

Alcohol and the Athlete

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Abstract

Alcohol and the athlete have been linked together since ancient times. It continues to be the most commonly consumed drug among the athletic population. Alcohol use carries significant potential adverse effects for both the health and welfare of the individual. It is suggested that alcohol related problems may be more prevalent in the athletic population due to their risk taking mentality and the age profile of athletes (18- to 24-year-old males). Alcohol consumption also appears to have a causative effect in sports related injury, with an injury incidence of 54.8% in drinkers compared with 23.5% in nondrinkers ($p < 0.005$). This may be due in part to the hangover effect of alcohol consumption, which has been shown to reduce athletic performance by 11.4%. Alcohol is a potentially lethal drug and is a banned substance for certain Olympic sports. Education is the cornerstone for appropriate social use of this drug. Athletes and coaches need to be aware of the sports related adverse effects of alcohol consumption and its role in sports injury and poor physiological performance. It is recommended that alcohol should be avoided by the serious athlete.

Alcohol has been used by humans since the beginning of time. In almost every culture fruit juice, honey and grains have been fermented in order to produce an alcoholic drink. Alcohol consumption is also part and parcel of the social aspects of many sporting events. However, alcohol is a depressant drug and excessive or inappropriate use of this drug can be the cause of both short and long term morbidity. Alcohol continues to be the number one killer of teenagers and young adults in North America. These alcohol related deaths are mostly from motor vehicle accidents: there were 17 461 reported in 1993. Of the 900 Americans who die each year in bicycle accidents, nearly one-third are found to be riding while under the influence of alcohol.^[1]

1. The Incidence of Alcohol Usage

Alcohol and sport have been linked since ancient times, when alcohol was considered to be the elixir of life.^[2] Alcohol is the most widely used drug among the athletic population. It has been reported that up to 88% of intercollegiate American athletes use alcohol.^[3] This is similar to the normal adult consumption of alcohol in North America, where 90% of the population consume this beverage.

Different sports appear to have different drinking patterns. In a recent survey,^[4] traditional field sports such as rugby, cricket, hurling, soccer and Gaelic football were found to have the highest percentage of athletes who consume alcohol compared with sports such as horse racing, cycling and tennis

Table I. The pattern of alcohol use and injury in 13 selected sports

Sport	Drinkers injured (%)	Nondrinkers injured (%)	Number that drink (%)	Number that drink and play/train next day (%)	Mean alcohol/week (units)
Gaelic football	71	18	77	75	15.3
Soccer	59	17	74	65	15
Hurling	71	14	84	71	22.1
Rugby	76	66	88	75	19.3
Basketball	69	16	68	68	10.3
US football	54	14	70	70	17.3
Track and field	64	22	61	56	10
Cycling	20	16	25	18	7.1
Rowing	44	14	48	36	10.7
Horse racing	0	75	20	20	10
Cricket	63	0	89	84	24.8
Tennis	83	33	40	40	13.3
Golf	38	0	76	70	15.8
Mean	54.77	23.46	63.08	57.54	14.69
SD	23.72	22.57	23.01	21.82	5.21

SD = standard deviation.

(table I). Despite a high reported use of alcohol among the athletic population, the actual amount of alcohol consumed by athletes in training is low.^[5] In another recent survey,^[6] the mean weekly intake among 13 different sporting populations was below the safe upper limit of 22 units per week recommended by the World Health Organisation and the Royal College of Physicians of England, with a mean weekly alcohol intake among all the athletes of 14.7 units a week (table I).

2. Social Consideration of Alcohol Intake

The World Health Organisation defines alcoholism as 'drinking that causes emotional, social or physical damage to the individual'. It is usually well described as 'a social disorder with medical complications'.^[7] Young men aged between 18 and 24 years have been shown to have an increased chance of problem drinking.^[8] This is also the age group where sports participation is the highest. Young men are initially exposed to alcohol in sports clubs, where they socialise independently of their families and guardians. Athletes and officials are no different from the general public when it comes to problem drinking. In fact, those involved in sport

may be at a greater risk of alcohol related problems as the opportunity to drink is often present in the sports pavillion. The majority of American college athletes report initial experiences with alcohol while in junior high school.^[9] Education should be aimed at young athletes, who may well have developed a drinking pattern before their early 20s.

3. Alcohol, the Law and Education

Over the past decades there have been many instances of high profile sporting athletes who have run into significant problems with alcohol, and many have served custodial sentences for drink driving offences.^[10] Athletes who retire early due to injury have also been shown to run the risk of alcohol related problems.^[11] Research has also shown that intercollegiate athletes have a significantly higher proportion of 'risky' lifestyle behaviour patterns compared with non-athletes. These include increased alcohol consumption, driving while intoxicated and riding in a car with an intoxicated driver.^[12] Therefore, it is important that sports clubs advise on patterns of alcohol consumption.

In North America, the use and abuse of alcohol is considered to be the most pervasive drug problem on college campus. It is a particular priority of the

National Collegiate Athletic Association (NCAA), which has a number of prevention and education programmes designed to address this issue. One of these is the NCAA/Betty Ford Center alcoholism and drug addiction awareness programme. The programme educates university officials and coaches on alcoholism and drug addiction.^[13] This gives the coach, who is the first person likely to identify a problem, an understanding of the warning signs of an alcohol abuser.

Familiarising sports administrators with methods of identification and detection of alcohol abusers, such as the CAGE questionnaire,^[14] is a worthwhile public health intervention.

4. The Effects of Alcohol on Sports Performance

Many recreational athletes still believe that short term ingestion of small amounts of alcohol enhances athletic performance.^[15] In 1982, the American College of Sports Medicine^[16] conducted a comprehensive analysis related to the effects of alcohol on human physical performance and came to the following conclusions:

- The acute ingestion of alcohol has a deleterious effect on many psychomotor skills.
- Alcohol consumption does not substantially influence physiological function crucial to physical performance [maximal oxygen uptake ($\dot{V}O_{2max}$), respiratory dynamics, cardiac function].
- Alcohol ingestion will not improve muscular work capacity and may decrease performance levels.
- Alcohol may impair temperature regulation during prolonged exercise in a cold environment.

More recent research suggests that the acute ingestion of alcohol does in fact decrease performance levels. In 1983, Bond and his group^[17] found that total cycling time to exhaustion was always shorter after alcohol use than after placebo. In 1985, a study on 10 athletes showed that serum alcohol concentrations over 100 mg/dl weaken the pumping force of the heart, even in healthy young adults.^[18] In 1987, a study of 18 male runners who underwent a 5-mile treadmill run showed that the average run-

ning time was 28 seconds longer after alcohol consumption.^[19]

These findings imply that the acute ingestion of alcohol before exercise should be actively discouraged, as it adversely affects athletic performance. This practice frequently continues at a recreational level in traditional sports such as rugby and union football.

5. Medical Hazards of Alcohol Ingestion and Sport

A more worrisome aspect of acute alcohol ingestion before activity is that it can be a prelude to a fatal event. Alcohol is described as an 'ergolytic' (performance impairing) drug,^[20] and small doses can temporarily weaken left ventricle contraction.^[21] In some cases acute ingestion will cause myocardial irritability, resulting in arrhythmias, particularly potentially fatal atrial arrhythmias.^[22]

Alcohol has also been cited as a precipitating factor of exercise-induced anaphylaxis and asthma,^[23] which can also be life-threatening. The incidence of upper respiratory tract infections has also been shown to be greater among male runners who consume alcohol.^[24]

The use of alcohol before aquatic activity should be stringently outlawed, as there is always the potential for a catastrophic outcome to an accident or medical emergency on the water. Alcohol has been reported as a significant factor in spinal injuries occurring in recreational water sports, and injured parties were shown to be more likely to have used alcohol than a control group.^[25] In scuba diving, the potentially fatal 'nitrogen narcosis' was shown to occur at a shallower depth when alcohol had been consumed.^[26]

The aetiological importance of alcohol in drowning has been highlighted in a North Carolina study.^[27] Of 752 victims, 53% tested positive for alcohol and 38% had blood alcohol concentrations of 100mg/100ml of blood or greater. Other acute effects of alcohol include: (i) vestibular system dysfunction (which will have a profound effect on activities which require excellent balance); and (ii) altered testosterone : epitestosterone ratio. This latter ef-

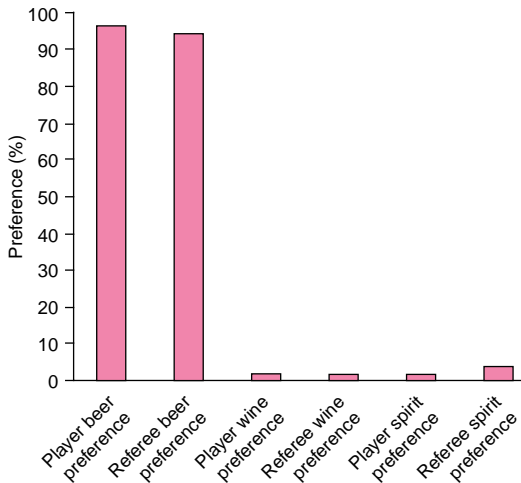


Fig. 1. Alcoholic beverage preference of field players and referees.

fect has been used as a defence against a clinically abnormal drug toxicology test. Further research is required to clarify this matter, to ensure that alcohol does not become an alibi for a drug abuser.

The pattern of a lifetime of chronic abuse of alcohol may have its beginning in the post-match social sports setting.^[5] The athlete is not immune in later life from the potentially fatal consequences of chronic alcohol abuse, including liver toxicity, endocrine dysfunction, decreased serum testosterone, seizures and altered lipid metabolism.

6. Alcohol and Injury Incidents

Previous research has indicated that the consumption of alcohol in the 24 hours prior to athletic activity significantly alters aerobic performance. This reduction of aerobic performance is reported to be of the order of 11.4%.^[5] Recent research^[4] has shown that there is a significant difference in injury rates between drinkers and nondrinkers in the athletic population. Those athletes who consumed alcohol at least once per week had a much higher injury rate, more than double that of athletes who were nondrinkers (table I). This injury rate affects all sports. The athletic population who drank alcohol at least once per week had an injury rate of 54.8%, whereas the nondrinking athletic popula-

tion had an injury rate of 23.5% ($p < 0.005$). Previous research with rugby players identified that 48% of this population drank alcohol the night before athletic participation.^[5] In the present survey, 58% of the elite athletes surveyed ($n = 423$) consumed an alcoholic beverage before competition or scheduled training.

7. Nutritional Aspects of Alcohol

Beer is the most popular alcoholic drink among field athletes and sport administrators ($n = 39$), with over 90% naming it as their preferred alcoholic beverage (fig. 1).^[28] This is due to the mistaken myth that beer is an effective beverage for replacing fluid and supplying high energy.^[5] However, beer will actually have the reverse effect, and will worsen dehydration due to the diuretic effect alcohol has on the renal system. Beer is inappropriate as a carbohydrate replacement, as the 7g of energy is 'empty calories' and does not provide available glucose.

In the chronic alcoholic, alcohol replaces the normal macronutrient intake (protein, carbohydrates and fats) and nutritional deficiency diseases can develop. These include chronic anaemia, pellagra, polyneuropathy, cardiac beriberi and Wernicks encephalopathy.

8. The Hangover Effect of Alcohol on Athletic Performance

The majority of competitive and recreational athletes do not drink alcohol on the day of the athletic event. However, many do consume alcohol the night before activity. This is particularly so in amateur games. A survey has been conducted to investigate the effect that alcohol consumption the night before activity would have on athletic performance.^[5] Athletes were asked to consume their normal Friday night quantity of alcohol. No particular quantity of alcohol was specified. All volunteers had a similar night's sleep, and all had a similar food intake for breakfast. They were asked to return to the training pitch 16 hours later, and post-alcohol (hangover) fitness assessments were then performed. The amount of alcohol consumed was

calculated in standard units of alcohol (1 unit of alcohol was equal to half a pint of beer, 1 glass of wine, 1 glass of sherry or 1 single measure of spirits).

The results of the experiment showed that alcohol hangover has a significantly negative effect on the aerobic performance of rugby players ($p < 0.001$). On average, volunteers performed 11.4% worse in the hangover phase. Any quantity of alcohol (1 to 38 units) produced a negative effect on aerobic performance. Anaerobic performance was unaltered by the consumption of alcohol. This research concluded that the hangover effect of alcohol did produce a significant decrease in aerobic performance after varying amounts had been consumed.

A similar finding of reduced function in the hangover period was noted in a group of pilots who had their visual-motor co-ordination assessment before and a day after a small amount of alcohol had been consumed.^[29,30]

9. The Effect of Alcohol on Aerobic Metabolism

The enzyme alcohol dehydrogenase metabolises 90% of alcohol in the liver, which occurs at the relatively slow fixed rate of 100 mg/kg/h. This equates to a metabolic rate of 10 g/h for a 100kg athlete, who will, therefore, take up to 10 hours to metabolise 100g (8 units) of alcohol; hence, only limited amounts can be disposed of in any period of time. Rates will be even slower for smaller athletes. Exercise will not increase alcohol metabolism.^[31] It is postulated that the decrease in aerobic performance observed in this group of rugby players can be explained by the metabolic effects of alcohol handling.

9.1 Effect on the Citric Acid Cycle

Alcohol is oxidised in hepatic cytosol by alcohol dehydrogenase. This reaction leads to an accumulation of free NADH and an increase in the NADH : NAD ratio. This reduction in NAD causes a slowing in the citric acid cycle at the malate dehydrogenase step (which is NAD dependent), resulting in a slowing of aerobic metabolism.

9.2 Effect on the Lactate : Pyruvate Ratio

The increased NADH : NAD ratio also ensures an increase in the lactate : pyruvate ratio.^[32] This results in hyperlactacidaemia and may be a factor in poor aerobic performance after alcohol ingestion.

9.3 Dehydrating Effect

Alcohol creates dehydration, which also is associated with reduction in aerobic performance. Fox^[15] concluded that dehydration of 2% of total body weight significantly reduces aerobic performance.

9.4 Effect on Available Carbohydrate

Skeletal muscle functions most efficiently aerobically when it uses carbohydrate as its primary fuel. It has been reported that alcohol ingestion will lower muscle glycogen levels.^[33] It is also suggested that there is a decrease in splanchnic glucose output associated with alcohol intake.^[33] The NADH produced by the alcohol dehydrogenase reaction inhibits gluconeogenesis, with a resultant reduction in blood sugar. These factors will decrease the available fuel for normal aerobic energy production.

9.5 Psychological Effect

Alcohol hangover is caused by alcohol toxicity, dehydration and the toxic effects of the congeners in alcoholic drinks. It is commonly characterised by a depressed mood, headache and hypersensitivity to outside stimuli.^[8] As a result, the athlete may not feel they are able to perform maximally.

10. Prohibited Substance

In clinical medicine, alcohol is occasionally used to treat intention tremor. It is also used by some athletes in 'aiming sports' to lessen tremor and improve performance. It is a banned substance for the Olympic modern pentathlon and fencing, and although it can also be randomly tested for in other Olympic sports, it is not proscribed. Levels above 50mg/100ml of blood are considered illegal. Testing is a 2-phase process. A breath sample is initially tested with a breathalyser, and competitors found to have levels greater than 50mg/100ml are requested

to give a blood sample, which is then analysed by the more sensitive gas chromatography.^[34] Alcohol is allowed in many other 'aiming' sports, and may be considered part of the social ritual of games such as snooker and darts.

11. Conclusion

Alcohol and drug abuse in sport must be considered within the context of the drugs in society at large. Alcohol continues to be the most commonly used drug in the athletic community. It is a depressant drug which, with inappropriate use, is associated with both short term and long term morbidity and possible mortality. Education of young athletes and coaches is a cornerstone in dealing with this problem. Affirming the positive effect of absence from alcohol on athletic performance has a very significant impact on drinking patterns in the young athlete.

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