

A rapid scoping review of self-initiated harm reduction strategies for ecstasy (MDMA) users in recreational settings

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Systematic Review

Keywords: MDMA, Ecstasy, Harm Reduction, Scoping Review

Posted Date: June 15th, 2023

DOI: <https://doi.org/10.21203/rs.3.rs-2178425/v2>

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Abstract

Background: Adverse drug reactions (ADRs) can occur due to ecstasy use, and the number of people dying due to drug-related deaths has increased in the past 10 years. Self-initiated harm reduction strategies could help prevent ADRs or decrease the incidence of life-threatening health consequences due to ecstasy use.

Methods: A rapid scoping review was conducted using adapted JBI methodology. The objectives were to describe the strategies employed by ecstasy users to minimise harm, the sources of information they rely on, and to assess the content of user-oriented websites regarding detrimental effects and harm reduction practices. Five databases (CINAHL, EMBASE, Medline, PsycINFO, CENTRAL) were searched for English language records from database inception to August 2022. User-oriented websites were identified via the project's stakeholder group and Google searches.

Results: Twenty reports representing 19 studies (one RCT, nine quantitative descriptive studies and nine qualitative studies) were included. A wide variety of self-initiated harm reduction strategies were reported, including drug checking, dose control (including buying from trusted sources), seeking peer support (e.g., looking out for friends), hydration management and temperature regulation (e.g., monitoring water consumption, taking rest breaks, and avoiding alcohol), avoiding polydrug use, and pre- / post-loading. Information on ecstasy's effects and/or harm reduction practices is obtained from a variety of sources including friends, nightclubs, drug leaflets, and user-oriented websites. Fourteen websites providing ecstasy-specific harm reduction information were also identified and quality assessed. However, only two webpages provided citations to the evidence used for the content.

Conclusions: The provision and quality assessment of ecstasy harm reduction advice from various sources has been collectively analysed for the first time. We hope and anticipate that use of this rapid scoping review will facilitate more comprehensive, evidence-based harm reduction messaging, reducing the likelihood of future ADRs and life-threatening health consequences related to ecstasy use.

Introduction

Ecstasy (3,4-methylenedioxymethamphetamine – MDMA) is a common recreational drug and sought effects include euphoria and feelings of happiness (Curran & Travill, 1997) along with increased energy, musical appreciation and emotional closeness with others (Pascoe et al., 2022). Illicitly acquired MDMA can vary in appearance, with crystalline and tablet forms available (Pascoe et al., 2022). The consistency of crystalline MDMA can range from crystals to crushed powder, with colours presenting from shades of beige to brown or off-white, and can be prepared into capsules or "bombs" (cigarette paper wraps) for oral consumption (Pascoe et al., 2022). Modern ecstasy tablets typically feature logos, fictional characters or other cultural references and are available in a range of shapes and colours (Pascoe et al., 2022).

Ecstasy is often taken in settings such as night clubs and raves where an individual may engage in prolonged and vigorous dancing, often coupled with high temperatures, while drinking very little water (ACMD, 2008). As a consequence, hyperpyrexia (hyperthermia; heatstroke) are frequently reported adverse drug reactions (ADRs) (MAPS, 2021; van Amsterdam et al., 2021). Another ADR that is frequently reported is water intoxication with secondary low sodium levels, referred to as hyponatremia (MAPS, 2021; van Amsterdam et al., 2021). The concurrent use of MDMA and alcohol may increase the risk of hyperthermia and hyponatremia (van Amsterdam et al., 2021). Other ADRs as described in published case reports range from milder problems, such as restlessness, insomnia, bruxism/muscular clenching, nausea and dry mouth, to serious health issues including psychiatric problems, hepatotoxicity secondary to hyperthermia, cardiac and/or respiratory disorders, acute renal failure, aplastic anaemia, allergic reactions and anaphylaxis, eye and skin conditions (MAPS, 2021). Although rare, the use of MDMA can also lead to seizure, coma and death, largely due to hyperthermia or hyponatraemia associated to water intoxication (Elkattawy et al., 2021).

Whilst relatively rare (MAPS, 2021), MDMA/ecstasy-related deaths have increased in England and Wales in the past decade, with the most recent figures reporting 67 deaths in 2021 compared to just 13 in 2011 (Office for National Statistics, 2021). Since the widely publicised ecstasy-related death of Leah Betts in 1995 (Gray, 2020), the media has continued to report on the stories of other young people who have tragically died following consumption of this drug (Atkinson, 2022; Gantzer, 2020; Jones & PA reporters, 2020; Keate, 2017; Roig, 2022; Whitney, 2001). One of the most recent deaths in the UK was of a 22-year-old, who died after taking a single 'Blue Tesla' ecstasy tablet in his bedroom to determine its strength (Merritt, 2023). These stories serve as poignant reminders of the potential dangers associated with MDMA/ecstasy, emphasising the importance of comprehensive harm reduction efforts and raising awareness about the risks involved with use.

The variation in purity and strength of MDMA can vary considerably between samples and over time this presents a significant problem because it poses risks to individuals who use ecstasy. As of 2020, the typical purity of MDMA powder/crystals in Europe was observed to range from 62–83% (EMCDDA, 2022), with changes observable between years (EMCDDA, 2020). These changes are relatively modest compared to ecstasy tablets, where the average MDMA content has increased by approximately 80% over the past decade (EMCDDA, 2022). This trend appears to be linked to the overall size/mass of tablets, which is also increasing (Vrolijk et al., 2022), and many tablets are now found to contain 2-3 times a typical recreational dose of 80-120 mg. Even within batches of similar tablets, ecstasy content and dissolution profiles can vary considerably, impacting pharmacokinetics upon consumption (Couchman et al., 2019). The inconsistent quality of MDMA samples means that users cannot accurately determine the potency or composition of the

substance they are consuming. This lack of knowledge increases the likelihood of unintended consumption of high doses, which can increase the risk of serious health consequences.

Harm reduction refers to a set of strategies and approaches that aim to prevent ADRs and reduce the occurrence of damaging health consequences associated with drug use (Allott & Redman, 2006). Self-initiated harm reduction strategies for ecstasy users involve taking personal responsibility and proactive steps to minimise potential risks and promote safer use practices. The strategies can include hydration management, temperature regulation, dose control, testing for purity/strength and seeking support/medical assistance (ACMD, 2008; Davis & Rosenberg, 2017; Gowing et al., 2002; van Amsterdam et al., 2021). Recreational venues like nightclubs, music festivals, and raves play a vital role in promoting harm reduction for ecstasy users. As popular settings for recreational ecstasy use, these venues can implement specific measures to enhance harm reduction efforts related to ecstasy use such as ensuring free water is easily accessible to event attendees and providing “chill out” spaces at venues to improve temperature control.

Recreational venues can also play a significant role in facilitating drug testing and drug checking services (Palamar et al., 2021). Unlike prescription medicines, which are produced under highly regulated and reproducible conditions, illicit MDMA is synthesised and distributed via criminal networks without due regard for quality control. This means that ADRs may occur due to drug mislabelling/misidentification, the presence of contaminants, or inaccurate tablet dosing (Rigg & Sharp, 2018).

These services, offered by organisations such as the Drugs Information and Monitoring System (Netherlands), DanceSafe (US) and The Loop (UK), facilitate testing of substances to determine purity and content. Such services may perform surveillance on circulating substances or invite users to submit substances for chemical analysis whilst providing individualised advice as part of a health consultation or intervention (Maghsoudi et al., 2022; Measham & Turnbull, 2021).

The provision of prevention or harm reduction information is crucial in mitigating drug-related morbidity and mortality associated with ecstasy use (Gascoigne et al., 2004). Sources of information on ecstasy’s effects and/or harm reduction practices information for young people include online resources, social media platforms, peer networks, school or college health programmes and public health campaigns and awareness events (Alcohol and Drug Foundation, 2021; Gascoigne et al., 2004). In the context of harm reduction, the internet is increasingly being used as source of information regarding the use and safer consumption of ecstasy. The internet serves as a platform where users can find for example guidance on safer dosing practices, information on testing the purity of ecstasy, user reports (e.g., pillreports.net), strategies to prevent dehydration and overheating, and recommendations for minimising potential drug interactions. Whilst there is a plethora of user-oriented drug information websites for ecstasy (Deluca & Schifano, 2007). It is vital to ensure that the information presented is evidence-based and supported by reputable sources to promote safer and informed ecstasy use (ACMD, 2008).

Based on an initial scope of the literature, we identified several reviews that had been conducted in relation to the use and safer consumption of ecstasy in recreational settings. These included an overview of ecstasy use (Peters & Kok, 2009); the harmful health effects of ecstasy (Gowing et al., 2002; Rodgers et al., 2006); and mechanisms leading to hyperpyrexia and hyponatremia (van Amsterdam et al., 2021). One further review (Maghsoudi et al., 2022) sought to identify what is known about drug checking services and people who use drugs, with just a brief mention of ecstasy. However, no scoping reviews specifically focusing on self-initiated harm reduction practices were identified. Additionally, there was one study that assessed the perceived accuracy and the significance of different information sources (Gascoigne et al., 2004) and another that conducted an analysis of information available online on ecstasy (Deluca & Schifano, 2007). We did not find any reviews that focused on the quality of information provided on the use and safer consumption of ecstasy, or the content of user-oriented drug information websites for ecstasy related to its detrimental effects and harm reduction practices. Therefore, this study aims to contribute to the existing body of literature in these areas by conducting a scoping review. The specific objectives were to describe:

- i). the self-initiated harm reduction strategies employed by ecstasy users in recreational settings;
- ii). the different sources from which ecstasy users obtain information related to its detrimental effects and harm reduction practices;
- iii). the content of user-oriented drug information websites for ecstasy related to its detrimental effects and harm reduction practices.

Methods

In order to conduct a scoping review within the required time available a rapid approach was conducted using established methods (Arksey & O’Malley, 2005; Levac et al., 2010; Peters et al., 2020) and reported using Preferred Reporting Items for Systematic Reviews and Meta-Analyses Scoping Review extension (PRISMA-ScR) (Tricco et al., 2018). Using a streamlined process (e.g., searching fewer databases and omitting critical appraisal) a rapid review can provide high-quality evidence and knowledge (Langlois et al., 2019). Rapid scoping reviews have been conducted across a wide range of health-related topics for the purposes of identifying key concepts or knowledge gaps within a short timeframe (Barker et al., 2017; Côté et al., 2021; Threapleton et al., 2017; Vogt et al., 2022). Our registered study protocol on Open Science Framework can be found at: <https://osf.io/tf427/>.

Eligibility criteria

The eligibility criteria are presented using the PCC framework (Peters et al., 2020), Participants (P), Concept (C) and Context (C), and can be found in Table 1 below.

Insert Table 1 here

Searching for research evidence

Four databases (on the EBSCO platform – CINAHL; on the OVID platform – EMBASE, Medline, APA PsycINFO and Cochrane Library: Cochrane Central Register of Controlled Trials (CENTRAL)) were searched for English language records from database inception to August 2022 using the keywords methylenedioxy-N-methylamphetamine OR MDMA OR ecstasy AND harm reduction OR modify) (see Additional file 1). Forward and backward citation tracking was undertaken using the web-based system Citation Chaser™ (Haddaway et al., 2022). All records were imported into reference software package EndNote X20™, duplicates removed and then all the records that remained were imported into the web-based systematic review software Rayyan™.

Searching for websites

We consulted with the project stakeholder group (Pollock et al., 2021) to identify UK based websites that provided harm reduction information on ecstasy and also conducted a Google search (Mahood et al., 2014). For the Google search the following terms were used: harm reduction and ecstasy; harm reduction and MDMA; safe and MDMA; safe and ecstasy. One reviewer (DE) conducted the search and subsequently screened the first page of each Google output for relevant UK websites.

Study selection process

Two reviewers (DE, EG) screened the titles and abstracts of records using Rayyan™ and any disagreements were resolved through discussion. Full texts were retrieved for records that met the inclusion criteria and for those where a decision could not be made based on the title and/or abstract alone. Full-text screening (with the aid of a screening tool) was then conducted by one reviewer (DE, JCs), and all decisions were checked by another (JC, CB, BH) with any disagreements resolved through discussion.

Data extraction

For the research studies all demographic data (country, focus, participants, age, gender, recruitment, study design and methods) were extracted directly into tables by one reviewer (DE, JCs) and checked by another (JCs, DE). Findings relevant to the review objectives were extracted by one reviewer (DE, JCs) and 50% checked for accuracy by another (JCs, DE). The software package NVIVO 12 Plus™ was used to facilitate this process. Quality appraisal was not conducted.

For the websites all relevant details (title of the webpage, country of publication, date of publication, url of the organisation, source and url of any specific MDMA harm reduction information) were extracted directly into tables by one reviewer (DE, JCs) and checked by another (JCs, DE). The software package NVIVO 12 Plus™ was used to facilitate this process.

Presentation of results

The review findings are presented in tables and as narrative summary following the approach described by Arksey and O'Malley (Arksey & O'Malley, 2005) and updated by Levac (Levac et al., 2010) and describe how the results relate to the review objectives and research question.

Study inclusions

Figure 1 shows the PRISMA-ScR flow diagram for study selection process (Tricco et al., 2018). Of the 877 records identified, 37 full-text reports were assessed for eligibility. Seventeen full-text reports did not meet the inclusion criteria (see Additional file 2). A total of 20 reports (representing 19 studies) were included. In addition, after duplicates had been removed 30 websites were assessed for eligibility and a total of 15 were included. Fifteen websites were excluded (see Additional file 3).

Insert Figure 1 around here

Characteristics of included studies

Publication type

Twenty reports representing 19 studies (see Tables 2 to 4) were selected for inclusion, one randomised control trial, nine quantitative descriptive studies and nine qualitative studies (across 10 reports).

Insert Tables 2 to 4 around here

Country and year of publication

The included studies were conducted in Australia (n=6), the USA (n=5 studies across six reports) the UK (n=2) and the Netherlands. Additionally, four studies were conducted across multiple countries, which often included USA, UK, Canada, among others, such as European countries, Mexico, and New Zealand. Dates of publication ranged from the year 2000 to 2022.

Participant details

Across the included studies the participants were all ecstasy users (n=14 studies across 15 reports) or ecstasy sellers, adult key informants which included drug checkers, drug sellers, or having extensive experience using or testing for new psychoactive substances or music festival attendees of which a proportion had at some point used MDMA at a music festival.

Most of the studies focused on young adults, with nine studies (represented across 10 reports) with participants reporting a mean age of under 30 years (mean age ranged from 21 to 28 years) and one further study reporting a median age of 25 years. In 11 of the studies some of the participants were 30-year-olds. Overall, the youngest participant across the included studies was 16, while the oldest was in the 51-60 age range.

Characteristics of included websites

Fourteen webpages were included, and further details are provided within Table 5.

Insert Table 5 around here

Review findings

Description of self-initiated harm reduction practices

The first objective was to describe the harm reduction strategies employed by ecstasy users in recreational settings. We found a wide variety of self-initiated harm reduction strategies for ecstasy users in recreational settings were reported (see Table 6). These were used to either avoid ecstasy-related side-effects, 'comedown' (hangover experiences) and/or neurotoxicity effects.

Regarding prevalence, Davis and Rosenberg (2017) reported that three quarters of those surveyed, regardless of whether a person was an occasional or regular ecstasy user or lived in the UK or USA, had employed 11 strategies at least once in the two-month assessment period out of 19 harm reduction practices proposed by the authors. The proposed harm reduction practices included ones presented in Table 6, as well as strategies aiming to enhance the effect of ecstasy, such as getting into a good mood prior to drug use (Davis & Rosenberg, 2017). All participants in the study by Allott and Redman (2006) had used at least one strategy from a predetermined list.

Insert Table 6 around here

Findings from the qualitative studies however reported that young people are not always concerned about the potential health risks of taking ecstasy as they have no personal experience of ADRs and there is often a disparity between the harm reduction strategies that young people report they engage in and their actual behaviour (Hansen et al., 2001). Although many young people are aware of the risks, Singer and Schensul (2011) reported that for some young people the benefits of ecstasy are more important to them than the potential harms and this justifies its use.

Drug checking

Ten studies focused on or mentioned drug checking as a potential harm reduction strategy which can be conducted either by using ecstasy self-testing kits, through using drug checking operations provided by harm reduction organisations at venues / events, or through laboratories which are set up for drug testing (Allott & Redman, 2006; Davis & Rosenberg, 2016, 2017; Hollett & Gately, 2019; Kelly, 2007; Murphy et al., 2021; Panagopoulos & Ricciardelli, 2005; Sharifimonfared & Hammersley, 2020; Singer & Schensul, 2011; Southey et al., 2020). Some participants across the studies reported visually inspecting the shape, size and colour of an ecstasy pill for signs of adulteration (Panagopoulos & Ricciardelli, 2005; Singer & Schensul, 2011).

Two studies reported on the psychological determinants of behaviour that influence drug checking intentions (Davis & Rosenberg, 2016; Murphy et al., 2021). One study found that attitudes, subjective norms and behavioural control (psychological determinants of behaviour) were found to have a significant positive association ($p < 0.001$) with drug checking intentions (Davis & Rosenberg, 2016). Greater baseline intentions to use drug checking services were a statistically significant predictor of engaging in this harm-reduction behaviour ($p = 0.018$) during a 2–3-month follow-up period (Davis & Rosenberg, 2016). Murphy et al.'s (2021) findings support this as attitudes ($p < 0.001$), subjective norms ($p < 0.001$), and perceived behavioural control ($p < 0.05$) were all found to significantly predict intention to use fixed offsite drug checking services. However, the authors differentiated between fixed offsite and onsite drug checking, and further findings indicated that in contrast to fixed offsite drug checking, subjective norms were the only significant predictors ($p < 0.001$) of onsite drug checking services (Murphy et al., 2021). Additionally, Murphy et al. (2021) explored intention to use ecstasy if drug checking was available and found that the availability of drug checking did not increase non-users' or experienced users' intention to consume the drug (p values not reported).

Risk reduction/pill consumption practices following drug checking results were explored across three studies. Southey et al. (2020) reported that regular (daily, weekly or fortnightly) ecstasy users in Australia were more likely to take the drug regardless of the presence of possible adulterants, than rare (to six monthly, yearly or one time) users. The hypothetical drug checking scenarios in the study by Hollett and Gately (2019) described either an inconclusive test (unknown substance), the detection of a high MDMA dose, or a harmful adulterant (such as paramethoxyamphetamine (PMA) or paramethoxymethamphetamine (PMMA)). It was shown that ecstasy users only reported a significantly greater likelihood of following harm reduction strategies compared to maintaining harm reduction intentions if known harmful adulterants were identified. Additionally, harm-reducing behaviours were significantly less likely for those who scored highly in 'sensation seeking' and particularly if a test result indicated a high MDMA dose ($p < 0.01$) (Hollett & Gately, 2019). Qualitative findings show that some ecstasy users chose not to use the drug even though they had paid for it because on drug checking it was found to contain adulterants (Kelly, 2007).

Dose control

Limiting the frequency and intensity of use was mentioned by participants across nine studies (Allott & Redman, 2006; Davis & Rosenberg, 2017; Hansen et al., 2001; Jacinto et al., 2008; Kelly, 2007; Murphy et al., 2006; Panagopoulos & Ricciardelli, 2005; Sharifimonfared & Hammersley, 2020; Singer & Schensul, 2011). This involved starting small, thereby minimising the quantity used in one go such as taking half a tablet, licking the tablet or dissolving the tablet under the tongue instead of swallowing. Other strategies included measuring the exact dose, limiting the total amount used within one session and spacing out the time between sessions (using it just monthly or just at weekends or on special occasions). Measuring the exact dose is possible in the case of MDMA crystals, though would require the use of precision scales; it is unclear how many individuals use scales when preparing MDMA for consumption. Murphy et al. (2006) reported that ecstasy users who exhibited a tangible level of concern were significantly more likely to limit their consumption as a precaution against the negative effects of ecstasy compared to those who were not concerned ($p = 0.033$). It was also demonstrated that females were

significantly more likely to limit their consumption than males ($p=0.003$) and that males were significantly more likely to take rest breaks than females ($\chi^2=5.70$, $p=0.017$). Associations across specific age groups were not reported.

Other related strategies included acquiring ecstasy pills from a trusted source to reduce the chance of having a pill that contains adulterants (Davis & Rosenberg, 2017; Hansen et al., 2001; Jacinto et al., 2008; Kelly, 2007; Palamar & Sonmez, 2022; Panagopoulos & Ricciardelli, 2005; Sharifimonfared & Hammersley, 2020; Shewan et al., 2000; Singer & Schensul, 2011), only using in familiar /comfortable surroundings or safe places where accessible assistance is available if needed (Davis & Rosenberg, 2017; Jacinto et al., 2008; Kelly, 2007; Singer & Schensul, 2011), and using a new batch of ecstasy tablets only after seeing how others reacted to it (Davis & Rosenberg, 2017; Jacinto et al., 2008).

Seeking support

The strategies related to seeking support included not using alone and only using in the presence of trusted friends (Davis & Rosenberg, 2017; Hansen et al., 2001; Jacinto et al., 2008; Kelly, 2007; Panagopoulos & Ricciardelli, 2005; Sharifimonfared & Hammersley, 2020; Shewan et al., 2000; Singer & Schensul, 2011). Additionally, it was felt to be important that friends looked out for each other, especially first-time users (Davis & Rosenberg, 2016; Hansen et al., 2001; Jacinto et al., 2008; Kelly, 2007; Panagopoulos & Ricciardelli, 2005; Sharifimonfared & Hammersley, 2020; Shewan et al., 2000; Singer & Schensul, 2011). The participants in the study by Jacinto et al. (2008) were sellers of ecstasy and they described their role as sometimes acting as “guides” or “trip sitters”.

Hydration management and temperature regulation

‘Chilling out’ as a temperature regulation strategy was mentioned across six of the included studies (Allott & Redman, 2006; Davis & Rosenberg, 2016; Kelly, 2007; Murphy et al., 2006; Murphy et al., 2021; Panagopoulos & Ricciardelli, 2005). In the context of harm reduction, chilling out involved taking regular breaks from a hot dance floor somewhere with a lower ambient temperature, often in designated rooms. This was used as a potential harm reduction strategy to minimise the risk of hyperthermia.

Drinking water to minimise the risk of dehydration and overheating was a frequently reported strategy across the included studies (Allott & Redman, 2006; Davis & Rosenberg, 2017; Hansen et al., 2001; Jacinto et al., 2008; Kelly, 2007; Murphy et al., 2006; Palamar & Sonmez, 2022; Panagopoulos & Ricciardelli, 2005; Rigg & Lawental, 2018; Sharifimonfared & Hammersley, 2020; Singer & Schensul, 2011). However, there were often issues with the supply of free water and the cost of bottled water across some venues; in some outdoor festivals, long queues hindered some attendees from rehydrating (Kelly, 2007; Palamar & Sonmez, 2022). There was limited reference about not drinking too much water, to avoid the risk of hyponatraemia/water toxicity, with participants in just one study referring to this practice (Panagopoulos & Ricciardelli, 2005).

Participants across five of the included studies reported that they chose not to mix ecstasy with alcohol (Jacinto et al., 2008; Kelly, 2007; Murphy et al., 2006; Sharifimonfared & Hammersley, 2020; Singer & Schensul, 2011). The reasons given included: to maximise the pleasurable effects (Jacinto et al., 2008; Sharifimonfared & Hammersley, 2020; Singer & Schensul, 2011), to minimize hangover (*‘comedown’*) effects (Jacinto et al., 2008; Kelly, 2007) and to manage the risk of dehydration (Kelly, 2007). However, participants within two further studies (Palamar & Sonmez, 2022; Rigg & Lawental, 2018) reported that they would mix alcohol and ecstasy as they were unaware of its dehydration effects (Rigg & Lawental, 2018) and because it is often cheaper to obtain alcohol than water (Palamar & Sonmez, 2022).

Polydrug use and pre- / post-loading

Controlling the number of other drugs consumed at the same time as ecstasy, especially class 1 drugs such as cocaine or heroin, was a behaviour reported by participants across two studies (Hansen et al., 2001; Sharifimonfared & Hammersley, 2020) although in three studies participants reported polydrug use as a perceived means to minimise harm especially for the “comedown” period particularly with class 2 drugs such as cannabis (Panagopoulos & Ricciardelli, 2005; Shewan et al., 2000; Singer & Schensul, 2011).

Pre-loading and post-loading as potential harm reduction strategies were reported by participants across 10 studies (Allott & Redman, 2006; Davis & Rosenberg, 2016, 2017; Hansen et al., 2001; Jacinto et al., 2008; Kelly, 2007; Kelly, 2009; Murphy et al., 2006; Panagopoulos & Ricciardelli, 2005; Singer & Schensul, 2011). This involves consuming prescription or over the counter medications to reduce serotonin depletion either before the consumption of ecstasy (preloading) or afterwards to deal with the coming down effects of ecstasy (post-loading) (Hansen et al., 2001; Panagopoulos & Ricciardelli, 2005). Substances consumed as part of pre-loading/post-loading ranged from pharmaceuticals to natural supplements and foods (see Table 7). Reasons

reported for engaging in pre-loading/post-loading were: harm reduction which included wanting to reduce comedown, hangover or crash (Allott & Redman, 2006), to facilitate sleep (Hansen et al., 2001; Panagopoulos & Ricciardelli, 2005), to mitigate post-ecstasy depression (Jacinto et al., 2008; Kelly, 2007; Kelly, 2009), to lessen physical side effects such as body aches and to replenish the body (Allott & Redman, 2006; Jacinto et al., 2008; Singer & Schensul, 2011), to decrease the chance of neurotoxicity (Allott & Redman, 2006; Kelly, 2007; Kelly, 2009) and in some instances to increase the enjoyable highs of ecstasy (Allott & Redman, 2006; Kelly, 2007; Kelly, 2009). Three studies investigated the factors associated with pre-loading/post-loading behaviour (Allott & Redman, 2006; Davis & Rosenberg, 2016; Murphy et al., 2006). Allott and Redman (2016) found that being younger ($p=0.011$) and the number of times ecstasy had been used (more than 50 times) ($p=0.007$) were significantly associated with engaging in pre-loading behaviour, while post-loading was significantly associated with the number of times ecstasy had been used (more than 50) ($p=0.001$) and frequency (monthly or more) ($p=0.036$). However, this contradicted the findings of Davis and Rosenberg (2016) who found that people who used ecstasy less frequently were significantly more likely to engage in pre-loading/ post-loading strategies ($p=0.012$). There was also a significant association ($p=0.046$) between the strength of a person's habit to pre-loading/post-loading and how likely were to engage in this behaviour (Davis & Rosenberg, 2016). Murphy et al. (2006) reported that ecstasy users who exhibited a tangible level of concern about harm were significantly more likely to take vitamin tablets as a precaution against the negative effects of ecstasy compared to those who were not concerned ($p=0.026$).

Insert table 7 around here

Sources of harm reduction information

The purpose of the second objective was to describe the different sources from which ecstasy users obtain information related to its effects and harm reduction practices. We identified five quantitative studies (Allott & Redman, 2006; Falck et al., 2004; Gamma et al., 2005; Murphy et al., 2006; Rigg & Lawental, 2018) and two of these reported that the most popular source of harm reduction information was friends (Falck et al., 2004; Murphy et al., 2006). Additionally, Murphy et al. (2006) reported that females were significantly more likely to use friends as a source of harm reduction information than males ($p=0.005$). Across four of the studies (Allott & Redman, 2006; Falck et al., 2004; Gamma et al., 2005; Murphy et al., 2006) around a third of respondents indicated other popular sources for harm reduction information were nightclubs, TV news, drug leaflets, music magazines and user-oriented drug information websites. Where nightclubs were chosen as a source of harm reduction information about ecstasy, the authors noted that it was not clear whether this related to having contact with others or whether printed information was available at such venues (Murphy et al., 2006). Although user-oriented drug information websites (such as DanceSafe and Erowid) were not amongst the top choice of sources of harm-reduction information (Falck et al., 2004) they were, however, deemed by some to be dependable (Gamma et al., 2005) and accurate sources (Falck et al., 2004). Falck et al. (2004) reported that educated users ($p=0.004$) and younger users ($p=0.005$) were significantly more likely to obtain harm-reduction information about ecstasy from the internet. Allott and Redman (Allott & Redman, 2006) also reported on where ecstasy users found out about preloading and post-loading and the most popular source was from their partner or friends, followed by the internet. Similar to Allot and Redman (2016), participants in the work of Rigg and Lawental (2018) mentioned that they learnt about the dehydrating effect of ecstasy from friends and the internet, highlighting the importance of these two information sources.

One randomised controlled trial (Whittingham et al., 2009) was identified which comprised two experiments. The first compared a harm reduction leaflet to a neutral information leaflet and the second compared a harm reduction leaflet to a harm reduction info-card. The leaflet was just above 1,200 words and was folded to credit card format on eight double-sided pages and the info-card was around 400 words with a weblink to further information. The leaflet contained information about the effects and risks related to ecstasy use and specific tips about how to use the drug in a safer way with specific recommendations to drink enough water while using ecstasy. The outcomes were concerned with whether ecstasy users had a more negative attitude and intention toward ecstasy use because of reading harm reduction information. The study was unable to demonstrate a change in outcome measures following the intervention and differences in responses between ecstasy users and non-users were not statistically significant ($p>0.05$).

Harm reduction content of user-oriented drug information webpages

Finally we sought to determine the content of user-oriented drug information websites for ecstasy in relation to the detrimental effects and harm reduction advice provided. A visual summary of the type of ecstasy specific harm reduction information that is covered across the content of the 14 user-oriented drug information websites (referred to as webpages through the rest of the text) is presented in Table 8.

All except one webpage (93%) provided information on initiating ecstasy use with a low 'tester' dose, such as splitting ecstasy tablets into halves or quarters. Eleven of the webpages (79%) recommended users to wait for a specified period before re-dosing, though recommended times varied from 1 to 3

hours. In some cases, users were recommended to halve the amount of MDMA consumed upon each subsequent re-dose; whilst this may be difficult to achieve in the case of ecstasy tablets. Overall, this harm reduction strategy was summarised by several sources by using the phrase “start slow, stay low”. Only two of the websites mentioned spacing out the time between sessions. Six of the webpages (43%) recommended that users have their ecstasy tested so that they know exactly what is in them. Thirteen of the webpages (93%) mentioned the risks of mixing ecstasy with alcohol and 12 of the webpages (86%) cautioned against polydrug use, while only seven (50%) provided information on interactions with prescription medication. A further five of the webpages (36%) provided a list of pre-existing conditions which may contraindicate which included high blood pressure; heart disease; epilepsy; liver problems; asthma or mental health issues such as depression or anxiety. All the webpages (100%) provided information on the risk of dehydration and drinking water to mitigate against this and thirteen of the webpages (93%) provided information about hyperthermia/heatstroke. Additionally, 11 of the webpages (79%) provided information on limiting the amount of water consumed due to the risk of hyponatraemia and two webpages (14%) recommended consuming isotonic sports drinks to reduce the risk of water intoxication. Seven of the webpages (50%) recommended that ecstasy is not taken alone but in the company of others, six of the webpages (43%) stressed the importance of looking out for others especially friends and 12 of the webpages (86%) identifying when to seek help.

Insert Table 8 around here

Discussion

This work contributes to the existing body of literature by conducting a rapid scoping review that focuses on the harm reduction strategies employed by ecstasy users in recreational setting. The specific objectives of this review are three-fold. Firstly, it seeks to describe the various harm reduction strategies employed by ecstasy users to minimize the potential risks associated with its use. Secondly, it aims to explore the different sources from which ecstasy users obtain information regarding its effects and harm reduction practices. Lastly, this review describes the content of user-oriented drug information websites for ecstasy regarding its effects and harm reduction practices.

Harm reduction strategies

Young people and adults who consume ecstasy in recreational settings use a wide range of harm reduction strategies as a precaution against ADR, although others having balanced the risk still intend to consume ecstasy. Palamar and Sonmez (2022) suggested that this is particularly problematic at festivals, as such annual events are often likened to ‘mini vacations’, with regular users frequently dosing and re-dosing, mixing drugs and not adhering to harm reduction recommendations like drinking fluid and taking rest breaks.

Drug checking (pill testing)

Ecstasy tablets are recognised to vary in strength (MDMA content) and purity. In some cases, they may contain other substances entirely (Pascoe et al., 2022). In the context of British festivals, purchasing substances at events has been observed to double the risk of adulteration compared to acquiring off-site (Measham, 2019).

Across 10 of the studies (53%), some participants reported that they utilised some form of drug checking as a harm reduction strategy. Drug checking strategies may vary considerably by the level of sophistication of the analysis. Colorimetric reagent kits lie at the lower end of the spectrum but are highly accessible and may be used at home by individuals. The reagents change colour depending on the substance present and can be used as a presumptive test to qualitatively identify the presence or absence of MDMA in an ecstasy tablet. Whilst useful for identifying tablets in which MDMA is entirely absent (e.g., tablets containing substituted cathinones or amphetamines such as PMMA), they are inaccurate in identifying tablets containing both MDMA and other substances. Moreover, the tests are unable to accurately quantify the MDMA content of tablets and some users may find interpretation difficult (Harper et al., 2017). More sophisticated techniques allow for the identification of MDMA content and the presence of adulterants, though require specialist equipment and must be performed in a laboratory. This typically occurs as part of a ‘drug testing’ or ‘drug checking’ service. In the UK, service providers include Public Health Wales (WEDINOS Project- <https://www.wedinos.org/>), TICTAC (<https://www.tictac.org.uk/>), The Loop <https://weartheloop.org/> and Manchester Drug Analysis and Knowledge Exchange (MANDRAKE – <https://www.sutcliffe-research.org/mandrake/>). In the context of drug *checking*, results may be communicated to service users as part of a health consultation (e.g., The Loop) or accessed remotely online (e.g., WEDINOS – <https://wedinos.org/sample-results>). In a systematic review, Maghsoudi et al. (2022) concluded that drug *checking* services can positively influence the intentions and behaviour of people who use drugs, particularly in cases where analytical results were other than expected. Moreover, Measham and Turnbull (2021), found that 59.4% of British festival attendees reportedly moderated their consumption of substances (i.e., took less) when they were identified as being stronger than expected. However, this is in contrast with some of the findings in this rapid scoping review, as Hollett and Gately (2019) reported that people would still intend to use ecstasy, even if double dose of MDMA was detected in their tablets. This indicates that further research might be needed regarding how drug checking results influence users’ behaviour.

Dose control

Starting with a low dosage was commonly mentioned as a harm reduction strategy by participants across the included studies. As the strength of ecstasy pills are often unpredictable (Couchman et al., 2019), this an important harm reduction strategy that may present users with an opportunity to avoid ADRs associated with atypically strong tablets or adulterants which produce effects discordant with those of MDMA. Generally, users are advised to wait a minimum of 2-3 months between sessions of use, to moderate depletion of serotonin (Drugs and me, 2021; Kish et al., 2000). However, participants in just one of the studies mentioned spacing out the time between sessions (Singer & Schensul, 2011).

Seeking support

Participants across eight of the included studies mentioned that they did not take ecstasy alone but in the company of others and that looking out for others, especially friends, was also considered an important strategy. Information provided via leaflets appears to be ineffective at promoting abstinence, though it remains unclear whether they may be useful for disseminating harm reduction information aiming to modify behaviour and risk. As ecstasy users rank partners and friends as the most popular source of information (Allott & Redman, 2006), peer-to-peer education may present good opportunities for disseminating drug-related information, including harm reduction advice.

Hydration management and temperature regulation

It has been reported that women may be at a greater risk of hyponatraemia/water intoxication following the use of ecstasy (Rosenson et al., 2007). However, there was limited reference to avoiding overhydration from ecstasy users across the included studies, with participants in just one study referring to this practice (Panagopoulos & Ricciardelli, 2005). Under Article 3, Section 3 of the Licensing Act 2003 (Mandatory Licensing Conditions) Order 2010, licensed premises in England and Wales must provide free tap water to customers upon request, where this is reasonably available; similar acts are in place in Scotland and Northern Ireland. As evidence suggests that dehydration can lead to hyperthermia, whilst water intoxication can occur when too much is consumed, establishing an optimal recommended water intake may be helpful. Environmental factors may significantly affect body temperature and levels of hydration. Currently, UK venues are not obliged to manage indoor temperature, though many provide areas for patrons to cool down. It may be useful to provide ecstasy users with information on recognising the signs of hyperthermia, dehydration, or water intoxication and when to seek medical support.

Alcohol is often used concomitantly with ecstasy particularly at leisure events (e.g., festivals and raves) (Gowing et al., 2002; Palamar & Sonmez, 2022; Rigg & Lawental, 2018). However, concurrent alcohol and ecstasy use may contribute to increased risk of adverse drug reactions, such as hyperthermia, dehydration, hyponatraemia, anxiety and hepatotoxicity (van Amsterdam et al., 2021; Vercoulen & Hondebrink, 2021). In this rapid scoping review participants across five (26%) of the included studies mentioned that they avoided mixing the two. Rigg and Lawenthal (2018) reported that some of the participants mentioned that they used alcohol to hydrate themselves partially due to a lack of knowledge about the dehydrating effect of alcohol. The antagonistic effects between alcohol and MDMA, which are CNS depressants and stimulants respectively, may dull desired effects. This may conceivably lead to users increasing the amount of MDMA consumed, to overcome this effect, as has been observed with other alcohol/stimulant combinations (Pennings et al., 2002).

Polydrug use and preloading / post-loading

Participants across two (11%) of the included studies declared not taking other drugs while using ecstasy. Due to the lack of human studies, there is a lack of clarity about interactions between ecstasy and other recreational drugs. However, roughly two thirds of MDMA/ecstasy-related deaths in England and Wales involve another drug that is not alcohol (Office for National Statistics, 2021). Combinations such as ecstasy and other amphetamine derivatives can lead to more severe long term cognitive changes and neurotoxicity (Mohamed et al., 2011). Prescription medications, antidepressants and other pharmaceuticals were widely reported to be used in preloading or post-loading strategies to avoid comedown or the neurotoxic effects of ecstasy. However, mixing antidepressants with ecstasy may increase the risk of serotonin syndrome, which may have fatal consequences (Dobry et al., 2013). Thus, it is important to raise awareness about the drug interactions and highlight which may be particularly harmful when used in combination with ecstasy. Some perceived harm reduction strategies, particularly those involving pharmacologically active substances, may increase the risk of ADRs. Participants within three studies in this review (Allott & Redman, 2006; Hansen et al., 2001; Panagopoulos & Ricciardelli, 2005) reported the use of sedatives (e.g., sleeping tablets/benzodiazepines) as a harm reduction strategy associated with ecstasy use. Ecstasy users may be unaware of the potentially dangerous interactions which occur when using multiple CNS depressants to manage undesired MDMA-related effects such as insomnia or anxiety. For example, in their survey of Australian ecstasy users, Allott and Redman (2006) reported that 81.0% of ecstasy users consumed alcohol at the same time as MDMA and 29.3% reported using sedatives afterwards. Some antidepressants reportedly used in pre/post-loading strategies (Allott & Redman, 2006; Kelly, 2007; Kelly, 2009), including SSRIs, may also be associated with increased MDMA-associated mortality (Cohen et al., 2021).

Sources of information

We only found one RCT (Whittingham et al., 2009) that investigated the effects of harm reduction information via drug leaflets on attitude and intent to use ecstasy. In the wider literature about harm reduction information sources and recreational drugs, most research focuses on cannabis and have mainly focused on prevention of cannabis use, and less about harm reduction when someone is likely to keep consuming (Laporte et al., 2017; McCambridge et al., 2008).

The scope and depth of harm reduction information provided from webpages specifically related to ecstasy varied from site to site with different websites providing varying levels of detail and comprehensiveness in the information they offer. All webpages provided information about dehydration risks and almost all provided information about hyperthermia/heatstroke (n=13, 93%), interactions with alcohol (n=13, 93%), initiating use with a low test dose (n=13, 93%), interactions with other illicit drugs (n=12, 86%), identifying when to seek help (n=12, 86%), waiting for a defined period between use (n=11, 79%) and hyponatraemia/overhydration (n=11, 79%). Additionally, two webpages recommended consuming isotonic sports drinks to reduce the risk of water intoxication but the wider evidence base suggests that this practice does not appear to reduce the incidence of exercise-induced hyponatraemia (Dugas, 2006).

Relatively fewer webpages provided information on interactions with prescribed medications (n=7, 50%), not using alone (n=7, 50%), recommendations on dosage or dosing strategies (n=6, 43%), information on drug checking (n=6, 43%) and looking out for friends (n=6, 43%). Information or recommendations were rarely provided regarding frequency of use (n=2, 14%), the safe use of supplements (n=2, 14%), or pre-existing conditions which may contraindicate use (n=5, 36%), or were information for users taking medications for certain conditions.

The findings of this rapid scoping review revealed that none of the webpages assessed could serve as a comprehensive "one-stop shop" for all relevant information. Despite the abundance of user-oriented drug information websites focused on ecstasy, there was a notable lack of websites that provided a comprehensive range of information. Several of the webpages seemed to focus on specific elements of MDMA use, such as its effects, dosage guidelines, or harm reduction strategies, while leaving out other essential areas of information.

Lack of an evidence base

Evidence supporting the various harm reduction practices was found to vary considerably. Given the 'underground' nature of drug use, as well as difficulties in conducting research in this area, some amount of misinformation and urban myth may be expected to exist within the community. This was particularly notable for pre-loading and post-loading strategies, where a range of foods and supplements (e.g., turkey) were reported as used to reduce harms. The use of 5-HTP, a serotonin (5-HT) precursor widely believed by ecstasy users to counteract MDMA-related serotonin depletion and neurotoxicity, is poorly supported by evidence.

Only two of the webpages provided any evidence-based citations to support listed harm reduction information. Nine provided links to other websites and six provided links to further information within their own websites. Due to the relative infrequency of occurrence, and difficulties in verifying which practices have been adopted by ecstasy users, building an evidence base for behaviours which reduce the incidence of ADRs is challenging. After all, it is difficult to establish when an ADR has been averted because of a particular behaviour. However, some behaviours known to increase risk, such as concurrent use of SSRIs and other drugs, have been established. It is unclear whether providing citations alongside advice may improve the adoption of harm reduction practices. Condensed info cards were found to be more effective communication tools than detailed leaflets (Whittingham et al., 2009), which may limit the ability to include citations on educational materials. Drug services should seek to involve service users in the design and evaluation of harm reduction educational materials, to ensure the language and messaging is appropriate for the target population.

Limitations

Conducting a rapid scoping review inherently carries some limitations, as some of the processes, such as screening and data extraction, are modified to produce swift results. For example we were only able to include UK based websites; RollSafe.org and Pillreports.net were not included. While initially the focus of this scoping review was young people, the included studies contained a wide age range, including 40-year-olds and over. This might influence the generalisability of the findings. A further limitation is that only three of the studies were published recently, post 2020, ten were published prior to 2010 and a further two studies being published over twenty years ago. Across the included studies the concept of harm education was interpreted differently, and the same strategies were often used for avoiding ecstasy-related side effects, 'comedown', neurotoxicity and for enhancing the positive experience. Additionally, in most quantitative studies participants were asked to choose from a predetermined list as opposed to listing what harm reduction strategies they used. For the qualitative studies participants were often asked about specific harm reduction strategies such as drug checking, pre-loading/post-loading, monitoring their fluid levels, limiting their consumption or taking rest breaks.

Conclusion

This review was able to identify a wide variety of self-initiated harm reduction behaviours utilised by people who use MDMA/ecstasy. Harm reduction behaviours can never eliminate the health risks posed by drugs and the safest practice is to avoid use entirely. Nevertheless, several strategies were identified for which there was some evidence of a reduction in risk. These included taking breaks to avoid hyperthermia, maintaining adequate (but not excessive) levels of hydration, avoiding particular polydrug combinations (including with alcohol), moderating consumption (“start slow, stay low”) and avoiding using alone. Further understanding of how ecstasy users measure dose (e.g., visual approximation versus weighing scales) may provide useful insights for future interventional developments. Some ADR avoidance strategies, particularly relating to pre-loading and post-loading, are poorly supported by evidence and, in some cases, may exacerbate potential harm. For example, the use of sedatives and antidepressants to counteract anxiety and insomnia can lead to increased risk of ADRs. Simple online tools (e.g., <https://combo.tripsit.me>) may aid users to better understand potential adverse interactions between substances, including some prescribed drugs, though could be expanded to include a larger number of substances. Information on potential interactions may be expected to improve in the coming years, as clinical trials involving MDMA as a therapeutic agent (for example to treat Post-Traumatic Stress Disorder (PTSD) progress (James et al., 2019).

Some gaps remain in determining an optimal communication strategy for disseminating harm reduction information, such as: i) who should provide the information and what information should be provided; ii) when and where should this take place; and iii) how do ecstasy users want to receive this information? Ecstasy users place a high degree of trust in peer-to-peer networks and individuals to whom they can relate, indicating a key role for human connection. Condensed information may be preferred for written materials whilst non-biased language improves perceived credibility. Co-developing and disseminating resources via trusted individuals/organisations/communities may further improve trustworthiness and should be explored further, to maximise potentially beneficial behavioural changes. Understanding actual or perceived barriers to the provision of harm reduction information, such as local licensing rules (if disseminated in licensed venues), or social media community guidelines, may help to establish areas of focus for future policy change.

These self-initiated harm reduction strategies provide ecstasy users with a sense of empowerment to actively minimise potential risks and adopt safer use practices. However, it is important to acknowledge that harm reduction strategies cannot eliminate all risks associated with ecstasy use. Therefore, it is vital for users to seek comprehensive information, support, and professional guidance to make informed decisions about their drug use. By combining self-initiated strategies with accurate information and access to appropriate resources, users can enhance their safety and well-being while using ecstasy.

Declarations

Disclaimer

The authors would like to state that neither they, nor Cardiff University, condone nor justify the use of any illegal substance.

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Deborah Edwards: Conceptualization, Methodology, Data curation, Formal Analysis, Writing – Original Draft Preparation

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Acknowledgements

We would like to acknowledge Mrs Joan Welsh, Joelle Welsh's grandmother. Joelle, a nursing student at Cardiff University, died due to an adverse drug reaction to ecstasy. The following individuals were also involved in shaping the direction of this review: Dr Sally Anstey, Dr Mathew Hoskins, Dr Nicholas

Supplementary information

Additional file 1: Full search strategies

Additional file 2: Excluded studies

Additional file 3: Table of excluded organisational websites

References

- ACMD. (2008). *MDMA ('ecstasy'): a review of its harms and classification under the misuse of drugs act 1971*.
- Alcohol and Drug Foundation. (2021). *Minising the harm of illicit drug use among adults. Exploring the data and the strategies that work*. https://cdn.adf.org.au/media/documents/Minimising_the_harm_of_illicit_drug_use_among_young_adults_-_full_report.pdf
- Allott, K., & Redman, J. (2006). Patterns of use and harm reduction practices of ecstasy users in Australia. *Drug & Alcohol Dependence*, 82(2), 168-176. <https://doi.org/doi:10.1016/j.drugalcdep.2005.09.009>
- Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, 8, 19-32. <https://doi.org/https://doi.org/10.1080/1364557032000119616>
- Atkinson, E. (2022). Boy, 16, dies in suspected ecstasy-related incident at Leeds Festival. *Independent*. <https://www.independent.co.uk/news/uk/crime/leeds-festival-death-boy-ecstasy-b2154612.html>
- Barker, S., Lynch, M., & Hopkinson, J. (2017). Decision making for people living with dementia by their carers at the end of life: a rapid scoping review. *International Journal of Palliative Nursing*, 23(9), 446-456. <https://doi.org/https://doi.org/10.12968/ijpn.2017.23.9.446>
- Cohen, I. V., Makunts, T., Abagyan, R., & Thomas, K. (2021). Concomitant drugs associated with increased mortality for MDMA users reported in a drug safety surveillance database. *Scientific Reports*, 11(1), 5997. <https://doi.org/10.1038/s41598-021-85389-x>
- Côté, D., Durant, S., MacEachen, E., Majowicz, S., Meyer, S., Huynh, A. T., Laberge, M., & Dubé, J. (2021). A rapid scoping review of COVID-19 and vulnerable workers: Intersecting occupational and public health issues. *American Journal of Industrial Medicine*, 64(7), 551-566. <https://doi.org/https://doi.org/10.1002/ajim.23256>
- Couchman, L., Frinculescu, A., Sobreira, C., Shine, T., Ramsey, J., Hecht, M., Kipper, K., Holt, D., & Johnston, A. (2019). Variability in content and dissolution profiles of MDMA tablets collected in the UK between 2001 and 2018 – A potential risk to users? [<https://doi.org/10.1002/dta.2605>]. *Drug testing and analysis*, 11(8), 1172-1182. <https://doi.org/https://doi.org/10.1002/dta.2605>
- Curran, H. V., & Travill, R. A. (1997). Mood and cognitive effects of +/-3,4-methylenedioxymethamphetamine (MDMA, 'ecstasy'): week-end 'high' followed by mid-week low. *Addiction*, 92(7), 821-831.
- Davis, A. K., & Rosenberg, H. (2016). Using the Theory of Planned Behavior to predict implementation of harm reduction strategies among MDMA/ecstasy users. *Psychology of Addictive Behaviors*, 30(4), 500-508. <https://doi.org/doi:10.1037/adb0000167>
- Davis, A. K., & Rosenberg, H. (2017). Specific harm reduction strategies employed by 3,4-methylenedioxymethamphetamine/ ecstasy users in the United States and the United Kingdom. *Drug Science, Policy and Law*, 3. <https://doi.org/doi:https://dx.doi.org/10.1177/2050324517711069>
- Deluca, P., & Schifano, F. (2007). Searching the Internet for drug-related web sites: analysis of online available information on ecstasy (MDMA). *American Journal of Addiction*, 16(6), 479-483. <https://doi.org/10.1080/10550490701641181>
- Dobry, Y., Rice, T., & Sher, L. (2013). Ecstasy use and serotonin syndrome: a neglected danger to adolescents and young adults prescribed selective serotonin reuptake inhibitors. *International journal of adolescent medicine and health*, 25(3), 193-199. <https://doi.org/10.1515/ijamh-2013-0052>
- Drugs and me. (2021). *MDMA*. Retrieved 11 August 2022 from <https://www.drugsand.me/drugs/mdma/>
- Dugas, J. (2006). Sodium ingestion and hyponatraemia: sports drinks do not prevent a fall in serum sodium concentration during exercise. *British Journal of Sports Medicine*, 40(4), 372. <https://doi.org/10.1136/bjism.2005.022400>
- Elkattawy, S., Mowafy, A., Younes, I., Tucktuck, M., & Agresti, J. (2021). Methylenedioxymethamphetamine (MDMA)-induced hyponatremia: case report and literature review. *Cureus*, 13(5), e15223. <https://doi.org/https://dx.doi.org/10.7759/cureus.15223>
- EMCDDA. (2020). *European Drug Report 2020: Trends and Developments*. https://www.emcdda.europa.eu/publications/edr/trends-developments/2020_en

- EMCDDA. (2022). *European Drug Report 2022: Trends and Developments*. https://www.emcdda.europa.eu/publications/edr/trends-developments/2022_en
- Falck, R. S., Carlson, R. G., Wang, J., & Siegal, H. A. (2004). Sources of information about MDMA (3,4-methylenedioxyamphetamine): perceived accuracy, importance, and implications for prevention among young adult users. *Drug and alcohol dependence*, *74*(1), 45-54. <https://doi.org/https://doi.org/10.1016/j.drugalcdep.2003.11.009>
- Gamma, A., Jerome, L., Liechti, M. E., & Lumnall, H. R. (2005). Is ecstasy perceived to be safe? A critical survey. *Drug and alcohol dependence*, *77*(2), 185-193. <https://doi.org/https://doi.org/10.1016/j.drugalcdep.2004.08.014>
- Gantzer, O. (2020). Reading Festival death: student nurse died of drug overdose. *The Reading Chronicle*. <https://www.readingchronicle.co.uk/news/18549553.reading-festival-death-student-nurse-died-drug-overdose/>
- Gascoigne, M., Dillion, P., & Copeland, J. (2004). *Sources of ecstasy information: use and perceived credibility*. NDARC Technical Report. No 202. <https://ndarc.med.unsw.edu.au/resource/sources-ecstasy-information-use-and-perceived-credibility>
- Gowing, L. R., Henry-Edwards, S. M., Irvine, R. J., & Ali, R. L. (2002). The health effects of ecstasy: a literature review. *Drug and alcohol review*, *21*(1), 53-63. <https://doi.org/https://dx.doi.org/10.1080/09595230220119363>
- Gray, B. (2020). Leah Betts 25 years on: The tragic photo and story of Essex girl's death that shocked a nation. *EssexLive*. <https://www.essexlive.news/news/essex-news/leah-betts-25-years-on-4704289>
- Haddaway, N. R., Grainger, M. J., & Gray, C. T. (2022). Citationchaser: A tool for transparent and efficient forward and backward citation chasing in systematic searching. *Research Synthesis Methods*, *13*(4), 533-545. <https://doi.org/https://doi.org/10.1002/jrsm.1563>
- Hansen, D., Maycock, B., & Lower, T. (2001). 'Weddings, parties, and anything...!', a qualitative analysis of ecstasy use in Perth, Western Australia. *International Journal of Drug Policy*, *12*(2), 181-199. <https://doi.org/https://dx.doi.org/10.1016/S0955-3959%2800%2900075-X>
- Harper, L., Powell, J., & Pijl, E. M. (2017). An overview of forensic drug testing methods and their suitability for harm reduction point-of-care services. *Harm reduction journal*, *14*(52), 2017. <https://doi.org/https://doi.org/10.1186/s12954-017-0179-5>
- Hollett, R. C., & Gately, N. (2019). Risk intentions following pill test scenarios are predicted by MDMA use history and sensation seeking: A quantitative field study at an Australian music festival. *Drug & Alcohol Review*, *38*(5), 473-481. <https://doi.org/doi:10.1111/dar.12936>
- Jacinto, C., Duterte, M., Sales, P., & Murphy, S. (2008). Maximising the highs and minimising the lows: harm reduction guidance within ecstasy distribution networks. *International Journal of Drug Policy*, *19*(5), 393-400. <https://doi.org/https://doi.org/10.1016/j.drugpo.2007.09.003>
- James, E., Robertshaw, T. L., & Westwell, A. D. (2019). Emerging from the dark side: new therapeutic applications of scheduled psychoactive substances. *Future Medicinal Chemistry*, *11*(3), 161-164. <https://doi.org/10.4155/fmc-2018-0447>
- Jones, V., & PA reporters. (2020). Mum warns other teens after schoolgirl's ecstasy death. *WalesOnline*. <https://www.walesonline.co.uk/news/uk-news/mum-warns-teens-after-schoolgirls-19290074>
- Keate, G. (2017). Student Calum Gill died after taking ecstasy for first time. *The Times*. <https://www.thetimes.co.uk/article/student-calum-gill-died-after-taking-ecstasy-for-first-time-nm3w372rd>
- Kelly, B. C. (2007). Club drug use and risk management among "Bridge and Tunnel" youth. *Journal of Drug Issues*, *37*(2), 425-443. <https://doi.org/https://doi.org/10.1177%2F002204260703700210>
- Kelly, B. C. (2009). Mediating MDMA-related harm: Preloading and post-loading among ecstasy-using youth. *Journal of psychoactive drugs*, *41*(1), 19-26. <https://doi.org/doi:http://dx.doi.org/10.1080/02791072.2009.10400671>
- Kish, S. J., Furukawa, Y., Ang, L., Vorce, S. P., & Kalasinsky, K. S. (2000). Striatal serotonin is depleted in brain of a human MDMA (Ecstasy) user. *Neurology*, *55*(2), 294. <https://doi.org/10.1212/WNL.55.2.294>
- Langlois, E. V., Straus, S. E., Antony, J., King, V. J., & Tricco, A. C. (2019). Using rapid reviews to strengthen health policy and systems and progress towards universal health coverage. *BMJ Global Health* *4*(1), e001178. <https://doi.org/https://doi.org/10.1136/bmjgh-2018-001178>
- Laporte, C., Vaillant-Roussel, H., Pereira, B., Blanc, O., Eschaliier, B., Kinouani, S., Brousse, G., Llorca, P.-M., & Vorilhon, P. (2017). Cannabis and young users—a brief intervention to reduce their consumption (CANABIC): a cluster randomized controlled trial in primary care. *The Annals of Family Medicine*, *15*(2), 131. <https://doi.org/10.1370/afm.2003>
- Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: advancing the methodology. *Implementation Science*, *5*(69). <https://doi.org/https://doi.org/10.1186/1748-5908-5-69>
- Maghsoudi, N., Tanguay, J., Scarfone, K., Rammohan, I., Ziegler, C., Werb, D., & Scheim, A. I. (2022). Drug checking services for people who use drugs: a systematic review. *Addiction* *117*(3), 532-544. <https://doi.org/https://doi.org/10.1111/add.15734>

- Mahood, Q., Van Eerd, D., & Irvin, E. (2014). Searching for grey literature for systematic reviews: challenges and benefits. *Research Synthesis Methods* 5(3), 221-234. <https://doi.org/https://doi.org/10.1002/jrsm.1106>
- MAPS. (2021). *MDMA Investigator's Brochure*. <https://maps.org/2013/11/12/mdma-literature-review-2/>
- McCambridge, J., Szym, R. L., & Strang, J. (2008). Randomized controlled trial of motivational interviewing compared with drug information and advice for early intervention among young cannabis users [<https://doi.org/10.1111/j.1360-0443.2008.02331.x>]. *Addiction*, 103(11), 1809-1818. <https://doi.org/https://doi.org/10.1111/j.1360-0443.2008.02331.x>
- Measham, F., & Turnbull, G. I. (2021). Intentions, actions and outcomes: a follow up survey on harm reduction practices after using an English festival drug checking service. *International Journal of Drug Policy*, Sep(95), 103270. <https://doi.org/https://doi.org/10.1016/j.drugpo.2021.103270>
- Measham, F. C. (2019). Drug safety testing, disposals and dealing in an English field: Exploring the operational and behavioural outcomes of the UK's first onsite 'drug checking' service. *International Journal of Drug Policy*, 67, 102-107. <https://doi.org/https://doi.org/10.1016/j.drugpo.2018.11.001>
- Merritt, A. (2023). *Tragic ecstasy death after 21st birthday sparks drug warning*. DevonLive. Retrieved 13/06/2023 from <https://www.devonlive.com/news/devon-news/tragic-ecstasy-death-after-21st-8132115>
- Mohamed, W. M., Ben Hamida, S., Cassel, J. C., de Vasconcelos, A. P., & Jones, B. C. (2011). MDMA: interactions with other psychoactive drugs. *Pharmacology, biochemistry, and behavior*, 99(4), 759-774. <https://doi.org/10.1016/j.pbb.2011.06.032>
- Murphy, P. N., Wareing, M., & Fisk, J. (2006). Users' perceptions of the risks and effects of taking ecstasy (MDMA): a questionnaire study. *Journal of Psychopharmacology* 20(3), 447-455. <https://doi.org/doi:>
- Murphy, S., Bright, S. J., & Dear, G. (2021). Could a drug-checking service increase intention to use ecstasy at a festival? . 40(6), 974-978. <https://doi.org/https://doi.org/10.1111/dar.13259>
- Office for National Statistics. (2021). *Deaths Related to Drug Poisoning in England and Wales: 2020 Registrations*. <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/deathsrelatedtodrugpoisoningbyselectedsubstances>
- Palamar, J. J., Fitzgerald, N. D., Keyes, K. M., & Cottler, L. B. (2021). Drug checking at dance festivals: a review with recommendations to increase generalizability of findings. *Experimental and Clinical Psychopharmacology*, 29(3), 229-235. <https://doi.org/https://doi.org/10.1037/pha0000452>
- Palamar, J. J., & Sonmez, I. (2022). A qualitative investigation exploring why dance festivals are risky environments for drug use and potential adverse outcomes. *Harm reduction journal*, 19(1), 12. <https://doi.org/doi:https://dx.doi.org/10.1186/s12954-022-00598-5>
- Panagopoulos, I., & Ricciardelli, L. A. (2005). Harm reduction and decision making among recreational ecstasy users. *International Journal of Drug Policy*, 16(1), 54-64. <https://doi.org/doi:10.1016/j.drugpo.2004.09.001>
- Pascoe, M. J., Radley, S., Simmons, H. T. D., & Measham, F. (2022). The Cathinone Hydra: Increased Cathinone and caffeine adulteration in the English MDMA market after Brexit and COVID-19 lockdowns. *Drug Science, Policy and Law*, 8, 20503245221099209. <https://doi.org/https://dx.doi.org/10.1177/20503245221099209>
- Pennings, E. J., Leccese, A. P., & Wolff, F. A. (2002). Effects of concurrent use of alcohol and cocaine. *Addiction*, 97(7), 773-783. <https://doi.org/10.1046/j.1360-0443.2002.00158.x>
- Peters, G. J., & Kok, G. A. (2009). A structured review of reasons for ecstasy use and related behaviours: pointers for future research. *BMC Public Health* 13(9), 230. <https://doi.org/https://doi.org/10.1186/1471-2458-9-230>
- Peters, M. D. J., Marnie, C., C., T. A., Pollock, D., Munn, Z., Alexander, L., McInerney, P., Godfrey, C. M., & Khalil, H. U. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBI Evidence Synthesis*, 18(10), 2119-2123. <https://doi.org/https://doi.org/10.11124/jbies-20-00167>
- Pollock, D., Davies, E. L., Peters, M. D. J., Tricco, A. C., Alexander, L., McInerney, P., Godfrey, C. M., & Khalil, H. (2021). Undertaking a scoping review: A practical guide for nursing and midwifery students, clinicians, researchers, and academics. *Journal of Advanced Nursing*, 77, 2102-2113. <https://doi.org/https://doi.org/10.1111/jan.14743>
- Rigg, K. K., & Lawental, M. (2018). Perceived risk associated with MDMA (ecstasy/molly) use among African Americans: what prevention and treatment providers should know. *Substance use & misuse*, 53(7), 1076-1083. <https://doi.org/doi:https://dx.doi.org/10.1080/10826084.2017.1392985>
- Rigg, K. K., & Sharp, A. (2018). Deaths related to MDMA (ecstasy/molly): Prevalence, root causes, and harm reduction interventions. *Journal of Substance Use*, 23(4), 345-352. <https://doi.org/https://doi.org/10.1080/14659891.2018.1436607>
- Rodgers, J., Buchanan, T., Pearson, C., Parrott, A. C., Ling, J., Heffernan, T., & Scholey, A. B. (2006). Differential experiences of the psychobiological sequelae of ecstasy use: quantitative and qualitative data from an internet study. *Journal of Psychopharmacology*, 20(3), 437-446. <https://doi.org/doi:https://dx.doi.org/10.1177/0269881105058777>

- Roig, E. F. (2022). Student, 19, died after night out with friends, inquest finds. *BristolLive*. <https://www.bristolpost.co.uk/news/bristol-news/student-19-died-after-night-6870874>
- Rosenson, J., Smollin, C., Sporer, K. A., Blanc, P., & Olson, K. R. (2007). Patterns of ecstasy-associated hyponatremia in California. *Annals of emergency medicine*, *49*(2), 164-171, 171.e161. <https://doi.org/10.1016/j.annemergmed.2006.09.018>
- Sharifimonfared, G., & Hammersley, R. (2020). Harm reduction and quitting techniques used by heavy MDMA (ecstasy) users. *Addiction Research & Theory*, *28*(3), 222-230. <https://doi.org/10.1080/16066359.2019.1622684>
- Shewan, D., Dalgarno, P., & Reith, G. (2000). Perceived risk and risk reduction among ecstasy users: the role of drug, set, and setting. *International Journal of Drug Policy*, *10*(6), 431-453. <https://doi.org/doi>
- Singer, E. O., & Schensul, J. J. (2011). Negotiating ecstasy risk, reward, and control: a qualitative analysis of drug management patterns among ecstasy-using urban young adults. *Substance use & misuse*, *46*(13), 1675-1689. <https://doi.org/doi:https://dx.doi.org/10.3109/10826084.2011.610398>
- Southey, M., Kathirgamalingam, A., Crawford, B., Kaul, R., McNamara, J., John-Leader, F., Heslop, J., & Pit, S. W. (2020). Patterns of ecstasy use amongst live music event attendees and their opinions on pill testing: a cross sectional study. *Substance Abuse Treatment, Prevention & Policy*, *15*(1), 1-13. <https://doi.org/doi:10.1186/s13011-020-00295-1>
- Threapleton, D. E., Chung, R. Y., Wong, S. Y. S., Wong, E., Chau, P., Woo, J., Chung, V. C. H., & Yeoh, E. K. (2017). Integrated care for older populations and its implementation facilitators and barriers: a rapid scoping review. *International Journal for Quality in Health Care* *29*(3), 327-334. <https://doi.org/https://doi.org/10.1093/intqhc/mzx041>
- Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K. C., H., Levac, D., Moher, D., Peters, M. D. J. H., T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., Lewin, S., Godfrey, C. M., . . . Straus, S. E. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. *Annals of Internal Medicine*, *169*(7), 467-473. <https://doi.org/https://doi.org/10.7326/m18-0850>
- van Amsterdam, J., Brunt, T. M., Pierce, M., & van den Brink, W. (2021). Hard boiled: alcohol use as a risk factor for MDMA-induced hyperthermia: a systematic review. *Neurotoxicity research*, *39*(6), 2120-2133. <https://doi.org/https://dx.doi.org/10.1007/s12640-021-00416-z>
- Vercoulen, E., & Hondebrink, L. (2021). Combining ecstasy and ethanol: higher risk for toxicity? A review. *Critical reviews in toxicology*, *51*(1), 1-14. <https://doi.org/10.1080/10408444.2020.1867822>
- Vogt, F., Kurup, K. K., Mussleman, P., Habrun, C., Crowe, M., Woodward, A., Jaramillo-Gutierrez, G., Kaldor, J., Vong, S., & Del Rio Vilas, V. (2022). Contact tracing indicators for COVID-19: Rapid scoping review and conceptual framework. *PLoS ONE*, *17*(2), e0264433 <https://doi.org/https://doi.org/10.1371/journal.pone.0264433>
- Vrolijk, R. Q., Measham, F., Quesada, A., Luf, A., Schori, D., Radley, S., Acreman, D., Smith, J., Verdenik, M., Martins, D., Cunha, M., Paulos, C. J., Piccinin, I. F., Gerace, E., Karden, A., Koning, R. P. J., Smit-Rigter, L. A., & Ventura, M. (2022). Size matters: comparing the MDMA content and weight of ecstasy tablets submitted to European drug checking services in 2012–2021. *Drugs, Habits and Social Policy*, *23*(3), 207-219. <https://doi.org/10.1108/DHS-01-2022-0003>
- Whitney, A. (2001). Student on ecstasy 'foamed at the mouth'. *Independent*. <https://www.independent.co.uk/life-style/health-and-families/health-news/student-on-ecstasy-foamed-at-the-mouth-a-a-9196087.html>
- Whittingham, J. R. D., Ruiters, R. A. C., Bolier, L., Lemmers, L., Van Hasselt, N., & Kok, G. (2009). Avoiding counterproductive results: An experimental pretest of a harm reduction intervention on attitude toward party drugs among users and nonusers. *Substance Use and Misuse*, *44*(4), 532-547. <https://doi.org/doi:https://dx.doi.org/10.1080/10826080802347685>

Tables

Tables 1-8 are available in the supplementary files section.

Figures

Figure 1: PRISMA 2020 flow diagram

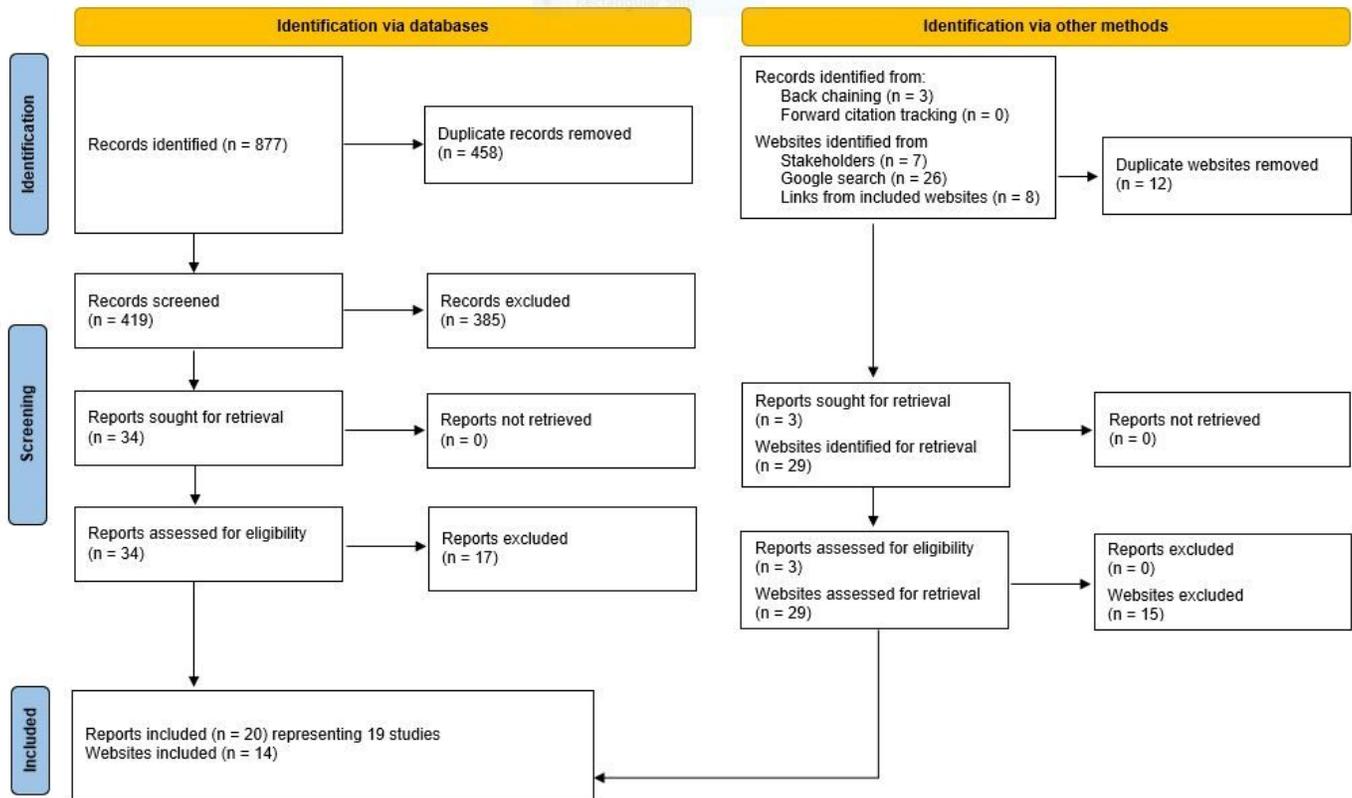


Figure 1

See image above for figure legend.

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