

POISONS CENTRES

# Gamma-hydroxybutyrate: Experience of 9 years of gamma-hydroxybutyrate (GHB)-related incidents during rave parties in The Netherlands

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**Objective.** The objective of this study was to determine the health disturbances and to assess the severity of the incidents as reported during a 9-year experience of gamma-hydroxybutyrate (GHB)-related First Aid Attendees attending First Aid Stations at rave parties.

**Design.** This study was a prospective observational study of self-referred patients from the year 2000 to 2008. During rave parties, First Aid Stations were staffed with specifically trained medical and paramedical personnel. Patients were diagnosed and treated, and data were recorded using standardized methods. **Results.** During a 9-year period with 202 rave parties, involving approximately three million visitors, 22 604 First Aid Attendees visited the First Aid Stations, of which 771 reported GHB-related health problems. The mean age of the GHB-using First Aid Attendees was  $25.7 \pm 6.1$  years, most of them (66.4%) were male. Approximately one-third (32.7%) of them used one substance, while 48.1% combined GHB with ecstasy, alcohol, or cannabis. One of five (19.2%) combined GHB with other substances or more than one substance. One case was categorized as severe/life-threatening and 202 (26.2%) cases as moderate, requiring further medical care. In total, 43 (5.6%) First Aid Attendees needed hospital care. The most encountered health disturbance was altered consciousness. Combinations of altered consciousness, vomiting, and/or low body temperature were found in 186 cases (24.1%) and considered to be potentially dangerous. GHB-related First Aid Attendees required a longer stay at the First Aid Stations than the total group First Aid Attendees did (median 45 min vs 10 min). **Conclusion.** We found very little, severe short-term GHB-related health disturbances during rave parties in The Netherlands. Hospital referrals were rare. The most found symptom was altered consciousness, sometimes accompanied by vomiting and low body temperature. At events where the visitors use GHB, a well-trained and qualified medical team, including nurses and physicians, is recommendable. They must be able to recognize GHB intake and prevent secondary problems such as aspiration and hypothermia.

**Keywords** CNS/psychological; Cardiac support; Respiratory support

## Introduction

In the late 1990s, a new recreational drug appeared in nightlife. This drug, gamma-hydroxybutyric acid or gamma-hydroxybutyrate (GHB), was mentioned in several studies around 1999 as emerging, life-threatening, and related to sexual assault.<sup>1–10</sup> In The Netherlands, it was introduced in the year 1999. A risk assessment was performed by the Dutch government.<sup>11</sup> It was expected that GHB could be used at so-called rave parties. Since 2002, GHB is an illicit drug in the Netherlands.

In the Netherlands, rave parties are organized for 500 to 60 000 visitors per event. These events, also known as raves or dance events, with DJ-directed fast-paced electronic music and light shows, are visited by about 800 000

youngsters every year in The Netherlands.<sup>12</sup> Parties are held during nighttime or, in summer, in daytime and last usually 9–12 hours. Several studies have indicated that the use of recreational drugs during raves is common, and the majority of visitors, mostly youngsters, uses one or more drugs.<sup>13–20</sup> In The Netherlands, rave parties are allowed under the condition of preventive measures, including the presence of an effective medical service system.

The amount of medical care at large-scaled events can be expressed in medical usage rate (MUR).<sup>21,22</sup> The number of (first aid) attendees per 10 000 (party) visitors defines MUR. In a survey in The Netherlands from 1997–2005, an average MUR of 79 (59–170) at house parties was determined.<sup>23</sup>

## Gamma-hydroxybutyric acid or GHB

Surveys conducted in dance music settings and other targeted surveys report lifetime prevalence of GHB use from 3 to 19%;<sup>24</sup> a survey of 408 pub visitors in

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Amsterdam conducted in 2005 reported lifetime prevalence of 10%. However, evidence suggests a niche market for GHB, where use is concentrated in very specific subpopulations. Among respondents sampled in Amsterdam bars frequented by gay men, the prevalence estimates for GHB use rose to 17.5%, and in the city's trendy bars up to 19% compared to less than 5% among respondents in the more mainstream or student pubs.

A Dutch survey conducted in 2001 among 72 GHB users reported that three quarters of the respondents used GHB at least once a month in the past year, and 50% of them had taken it at least once a week. GHB was mostly taken in combination with other substances.<sup>25</sup>

In 2008/2009, the use of substances was investigated among parties and festivals. For GHB, lifetime prevalence of 14% was found. Three percent of all visitors used GHB, but great differences were found between parties (range 0–20%).<sup>20</sup>

The objective of this study was to determine the health disturbances and to assess the severity of the incidents as reported during a 9-year experience of GHB-related First Aid Attendees attending First Aid Stations at rave parties.

## Methods

### Design and participants

A prospective observational study of self-referred patients who reported to an available First Aid Station (First Aid Station) during Dutch rave parties was conducted. All users of medical care were registered, but only those with GHB-related problems were included in this study.

A standard registration questionnaire was developed to gather the reported health problems. Part of the information that was collected included the type and the number of substances that were used as well as contributory health complaints. All cases were scored on a two-dimension level. Incidents were categorized as medical, trauma, psychological, or miscellaneous (Table 1). Next to these categories, each incident was classified as mild (defined as absence of professional medical care), moderate (defined as

professional medical care required), or severe (defined as life-threatening), based on the Severity Index.<sup>26</sup>

Qualified nurses, paramedics, and physicians, all with additional specific training on party-related risks, including effects of recreational drugs, examined the patients. Of all First Aid Attendees, level of consciousness and body temperature were measured. Members of staff of the First Aid Station were trained in using the questionnaire as well in an introduction course and a yearly refresher and update course. A colleague, who was especially appointed to support the staff in filling out the questionnaires, coached all staff members. Mistakes and inconsistencies were corrected on scene.

The number of visitors was obtained from the organizers of the events (total number of sold tickets).

### Procedure

After entering the First Aid Station, the attendee was received by a front desk officer, who asked the patient about his complaint, injury, or question. Some visitors attended the First Aid Station for self-treatment; they asked to get a band-aid to avoid blisters or asked for a painkiller to relieve their headache, and therefore were not assessed as a medical problem. All other attendees were transferred to a member of the medical staff, who assessed the health problems. All data were registered in the standard questionnaire.

After discharge from the First Aid Station or transfer to ambulance personnel for hospital transport, a staff member who was especially assigned to verify the registration checked all data on the questionnaire. This official also classified the incident as mild, moderate, or severe and categorized it as medical, trauma, psychological, or miscellaneous.

### Statistics

Descriptive statistics were used. For comparison of nonparametric data, Mann–Whitney *U*-test was used, whereas for normally distributed data, a Student's *t*-test was used. A *p*-value of <0.05 was considered significant. All analyses were performed using SPSS version 17.0 (SPSS Inc).

**Table 1.** Categorized health problems.

Category	Definition	Questionnaire items
Medical	General medical complaints or health disturbances	General unwell-being/fainting, nausea, vomiting, dizziness, altered consciousness, palpitations, altered body temperature, stomach ache, hyperventilation, dyspnea, and cramps
Trauma	Local injuries	Wound/laceration, burn, blister/skin injury, contusion, distortion, fracture, tooth injury, insect bite or stitch, nail problem, foreign body, and local inflammation
Psychological	Psychological and psychiatric symptoms	Anxiety, disorientation, psychotic delusion, and agitation
Miscellaneous	A combination of medical, trauma, and/or psychological, or not fitting in other categories	

## Results

### Demographics

A summary of all rave parties included in this study is in Table 2. Data from 202 events, totaling approximately three million visitors and 22 604 First Aid Attendees, were collected. Mean age was  $22.3 \pm 5.4$  years. The male/female ratio was 52.4/47%. Of all First Aid Attendees, an average of 32.9% suffered from a substance-related health disturbance.

In total, 771 attendees visited the First Aid Station after the use of GHB. Mean age was  $25.7 \pm 6.1$  years. Approximately two-third (66.4%) of them were male. Median stay at the First Aid Station was 45 min and significantly longer than the median stay of the total group of First Aid Attendees, which was 10 min ( $n = 22\ 604$ ,  $p < 0.001$ ).

Of all GHB-using First Aid Attendees, 252 (32.7%) attendees used GHB only (one substance), 190 (24.6%) combined GHB with ecstasy, 123 (15.6%) with alcohol, and 61 (7.9%) with cannabis. The remaining 145 persons (18.8%) combined GHB with other substances, such as amphetamine (2.3%) or cocaine (0.8%), or more than one other substance. In total, 97 (12.6%) First Aid Attendees used a combination of GHB, ecstasy, and alcohol.

### Clinical features

One of 252 cases of First Aid Attendees using only GHB was categorized as severe/life-threatening (respiratory

failure), while 55 cases (21.8%) scored moderate on the Emergency Severity Index.<sup>26</sup> The severe case concerned a 43-year-old man with a pre-existing trachea aberration. Endotracheal intubation failed on scene. The patient was discharged from the hospital after only 2 days.

Most First Aid Attendees using only GHB (67.7%) suffered from mild problems. In First Aid Attendees who combined use of GHB with other substances ( $N = 519$ ), no life-threatening cases were found. In total, 147 First Aid Attendees (28.3%) were classified as moderate severity (Table 3).

Most occurring health disturbances of First Aid Attendees using only GHB were altered consciousness (56.0%), followed by general unwell-being (34.5%), low body temperature (22.2%), vomiting (17.5%), disorientation (8.7%), and dizziness (7.1%). Other reported symptoms were cramps and agitation (both 2.0%); trauma (1.4%); anxiety, gastric pain, high body temperature, and psychotic delusion (all 0.8%); and stomach ache (0.4%).

Of all 87 GHB-related cases of altered consciousness, half of them scored lower than eight on the Glasgow Coma Scale (GCS) on the range of 3–14 (Fig. 1). With 54 cases, altered consciousness was also found, but the GCS-score remained unknown. In 56 (7%) cases using GHB, low body temperature ( $< 36.6$  C) was found. No case of severe hypothermia ( $< 32$  C) was seen. One case was classified as moderate and 24 cases as mild hypothermia.

**Table 2.** Party characteristics, medical usage rate, and substance-related First Aid Station visits.

Year	Parties	Party visitors	First Aid Attendees	MUR*	Substance-related visits†(%)
2000	14	226 500	1843	81	670 (36.4)
2001	29	420 500	3629	86	1371 (37.8)
2002	26	466 000	2971	64	1109 (37.3)
2003	35	476 750	3337	70	1135 (34.0)
2004	33	453 500	3818	84	1166 (30.5)
2005	33	455 750	2690	59	914 (34.0)
2006	10	265 000	1249	47	351 (28.1)
2007	13	297 000	1600	54	444 (27.8)
2008	9	252 000	1467	58	442 (30.1)

\* MUR, Medical Usage Rate – amount of First Aid Attendees per 10 000 party visitors.

† Percentage of the First Aid Attendees.

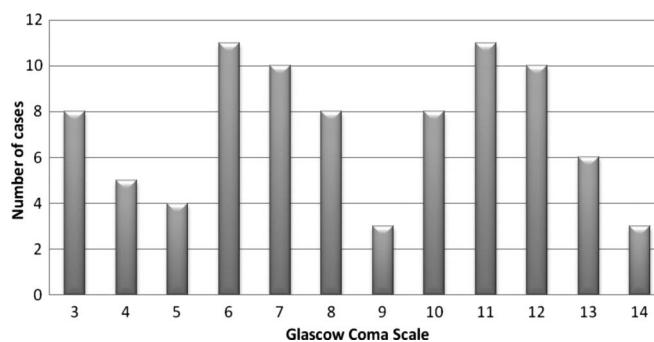
**Table 3.** Severity index and classifications of GHB-related health problems and of problems with GHB combined with other substances.

	GHB alone (N = 252)			GHB plus other substances (N = 519)		
	Severe*	Moderate†	Mild‡	Severe	Moderate	Mild
Medical	0.4% (1)	20.2% (51)	64.7% (163)	0	25.2% (131)	60.5% (314)
Trauma	0	0	0.4% (1)	0	0.2% (1)	0.8% (4)
Psychiatric	0	0.4% (1)	1.2% (3)	0	1.0% (5)	2.1% (11)
Miscellaneous	0	1.2% (3)	11.4% (29)	0	1.9% (10)	5.45 (28)

\* Life-threatening.

† Not life-threatening, but professional medical care required.

‡ Absence of professional medical care.



**Fig. 1.** Cases of GHB-related altered consciousness with GCS < 15 (N = 141, median = 8, and range = 12).

### Treatment and clinical referrals

Most First Aid Attendees were treated at the First Aid Station. Three persons (0.4%) were referred to their family doctor, and 43 (5.5%) patients were transported to the hospital emergency department, because of persevering altered consciousness and potentially threatened airway.

### Discussion

During 9 years of experience at rave parties with over three million visitors, 771 First Aid Attendees (3.4% of all First Aid Attendees) who used GHB were seen at the First Aid Station on scene. Compared to other substance-related problems, this is indeed a very low number of cases. In a 9-year lasting study among rave party visitors, most substance-related health disturbances of First Aid Attendees were related to ecstasy (21.8%) and alcohol (16.1%).<sup>23</sup>

In 23.6% of the GHB-using First Aid Attendees, serious symptoms such as altered consciousness were present. One severe case of respiratory failure was presented, requiring short-term hospital stay and mechanical ventilation. No GHB-related mortality was observed.

GHB is frequently used in combination with other party drugs. This implies that in case of patients with suspected GHB-related symptoms, the likelihood of other drugs involved should be taken into account. However, in our series, no differences in severity of symptoms were found in First Aid Attendees using only GHB vs those who used GHB in combination with other substance(s). But patients with GHB-related problems require a longer stay in the First Aid station than other First Aid Attendees. Accidental hypothermia is a potentially dangerous condition and can easily be overlooked. Our observation of the present combination of altered consciousness, vomiting, and hypothermia underscores the importance of systematic examination of First Aid Attendees suspected of GHB-related symptoms. Instruction and training of staff involved in medical assistance during rave parties should therefore focus on these symptoms, using appropriate protocols. It is

of note that this combination of conditions is underreported in the current literature.<sup>25,27–30</sup>

Interestingly, the majority of First Aid Attendees with GHB-related complaints did not require hospital care: the supportive care of First Aid Stations with appropriately trained staff was sufficient to deal with most encountered problems.

Some symptoms, such as general unwell-being, nausea, and dizziness, were likely not GHB-specific. It is conceivable that some of the rave visitors developed these complaints after a 6–12-hour lasting event, because of tiredness and dehydration.

Questions remain as to whether the relatively low rate of severe incidents is related to the open and legal circumstances under which rave parties take place in The Netherlands. It is not unlikely to assume that an open and easy access to medical facilities during rave parties encourages early recognition of complaints and thereby more health-promoting behavior (disease-limiting behavior) in visitors of rave parties. Data from The Netherlands can, therefore, not be extrapolated automatically to other countries, where rave parties with party drugs take place in more or less hidden and secret conditions. It would, therefore, be of interest to investigate the incidence of health-related problems during rave parties in other countries. It will, however, by definition be difficult to compare data of different countries with different legislation and medical infrastructure during rave parties. To our knowledge, no publications on GHB-related cases during large-scaled events at First Aid Station are available at this time.

### Limitations of the study

Long-term effects of substance use or drug addiction were not investigated and remain, therefore, unknown. Other limitations of this study include that although the sample is large, it only includes self-referrals and does not necessarily provide a complete overview of all GHB-related disturbances at rave parties. It is possible that a number of persons suffered from complaints, but did not visit the First Aid Station. Wijngaart et al and de Bruin et al found that some party visitors sought help with friends, security personnel, or catering staff.<sup>18,19,31</sup> Furthermore, some visitors with health complaints may have gone directly to their general practitioner or a hospital emergency room, instead of attending the on-scene First Aid Station.

In some cases, the questionnaire was not filled in accurately. Specifically, for 54 cases, altered consciousness was reported, but no score on the GCS was given.

No biological confirmation of the substance intake by toxic screening of urine or blood was done. We have not measured to what the attendees were exposed to, quantitatively or qualitatively. We only know what they voluntarily reported. Next to this, substance use may have been underestimated related to stigmatization or fear of law enforcement.



## Conclusions

We found very little severe short-term GHB-related health disturbances during rave parties in The Netherlands. Hospital referrals were rare. Most found symptom was altered consciousness, sometimes accompanied by vomiting and low body temperature.

At events where the visitors use GHB, a well-trained and qualified medical team including nurses and physicians is recommendable. They must be able to recognize GHB intake and prevent secondary problems such as aspiration and hypothermia.

## Declaration of interest

The author reports no conflicts of interest. The author alone is responsible for the content and writing of the paper.

## References

- Munir V, Hutton J, Harney J, Buykx P, Weiland T, Dent A. Gamma-hydroxybutyrate: a 30 month emergency department review. *Emerg Med Australas* 2008; 20:521–530.
- Williams H, Taylor R, Roberts M. Gamma-hydroxybutyrate (GHB): a new drug of misuse. *Ir Med J* 1998; 91:56–57.
- Hodges B, Everett J. Acute toxicity from home-brewed gamma hydroxybutyrate. *J Am Board Fam Pract* 1998; 11:154–157.
- Ryan JM, Stell I. Gamma hydroxybutyrate – a coma inducing recreational drug. *J Accid Emerg Med* 1997; 14:259–261.
- James C. Another case of gamma hydroxybutyrate (GHB) overdose. *J Emerg Nurs* 1996; 2297.
- Ross TM. Gamma hydroxybutyrate overdose: two cases illustrate the unique aspects of this dangerous recreational drug. *J Emerg Nurs* 1995; 21:374–376.
- Graeme KA. New drugs of abuse. *Emerg Med Clin North Am* 2000; 18:625–636.
- Eckstein M, Henderson S, Delacruz P, Newton E. Gamma hydroxybutyrate (GHB): report of a mass intoxication and review of the literature. *Prehosp Emerg Care* 1999; 3:357–361.
- ElSohly M, Salamone S. Prevalence of drugs used in cases of alleged sexual assault. *J Anal Toxicol* 1999; 23:141–146.
- Kam P, Yoong F. Gamma-hydroxybutyric acid: an emerging recreational drug. *Anaesthesia* 1998; 53:1195–1198.
- Keizer ADJ, Scholten WK, Lousberg RJJ, Kustner B, Knaack F, Spruit IP, et al. Risicoschattingsrapport betreffende gammahydroxybutyraat (GHB). Den Haag: IGZ; 1999.
- Gram H, Jongedijk S, Olthof S, Reinders A, van Schubert D. Dance in Nederland. De betekenis en impact van dance op de Nederlandse economie en maatschappij: Een verkenning. KPMG: Amstelveen; 2002.
- Abraham MD, Kaal HL, Cohen PDA. Licit and Illicit Drug Use in The Netherlands 2001. Amsterdam: Cedro/Mets & Schilt; 2002.
- Engels RC, ter Bogt T. Outcome expectancies and ecstasy use in visitors of rave parties in the Netherlands. *Eur Addict Res* 2004; 10:156–162.
- Pijlman FTA, Krul J, Niesink RJM. Uitgaan en veiligheid: feiten en fictie over alcohol, drugs en gezondheidsverstoringen. Utrecht: Trimbos; 2003.
- ter Bogt TFM, Engels RCME. Partying hard: party style, motives for and effects of MDMA use at rave parties. *Subst Use Misuse* 2005; 40:1479–502.
- ter Bogt TFM, Engels RCME, Dubas JS. Party people: personality and MDMA use of house party visitors. *Addict Behav* 2006; 31:1240–1244.
- van de Wijngaart GF, Braam R, de Bruin D, Fris M, Maalsté N, Verbraeck H. Ecstasy in het uitgaanscircuit. Utrecht: CVO; 1997.
- van de Wijngaart GF, Braam R, de Bruin D, Fris M, Maalste NJM, Verbraeck HT. Ecstasy use at large-scale dance events in the Netherlands. *J Drug Issues* 1999; 29:679–702.
- van der Poel A, Doekhie J, Verdurmen J, Wouters M, Korf DJ, van Laar M. Feestmeter 2008–2009. Uitgaan en middelengebruik onder bezoekers van party's en clubs. Utrecht: Trimbos-instituut; 2010.
- Milsten AM, Maguire BJ, Bissel RA, Seaman KG. Mass-gathering medical care: a review of the literature. *Prehospital Disast Med* 2002; 17:151–162.
- Milsten AM, Seaman KG, Liu P, Bissel RA, Maguire BJ. Variables influencing medical usage rates, injury patterns, and levels of care for mass gatherings. *Prehospital Disast Med* 2003; 18:334–346.
- Krul J, Girbes ARJ. Experience of health-related problems during house parties in the Netherlands: nine years of experience and three million visitors. *Prehospital Disast Med* 2009; 24:133–139.
- Nabben T, Benschop A, Korf DJ. Antenne 2005: Trends in Alcohol, tabak en drugs bij jonge Amsterdammers. Amsterdam: Rozenberg; 2006.
- Korf DJ, Nabben T, Leenders F, Benschop A. GHB: Tussen Extase en Narcose. Amsterdam: Rozenberg; 2002.
- de Boer J. Rampengeneeskunde. Een samenvattend overzicht. Spoeisende en rampengeneeskunde. Amsterdam: VU Uitgeverij; 2001. pp 179–191
- Bodson Q, Denooz R, Serpe P, Charlier C. Gamma-hydroxybutyric acid (GHB) measurement by GC-MS in blood, urine and gastric contents, following an acute intoxication in Belgium. *Acta Clin Belg* 2008; 63:200–208.
- Degenhardt L, Darke S, Dillon P. GHB use among Australians: characteristics, use patterns and associated harm. *Drug Alcohol Depend* 2002; 67:89–94.
- Galicía M, Nogue S, To-Figueras J, Echarte JL, Iglesias ML, Miro O. Poisoning by liquid ecstasy (GHB) in hospital emergency departments of Barcelona: a 2-years study. *Med Clin (Barc)* 2008; 130:254–258.
- Sporer KA, Chin RL, Dyer JE, Lamb R. Gamma-hydroxybutyrate serum levels and clinical syndrome after severe overdose. *Annals Emerg Med* 2003; 42.
- de Bruin D, Maalste NJM, van de Wijngaart GF. Goed fout gaan. Eerste hulp op grote dansevenementen. Utrecht: CVO; 1998.