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2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness.

Title 2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness.

Abstract

Background

Despite not being licensed for human consumption, the internet has triggered renewed, widespread interest and availability of 2,4-Dinitrophenol (DNP). DNP, a cellular metabolic poison causes thermogenesis resulting in fat burning and weight loss. Whilst extensively available for purchase online, research on user experiences of DNP is limited.

Methods

A netnographic approach was used to describe user experiences of DNP via online public websites. Public websites discussing DNP were identified and a purposeful sample selected. Discussion threads were downloaded and a textual qualitative analysis conducted. Four themes containing 71 categories were generated.

Results

There exists a plethora of communal folk pharmacological advice and recommendations for DNP manufacture and use, together with associated harms and outcomes. The efficacy and untoward effects of DNP were described and discussed alongside the notion that DNP should only be used by experienced bodybuilders. Dosage and regimes for optimal use were also described.

Conclusion

This unique study provides a rich examination of the knowledge, attitudes and motivations of DNP users, illustrating the significant role of online public websites in sharing information. Further understanding of DNP users and the online communities in which they reside is warranted to facilitate engagement and formulate appropriate and effective policy responses.

Key Words

DNP; 2,4-Dinitrophenol, Internet, Fat burn

Title 2,4-Dinitrophenol, the inferno drug: a netnographic study of user experiences in the quest for leanness.

Background

The availability of substances with the potential to enhance human performance or attributes is by no means a new phenomenon. These drugs can be split into categories based on their functionality and include the structure and function of muscle, the cosmetic appearance of skin, sexual function and behaviour, cognitive function, mood or social behaviour and those that can aid weight loss (McVeigh, Evans-Brown, & Bellis, 2012) and have been termed 'lifestyle drugs'(Gilbert, Walley, & New, 2000). All drugs are capable of causing harm regardless of legality, purpose or motivation of use. In the case of the industrial chemicals dinitrophenols and dinitrocresols there exists a group of highly dangerous substances with a 100 year track record of causing harm. There are six different dinitrophenols (Agency for Toxic Substances and Disease Registry, 1995a) and 18 different dinitrocresols (Agency for Toxic Substances and Disease Registry, 1995b) however the most important of these substances, both commercially and from a public health perspective is 2,4-dinitrophenol (commonly referred to as DNP). It is not licensed or produced for human or veterinary consumption with its legitimate use restricted to that of a fungicide, insecticide, preservative used in the production of dyes, explosives and in photographic development (Llewellyn, 2012; Politi, Vignali, & Polettini, 2007). DNP completely by-passes the most rudimentary pharmaceutical safeguards with the quality, purity and chemical composition of the substance a complete unknown (Reuter & Caulkins, 2004). The extremely narrow therapeutic window associated with DNP, as identified from the research of the 1930s (Masserman & Goldsmith, 1934) to the present day (Grundlingh, Dargan, Wood, & El-Zanfaly, 2011), combined with the unknown strength of an illicitly manufactured drug, poses a threat to public health.

When consumed by humans, DNP stimulates metabolism by inhibiting the mitochondria from making adenosine triphosphate (ATP). It is the release of heat from the mitochondria that results in thermogenesis and consequent fat burning leading to weight loss (McFee, Caraccio, McGuigan, Reynolds, & Bellanger, 2004). Reports of the level to which DNP can result in weight loss are truly staggering. Within bodybuilding circles there is an acceptance that a bodybuilder weighing 220lbs can lose 20lbs of body fat in a matter of only a few weeks with the use of a single 200mg capsule per day (Llewellyn, 2012).

The earliest reports of DNP relate to its industrial application, specifically, its use in the manufacture of munitions during World War I in France. Adverse health consequences associated with exposure to DNP were published (Perkins, 1919) shortly after the war, providing early evidence of a link between weight loss and DNP. This was supported by reports of deaths in the dye industry of the United States (Hamilton, 1921; Tainter, Stockton, & Cutting, 1935)with cases of continued increases in body temperature post mortem. Sporadic reports of fatalities due to the accidental ingestion of DNP have continued (Cann & Verhulst, 1960).

By the mid-1930s 'secret remedies' in the United Kingdom and 'patent medicines' in the United States were big business, with DNP at the forefront of popularity. It was estimated in 1935 that over 100,000 people in the United States had used DNP (Tainter et al., 1935). Large numbers of weight reducing preparations containing DNP were being sold across America, some products in which DNP was the sole active agent but often as just one constituent of a cocktail of weight loss ingredients (Hecht & Jannssen, 1987). DNP was heavily marketed, with newspaper adverts featuring subtle and not so subtle headlines such as "Now you too can take off pounds of ugly fat this safe easy quick way" (Evans-Brown et al., 2012), "…absolutely no ill effects" (Colman, 2007), "no dieting, or self-denial, no strenuous exercise" (Evans-Brown et al., 2012).

Medical journals and the mass media soon became aware of a growing number of adverse effects amongst users of DNP(Evans-Brown et al., 2012). By the end of the 1930s DNP had been discredited and taken off the market due to a range of serious adverse effects and consequences, including by this stage over 160 cases of cataracts, (Horner, Jones, & Boardman, 1935) liver failure, agranulocytosis and at least ten fatalities in those consuming DNP for weight loss purposes (Evans-Brown et al., 2012). Predictably, reports of negative effects due to the ingestion of DNP diminished significantly following the banning of the substance and its formal removal from the market in the United States and Europe. However, occasional occurrences were still recorded, sometimes as a result of DNP being a 'hidden' ingredient within a preparation (Cann & Verhulst, 1960; Kurt et al., 1986; LLewellyn, 2012; McVeigh et al., 2012). There is evidence that DNP continued to be used in some private weight loss clinics, sometimes with devastating results (Cann & Verhulst, 1960). However, it was in the underground anabolic steroid-using communities of the early 1990s that DNP underwent something of a revival (Grundlingh et al., 2011). Dan Duchaine, the "Steroid

Guru" and author of highly influential publications (e.g. (Ducahine, 1989)) is partially credited with the re-emergence of DNP, although he did not try to conceal the clear dangers associated with its use (Baker, 1997). Those publications of the 1980s and early 1990s inevitably had a limited circulation and appeal and whilst they may to some extent be credited with the re-emergence of DNP, the introduction and growth of the Internet triggered the widespread interest and availability of DNP, together with a pharmacopeia of other human enhancement drugs (Llewellyn, 2012).

Whilst DNP has previously been linked to illicit anabolic steroid users, (Grundlingh et al., 2011; Le, Wood, & Kumarasinghe, 2014), the growth of the internet has coincided with an increasing interest and availability of DNP. The use of DNP has been identified in dieters (Wise, 2014) seeking rapid weight loss (Sawer & Mendick, 2013). With an increase in availability and broadening interest there have inevitably been media reports discussing the use of DNP, further promoting awareness of the drug and its potential for dramatic fat loss. Recent deaths have been reported in those suffering with eating disorders (Sawer & Mendick, 2013), sports competitors (Brooke, 2013) as well as those associated with bodybuilding (BBC, 2012; Matharu, 2014) and more recently in healthy young people (Cullen, 2015; Morris, 2015) . However, the estimated number of deaths due to the ingestion of DNP in recent years are inexact. In the context of Kamour et al's (2014) recently published work, Grundlingh et al (2011) review (Grundlingh et al., 2011) of reported fatalities may be merely an early warning of an emerging public health concern.

In contrast to many of the sought after human enhancement drugs of today, DNP has an established history of use stretching back approximately 100 years. While the rapid increase in interest in relatively new substances such as modafanil, melanotan I and II and a range of anabolic peptide hormones can be linked to the growth of the internet (McVeigh et al., 2012), in the case of DNP it could best be described as being re-launched via the internet. We are aware of the dynamic nature of the internet in fuelling communal folk pharmacology around novel psychoactive drugs (Corazza, Schifano, Demetrovics, & van den Brink, 2013; Corazza et al., 2012) and performance and image enhancing drugs (PIEDs) (Smith & Stewart, 2012; M. C. Van Hout, 2014a). In terms of body transformation, online cyber activity drives the expansion of self beyond physical limitations (Fernback, 2007; Robinson, 2007), and fuels the distribution of knowledge between users and interested parties (Smith & Stewart, 2012). However, the fact that the use of DNP as a weight loss product by far out dates the internet,

does not diminish the role that the internet has in influencing views, opinions and beliefs or in stimulating and facilitating the illicit market (Evans-Brown et al., 2012).

The relationship between drugs, the Internet and consumerism is compounded by difficulties in distinguishing between self-medication, hedonism or the pursuit of image ideals, and equally the division between pharmaceutical, recreational and lifestyle drugs (Walsh, 2011). According to van Ree (351-352); *Drugs are the product of consumer culture'* (Van Ree, 2002). As a result, internet monitoring and the collection of information via online communities (Boyer, Lapen, Macalino, & Hibberd, 2007; Boyer, Shannon, & Hibberd, 2005; Rheingold, 1993) is increasingly utilised for the observation of recreational, psychonautic, self-medicative and lifestyle drug consumptive behaviours (Cambell et al., 2001; Hsiung, 2000; Saba & McCormick, 2001). Of interest for this study, is the passive monitoring of asynchronous communication between DNP users and exploration of the divergence of opinions on this compound within dynamic forum discussions (Day & Keys, 2008; Fernback, 2007). We recognise that monitoring of public forums is more likely to capture a specific type of computer *'savvy'* DNP user. That said, the study is unique in that it provides insight into a poorly understood phenomena in the form of DNP which is being used for performance and image enhancement. This netnographic study aimed to explore the word of '*mouse*' sharing of pharmacological knowledge, practice and protocols for DNP use amongst individuals engaging in internet forum activity. Of particular interest was descriptive information relating to DNP user experiences of purchasing, use, side effects, outcomes and regimes.

Methods

We utilised a similar approach as phenomenological internet forum studies on novel psychoactive drugs (Kjellgren, Henningsson, & Soussan, 2013; Kjellgren & Jonsson, 2013 Kjellgren & Soussan, 2011; M Van Hout, 2014) and virtual ethno-pharmacological studies on performance and image enhancement drugs (Jespersen, 2013; Smith & Stewart, 2012). Netnography is a novel qualitative research methodology adapting ethnographic research techniques to *'the study of cultures and online communities emerging through computer-mediated communications*' (Kozinets, 2002). Internet searches were carried out in April 2014 using specific key words; *'2,4-DNP; '2,4-Dinitrophenol', 'Nitrophen', 'Fenoxyl Carbon N; Nitrophen'; 'Nitrophene'; 'Phenol', 'Solfo Black; 'Tertrosulphur'; 'Chemox' 'Dinitro'; 'Nitro' ; 'Dinitra'; 'Aldifen',* and *'Chemox'*. A purposeful sample of the top ten Google hits pertaining to public websites discussing DNP was chosen. In each site, the first 60

screenshots of discussion threads posted by DNP users and parties interested in using DNP were downloaded. It was decided by the team that 60 screenshots per site was optimal in reaching data saturation whereby new threads would not produce new or novel information on DNP (Gillham, 2005). See Table 1.

Insert Table 1 about here

No records were excluded due to incomprehensibility. 12 duplicates were removed. The final data set of 414 screen shots was transferred into a Word file and stored on an online password protected computer. All postings were anonymous (Smith & Stewart, 2012; Wilkinson & Thelwall, 2011), with further confidentiality ensured by the removal of URLs, user pseudonyms and country or city identifiers.

A textual qualitative analysis of forum postings was conducted (Fielding, Lee, & Blank, 2008; Miller & Sønderlund, 2010). The data file was read three times so as to familiarize and achieve an overview of the postings in an unbiased and open manner, and in the absence of any specific hypothesis pertaining to DNP. Interpretative validity (Maxwell, 1992) was ensured by respecting perspectives and experiences of DNP users. Codes were used to structure the textual data into categories, which were then collectivised into themes, in order to raise the level of abstraction through patterns identified in related categories (Crossley, 2007). Four themes containing 71 categories were generated. See Table 2.

Insert Table 2 about here

Results

Given the nature of this passive site monitoring exercise, it is not possible to provide detailed participant information such as age and gender. This section presents the themes with illustrative narratives.

DNP Manufacture, Sourcing and Products

DNP was described as sold by industrial vendors as pure crystalline (100% dry) DNP, and powdered DNP (usually 5-10% moisture). Comments centred on its regulatory status and similarities to the '*research chemical markets'*.

‘DNP is not a drug, or a scheduled substance. It's a chemical, DNP is regulated by law to prohibit misuse, improper disposal, improper transit, and because in its raw form it is very combustible.’

Online discussion relating to the sourcing of DNP and product nomenclature is not permitted. However, some users referred to the following products *‘Dinitro’, ‘Pyrex’, ‘Genotec’, ‘Madox Medica DNP’,* and *'D-Hacks DNP'* and vendors; *‘Dynasty China Labs’* and *‘Zhengzhou Nongda Biochemical Products Plant.’* Export appeared most common from China, India, Turkey and Pakistan. Western Union and Escrow[1]were commonly used to transfer funds between vendors and buyers. User discussions centred on finding reliable and credible sources and difficulties in the verification of content. Many users reported concern for estimation of capsule dosage when reliant on third party manufacture.

‘The fact that DNP, under therapeutic dosages is safe overall doesn't mean that DNP from clandestine online-suppliers are automatically safe too.’

Some users described verifying content of DNP powder by virtue of its luminous yellow colour.

‘Put some of the powder on your finger tips and rub together. If your skin turns yellow and stays that way until those layers of skin fall off then it's real.’

DNP powder is reportedly shipped in metal containers holding a cushioned glass jar to prevent exposure to heat or shock and risk of explosion in transit. Advice around how to make DNP capsules at home was provided on seven sites, with recommendations to wear goggles, masks and two sets of gloves, as DNP was observed by some users to absorb through single sets of gloves.

‘DNP will turn everything and anything yellow including skin, clothes, carpet, and hair. You think you have washed it off your hands and you touch something and later you see yellow spots on what you touched.’

Due diligence and care was reputedly required when preparing to encapsulate DNP ‘by drying out the powder in a low heat oven to eliminate water content, and measuring powder and

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additives such as corn starch, salt, sugar or Vitamin C. Reliable scales, a *'Cap M Quik Device'* and size "O" caps are used.

> *'You can use any edible powder as filler, even sugar or salt... the best would be something with similar volume per weight. Spread about 1/4 of the package into a small plate and place in the oven at about 60c for around 3 hours. I checked progress every once per hour and revolved the powder in the plate each time (although that's not really necessary). Then I left resting for some minutes until it reach ambient temperature. After that it was necessary to grind into a finer powder using the smooth part of a meat hammer. Then I used a plastic sieve to filter the powder, getting a fine and homogeneous powder ready for encapsulation.'*

DNP Popularity, Risk Perceptions, Potential for Harm and Informed User Decision-making
User discussions centred on DNPs steady increase in popularity. Choices to use DNP also centred on the relatively controlled 50% elevation in resting metabolic rate as opposed to the ECA (ephedrine, caffeine and Aspirin), stack. Favourable views on DNP appeared grounded in its lack of anorectic effect in comparison to ephedrine or other thermo genic agents. Other discussions mentioned the unpleasant stimulatory effect of *'clenbuterol'*. Some users advocated co administration of ECA, clenbuterol and *'Yohimbine'* (mild MAOI with stimulant and aphrodisiac effects) to optimise fat burning capacity.

> *'DNP 'upgrades' the effects of clen [clenbuterol]. If you have used clen before and it had/has stopped working, then DNP will bring back its glory.'*

Conversations centred on DNP's attraction to the *'wrong crowd in general'*, those ill-informed as to the risks associated with DNP and seeking the short cut to leanness.

> *'DNP is not a drug for everyone, definitely not the beginner who just wants to lose a couple of pounds to look better with the shirt off… Without proper education on its use, DNP can be deadly.'*

> *'My only opinion is that before taking any supplement or drug the individual should research fully. Internet advice is just that, rather look for actual studies and get the full picture. DNP rightly has a scary reputation, not so much for the*

actual amount of incidents that have occurred but more so the risk involved with improper use/abuse.'

DNP was described as an *'intolerable but effective fat burning drug'* carrying significant potential for harm in the event of incorrect use.

'When done correctly, it is the perfect fat loss drug. DNP is definitely for experienced users only. This is probably the only thing out there that can actually kill you.'

Experienced users and those who had researched the drug were aware of dangers in the lack of upper limit in thermogenic increases. Heat radiation from the head and body surface, and lack of negative feedback within the body in the event of overdose were described, with most users aware of the reported 10% increase in metabolic rate for every 100mg of DNP. Tentative approaches to use were advised.

'Many people think this drug is very dangerous... and it is... if misused... basically, there is no upper-limit to how high your body-temperature can go on this stuff... which means your dosage really has to be watched closely.'

Most users were aware of the carcinogenic potential of DNP's phenol status and the harmful nature of production of free radicals during rapid fat oxidation. Discussions also centred on incidence of cataracts and potential damage of reproductive organs in females. Harm on inhalation of powder, sub dermal absorption, skin and eye irritation, and damage to liver and kidneys were also discussed.

DNP Outcomes, Management of Side Effects and Supplementation

Fat losses of between 10 and 12lbs were purported within 8-10 days of use. Mixed views were evident with regard to DNP results in males versus females. However, fat loss was reportedly masked by water retention during cycling, despite efforts to restrict dietary intake, and with true DNP outcomes impossible to calculate until post DNP cycle and subsequent loss of water weight. Optimal outcomes were visible 3-5 days following cessation of use.

'DNP is evil in the way it blunts thirst, while at the same time doing the cruel trick of bloating your body with water WHILE dehydrating you from water in your organs.'

Common short term side effects of DNP were reported by users to include thirst, shortness of breath/ rapid breathing, yellow vision, sore throat, flulike symptoms, fever, swollen lymph nodes, yellow eyes, hand tremors, fatigue, lethargy, dehydration, headaches, weakness, vomiting, abdominal pain, convulsions, nausea, neuropathic pain, rashes, reduced blood pressure and sweating.

'The side effects are serious and numerous, but if used correctly, none of the side effects are permanent. Despite these numerous side effects people still use it because it works when nothing else will.'

Discomfort and at times profuse sweating were described by all users, with most choosing to cycle DNP during the winter months, or during holidays so as not to impact on their professional lives. Bodily fluids such as urine and semen were described as becoming yellow and darkened. A characteristic DNP body odour was described by some users. Temporary neuritis or peripheral neuropathy was reported by several users.

'DNP is one of the best fat burners out there-if you can stand the sides, constant sweating, irritable, lethargic, dehydrated.....it is difficult to workout! 'You will be very uncomfortable... and very hot. Take this into consideration if you have a job... you'll look like you just ran a marathon.'

Practical considerations when embarking on a DNP cycle (and viewed by many users as facilitating use of higher doses) included aiming fans at head height, washing bed linen daily, remaining indoors during DNP cycle in summer or in hot climates, proper hydration, use of glycerol to aid in muscle hydration, care in cardiovascular training, avoidance of overeating and overheating, use of body thermometers, cold bathes, cold pads, and restricted consumption of carbohydrates.

Always follow DNP exercise with antioxidants, carbs, and this is a good time to use your multivitamin.'

Insomnia resulting from sweating and nausea was managed by holistic supplements, melatonin, prescription or over the counter (OTC) medications. Allergic reactions were described as dose and tolerance dependent, with some users experiencing rashes in first cycles only. Options to manage this included anti histamine therapy.

> *'The allergies manifest themselves first as itching without any rashes or redness.. It will later develop into rashes and or hives around the body and possibly spread to the face, neck, lips, and scalp area in severe cases. Any over the counter or prescription allergy medication (anti histamine) will cure the allergies. Also if you're allergic to DNP it doesn't mean you can't use it in the future. Allergies to DNP seem to have a tolerance factor.'*

The following supplements were advised to aid DNP's effectiveness and improve user comfort;

> *'Magnesium (1500mg); Vitamin C (3000mg in divided doses); Vitamin E (1200 IU in divided doses); Glutathione (200mg in divided doses); NAC (various amounts); T3 (dose according to personal preference); Calcium (2000mg not taken with the Magnesium); 5-HTP (if not on antidepressant medication) (various amounts); Meridia, Redux, or Fenfluramine (various amounts); Hydroxycitric Acid (particularly in the evenings to curb cravings); Pyruvate (2-6g/day in divided doses); Glycerol (3 tbsp/day in divided doses)" and "Alpha-Lipoic Acid (500-1000mg daily in divided doses).'*

Other substances advised included, '*sibutramine, gluthathione, potassium, fish oils, green tea extract, selenium'* and '*multivitamins'*. Combination DNP capsules were reported as containing '*200 mg DNP, 100 mg Quercetin (anti-histamine and anti-oxidant), 10 mg Sibutramine HCL (Appetite suppressant), 150 mg Magnesium Malate, 180 mg Synthetic Vitamin E (400 IE/IU), 5 mg Vitamin B12 and 5 mg Yohimbine HCL'*.

Users were advised not to consume prescribed medications such as anti-depressants, muscle relaxers, beta blockers, diuretics, or alcohol or illicit drugs such as MDMA or GHB.

‘Any medications that suppress energy. No allergy meds, antidepressants, muscle relaxers, or beta blockers. DNP will have you low as it is; don't worsen your body's energy by taking something that suppresses you further.’

DNP Dosage and Regimes for Optimal Use

The typical DNP cycle was 7-8 days on, followed by 7-8 days off. Doses of 375mg per day were purported resulting in increases of up to 55% in metabolic rate,.. Many discussions speculated on fatal dosage of DNP, which was estimated to range from between 1 and 3 grams (approximately 20-30 mg/kg). Some sites reported the lethal dose as 1200mg. Overdose was described by one user as an ‘*inferno cycle’*.

‘A lethal dose and the effective dose needed to lose fat rapidly are much too close together. A little too much DNP will send you to the hospital and perhaps to the grave.’

The importance of ‘correct dosage’ (3-mg/kg of bodyweight) was with recommendations to gauge tentatively in response to side effects. Discussions recommended user awareness of a 36 hour DNP half-life, with some users reported experiences of DNP half-life lasting over 48 hours. Many employed a calculative approach using Excel sheets to estimate accumulative amounts of DNP in the body.

‘Too many people don’t see the pounds melting off of them and panic so keep upping the dose. Not waiting for the DNP to do its job and more often not realizing that the scale isn’t moving like it should because they are holding a lot of water that won’t leave until several days after they stop DNP.’

Mixed views related to the effects and efficacy of *‘frontloading’*. Split dosage was also advised, and no greater than 300mg per time.

‘You could front load 600mg, then switch to 200mg every day after. This will give you an immediate and rather consistent 600mg bloodstream level. This works because the 600mg will breakdown to 420, then get pushed up to 620 by next 200mg dose. .Using it sparingly with a proven method to boost results is a wise choice. In fact using it "tactically" for short-term goals rather than "strategically"

for long-term objectives is a big difference and a way to substantially reduce risks.'

Experienced users reported the emergence of tolerance in lower dose ranges over time. The need for higher doses to elicit similar metabolic effects necessitated due diligence and management of unpleasant side effects;

'The average dose is 400-600/day, and more than that gets a little severe. A full gram is the highest dose I've heard anyone use. I've used that much, and it's hell. I like to stay around 600 a day, which is hot, but safe and effective. Take caps even hours apart through the day, ending about 4-5 PM'.

Oral administration of capsules was most common, with some reports of eating DNP out of the bag with a spoon, mixing with fruit juice, and consumption of powder within sweets.

'I'd unwrap and put a starburst in microwave for 10 seconds to soften. Flatten out starburst and put dose of DNP powder in the centre of the starburst. Wrap the starburst so that the DNP is at the centre. I'd swallow the DNP/starburst whole washed down with some h2o.'

Due to carbohydrate cravings and consumption of additional calories, diet was viewed as potentially negating the effects of DNP. Discussions underscored that the greater amounts of carbohydrate consumed when on DNP, the greater body temperature elevation.

'Be aware that eating high-carb foods will increase the heat sensation within an hour, and last about 2 hours.'

Isometric diets whilst on DNP were extensively discussed on all forums. Optimal DNP diets varied between '*33% protein, 33% fat, 33% carbs'; '0% carbs, 35% protein, 15% fat' a*nd '*50% carbs, 35% protein, 15% fat.'*

'Restricting carbs will put the body in a state of hypoglycemia and can be dangerous to the health and also the mental wellbeing. DNP also mimics insulin in that it shuttles glucose into the cells in the absence of glucose. This is great for

fat burning, but when carb intake is too low, the blood glucose can be at dangerously low levels as well

Fitness training in the form of resistance and cardiovascular workouts were advised to be tailored, and cognisant of the users reduced capacity for work. Muscle soreness, fatigue and delayed recovery (in extreme cases, muscle catabolism) was recommended to be managed by specific high repetition low weight sets.

'Keep lifting short, 30-40 minutes. Don't try to repeat your usual workouts. Drop to moderate weights, 8-12 reps, not to failure, and with plenty of walking rest between sets. You are not going to grow muscle on DNP, so don't use your usual heavy routine.'

Discussions centred on the use of DNP prior to anabolic androgenic steroid (AAS) cycling in order to lose body fat going into the cycle in preference to losing fat post AAS cycle. DNP was described as the '*perfect off cycle'*, with DNP used to ensure weight gain in terms of muscle and not fat. Most users were aware that anabolic rebound effect could be experienced whereby the user reduces fat and experiences hypertrophy of muscle. For bodybuilding competitors, DNP was advised 8 days prior to competition, with carbohydrate depletion after 3 days of the last capsule, and carbohydrate loading 2 days prior to competition with restricted fluid intake.

Discussion

This study provides rich, novel data regarding the population of DNP users' views and practices. We recognise that findings may be confounded by self-report issues and lack of verification of DNP products used. That said, validity is ensured by virtue of the systematic manner by which embedded, multi-level and multi sited online DNP phenomena were examined and given the verification of extensive vertical and horizontal similarities across forum activity relating to choices to use, practices and outcomes ensures '*trustworthiness'* (Wallendorf & Belk, 1989) of the study. A comprehensive understanding of the knowledge, attitudes and beliefs of a population is a pre-requisite for the development of any public health interventions that look to reduce the harm associated with a specific behaviour.

There are clear similarities between the DNP market, novel psychoactive substances market (Grundlingh et al., 2011) and anabolic steroids market, (Evans-Brown, Kimergard, & McVeigh, 2009) with a general user acceptance and understanding that there can be no guarantee of the quality or safety of products. There is also a culture of myths passing for facts and guesswork/personal observation or experience being accepted as evidence. In some cases the motivation for the promulgation of this dubious information is linked to financial gain due to vested interests in specific products. For some, the messages appear to be driven by a genuine wish to inform and educate. One such forum participant claimed to be able to assess the quality by suggesting that one should '… put some of the powder on your finger tips and rub together'. Forum discussions often appear to be grounded in scientific theory, with exchanges making reference to chemical nomenclature. Similar has been observed in the case of novel psychoactive drugs, sold as research chemicals (Corazza et al., 2013; Corazza et al., 2012) and synthetic peptides for tanning (Marie Claire Van Hout, 2014). However, the same discussions also describe 'safe therapeutic dosages', which for a metabolic poison that is not for human consumption, is an oxymoron. A further example is the juxtaposition of procedures requiring 'zero margin for error', an impossibility while manually drying and measuring the ingredients.

The detailed discussions regarding the production processes and the often complex administration regimes may facilitate some feeling of control for those involved in the supply or self-administration of DNP. With a product that is demonstrably highly dangerous, 'expert experience', complex lore and pseudoscience create a veneer of comfort, providing reassurance to all concerned. For those forum users who appear well versed in the diverse adverse effects impacting on various systems and organs throughout the body, this knowledge is viewed within the context of potential dramatic weight loss, a calculated gamble. A common distinction is made between those who use and misuse DNP. 'Informed DNP users' rationalise their use as being driven by evidence. Negative outcomes and adverse effects are attributed to those who are 'ill-informed'. Product knowledge exchange and purporting of indigenous harm reduction practices amongst online communities of illicit drug and PIED users are observed in netographic studies (Marie Claire Van Hout, 2014; M. C. Van Hout, 2014a, 2015). For many users, the adverse effects of DNP use tend to be described in terms of discomfort and general inconvenience rather than serious harm to health and discussed in terms of the most effective methods of managing these symptoms including cold baths, together with a plethora of medications and supplements often motivated by the opportunity

to take higher dosages for maximum weight loss.. There is considerable variation in the experiences of DNP users and contradictory advice regarding dosage, regime, diet, exercise and use of additional drugs and supplements. It is essential that the development of any interventions to protect the health of those using or contemplating the use of DNP take account of the beliefs and motivations of the target audience. DNP is no ordinary dietary aid and has more in common with the most dangerous of 'problem drugs' than with other weight loss products.

So how do health professionals and educators best engage with the population of DNP users? Unlike anabolic steroid users who may be targeted at gymnasia, NPS users who may frequent nightclubs or many other drug users who may gravitate to specific services such as needle and syringe programmes or methadone clinics, DNP users do not have a physical environment where they may be targeted. While some DNP users may also be users of other PIEDS, this is a subset of individuals. Clearly, engagement with the online community is needed to reach sections of the population of users. DNP 'gurus' exert a significant influence on both the beliefs and practices of DNP users and it is likely that any health campaigns that directly contradict these key influencers will be dismissed. Therefore establishing contact and maintaining communication and directly influencing these 'gurus' within the DNP community may be an essential element of any effective harm reduction and health promotion strategy.

Conclusion

These findings provide a unique insight into the motivations practices and beliefs of this population, it barely scratches the surface of the complex interface between cyber pharmacology and folklore. It is clear that a greatly improved understanding is required if any of the tried and tested health promoting approaches are to be effectively utilised. Equally, given the expansion of web retailing of DNP and the lack of reporting of adverse events, continued pharmacovigilance and surveillance is warranted.

List of abbreviations

DNP - 2,4-Dinitrophenol
AAS - Anabolic androgenic steroid
OTC – Over the counter

The authors confirm that:

The material has not been published elsewhere or is being considered for publication elsewhere.

The authors have all be involved in the work. The first author had a substantive role in conceptualising the research aim and methods, contextualising the study, interpretting the findings and drafting the overall manuscript. The second author has contributed to writing this paper. The last author was responsible for data collection, analysis and interpretation, and reviewing the final manuscript. All authors have read and approved the final draft.

No ethical approval was required,

No funding sources were sought.

Reference

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Table Listing of top ten sites discussing DNP.

FORUM	Screenshots	Address
Body Recomposition	60	www.bodyrecomposition.com
Forum Bodybuilding	35	www.forumbodybuilding.com
Muscle Talk	11	www.muscletalk.co.uk
UK Muscle	60	www.uk-muscle.co.uk
Steroidology	60	www.steroidology.com
Think Steroids	60	www.thinksteroid.com
T muscle	12	www.tmuscle.co.uk
Professional Muscle	49	www.professionalmuscle.com
Hyper muscles	7	www.hypermuscles.com
Underground	60	www.ugbodybuilding.com
Total	414	