows us to develop some preliminary conclusions about the key factors that could improve the potential toxic mix of young people, alcohol and traffic in the future.

## **2. ALCOHOL USE BY YOUNG PEOPLE – INTERNATIONAL CONTEXT**

Most societies discourage consumption of alcohol by children but tolerate it among adults. Young people, falling midway between these groups, become exposed and accustomed to alcohol in different ways and at different stages of their transition to adulthood. Common in the international literature are the difficulties associated with this transition: excessive/binge drinking; social pressures to conform, the relationship between alcohol, inhibition and sexuality among others which emerge largely during the period of adolescence. These are common issues that can lead to social and health problems; drinking to intoxication has been linked with unsafe sexual behaviour (Scott-Sheldon et al, 2012), with crime (Parry et al., 2002); absenteeism and academic failure (Flisher, et al, 2003) and of course to increased risk of road traffic injury (O'Malley & Johnston, 2003; Siliquini, et al., 2011).

Culture is a major influence on how early alcohol consumption is tolerated among the youth. In a small number of Mediterranean countries children are introduced to alcohol gradually from an early age. In most other cultures, however, alcohol consumption is forbidden until the child has achieved a certain age or level of development. The response and consequences of the two approaches directly influence norms and expectations around alcohol, and as a result the behaviour that is associated with alcohol consumptions among adolescents in particular (Engels & Knibbe, 2000; McCambridge, McAlaney & Rowe, 2011).

Linked to the influence of culture is the influence of parents – patterns of alcohol consumption tend to reappear in the behaviour of their offspring (Belles et al, 2011, Vermeulen-Smit et al, 2012). Youngsters with close and supportive family networks are less likely to develop abusive or dependent relations with alcohol than youngsters who

lack adult support. Within the family, extreme attitudes to alcohol can also evoke extreme and opposite responses. The influence of not only parents but role models in general is considerable.

Peers and friend are also major influences of patterns of alcohol consumptions; this appears to be greater in the absence of strong family supports though evidence here is somewhat inconclusive. It seems clear that the influence of peer pressure on a range of activities is a major determinant of adolescent behaviour (Hahm et al 2012, Kiuru et al, 2010).

As far as gender differences are concerned, studies show that young males are more likely to drink than young females, however in recent years the gap appears to be closing, even in more conservative societies (Gill, 2002; Woolfson & Maguire, 2010). Females are not only drinking more frequently than in the past but also in greater volume.

### **3. METHODOLOGY**

The primary sample population comprised two cohorts of young people in the suburbs of Belhar/Kuils River in Cape Town, and Lekazi, Mbombela (Mpumalanga province). The study areas were chosen to represent two different cultural contexts that are common in South Africa – one, a culturally consistent community which has evidenced low rates of population change over the past decade; and secondly a community characterized not only by rapid population growth but also one in which different cultures coexist. Both areas represent lower income neighbourhoods with higher than average unemployment rates and lower than average incomes: in Belhar 24.9% of those who were employed earned less than R1,600/month (City of Cape Town, based on 2001 census). In Lekazi this figure is estimated to be in the region of 41.3% (Mbombela Annual report, based on 2001 census). Belhar is an established urban community and Lekazi a semi-rural town that has largely sprung up as a dormitory community to service the increasingly urbanized Mbombela area.

In both communities we examined two distinct cohort groups. The first included young adolescents, primarily school pupils, aged between 15 and 17 years. The older cohort was youth aged 18 to 26 years. For the most part this paper combines the results from both groups unless significant differences were seen or are considered relevant.

The primary research instrument was a questionnaire that had been developed primarily by the project leaders in Europe and was designed around questions that were relevant to youth in all three study countries. The survey asked basic information about the respondents (age, gender, place of residence), questions about mobility preference and choices, about use and consumption of alcohol, knowledge of the effects of alcohol, knowledge of road safety, and opinions about the relationship between alcohol and safe mobility. In all a total of 200 surveys were completed in each study area for the younger groups, with an additional 256 completed for the older youth in Belhar and 166 in Lekazi.

In addition to the primary survey a number of in-depth interviews were conducted; both one-on one and focus group interviews with stakeholders such as teachers, parents and professionals (police, medical personnel etc.). Finally, household surveys were conducted to assess the socio-economic position of households in the area. Given space constraints this paper concentrates only on the quantitative results obtained through the surveys and does not include qualitative information.

### **4. RESULTS**

#### 4.1 Mobility

To establish patterns of mobility among the two groups a question was asked about the types of vehicles that they drove or rode. In response to the question "What type of vehicle do you drive?" the vast majority of the respondents confirmed that they did not drive at all, with 45% of Belhar respondents aged 18-25 years and 59% of older Lekazi respondents confirming this to be the case.

Figure 1 gives a breakdown of the transport modes for each area.

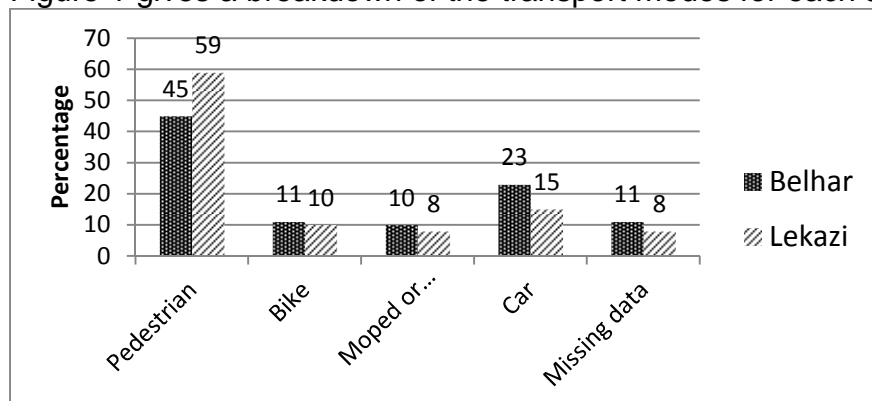


Figure 1: Transport modes, Belhar and Lekazi

Very few of the young people in either area had driving licenses of any kind. – in Belhar 25% of the older cohort held some form of license (10% learners' license; 11% motorbike and 4% car) compared with 13.6% of youngsters in Lekazi (5.6% learners' 3.3% motorbike and 4.7% car). What was interesting, however, was that for every category of vehicle there were significantly fewer formally licensed drivers than there were drivers. While this is not a focus of the alcohol study itself it does highlight one of the factors that influence the high collision rates on South African roads.

In terms of day to day mobility, particularly around the movement of young people to and from recreational activities (as opposed to educational or work-related opportunities) respondents were asked to confirm how they would normally access leisure activities. The responses indicate that among Belhar respondents most (37%) travel to their leisure activities as passengers in conventional vehicles, followed by 28% who walk. In Lekazi the figures indicated a small difference, with most (35%) choosing to walk and fewer (25%) being car passengers. More Lekazi respondents used the train but other forms of transport were almost the same in terms of popularity. Minibus taxis accounted for 10%-11% of trips, motorbikes or mopeds 9%-10%, and bikes were used to access leisure activities only 2% of the time.

#### 4.2 Experience of crashes

Table 1: Personal involvement of respondents in crashes

In the last three years, how many traffic accidents have you been involved in as...?		
	Belhar	Lekazi
Pedestrian	11.3%	12.1%
Cyclist	1.2%	7.8%
Motorbike/Moped rider or passenger	6.4%	3.0%
Car driver	5.1%	2.8%
Car passenger	20.3%	10.9%
Other (taxi, bus etc.)	13.4%	1.1%

The results indicate that the youth in both areas have relatively high exposure to crash risk and injury, in spite of the fact that they were largely non-drivers themselves. For many the

risk came as a result of other people's driving – either drivers of the vehicles in which they were passengers, or of the vehicles with which they came into conflict as pedestrians. As can be seen in Table 1 above, higher numbers of Belhar respondents had personally been involved in crashes as car passengers and as passengers in taxis and buses than Lekazi respondents. Within the Belhar group the exposure of this cohort to crash risk is high: 20.3% had experienced a crash as a passenger; 13.4% had been involved in a crash involving a taxi or bus. In Lekazi, slightly higher percentages were involved as pedestrians and cyclists, possibly reflecting the dominance of these forms of mobility in the Lekazi area. For both groups, over 10% had had personally been involved in a collision as a pedestrian over the past three years. Of all respondents who reported involvement in collisions, 25% Belhar and 20% of Lekazi respondents suffered minor or serious injury.

#### 4.3 Alcohol consumption

The respondents were asked about the average number of drinks that they consume when they are engaged in leisure activities. In the combined age groups the majority of respondents in both areas stated that they did not drink (Belhar 51% and Lekazi 64%) However, looking at the older group of youth these figures change – for the 18-25 years olds in Belhar 30.9% did not drink and in Lekazi 40.1% of the group were teetotal. In both areas the number of non-drinkers was lower than the national average of 59% (Department of Social Development research 2011).

In terms of number of drinks consumed by the older cohorts, a surprisingly high number of respondents both areas (20.3% in Belhar and 17% in Lekazi) did not keep track of the number of drinks consumed (refer to Figure 2). This could indicate a perceived lack of relevance of this information, or possibly the fact that respondents 'lose' count after a while. It is impossible to tell from this data. As can be seen from Fig. 2, significant numbers of the Belhar youth surveyed (23, or 9%) consume more than ten drinks on an average night out. These figures were higher than those recorded in Lekazi, where excessive numbers of drinks appears to be less of a problem. Here, 20% of Lekazi drinkers would routinely consume more than 5 drinks per night, compared with 24% of drinkers in Belhar.

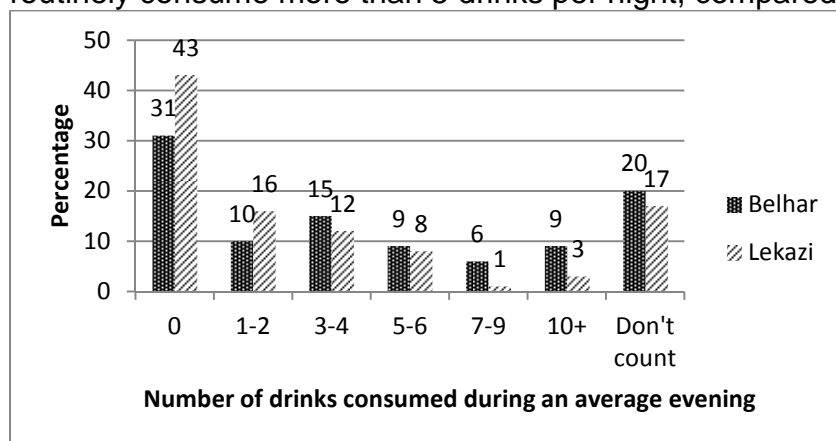
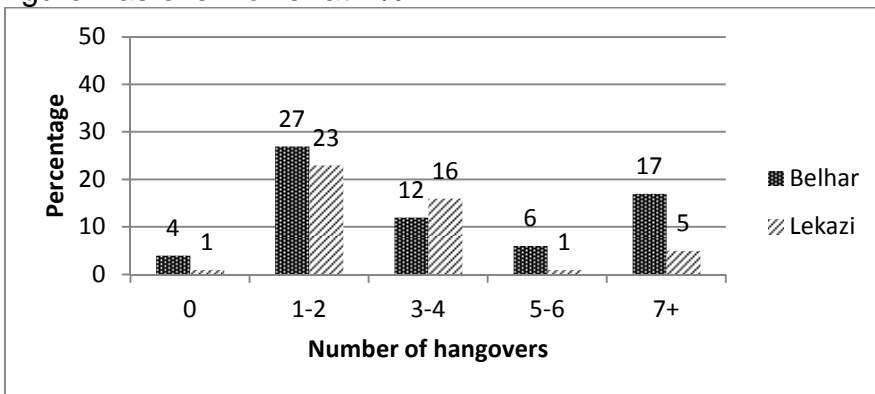


Figure 2: Average number of drinks consumed

When the gender breakdown of the results is considered these become very interesting. Of the older cohort females, 20.7% of Belhar and 21.2% of Lekazi respondents confirmed that they did not count their drinks – this figure was similar to the male responses, and was something of a surprise given that the conventional understanding is that females are more careful drinkers than males. Females were also as likely as males to drink in excess of 5 drinks an evening. This suggests that the problem of excess drinking is no longer clearly divided by gender lines. Females appear to be consuming alcohol in very similar patterns to males.

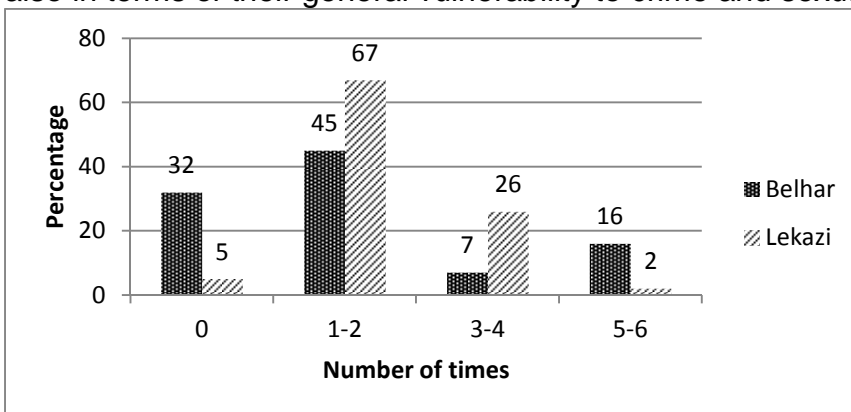
How often respondents drank in excess was also of interest. In Figure 3 below it is clear that those that do drink alcohol frequently drink to excess – in the Belhar older group only

4% of respondents who drank some level of alcohol (i.e. excluding the teetotal portion) reported that they had *not* been hung-over in the previous three months – in Lekazi this figure was even lower at 1%.



**Figure 3: Frequency of hangovers**

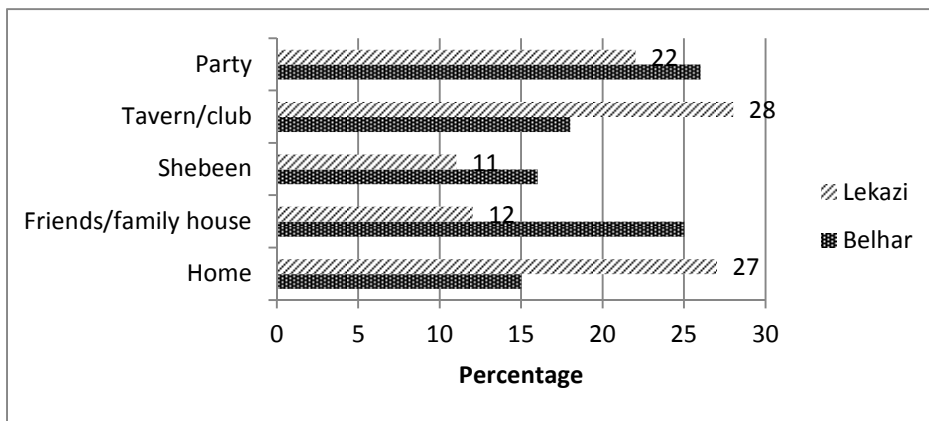
The issue of binge drinking was pursued in a further question, the results of which again confirm a significant level of alcohol abuse in this community. As can be seen in Figure 4, almost 47% of the respondents in Belhar and 37% in Lekazi had experienced being so intoxicated that they could not remember getting home at least once in the past 6 months. This has serious implications for their safety on the roads, both in terms of road safety but also in terms of their general vulnerability to crime and sexual abuse.



**Figure 4: Number of times in past six months the respondent could not remember getting home after drinking alcohol**

#### 4.4 Access to alcohol

In Belhar, 46% of all respondents lived within a 5 minute walk of a bottle-store, shebeen or tavern (bar or club). This contrasts with Lekazi where the total was slightly higher at 60%. In Belhar, the favourite venue for consuming alcohol was parties, followed by the homes of friends or family (refer to Figure 5). For Lekazi, taverns were the most popular followed closely by home. In both areas shebeens were the least preferred venue, possibly because they are seen by many as the domain of older drinkers.



**Figure 5: Preference for alcohol venues**

#### 4.5. Drinking and driving

The results above established that fairly substantial amounts of alcohol are consumed by the respondents. In order to determine the risk of collision as a result of alcohol consumption, further questions were asked. One, for example, was “Over the last 3 months how many times have you driven any vehicle after having drunk three cans (330ml) of beers (5%) or 3 glasses (90ml) of wine (16%) or three shots (40ml) of whiskey (40%) or more?” A small majority of drivers in both groups confirmed that they had not driven – 54% of drivers had not driven at all after consuming these levels of alcohol. However 46% had done so at least once in the past three months.

A further question was designed to establish how frequently, in the previous three months, respondents had been a passenger with an intoxicated driver.

**Table 2: Number of times in last three months respondents had been a passenger with an intoxicated driver**

Number of times as passenger	Belhar (n =256)	Lekazi (n =167)
0	<b>142</b> (55%)	<b>138</b> (83%)
1	<b>19</b> (7%)	<b>17</b> (10%)
2	<b>23</b> (9%)	<b>10</b> (6%)
3	<b>27</b> (11%)	<b>0</b> (0%)
4	<b>2</b> (1%)	<b>1</b> (0.5%)
5	<b>26</b> (10%)	<b>1</b> (0.5%)
6	<b>2</b> (1%)	<b>0</b> (0%)
8	<b>5</b> (2%)	<b>0</b> (0%)
10	<b>10</b> (4%)	<b>0</b> (0%)

Table 2 shows that while the majority of respondents in both areas had not been exposed to this risk in the preceding three months, 45% of the Belhar sample, and with 17% of the Lekazi sample, had been in that situation at least once. Of the Belhar group, exposure to this risk was markedly higher: 29% of respondents indicating that they had driven with an intoxicated driver at least three times in the preceding three months.

#### 4.6. Drinking and walking

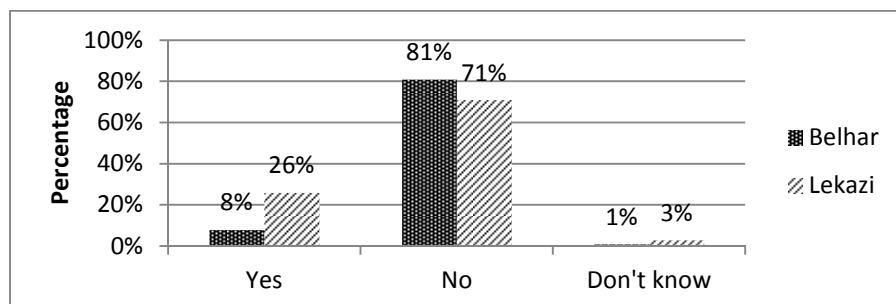
In Belhar, 38% of those who consume alcohol reported walking home drunk at least once in the past three months; compared with 48% of all alcohol drinkers in Lekazi.

Some of the concerns that were raised by the respondents in the subsequent interviews about walking in the areas related to lack of lighting, speeding vehicles and drunk drivers. None mentioned the dangers inherent in being an intoxicated pedestrian.

#### 4.7. Knowledge of drinking and driving

The results obtained in the knowledge section reflect an extremely low level of knowledge and understanding of the legal constraints on drinking and driving and indeed the impacts

of alcohol on human performance. One of the key findings was that for both groups, only 21% of all respondents had had any formal education into road safety and alcohol risk – for this small minority most had been participants in their schools’ scholar patrols. There appears to have been no other education into the dangers associated with alcohol and road use for these groups. The lack of knowledge was illustrated through a number of questions.



**Figure 6: Belhar: Do you know what the legal alcohol test limit is for your country?**

As is evident in Figure 6, of the Belhar sample, only 8% believed they knew what the limit was, yet only 2 % of respondents actually got the correct answer. Oddly, a far higher percentage of Lekazi respondents believed they knew what the limit was (26%), yet again only a small percentage (7.5%) was correct. It is clear that even something as basic as a BAC level has either not been communicated to these young people or is not understood by them. The lack of understanding emerged in subsequent questions. For example, when asked to estimate the number of alcohol drinks (of various types) that can be consumed in an hour before reaching the BAC limit (allowance was made for different body weights so a range of answers would have been acceptable), only 7% of Belhar respondents and 12% of Lekazi respondents answered within a correct range.

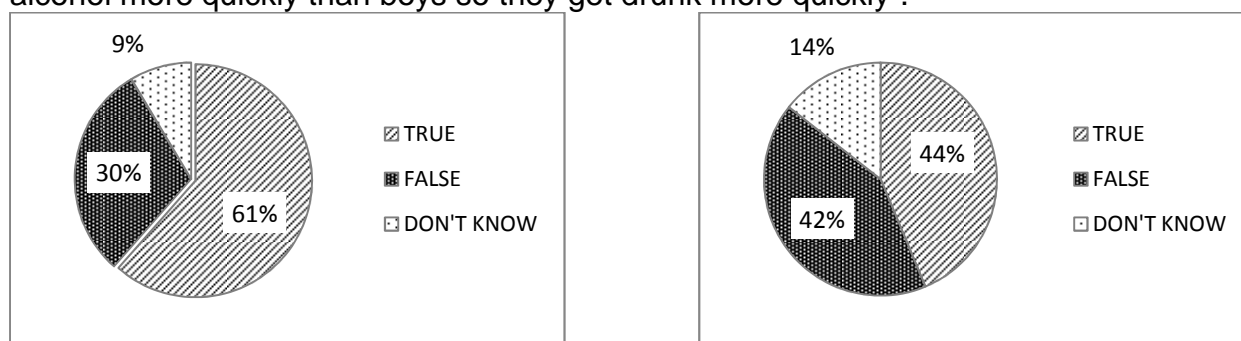
There was also a significant amount of misunderstanding about the physiological impact of alcohol. Table 3 below gives a sample of some of the questions that were asked, with levels of responses in each area that were correct. These questions were given in *True/False/I don't know* format.

**Table 3: Knowledge of impact of alcohol**

Question	Correct responses	
	Belhar	Lekazi
If you drink only beer, you cannot become an alcoholic	65%	80%
Girls generally absorb alcohol faster than boys so they get drunk faster	58%	66%
Drinking a little alcohol can improve a driver's reflexes	59%	56%
Drinking black coffee can help the sobering up process	23%	16%
Alcohol only has a negative effect on driving if BAC levels are higher than the legal limit	55%	48%
BAC levels are the same for all drivers?	25%	29%
Alcohol makes the driver feel less tired and more awake	60%	59%
A person can die of alcohol poisoning	70%	79%

An area of concern is the degree to which both sexes did not understand the biological differences in alcohol consumption. In Figure 7 below it can be seen that female

respondents in the Belhar sample are even less aware of their lower tolerance for alcohol than their male counterparts. These responses were made to the statement "Girls absorb alcohol more quickly than boys so they get drunk more quickly".



**Figure 7: Male (left) and female (right) responses to the statement: Girls absorb alcohol quicker than boys so they get drunk faster**

## 5. DISCUSSION AND CONCLUSIONS

This project has highlighted some of the early findings from a long-term research project that is investigating alcohol consumption patterns among the youth, and identifying possible links between such pattern, knowledge and representations around alcohol and road safety risk in two communities. The nature of this paper has meant that only a small amount of data can be presented and discussed. However, some conclusions can be reached even with this fairly superficial level of analysis.

The first is that knowledge around alcohol use and road safety risk is extremely poor in both communities. To some extent, this is to be expected where few formal road safety education programs have been provided. Yet even older youths, with more experience of alcohol consumption are worryingly ignorant about the impacts of alcohol and the risks associated with road use – as a driver, passenger or pedestrian.

Secondly, both communities displayed levels of alcohol consumption that were higher than national averages. Incidents of hangover and inability to remember getting home after a night out were significant and appear to be regular features of life for young people in these areas. Female respondents were as inclined to excessive alcohol consumption as males.

Thirdly, the research indicated already high levels of exposure to collisions by these two groups, particularly as pedestrians. It showed high risks for passengers – driving with an inebriated driver is one of the most common risks facing the youth in these two groups, particularly in Belhar. The alternatives to 'lifts home' are, however, problematic. Although these issues were not covered in the quantitative section of the project it emerged from qualitative interviews that public transport alternatives are few, and that walking home can itself attract other risks. To some extent the youth may seem to be trapped between a rock and a hard place as far as safe trips home are concerned.

Of concern to us as road safety professionals, however, is that fact that youth are not making informed choices about their mobility after drinking because they are not in possession of the right facts. For youth to understand their choices, and the risks associated with each, they need to be better armed with knowledge. This is an area of utmost importance if we, as a nation, are to make any improvement in the safety of youth on the road.

## REFERENCES

- Belles, S., Budde, A., Moesgen, D. & Klein, M. 2011. Parental problem drinking predicts implicit alcohol expectancy in adolescents and young adults. *Addictive Behaviours*, 36(11): 1091-1094.
- Chassin, L., Pitts, S.C. & Prost, J. 2002. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. *Journal of Consulting and Clinical Psychology*, 70(1): 67-78.
- Engels, R.C.M.E. & Knibbe, R.A. 2000. Young people's alcohol consumption from a European perspective: Risks and benefits (report). *European Journal of Clinical Nutrition*, 54S52.
- Fisher, A.J., Parry, C.D.H., Evans, J., Muller, M. & Lombard, C. 2003. Substance use by adolescents in Cape Town: Prevalence and correlates. *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine*, 32(1): 58.
- Gill, J.S. 2002. Reported levels of alcohol consumption and binge drinking within the UK undergraduate student population over the last 25 years. *Alcohol and Alcoholism*, 37(2): 109-120.
- Hahm, H.C., Kolaczyk, E., Jang, J., Swenson, T. & Bhindarwala, A.M. 2012. Binge drinking trajectories from adolescence to young adulthood: The effects of peer social network. *Substance use and Misuse*, 47(6): 745-756.
- Kiuru, N., Burk, W.J., Laursen, B., Salmela-Aro, K. & Nurmi, J.-. 2010. Pressure to drink but not to smoke: Disentangling selection and socialization in adolescent peer networks and peer groups. *Journal of Adolescence*, 33(6): 801-812.
- McCambridge, J., McAlaney, J. & Rowe, R. 2011. Adult consequences of late adolescent alcohol consumption: A systematic review of cohort studies (report). *PLoS Medicine*, 8(2):
- O'Malley, P.M. & Johnston, L.D. 2003. Unsafe driving by high school seniors: National trends from 1976 to 2001 in tickets and accidents after use of alcohol, marijuana and other illegal drugs \*. *Journal of Studies on Alcohol*, 64(3): 305.
- Parry, C.D.H. 2002. Alcohol use in South Africa: Findings from the South African community epidemiology network on drug use (SACENDU) project. *Journal of Studies on Alcohol*, 63(4): 430.
- Reynaud, M., Le Breton, P., Gilot, B., Vervialle, F. & Falissard, B. 2002. Alcohol is the main factor in excess traffic accident fatalities in France. *Alcoholism: Clinical and Experimental Research*, 26(12): 1833-1839.
- South Africa Central Drug Authority: "Substance use and abuse in South Africa". A presentation to the Portfolio Committee of Social Development, 8 November 2011.
- Scott-Sheldon, L. 2012. Patterns of alcohol use and sexual behaviours among current drinkers in Cape Town, South Africa. *Addictive Behaviours*, 37(4): 492.
- Siliquini, R. 2011. Correlation between driving-related skill and alcohol use in young-adults from six European countries: The TEN-D by night project (research article). *BMC Public Health*, 11526.
- Vermeulen-Smit, E., Koning, I.M., Verdurmen, J.E.E., Van der Vorst, H., Engels, R.C.M.E. & Vollebergh, W.A.M. 2012. The influence of paternal and maternal drinking patterns within two-partner families on the initiation and development of adolescent drinking. *Addictive Behaviours*, 37(11): 1248-1256.
- UK Department of Transport: Reported Road Casualties Great Britain, Research Report, 2011. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/9273/rccgb2011-00.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9273/rccgb2011-00.pdf)
- US Department of Transportation, NHTSA, Traffic Safety Facts 2006. <http://www-nrd.nhtsa.dot.gov/Pubs/810818.pdf>
- Woolfson, L.M. & Maguire, L. 2010. Binge drinking in a sample of Scottish undergraduate students. *Journal of Youth Studies*, 13(6): 647-659.