WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTÉ

WHO/PT/128.65

ENGLISH ONLY

PSYCHOACTIVE DRUGS AND ROAD SAFETY

Medical Aspects*

CONTENTS

* Report prepared in connexion with discussions on this subject at the eighteenth and nineteenth sessions of the United Nations Commission on Narcotic Drugs.

1. Significance, nature and extent of the problem

Traffic accidents do not usually have a single cause. Each accident is likely to have several causative factors and these factors vary in their impact on traffic accidents. Personal factors are amongst the fundamental reasons for accidents and some workers estimate that 80-90 per cent. of accidents are due to them.[1] Human performance has to be at its highest level to ensure safe driving. Its impairment by drugs may be a significant element in the causation of traffic accidents. This study is limited to a survey of those effects of psychoactive drugs, whether medically indicated or abused, which have been shown to, or can be expected to, impair a motor-vehicle driver's performance.

The effects of internationally controlled drugs (opium, its alkaloids and synthetic substances with morphine-like effects, cannabis and cocaine) in this respect are well known.[1,2,3,4,5,6] They include drowsiness, sedation or excitation, a feeling of well-being, difficulty in concentrating with a rapid flow of uncontrolled thought, visual disturbances, and effects on sensory function and reaction time. Obviously, persons under the influence of these drugs should not drive motor vehicles.[7,8] Therefore, this report will deal only with sedatives, tranquillizers and stimulants.

At first glance the subject of the influence of psychoactive drugs on driving performance appears to be simple and clear-cut. However, when studying the matter more closely it soon becomes evident that most literature on this subject has few statistics to back up the supposition presented. The rate of traffic accidents has increased considerably during the past 10 years and continues to grow steadily. It is becoming one of the leading causes of death and it is considered now to be a major public health problem in many countries of the world. In the United Kingdom, for example, an average of 20 people are killed in traffic accidents and 250 persons are seriously injured every day.[9] In the United States of America[10] traffic accidents killed 37 000 people in 1958, and injured 1 350 000, according to the National Safety Council. It has been predicted that one person in every 10 in the United States will be injured or killed in a motor-vehicle accident within the next four years.

In the Federal Republic of Germany[11] in 1936 there were 153 000 car accidents with 107 578 injured or killed in traffic accidents, while in 1959 there were 804 915 traffic accidents with 404 262 persons injured and 13 536 killed. In France the rate of traffic accidents is also increasing. In 1950, 7.7 per 100 000 inhabitants were killed in traffic accidents while in 1960 the rate had increased to 17.9 per 100 000 inhabitants. In other countries, particularly those which have become highly motorized, considerable increases in the rate of death have also been recorded. The mortality and morbidity from road traffic accidents assume greater importance as the country becomes more highly developed. At an average there are at least 100 serious injuries for every death from motor-vehicle accidents. According to a recent report from the Road Research Laboratory, the slaughter and maiming in Great Britain are greatest among young adult persons and the older teenage group who have just begun, or are about to begin, their lifetime of productive work for the country.

In recent years the medical use and abuse of psychoactive drugs has become a problem of increasing concern. The World Health Organization Expert Committee on Addiction-Producing Drugs is keeping a continuous watch on abuse of such sedative and stimulant agents and drew attention repeatedly to the steadily increasing abuse of these drugs in various parts of the world, and recommended that counter-measures be taken by governments on the national level of control.[12] This abuse is also under surveillance by the United Nations Commission of Narcotic Drugs which passed several resolutions recommending governments to provide effective measures of control to prevent and curb such abuse.[13]

The United Kingdom Interdepartmental Committee[14] estimated that the total quantities of barbiturates prescribed by general practitioners in the national health service had increased from 81 000 lb. in 1953 to 162 000 lb. in 1959, and that psychoactive and analgesic drugs prescribed under the national health service in 1957 and 1958 amounted to one-fifth of all drugs prescribed. It was also found that over the past few years preparations of barbiturates constituted about seven per cent. and of non-barbiturate hypnotics 2.5-3 per cent. of all prescriptions issued. Amphetamines were found to account for approximately 2.5 per cent. of the total in 1959, that is, five-and-a-half million prescriptions for amphetamine stimulants out of 214 million prescriptions.

From Denmark[15] it was reported that 80 000 males and over 70 000 females had used hypnotics in the course of one month.

In Norway[16] the annual consumption of barbiturates increased from 3.4 tons (equivalent to 100 000 tablets of about 0.1 g per day) in 1950 to five tons in 1956.

In Switzerland[17] about 150 million tablets of analgesic preparations were consumed in 1955 and many of these tablets contained barbiturates. This would represent an average of 30 tablets per person annually.

In the United States of America at least 700 000 pounds of barbiturates have been produced each year since 1954. In 1960 the figure was 852 000 pounds, which it has been estimated would provide enough raw material to make approximately six billion one-grain barbiturate capsules or tablets, or about 33 for every man, woman and child in the United States of America. In a recent hearing before a Senate Sub-Committee, it was noted that in 1961 Americans ingested 1 400 000 pounds of tranquillizers.[18] It was estimated that one in every seven Americans takes these mood pills.

The fact that information on other countries and on other psychoactive drugs is not included does not indicate that they may not have a problem of increased consumption and abuse of these drugs.

In any road accident a variety of causative factors is usually involved. These factors vary also in magnitude. A report of the American Medical Association[10] emphasized that human factors overshadow all other factors in the production of traffic accidents. This study is concerned with the possible detrimental effects of psychoactive drugs on the behaviour and the personality of the driver which consequently affect his ability, skill and performance.

In studying the epidemiological factors of motor-vehicle accidents much attention has been given to the effects of alcohol on the driving performance, while little or no attention has been given to the deteriorating effects of psychoactive drugs. These drugs have an affect on behaviour and judgement as well as on the sensory and motor systems. Nowadays more and more psychoactive drugs are being taken which can be roughly grouped into sedatives, stimulants and analgesics. As shown above these drugs

are being used and abused at a steadily increasing rate, but it is often not realized that psychoactive drugs may impair certain abilities including that of driving a motor vehicle. Specific statistical data on road accidents caused by the consumption of these drugs are as a rule not available, but there is enough evidence of the harmful effects of those psychoactive drugs on those common but complex actions which most people engage in as part of their daily activities, that is to say, driving motor vehicles. Such information could be obtained from general observations of the pharmacological effects of these drugs and from subjective reports as well as from experimental studies both on animals and human beings. The question of how alcohol may interfere with those effects deserves particular attention.

2. Factors modifying the effects of psychoactive drugs on driving performance

The various responses of normal subjects to psychoactive drugs are well known, but they might vary greatly with different personalities and backgrounds. It has been emphasized repeatedly[19,20,21,22] that the psychopharmacological effects of a drug are not entirely a function of the drug's pharmacological properties. The psychology of the subject, his reactivity and the situation in which a drug is administered are important determinants of its effects. Although special features may be attached to a certain psychoactive drug, it may be over-simplification to speak of drug-specific patterns. Experience suggests that the same drug in the same dose in the same subject may produce very different effects according to the personal and motivational situations in which the drug is given. In addition to this, some persons experience unusual reactions to drugs that ordinarily do not produce disabling symptoms. These unusual reactions, allergic or otherwise, may impair sensory mental or physical function, making it unsafe to drive.

The degree of impairment varies considerably depending on several factors such as the type of drug taken, dose of the drug, the duration of being under the influence of the drug, the mental state of the person and the circumstances. Therefore the responses by a subject to any drug are influenced in many ways. Although the direct effects of these drugs on the normal skills can be tested to some extent by a variety of laboratory tests, other effects, e.g. the impairment of interpersonal relationships, are difficult to test and have hardly been studied at all. Under the influence of and during recovery from, these drugs, for example chlordiazepoxide, uncontrolled aggressiveness has been reported to occur.[23]

The combination of several psychoactive drugs should always be approached with caution as unusual syndromes such as drowsiness and unsteadiness of motor performance have been reported. Quite a few of the currently used psychoactive drugs are really not fully tested and investigated before their release for general use, and although a number of them are restricted to be used only on medical prescription, many medical doctors are actually not fully aware of their dangerous effects on behaviour and sensory and motor activities. The problems of abuse and self-medication with these drugs make it difficult to establish their role in the causation of accidents. Under the effect of mood changes, hallucinations and over-confidence produced by such substances people are more apt to deny the use of any drugs and unfortunately it might well be in this group where self-administration is practised that the more unstable individual with resulting drug-induced mood change might be found.

3. Effects of psychoactive drugs on driving performance

To what extent medically indicated use, self-medication and abuse of pscyho-active drugs can affect driving capacity is just beginning to come to light. There is general consensus that great caution should be exercised in prescribing these drugs for drivers.[24]

Gross disturbances of motor co-ordination by psychoactive drugs were noted long ago by Flourens in 1842[25] who studied such effects on standing and walking. Goldberg[26] studied various hypnotics and tranquillizers as well as analgesics and antihistamines, and demonstrated their impairing standing steadiness. Aschan et al.[27] reported that many psychoactive drugs could elicit abnormal nystagmus or interfere in some other way with vestibular mechanisms.

Burner et al.[28] studied in healthy, rested young individuals the influence of psychoactive drugs on performance with regard to driving motor vehicles. Some psychoactive drugs which show favourable results in bed-ridden patients were even in small doses capable of impairing in out-patients the capacity of meeting with the demands of road traffic. They also found that temporary indisposition, age, illness and stress are contributing factors towards such incapacity. They concluded that even low doses of these drugs might induce total loss of traffic ability, and

recommended that all new psychoactive drugs should be specially tested with regard to their effect on the ability to drive and should be labelled "suitable" or "not suitable" for traffic participants in the therapeutically active dose prescribed, and further that regulations considered self-evident in the case of alcohol should be made compulsory for psychoactive drugs too.

A study has been made in Germany[29] on 2060 traffic participants under the influence of alcohol. All were medically examined and questioned on drugs taken within 24 hours preceding the offence and 11 per cent. answered affirmatively. Of these, 50 per cent. had been taking mild analgesics, about 10 per cent. sedatives, and three per cent. hypnotic drugs. Among the individuals who admitted to the use of sedatives in addition to alcohol the percentage of accidents was found increased by 77 per cent.

The considerable increase in traffic accidents and the wide use of psychoactive drugs assuming alarming proportions in France, the Academy of Medicine was requested by the Ministry of Health to study this matter. A government commission on traffic accidents and a number of physicians[30] studied the problem and they recommended that the drivers of motor vehicles must always be in the best of physical and psychical states. Since some psychoactive drugs such as stimulants, sedatives and tranquillizers were capable of altering the behaviour and alertness of the driver and affecting his driving skill, it was recommended that a public educational campaign against the abuse and self-medication of these drugs be undertaken, similar to that taken against the immoderate consumption of alcohol while driving motor vehicles. In two recent announcements the Academy of Medicine in France requested that doctors be very careful in prescribing psychoactive drugs and warn their patients against driving during the period of drug-taking. In France about 60 000 persons were estimated to leave psychiatric hospitals and institutions each year who are on maintenance doses of various psychoactive drugs, and many of whom drive cars.

Recently the Committee on Public Health of the New York Academy of Medicine[31] recommended that persons should not drive under the influence of drugs such as barbiturates, tranquillizers and amphetamines in doses that may produce mental confusion or drowsiness.

The British Ministry of Aviation has issued a warning to the staff of commercial aeroplanes, especially the pilots, that various medicines may impair their performance. Pilots are urged not to take any drugs before or during a flight unless they know how the medication affects them. The list includes amphetamines, antihistamines, antibiotics and tranquillizers. The circular states that fear is an effective stimulant and that tranquillizers and sedatives which reduce this reaction can lead to serious aircraft accidents.[32]

In the following, the most common types of psychoactive drugs will be discussed separately in relation to road accidents.

3.1 Sedatives

3.1.1 Barbiturates and allied substances

Sedative drugs are depressants of the central nervous system and are abused in various ways, e.g. to obtain euphoric effects, to reinforce the effect of alcohol, as an antidote for stimulants of the central nervous system (amphetamines), or for suicidal purposes.

The clinical symptoms of chronic barbiturate intoxication are quite similar to those of alcohol intoxication, i.e. difficulty in thinking, impairment of ego control, emotional instability, over-sedation, euphoria, impairment of higher intellectual functions, poor judgement, motor incoordination (leading to falls, injuries), accidents, and confusional psychosis. Sedatives of barbiturate and other chemical types can cause drug dependence (addiction).[33,34,35] The pattern of addiction to them resembles that of alcoholism and the symptoms of withdrawal equally so. The extent of the medical use and abuse of sedatives is progressively increasing.[36,37]

Loomis & West[38] in their study on the effects of barbiturates on the simulated driving performance of human volunteers reported that 100 mg of secobarbital produced impairment of function at least as great as that produced by alcohol when the blood alcohol concentration was 150 mg per cent. noting that in the United Kingdom a blood alcohol level of 50 mg per cent. was considered sufficient to cause impairment of performance and unfitness of driving a motor vehicle.

The Committee on "Medical Aspects of Automobile Injuries and Death" of the American Medical Association[39] stated that hypnotics (barbiturates and other sedatives) are not only depressants of central nervous activity, producing drowsiness and sleep, but may also produce motor and sensory changes, and that there is no doubt that small doses of some of these drugs, quietening a highly excited and jittery patient, may actually temporarily improve his driving ability. They recommended that, as a barbiturate addict is definitely incapable of safe driving, any patient receiving barbiturates should be advised not to drive a motor vehicle.

Smith & Beecher[40] in their double-blind study on the effects of barbiturate on skilled performances found that 100 mg of secobarbital per 70 kg of body-weight can under certain circumstances produce a profound distortion in judgement and concluded that this is particularly important in regard to road safety. Kornetsky et al.,[41] administering secobarbital in 100- and 200-mg doses and placebo to 18 healthy volunteers on a double-blind basis, reported "hangover" effects and significant impairment of the subjects' performance in various psychologic tests.

Mirsky et al.,[42] administering 200 mg of secobarbital sodium or placebo double-blind to 12 normal individuals, concluded that the drug, disturbing the subcortical activating system, will produce impairment in the continuous performance test. Kornetsky & Humphries[43] worked with 12 normal volunteers receiving 100 and 200 mg of secobarbital and chlorpromazine respectively as well as placebo using a variety of psychologic tests. In a test related to intellectual functioning, 200 mg of secobarbital had a greater effect than chlorpromazine in the same dosage.

Legge & Steinberg[44] administered to volunteer medical students cyclobarbitone 300 mg and amphetamine 15 mg in single doses and a mixture of both in the same dosage under double-blind and placebo conditions. Cyclobarbitone had the most marked effect on simple skill performance and it made efficiency as measured in three tests consistently worse. The mixture produced a pattern of effects which differed from that produced by either drug separately; it impaired the efficiency of simple motor and mental tasks much less than did the barbiturate alone, and it produced subjective elation in many more subjects than either drug separately. The study of Nowlis & Nowlis[45] suggests that after administration of a mixture of barbiturate and amphetamine

their subjects felt somewhat more expansive and elated or uninhibited than with amphetamine alone. Lazentta et al.[46] and Laties[47] reported that on administering a mixture of barbiturate and amphetamine to normal human volunteers the subjective effects were elation, sociability and over-confidence, and results of efficiency of performance tests variable. Evrard[48] studied the effects of barbiturate on the performance of aeroplane pilots and recommended that barbiturates should not be prescribed for pilots during their flying time, and that if they must be prescribed the pilot should be exempted from his flying duty during the period of taking the drug and a period of at least 24 to 48 hours should elapse after the administration of the last dose before duty, and that this should equally apply to drivers of motor vehicles. The capacity for participating in traffic is considered impaired for a period of 24 hours following ambulatory short narcosis with thiobarbiturates.[49] Melander[50] studied the effects of 400 mg of amobarbital and placebo in a simulated automobile driving test; amobarbital did depress driving skills. Benjamin et al.[51] showed that 10 mg of phenobarbital and 10 mg of prochlorperazine decreased the performance of human volunteers in tests involving muscular co-ordination and exercise. Goodnow et al.[52] in a study on pentobarbitone in 100-mg doses reported that they caused mild impairment of manual skills. 500 mg of methylpentynol had similar effects.[53]

3.1.2 Tranquillizing agents

The consumption of this group of psychoactive drugs is increasing, both under medical control and by way of self-medication or abuse. The apparently prevalent notion that all anxiety is undesirable and the amount of publicity given them by manufacturers cause further increases in their use. Thousands of individuals take these drugs as out-patients on an ambulatory basis and very many individuals use these drugs in maintenance doses after being discharged from psychiatric institutions. In addition there is the progressive increase in the abuse of these drugs, some of which are reported to cause physical and psychic dependence.[54,55,56,57]

Tranquillizers, although very diverse in their chemical characteristics, produce as principal pharmacological effect depression of the central nervous system and hence sedation and sleep like the barbiturate group. Their various psycho-pharmacological

effects are likely to impair human capacity with regard to driving motor vehicles. Such drugs can induce mood changes and affect behaviour, the sensory organs, particularly vision and motor co-ordination and, hence, reaction time. Many clinical and experimental studies have been made on the impairment of driving performance by tranquillizers.

Loomis & West[38] studied meprobamate, chlorpromazine and phenaglycodol for their effects on certain motor, sensory and psychomotor functions of normal subjects, using a simulated automobile driving apparatus and double-blind procedure. The first dose of 400 mg of meprobamate had a tendency to impair functions during the first hour and decreased the performance significantly two hours later. The second dose, however, impaired functions significantly already after one hour. Chlorpromazine 50 mg produced a significant decrease in performance with a delayed onset of action. Neither placebo nor phenaglycodol produced a significant effect on the performance in the driving test.

The authors[58] investigated the effects of ethyl alcohol on simulated driving performance in the same subjects and the driving performance was significantly lower when the blood alcohol concentration was 50 mg per cent. The impairment of performance produced by chlorpromazine in the dose used approached that observed with a blood alcohol of 70 mg per cent. Kornetsky[59] studied the effects of meprobamate on the performance of normal healthy subjects with a multiple stimulus response apparatus; 1600 mg of meprobamate significantly impaired motor co-ordination and reaction time, and 800-mg and 1600-mg doses significantly affected the learning rate. Lemere[60] reported that one of his cases had a car accident because of being "drunk" after self-administration of meprobamate with ensuing mental sluggishness and slowed reflexes. Jonsson & Andersen[61] studied the effects of meprobamate, emylcamate and placebo given on a double-blind basis using a battery of psychological tests; meprobamate in single doses of 1200 mg and 1800 mg significantly impaired performance on the vigilance test, various visual motor dexterity tests and grip strength; single doses of 1800 mg of emylcamate had depressant effects similar to those of meprobamate. Ideström[62] studied the effects of meprobamate on 20 healthy volunteers in a double-blind technique with several psychomotor tests (reaction time, motor co-ordination,

trembling of hands and standing stability); 1600 mg of meprobamate significantly impaired the performance of the above-mentioned tests, while placebo did not. Eighteen subjects showed signs of fatigue after meprobamate.

Chlordiazepoxide is another commonly used tranquillizer; in the normal daily dose range of 10-15 mg it may cause drowsiness, euphoria, and slowness of thinking. Some investigators[63] reported an increase in aggressiveness, irritability and agitation symptoms reminiscent of barbiturate intoxication. Cumulative effects have also been observed in some patients. Miller[64] reported that chlordiazepoxide diminished accuracy in judgement, produced some degree of euphoria, and significantly decreased visual acuity. Murray[65] registered the effects of methaminodiazepoxide on 68 drivers taking it in adjusted maintenance doses ranging from 10 to 100 mg daily; in a 90-day period 10 minor and six major motor-vehicle accidents occurred in the group of drivers, which is considered a tenfold increase on the basis of projected statistics. Ataxia was also observed as a cumulative phenomenon. Changes in the driving behaviour of these subjects occurred insidiously and cumulatively, becoming manifest usually after they had been taking the drug for about four to six weeks. The author recommended that individuals taking this drug should be warned against the danger of possible changes in driving habits since the potential liberation of latent hostile, self-destructive or impulsive behaviour patterns accompanied by spino-cerebellar disturbances might impair their judgement so that they may become a danger to themselves or to others. In a long-term study on the effect of chlordiazepoxide involving 159 persons[66] changes in eyesight were observed after daily doses between 30 and 75 mg.

Diazepam, another tranquillizer commonly used, is similar chemically to chlordiazepoxide; drowsiness, motor incoordination and ataxia have been reported after therapeutic doses.[67] These symptoms, which often make patients feel drunk, are hazardous to motor-vehicle drivers and manufacturers often include special warnings in the labelling. Because of the long half-lives of chlordiazepoxide and diazepam caution should also be observed for a few days after discontinuance of the drug. In addition, dependence (addiction) and withdrawal syndromes after daily doses of 80 mg were reported.[68]

The depressant effects of this group of drugs are reported to be qualitatively different from those of other central nervous system depressants such as barbiturates.[69] Kornetsky et al.[41] compared the effects of chlorpromazine, 100 to 200 mg, and of 200 mg of secobarbital and placebo given orally to normal subjects at bed-time. Both drugs produced a significant increase in sleeping time and significantly impaired performance of various psychological tests the following morning. Benjamin et al.[51] studied the effects of 10 mg of prochlorperazine and 10 mg of phenobarbital; tests involving muscular co-ordination and muscular exercise showed a decrease in performance. 100- and 200-mg doses of chlorpromazine produced impairment of performance in the continuous performance test with 12 normal persons.[70] Klerman & Di Mascio[71] compared the effects of single doses of chlorpromazine, promethazine, perphenazine and trifluoperazine in 36 normal human subjects in a double-blind fashion; promethazine and chlorpromazine produced a marked decrease in psychomotor function, impairment of intellectual tasks, and drowsiness. In another study[72] chlorpromazine and promethazine were given in 25-, 50-, 100- or 200-mg doses a day and perphenazine and trifluoperazine in 2-, 4-, 8- or 16-mg doses a day; both chlorpromazine and promethazine produced psychomotor inhibition, mental confusion, alteration in autonomic function, and sedation.

Several other workers have reported and emphasized that phenothiazine drugs can mimic extrapyramidal symptoms and that seizures or convulsions following therapeutic doses of these drugs can often be quite dramatic. Ayd[73] observed an approximately 39 per cent. incidence of extrapyramidal reactions in 3775 persons treated for three months to six years with various phenothiazine drugs; motor restlessness or ataxia occurred in about 21 per cent., parkinsonism in 15 per cent. and dyskinesia in two per cent. Shaw et al.[74] reported many cases of severe extrapyramidal symptoms which sometimes appeared within hours after small therapeutic doses and were frequently misdiagnosed as convulsions or tetanus. Scime & Tallant[75] also reported such symptoms after therapeutic doses of prochlorperazine. Harkoff et al.[76] in a two-week double-blind trial with out-patients using 50-mg doses of chlorpromazine, 200 mg of meprobamate, 10 mg of chlordiazepoxide, and placebo, reported that chlorpromazine showed the highest incidence of untoward effects and somatic discomfort. The American Medical

Association's Medical Guide for Physicians in Determining Fitness to Drive a Motor Vehicle (1958) recommended that "patients stabilized on a maintenance dose of these drugs who are without symptoms of drowsiness or episodes of faintness may drive a private motor vehicle, but should be advised not to drive a commercial or passenger transport vehicle". The report of the Committee on Medical Aspects of Automobile Injuries and Deaths[77] also stated that tranquillizing drugs such as meprobamate, chlorpromazine and reserpine frequently cause drowsiness during the initial period of administration. With large doses the accompanying hypotension may occasionally produce short episodes of faintness. The Federal Medical Council of Germany[78] commented on the use of tranquillizers in relation to road accidents and stated that under certain circumstances their use by motor-vehicle drivers could be dangerous and lead to traffic accidents, as these preparations have sedative effects and may produce a certain indifference to external stimuli.

A common feature of antihistaminic drugs is sedation and disturbance of autonomic functions. Wagner[79] studied the effects of many drugs of this category on the driving performance and recommended that patients should be advised not to drive a vehicle for the duration of the treatment. The Federal Medical Council of Germany included antihistamine preparations and related drugs used against travel sickness in the aforementioned statement. In fact many air companies strictly forbid their pilots the use of these drugs.

It is evident that tranquillizers might impair and deteriorate the driving performance. They can definitely cause drowsiness and also short episodes of giddiness or faintness and can affect behaviour and sensory and motor activities. During the time of initial administration patients should not be permitted to drive motor vehicles until they have determined their own tolerance to these drugs

3.1.3 Combined action of sedatives and alcohol

Due to its direct action on perception, thought, and mood, i.e. on behaviour, ethyl alcohol is the favourite chemical for reducing anxiety and tension and easily available as a social euphoriant and disinhibitor. It is in the same way that psychoactive drugs may induce inappropriate behaviour.

A high percentage of those consuming alcoholic beverages are considered socially accepted alcohol drinkers, but there are large numbers who are considered alcoholics. While in France[30] 10 per cent. of the population of 45 million are estimated to suffer from alcoholism, the alcoholism problem in the United States of America is considered second to France with three per cent. of the population, or five million alcoholics. In Sweden alcoholism incidence is about two per cent. and in England about one per cent.[80] All these figures are for alcoholics and not for the normally accepted social drinkers who may number several hundred millions. A large proportion of them consume also psychoactive drugs, either under medical supervision or by way of self-medication.

In the majority of people alcohol unveils an aggressive character, while in others it may be just the opposite, that is to say, it might elicit social withdrawal and even sometimes depression. Alcohol depresses the central nervous system, and the appearance of stimulant effects is explained by the release of the lower centres from the control of the specific areas of higher nervous centres. It leads to a feeling of well-being and an individual usually becomes over-confident of himself, overestimates his capacity to carry out physical and mental tasks and underestimates the risks and mistakes which he makes during their performance. The effects of alcohol on the performance of motor-vehicle driving have been widely studied and are well known. Even moderate doses of alcohol prolong the reaction time to visual, tactile and auditory stimuli. Tests resembling driving on a dummy car showed that small amounts of alcohol consumption may impair a person's capacity to drive with the maximum skill and care of which he is capable.[81,82,83] The studies by Cohen et al.,[84] Bjerver & Goldberg,[85] and Gelin & Wretmark,[86] of the effects of alcohol on the actual driving performance confirmed the results. Statistical data regarding the relation of alcohol consumption to traffic accidents[87,88,89] and the surveys of Toronto[90] and Baltimore City[91] indicate an increased number of fatal road accidents attributed to the consumption of alcohol.

These effects of alcohol had to be mentioned because of the widespread acceptability of alcohol consumption on the one hand and the frequent combination with psychoactive drugs on the other. If those who are considered socially accepted

alcohol drinkers (not exceeding 0.05 per cent. alcohol in the blood, which as a rule is considered compatible with driving a car) take any psychoactive drug which may add to the effect of the alcohol by augmenting the depression effects, such a combination becomes dangerous. Although psychoactive drugs and alcohol are not usually prescribed together, their combined presence is not unlikely because of the steadily increasing medical prescribing of the drugs, or self-medication, and social drinking.

It is generally believed that low doses of alcohol will not impair motor skills, nor will one or two daily doses of psychoactive drugs cause impairment of the visual and other proprioceptive mechanisms and motor skills. However, only a few investigators have studied what effects are to be anticipated when socially accepted amounts of alcohol are consumed in conjunction with therapeutic administration, self-medication or even abuse of psychoactive drugs. Such studies have just begun and any psychoactive pharmaceutical preparation should be tested for its inherent effects on behaviour alone or in combination with the consumption of alcohol, so that a proper warning can be issued when it is prescribed.

Many psychoactive drugs, particularly hypnotics, tranquillizers, and analgesics such as codeine and morphine, have been shown to enhance the depressant action of alcohol in animals and man.[92,93,94,95,96,97,98]

Hughes & Forney[99] found that after administration of alcohol and psychoactive drugs to rats or dogs the depressant action of alcohol was enhanced and potentiation occurred in the following descending order: reserpine, chlorpromazine, meprobamate, chlordiazepoxide, hydroxyzine, phenaglycodol, morphine sulfate, d-propoxyphene, codeine, pentobarbital.

In Germany[29] a study has been made on 2060 traffic offenders under the influence of alcohol. They were medically examined and questioned on drugs taken in the 24 hours preceding the offence, with the conclusion that the danger in traffic incurred through uncontrolled application of analgesic or sedative drugs and the potentiation of their effects by alcohol is by no means negligible. In a survey of traffic accidents on a highway in Arizona, United States of America, it was reported that 18 per cent. of those involved had admitted taking alcohol or drugs. Essig[100] concluded that the intoxication produced by the combination of sedatives or tranquillizers

with alcohol may become a public health problem and that the resulting clouded mental state and impaired motor co-ordination are conducive to accidents. Subjects receiving 60 ml of alcohol or 130 mg of phenobarbitone or both together in half the amounts believed that they would perform and had performed well at a time when their performance had significantly deteriorated.[101] The workers concluded from their studies that phenobarbitone potentiated some of the effects of alcohol. Doenicke[49] reported that, in view of the potentiating effects of barbiturate, even small quantities of alcohol may cause inebriation, and recommended abstention from alcohol up to 24 hours after application of barbiturates and further recommended the inclusion of a corresponding warning in the labelling and promotional literature. While a few workers[102,103,104] reported that alcohol potentiates the sedative effect of barbiturates in animals, the majority[92,105,106,107,108,109,110,111,112,113] agreed that the effect was a simply additive one.

With the widespread use of tranquillizers, it becomes inevitable that their combination with alcohol must occur frequently. Zirkle and collaborators[114] made a study of the effects of simultaneous use of chlorpromazine and alcoholic drinks on neuromuscular co-ordination, using double-blind techniques in 24 normal individuals; the combined effects of alcohol and chlorpromazine significantly impaired the performance. The subjects became aware of dullness, lethargy and poor motor co-ordination and the more complex the task the more they were affected. The authors[95] studied also the effects of meprobamate (400 mg) and small amounts of alcohol on the performance of 22 normal persons, in order to determine whether a combination of meprobamate and alcohol interfered with ability, co-ordination and judgement more than either of these drugs individually. The dosage of alcohol was adjusted to produce a blood concentration of 0.05 per cent. Over-all test performance was best with placebo and worst with the combination. Goldberg[115] in his study on the effects and after-effects of alcohol, tranquillizers and fatigue on nystagmus found that moderate doses of alcohol in conjunction with tranquillizers may induce a marked intoxication, while the same alcohol dose alone might bring about no apparent intoxication. Many more studies have been carried out on the combined effect of alcohol and several tranquillizers in mice, dogs and rabbits;[92,97,116,117,118,119,120,121,122] they all showed that in such combinations the depressant effects of the drugs are enhanced.

3.2 Stimulants

The most commonly used stimulants of the central nervous system are of the amphetamine type, and their psychic effects have been studied in great detail. The responses depend upon the dose and personality and mental state of the individual. Normal therapeutic doses usually produce alertness, wakefulness, increased initiative, elation of mood, euphoria, enhanced confidence, and an increased motor and speech activity. The effect on psychomotor performance is such that more work may be accomplished but the number of errors in not necessarily decreased; on the contrary, the quality of performance may be lessened. The pleasurable effects may be reversed by overdosage or repeated medication, with the appearance of headaches, dizziness, vascomotor disturbances, palpitation, agitation, confusion, dysphoria, apprehension and depression and fatigue as after-effects. Besides the above-mentioned effects, amphetamines have several other effects on various systems of the body, such as respiratory stimulation, depression of the gastro-intestinal tract, decreased appetite and dilatation of the pupil. The use of amphetamines for weight reduction may result in abuse for obtaining the desired psychic effects.

The extent of the medical use of these drugs and their abuse is increasing. Tolerance to amphetamine is common, i.e. many persons manifest decreasing susceptibility to the effects of the drug upon continued usage and larger doses must then be administered to obtain the desired purpose. Marked tolerance to amphetamine occurs especially in neuropsychiatric patients who tolerate big daily doses (up to 50 times and more the normal therapeutic dose) which would cause serious or even fatal effects if taken by non-tolerant persons. A not infrequent result of such intoxication is a psychotic reaction which is usually in the form of schizophrenic-like illness.[123,124,125] Its relative frequency is not always realized even by the psychiatrist and is often misdiagnosed. Psychosis nearly always is associated with prolonged consumption of amphetamines in daily dosages of up to 500 mg, the minimum daily dose reported as associated with psychosis being 20 mg.[126] The majority of the literature mentions the existence of paranoid features.[134] Wilkie[135] advocated the withdrawal of amphetamines from the British Pharmacopoeia on the basis that they hazard a formidable risk of addiction which outweighs any possible drug benefit.

Amphetamine can cause disturbances of equilibrium resulting in the breaking down of defences and the appearance of regression.[127] Amphetamine abusers may become rude, arrogant, aggressive, violent, irresponsible, impulsive and delinquent in their behaviour, and show impairment of judgement and extravagance.[128] The dose required to produce these side-effects varies widely from one person to another.[129] Dependence on amphetamine occurs and persons will go to great lengths to maintain their supplies. It heightens confidence and increases decisiveness, and gives subjective feelings of increased efficiency.[130,131]

In Japan the abuse of amphetamine had become a serious social problem.[132] In 1954 the Pharmacists' Association of Japan estimated that one-and-a-half million of the population of 83 million abused this drug. Hara[133] reported that amphetamine-dependent persons showed auditory hallucinations in most of his cases. The WHO Expert Committee on Addiction-Producing Drugs,[132] studying the problem of amphetamine abuse, drew attention to its increase in various parts of the world and recommended that counter-measures be taken by governments on the national level of control.

It is a well-established medical fact that prolonged wakefulness as such beyond the fatigue limit will result in a loss of muscular and mental co-ordination, impairment of judgement, and hallucination. Drivers of motor vehicles under the influence of amphetamine may suffer from these symptoms. In the United States during recent years a widespread increasing use of the amphetamine group of drugs has been of sufficient magnitude to warrant governmental concern. The United States Food and Drug Administration[129] obtained evidence that more than 200 operators of truck stops and similar establishments were selling amphetamine tablets to drivers. One of the amphetamine peddlars was arrested and 625 000 tablets of amphetamine were found in his possession. The production of this drug in the United States in 1958 was about 7500 pounds, enough to make about 3.5 billion amphetamine tablets, or about 20 tablets for every man, woman and child in the United States.[129] The prevention of the desire for sleep is one of the bases for large illegal trading in amphetamine among truck drivers in the United States, to enable them to stay awake beyond the limit of physical and mental endurance. While it is difficult to prove conclusively that any motor accident is due to the use of amphetamines by the drivers, these drugs have been

found on drivers in a large number of fatal traffic accidents.[29] The amphetamine tablets are illegally sold under the names "Benny pills", "Capitals", or "Stay-awake pills". Miller[6] suggested that long-distance drivers may be particularly exposed to this risk and recommended that if the dosage of amphetamine does not exceed 10 mg a driver may be permitted to carry on driving for a period of no more than two hours, and that the drug should not be repeated on the same day. Swanton[128] reported that in Australia some inter-state transport drivers have found the drug useful, not realizing its dangers, and that this has been a factor in some of the traffic accidents that have occurred. Some drivers have confessed that they had been taking up to 500 mg of dexedrine in 48 hours.

In a study[136] on risk-taking in 29 male prisoners, 10 mg of amphetamine produced a significant increase in risk-taking. Evrard[48] found that small doses of amphetamine and other stimulant drugs increased psychomotor activity and in therapeutic doses affected judgement. Miller[64] concluded from his experiments on the effects of several psychoactive drugs including amphetamine on driver behaviour of persons who are under the influence of these compounds that they should not drive during the first few days of administration in order to determine whether drowsiness or other behavioural toxicity occurs. In his study on amphetamine drugs' effects on driving performance, Kraft[137] referred to the possibility of dangerous driving caused by various central stimulating drugs and cited case histories to prove this. Some of these substances are reported to cause, depending on the dose applied and the basic condition of the vegetative nervous system, impairment of psychomotor performance (inaccuracy) followed by reaction fatigue (hangover).

4. Conclusions

Many psychoactive drugs have been shown in human and animal studies to deteriorate the ability to drive motor vehicles, but there are not enough statistical data to assess the extent to which these drugs are a causative factor in motor-vehicle accidents. Nevertheless, preventive measures to safeguard the public from this danger are possible; they might include the following:

I. The administration of psychoactive drugs should be under full medical supervision and these drugs should be available on medical prescription only.

II. Doctors prescribing psychoactive (including narcotic) drugs should warn their patients not to drive.

III. The manufacturers' responsibilities should include avoidance of public advertising and exaggerated distribution to the medical profession of promotional literature encouraging indiscriminate use; and obligation to mention clearly in labels and promotional literature a warning against driving while under the influence of certain psychoactive drugs.

IV. Research on the effects of drugs on behaviour, both alone and in combination with alcohol, so that a proper warning can be issued when they are prescribed.

V. Education of the public as well as the medical profession in matters of drugs and driving with proper attention to the similarity between the effects of psychoactive drugs and those of alcohol on driving performance, i.e. the education campaign concerning alcohol and traffic should be expanded to cover psychoactive drugs.

VI. The experiences gained from penal provisions for traffic offences involving alcohol should be applied umtatis umtandibus to cases involving psychoactive drugs, keeping also in mind the motivation to seek cure from the drug abuse where such cure is required for the reissuing of the suspended driving licences.

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