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Research Paper

Off-label Semaglutide & GLP-1 weight-loss medicine use for anti-ageing: A Netnography of older bodybuilders' experiences and understandings

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ABSTRACT

Background: GLP-1 weight-loss medicines (e.g. Semaglutide; Tirzepatide) are increasingly prevalent, with many users accessing these drugs off-label through the internet for lifestyle purposes. However, to date there has been little research examining their use for anti-ageing purposes. This article fills this gap by examining the perspectives and experiences of older bodybuilders on forums regarding their use of GLP drugs for anti-ageing.
Methods: This research was a netnography of the two largest bodybuilding and steroid specific forums on the web, exploring 12,392 unique posts from the top 160 threads, captured in 2024. Qualitative thematic analysis of posts was undertaken.
Findings: GLP drugs were felt to have a number of benefits for anti-ageing, longevity and general wellbeing. Many older bodybuilders took them for their anti-inflammatory effects, which allowed them to train despite age-related joint pain and general inflammation. Further, many bodybuilders highlighted emerging scientific research regarding GLP medicines' potential benefits for anti-ageing more broadly, including brain and heart health, and improving insulin sensitivity when older. The role of 'expert' users on forums sharing findings from scientific research encouraged forms of use beyond existing clinical guidelines, but also facilitated harm reduction by encouraging forum users to switch from higher risk drugs like HGH and growth hormone secreting peptides to GLP medicines for anti-ageing.
Discussion: It is clear that anti-ageing is a significant motivator for GLP use among older bodybuilders, and public health policy must understand and acknowledge older users' distinct motivations and approaches to use in order to best serve this population. The role of forum folk pharmacology in both encouraging unapproved therapies, but also enabling harm reduction through encouraging safer approaches to drug use is also important to understand when considering public health approaches to this population.

1. Introduction

GLP-1 agonist medicines (GLPs) are insulin-regulating compounds that have been recently approved as prescription medicines for anti-obesity treatments in several countries (DHSC, 2023; TGA, 2024). There are a range of GLP weight-loss medicines currently available, including Semaglutide (Ozempic/Wegovy), Tirzepatide (Mounjaro), and Liraglutide (Saxenda), along with other potential therapies awaiting approval, including Retatrutide. These drugs appear to be highly effective at suppressing appetite and inducing a weight-loss state, leading to significant media discussion around their potential as 'miracle drugs' for the treatment of obesity (e.g. Cox, 2024; Lesh, 2024).

While currently classified as prescription-only medicines in countries such as the US, UK, and Australia, recent discourse surrounding GLPs' effectiveness for fat-loss purposes has led to many users accessing them without prescription for aesthetic and lifestyle purposes, largely through online platforms such as social media beauty pages (Hirst & Turnock, 2024). By May 2022, the hashtag #Ozempic (the most prominent brand name GLP medicine) had been viewed over 74 million times on the social media platform TikTok (Kolovos, 2022), and Google searches for both Semaglutide and related GLPs exploded at that time, increasing almost tenfold between December 2021 and December 2022 (Han *et al.*, 2024). The demand for these drugs for off-label use was so high that it led to global shortages for those using for medical purposes (e.g. for

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type-II diabetes) (Kolovos, 2022), and the market for 'generic' and counterfeit versions has grown to vast proportions, with illicit market GLPs now readily available through a number of easily accessible 'surface web' platforms (Hirst & Turnock, 2024; Turnock, Hearne & Lazuras, 2025).

Despite stereotypes that weight-loss drugs are consumed exclusively by women looking to lose weight, or young men participating in bodybuilding subculture, their use is in fact expansive and heterogenous, with diverse motives documented across user populations (Germain *et al.*, 2019). Indeed, even within 'stereotypical' user cultures such as bodybuilders, it is important to understand diverse motives for use, including their potential applications for anti-ageing purposes, and broader wellbeing motivations among older users. Notably, the possibility of GLP use specifically for anti-ageing purposes has been highlighted in recent clinical studies (McKie, 2024; Hancock, 2024), with subsequent media discourse asking whether they could be the elusive chemical '*fountain of youth*' (Sky News, 2024; Walters, 2024), paralelling narratives previously seen in relation to human growth hormone (HGH) therapy in older individuals (Zeman, 2012).

Hearne *et al.* (2024) highlight the importance of understanding older (>40 years) men's use of image and performance enhancing drugs (IPEDs) for public health, given they may have more complex motivations for use than stereotypical young male bodybuilders, and need specifically tailored policy responses. With a growing body of research exploring men's use of illicit market Testosterone for self-medicated Testosterone replacement therapy (TRT) (Harvey *et al.*, 2022; Turnock, 2022; Underwood *et al.*, 2021), it is clear that the ways in which older men interact with and use steroids must be explored specifically to understand potential risks and avenues for harm reduction within this population, and such research should be expanded to other IPEDs, including weight-loss peptides (Turnock & Hearne, 2024). Building on Hearne et al's (2024) recommendation, along with McVeigh *et al.*'s (2021) suggestion that the drug use practices of enhanced bodybuilders are important to monitor for broader public health policy since they are often at the forefront of experimental and emergent forms of drug use, this research sought to explore older bodybuilders' perspectives and experiences of GLP medicine use for anti-ageing purposes. This was achieved through a netnography of 12,392 unique posts from 160 forum threads, posted across two of the world's largest bodybuilding and enhancement drug forums, conducted in 2024.

2. Background

2.1. Lifestyle medicines, anti-ageing, and public health

Walley (2002) describes lifestyle medicines as those used to meet patient aspirations rather than traditionally defined medical need, and notes that in an increasingly consumerist society, older individuals may have expectations of access to medicines that make them feel more youthful, beyond traditional understandings of health and illness. In exploring the trade in illicit and counterfeit lifestyle medicines, Hall (2019) notes how cultural demands in the workplace and society more broadly are emphasising an ideal of 'wellness', youth, and beauty that many can only fulfil through chemical enhancement. As society becomes increasingly pharmaceuticalised, and the notion of the individual as an empowered health consumer becomes ever more culturally expected (Cederström & Spicer, 2015), blurring lines between what is considered 'normal' and 'enhanced' (Hall, 2019), the off-label use of medicines for anti-ageing motivations is likely to increase.

The notion of 'wellbeing' in middle and later life is strongly linked to subjective feelings of youthfulness based on appearance, energy levels, libido, and other factors that lifestyle medicines may serve to increase (Hearne *et al.*, 2024). Hall and Antonopoulos (2016) note how this has led to a high demand for counterfeit medicines, with the illicit lifestyle medicine market in the UK alone valued at almost half a billion pounds, suggesting a worldwide market valued in the tens of billions per year. While policies relaxing the scheduling of certain medicines – notably sildenafil (Viagra) – have brought some of this trade into the licit pharmaceutical sphere (see MHRA, 2017), the demand for these medicines and prevalence of online access is nonetheless indicative of a growing demand for drugs providing feelings of 'wellness' and youthfulness (Hirst & Turnock, 2024; L. Turnock & Gibbs, 2023a).

Hearne *et al.* (2024) note that the average age of AAS users accessing needle and syringe programmes (NSPs) has increased since the 1990s likely due to both ageing cohort effect and new, older initiates, thus reflecting the suggestion that older men are increasingly using illicit and off-label lifestyle drugs. Beyond the social-cultural pressures on body image that affect IPED users of all ages, the cultural demand for subjective feelings of youth as a part of the broader 'pharmaceuticalisation' of natural ageing processes (Dunn *et al.*, 2021) appears to be fuelling this demand. Recent research examined older men's motivations and use of off-label testosterone for perceived testosterone replacement therapy (TRT), enabling them to feel youthful and attain a physique and energy levels associated with young male vitality (Gibbs, 2023; Turnock, 2022; Underwood *et al.*, 2021), and such motivations underpin a range of lifestyle medicine use (Turnock & Hearne, 2024).

Importantly, Hearne *et al.* (2024) note that the use of enhancement drugs among older men may serve as a means of upholding their perceived 'male status', through allowing them to attain/maintain the physique associated with young men, and perform sexually later in life (see also Harvey *et al.*, 2022). Decline in aesthetics and performance associated with age may have negative impacts on the psychological wellbeing of older men, motivating them to use enhancement drugs to reverse this. While cited by Hearne *et al.* (2024) in the context of older men's testosterone use, these motivations clearly intersect with fat loss and the anti-ageing benefits of other enhancement drugs, including GLPs.

The use of various peptide drugs for anti-ageing has been documented in prior netnographies, with Van Hout and Hearne (2016) noting that the growth hormone secretagogue CJC-1295 was often used by women in digital fitness spaces for age-related concerns relating to addressing inflammation and joint pain, along with more aesthetic benefits including youthful looking skin. Turnock and Hearne (2024) expand on these findings, noting the increasing range of experimental peptides being employed by older trainers for a range of concerns, including speeding up recovery from injuries, everyday feelings of wellbeing, and broader anti-ageing treatments. With the rising prominence of GLP medicines, and increased media discussion of their purported anti-ageing benefits (Hancock, 2024), specific in-depth research of this type into users' beliefs, motivations, and experiences of GLP use for anti-ageing is therefore significant to understanding evolutions in the ever changing market for lifestyle medicines and forming effective harm reduction policy for these users.

2.2. Bodybuilding forums and folk pharmacology

With much knowledge on enhancement drug use being disseminated through online forums (Brennan *et al.*, 2018; Tighe *et al.*, 2017; Turnock, 2021), an important component to understand for public health policy formation is the development of communal folk pharmacologies (Underwood, 2017; Van Hout & Hearne, 2016) in these spaces, which inform the use of these drugs, and encourage particular norms of use and approaches to user-led harm reduction. Van Hout and Hearne (2016) found that the communal folk pharmacologies of fora users potentially created personal and social normalisation of growth hormone secretagogue use to attain hyper fit and youthful bodies, with knowledge regarding substance effects, dosages and polydrug routines shared among users as part of this normalised cultural space.

Studies of people who use drugs have long noted how social advice mechanisms, social controls on use, cultural recipes and other processes of informing drug use occur within subcultures (Gamble & George, 1997; Maloff *et al.*, 1979; Rhodes, 1996). Southgate and Hopwood

(2001) looked to develop a theoretical framework to understand the social and cultural contexts to illicit drug use within a network of gay men who used drugs in Sydney, including how 'expert' advice on dosages, safe use and harm reduction was disseminated through this network. They note how folk knowledge on appropriate combinations of drugs, dosing practices, assessing drug quality, 'safe scoring' and potential harms of drugs, as well as knowledge regarding how to minimise these harms circulated within the community studied, terming this peer knowledge exchange 'folk pharmacology'. This knowledge exchange was often facilitated by 'network nannies', or informed users with experience who would support others in their use of drugs.

With the rise of digital networks, such knowledge exchange and diffusion by network experts now occurs in digital spaces, with forums offering a clear example of how folk pharmacologies develop for a range of drugs and associated communities. Hearne and Van Hout (2016) highlight how novel psychoactive substance (NPS) users would share their experiential learning with compounds in digital forum spaces, along with strategies for mitigating or navigating negative effects, including recommending engaging with a 'trip-sitter' to monitor one's use. This led to the forums developing a communal folk pharmacology of use for interested parties, informed by experiential learning of more 'expert' NPS takers (see also Van Hout & Hearne, 2015). More recent studies have observed similar social learning practices among Nitrous Oxide users on Reddit regarding maximising pleasures and minimising harms (MacLean *et al.*, 2022), and IPED forums evidence the same development of folk pharmacologies and communal harm reduction practices among users (Van Hout & Hearne, 2016; Turnock & Hearne, 2024).

Regarding IPED use among bodybuilders, Underwood (2024) highlights how forums may serve as 'enabling environments' (Duff, 2010) for drug use, which do not simply encourage drug use, but also inform safer and harm conscious drug use, led by peer disseminated knowledge (see also Turnock & Townshend, 2022), building on these earlier analyses. Notably, Underwood (2024) documents how forum users are increasingly integrating findings from scientific research on drugs into their folk pharmacologies, in an attempt to move beyond traditional understandings of 'what works' associated with 'broscience', towards an understanding of how and why drug effects are observed. This indicates an evolution of 'expert' users in communal networks of IPED users, where experiential learning is increasingly coupled with academic understandings of pharmacological effects and risk. Nonetheless, much advice remains grounded in self-experimental use of compounds, particularly in relation to emerging and novel drugs (see Turnock & Hearne, 2024).

With the experiential knowledge of enhanced bodybuilders often diffused to broader gym cultures and weight-loss drug users through digital platforms and gym environments (McVeigh *et al.*, 2021; Piatkowski *et al.*, 2024), bodybuilders' understandings of IPED use are important to study from a public health perspective, as they are likely to be indicative of future trends in use among the broader enhancement drug-using population (McVeigh *et al.*, 2021). Consequently, this research explores in-depth the experiences of older users on two bodybuilding and steroid forums who accessed GLPs off-label for anti-ageing purposes, and the folk pharmacology of these forum spaces, to contribute to knowledge on this emergent form of IPED use.

3. Methods

The research followed a netnographic approach (Kozinets, 2010) to studying discourse relating to GLPs and anti-ageing on two of the largest bodybuilding and steroid forums on the internet, established via a Google search. Bodybuilding forums were selected owing to their norms of information sharing regarding drug use, where unfiltered discussion of drug experiences and linking to information sources is common (Underwood, 2024), meaning there would be sufficient scale, interactivity and heterogeneity of posts to satisfy Kozinets' (2010) requirements for conducting effective netnography. Additionally, this choice reflected the fact that bodybuilders are often at the forefront of knowledge regarding experimental approaches to drug use (McVeigh *et al.*, 2021), meaning the discussions in these forum spaces would offer greater understanding of this emergent form of use.

A total of 12,392 unique posts from 160 total threads were analysed (80 per forum). Mean posts per thread were 77.5, with a Median of 16, reflecting the fact that most questions were posted in each respective forum's GLP 'Mega thread', which in both cases had thousands of posts (n = 3825; 3737 respectively), with other threads tending to relate to more specific queries, resulting in fewer replies. Relevant threads were identified following a search for key terms ('GLP', 'Semaglutide', 'Tirzepatide', 'Retatrutide', 'Ozempic', 'Wegovy', 'Mounjaro' and shortened versions, e.g. 'Sema') using the forums' built-in search functions. While the earliest identified thread came from 2012, the vast majority of posts (90+ %) came from 2021–2024, reflecting the period in which awareness of these drugs grew among broader (non-bodybuilding) populations. The mega threads were set up in 2021, as increasing numbers of forum users began to ask about them, likely fuelled by growing awareness of the drugs in broader media filtering into bodybuilders' discussions.

Threads were initially read for relevance by the first author, with the top returned results matching our selection criteria read in turn. Relevance was determined by the first author's reading of threads to ensure they contained discussion of GLP medicines and user interactions regarding their use, effects, benefits, applications, potential harms, or similar related topics. The first author's background as a long time IPED forum lurker and researcher already engaged in GLP-related research (see Turnock, Hearne & Lazuras, 2024) facilitated his determination of relevance. Additionally, searches were further refined by searching for 'anti-ageing', 'age' and 'older' along with the aforementioned terms to return more relevant results. The top 80 posts from each forum (following the researcher's reading for relevance and application of exclusion criteria) were then sampled for data analysis, with relevant data extracted into a Word document. Those threads without any replies were excluded owing to the lack of interactivity meaning they could not be said to reflect communal understandings of use, as were threads posted (or which appeared to have been posted) by a GLP or peptide seller looking to promote their product, as these posed a greater risk of containing posts by 'fake' or 'sockpuppet' accounts (see Turnock & Hearne, 2024).

Data was analysed following the approach to thematic analysis outlined by Braun and Clarke (2006), with initial categories developed inductively by the first author when reading the data, before reanalysing the data and refining categories and themes using the constant comparative method. In this initial reading, a range of codes were developed, with GLP-related posts often containing multiple codes. This included codes such as anti-ageing use; older poster (40+); health benefits; advice-seeking; experiential knowledge; dosing advice; harm reduction; folk pharmacology; expert poster; avoiding bro-science; motivations for use; dosing; tolerance; off-setting side-effects; product quality and more. This was followed by a process of searching for and refining main themes, with 'anti-ageing' as a main theme including explicit discussion of anti-ageing use, older posters' (40+) motivations and experiences, anti-inflammatory effects; potential health benefits (cardiovascular, neurological), and so on. Similarly, the 'folk pharmacology' main theme included codes relating to expert posters, dosing advice, harm reduction, avoiding bro-science and discussions of safety. From this, we defined and named the core sub-themes of each main theme (two from each), which are the titles of the four findings sections below (Section 4). Other themes relating to codes not belonging to these four themes relevant to anti-ageing were excluded from this specific article, but were used in our analyses elsewhere (see Turnock *et al.*, 2025). The first author's initial coding and analysis was checked by co-authors to check and refine the themes, and help define and name the final themes. Naturally, there is some overlap between scientific

discussions of anti-ageing applications of GLPs and the advice offered by expert users drawing on these sources grouped under the 'expert advice and folk pharmacology' theme, reflecting that there is some interpretation of which data best fits which theme when multiple codes apply.

Reflecting established ethical norms for netnographic research, we selected forums which allowed the viewing of posts without a specific requirement to register an account or log in, meaning discussions could be conceptualised as occurring in 'public space' (Enghoff & Aldridge, 2019). Although forums are already pseudo-anonymous spaces (Germain *et al.*, 2019), we anonymised personal details like names and specific geographical location in the data collection, although kept track of poster ages and genders when posted, since these could be relevant to findings. This is in line with the approach of prior netnographies into IPED-related forum posts (Brennan et al., 2018; Henning & Andreasson, 2021; Van Hout & Hearne, 2016). Finally, this was a 'passive' netnography (Brennan *et al.*, 2018), and based only on existing discussions hosted on the forums, without any attempt by the researchers to actively elicit data (Enghoff & Aldridge, 2019). Ethics approval for the research was granted by the University of Lincoln (Reference 2024–19,099).

4. Findings

GLPs were discussed as having broad benefits for a range of anti-ageing purposes. Four key themes were identified: Anti-inflammatory effects and everyday wellbeing; Protection against age-related conditions; 'Expert' advice and folk pharmacology; And the perceived safety of GLPs compared to other lifestyle drugs used for anti-ageing.

4.1. Anti-inflammatory effects and everyday wellbeing

One of the main benefits to GLPs for anti-ageing purposes were their anti-inflammatory effects. With age often correlating with joint pain and general inflammation, the ability of GLPs to seemingly reduce inflammation and associated pain made them appealing to older posters looking to participate in gym training:

'Tirz[epatide] is my go-to for painless knees… not NSAIDs.'

'I decided to try Sema/Tirzep and felt like a million bucks. My inflammation is gone.'

Dealing with everyday aches and pains has previously been highlighted as a significant motivation for using peptide drugs such as BPC-157 and TB-500 among gym users interested in anti-ageing (Turnock & Hearne, 2024), and with rising awareness of GLPs, forum posters with these motivations appeared to be experimenting with GLP use to address similar concerns. Inflammation was a significant concern for many older posters, who would reference research pointing to GLPs' ability to reduce inflammation and everyday pains, noting that this was a significant benefit beyond their typical uses as diabetes and weight-loss drugs:

'So many new studies coming out about how GLP1s act on inflammation in the body. It's crazy how much more they do than just glucose control and weightloss.'

One older (late-40 s) female poster highlighted how she had begun using a range of experimental peptide drugs like CJC-1295 specifically for their anti-inflammatory effects after hearing about them on the forum, but upon learning that GLPs also had anti-inflammatory benefits had transitioned towards using these:

'This right here is why I started down the peptide journey. I really knew nothing about peptides but when my inflammation was eased I wanted to know what else was out there.'

Explaining how she had trained when younger (in her 20 s) but stopped working out 24 years ago after a severe illness hospitalised her, this poster noted the difference that GLPs had made to her ability to get back into training at an older age:

'Couple years ago I got back into weight training and tracking all of my food. I felt good but the scale would go up and down … My inflammation was so high and never got relief. I started taking Sema the end of April which really helped my inflammation so my joint pain was a lot better. I was exhausted on it all the time though [so] switch[ed] to Tirz and felt a lot better.'

This highlights how knowledge sharing and self-experimentation in forum spaces often encouraged use for purposes which are not yet clinically approved, but that there was some evidence the drugs could be effective for. Older trainers searching for advice on how to deal with joint pain and inflammation were increasingly exposed to posts discussing how GLPs could be effective for these purposes, and those who had accessed GLPs for these reasons appeared to find them effective at reducing inflammation-related pains. While some had preferences for specific GLPs (e.g. Tirzepatide over Semaglutide), those who used them for inflammation and everyday pains noted the significant impact they could have on restoring a feeling of wellness and subjective youthfulness, allowing them to return to gym training at an older age.

Notably, the above poster had switched from Semaglutide to Tirzepatide following recommendations from forum members when complaining about feeling fatigued on Sema, reinforcing the suggestion that communal knowledge exchange on forums led directly to changing practices among users:

'I will always recommend Tirz over Sema and Reta. No harsh side-effects but all the good benefits.'

'The exhaustion got so bad on Sema I had to figure out something different! [Tirz] Should be here in a week or so.'

When considering anti-ageing, fatigue (a common side-effect of GLP medicines) could clearly diminish subjective feelings of youthfulness, thus the broader feedback on effects, side-effects and product recommendations from bodybuilders also fed into those looking at using the drugs for anti-ageing purposes, reinforcing the role that communal folk pharmacology played for these forum users.

Significantly, anti-ageing users would frequent post that they were taking doses lower than those used for clinical weight-loss. The above older female noted that she had been taking Semaglutide at 1.25mg/week, approximately half of the maximum clinical dose (2.4mg/week) recommended for weight-loss or diabetes treatment. Several posters discussed using Tirzepatide at 5mg/week despite the maximum clinical dose being 15mg/week. Much like TRT in comparison to cycling or blasting steroids, it therefore seems that for those interested in reducing inflammation, a lower dose of GLP medicines could be used than an 'enhancement dose'. As an individual who had been suffering from chronic inflammation-related knee pain before using Tirzepatide joked, "*1–2* mg *per week is all I (k)need*" for anti-inflammatory effects.

With scientific research suggesting that GLP medicines, particularly Tirzepatide, may have anti-inflammatory effects, and recommending large-scale clinical trials look specifically at this potential benefit (Sokary & Bowadi, 2025; Taktaz *et al.*, 2024), older bodybuilders' experiential knowledge of subjectively reduced inflammation appears to align with the scientific literature, reinforcing the potential value of these drugs for such purposes. As their anti-inflammatory effects come to be better understood, it is therefore likely that other groups will begin to use them for these purposes beyond bodybuilders, highlighting the importance of research into this emerging form of anti-ageing use.

4.2. Protection against age-related conditions

In addition to weight-loss and anti-inflammatory effects, many posters commented on GLPs' broader potential benefits to anti-ageing. This included their ability to regulate blood glucose levels and affect insulin sensitivity. Several forum posters noted that even among those who were not diagnosed as diabetic, improving insulin sensitivity could be beneficial, especially among older users:

'You can be doing everything right but some people when they get older have poor insulin sensitivity. Semaglutide improves this enormously and makes your body operate like it's supposed to when you were young.'

'Do you know how much insulin sensitivity declines with age?'

Awareness of Semaglutide's medical application for treating diabetes and pre-diabetic patients had thus filtered into the folk pharmacology of forums, who extended their understanding of these uses to other circumstances where improving insulin sensitivity could be beneficial. Making one's body *feel* subjectively younger is an important motivation for lifestyle drug use, and countering age-related insulin resistance was one means of contributing to this feeling among older posters. While some posters experienced fatigue on Semaglutide (as noted above), this seemed to be person and drug dependent, and many felt GLPs gave this benefit of subject feelings of youth without this side-effect, making them valuable anti-ageing drugs for these posters.

In another example, when a 56 year old male enquired about which drugs the steroid forum would recommend for anti-ageing, many responses recommended a 'TRT dose' (125–250mg/week[1]) of Testosterone for rejuvenation and general feelings of wellbeing. However, in detailing his health concerns and motivations for drug use, the poster noted a family history of diabetes (father and brother), which owing to his age elicited the following response:

'If you have a family history with diabetes would some semaglutide (a GLP-1 agonist that improves insulin sensitivity and weight loss) be beneficial? … It could prevent you becoming diabetic or at least significantly delay it. That's what I'd do.'

GLP use for anti-ageing thus straddled the line between 'lifestyle enhancement' in the form of feeling younger, as well as self-medicating as protection against age-related medical conditions. As knowledge of these potential benefits spread, forum users would increasingly ask questions regarding the potential of adding GLPs to their training regimens for their anti-ageing benefits:

'Any more I can read about this? Hear much about people who are already lean doing a low weekly dose just for some anti-aging benefit?'

In explaining why GLPs were emerging as anti-ageing lifestyle medicines, one poster detailed how their mechanism of action combated the main physiological features of what we typically define as 'ageing', suggesting they were effective at combating the main harms associated with biological ageing:

'If we define aging as cellular damage over time, GLPs clearly have a potent impact against two of the major sources of that damage, oxidative stress and chronic inflammation.'

This reply speaks to the prevalence of 'expert' advice on the forums, where informed posters would often explain and highlight findings from the broader scientific literature to supplement the self-experimentation and lived knowledge of other users (see Underwood, 2024). These posters would highlight some of the less-understood mechanisms by which GLPs had 'anti-ageing' benefits, and advanced communal understandings of their potential benefits beyond the subjective observations of posters who were simply using the drugs:

'The neuroprotective and neurogenerative effects of GLP receptor activation on nerves makes it a must do for the anti-aging and longevity crowd interested in keeping their vision and brain degeneration to a minimum over the long haul.'

The discussion of emerging scientific research led to these 'expert' posters highlighting potential uses for GLPs that were less understood, but likely of interest to those looking for anti-ageing medicines, as in the example of potential benefits to brain health quoted here. This has been highlighted as a likely benefit of GLPs in recent reporting on the drugs (Cox, 2024), and forum posters were already suggesting these findings indicated significant anti-ageing potential for these medicines. The presence of these posters who integrated emergent scientific knowledge into their understanding of drugs discussed on the forum thus led to potential anti-ageing benefits being highlighted, and their role in knowledge dissemination and the communal folk pharmacology of the forums is therefore significant to explore in itself.

4.3. 'Expert' advice and folk pharmacology

The prominence of 'expert' posters who expanded the forums' understanding of drug applications was notable, and a number of seemingly well-informed individuals would highlight emerging studies relating to GLPs to indicate where their benefits may lie beyond those already commonly understood. While 'expert' users made up a small percentage of posters (perhaps 5 %), they were nonetheless responsible for a significant number of posts, being regular and experienced forum users, and would frequently reply to threads to offer their insights. These posters would often comment in the GLP 'mega threads', but would also reply to posters with specific queries, offering more depth on the scientific underpinnings to effects they were experiencing, or applications they had heard discussed elsewhere.

Underwood (2024) discusses how digital bodybuilding cultures are increasingly trying to integrate scientific understandings into their folk pharmacologies through engaging with academic research (see also Andreasson & Henning, 2023). This was most notable on forum 2, where the lead moderator would pin and link to posts written by academics and other experts regarding the use of various lifestyle drugs, which would lead to greater views and engagement on those specific posts, encouraging forum users to refer to these scientific findings. While there may be difficulties in distinguishing which posters actually have a scientific knowledge base versus those who are simply able to talk convincingly in scientific sounding language (Underwood, 2024), there are a range of people with scientific backgrounds and Doctorates who frequent forum spaces (Turnock, 2021; Underwood, 2024), and having a moderator with an interest in scientific research helped with identifying these individuals on forum 2. Consequently, a significant number of GLP-related posts discussed emerging scientific findings regarding their potential applications, most notably with regards to their anti-ageing effects:

'[Benefits include] blood vessel inflammation cooling down preventing plaque buildup, heart remodelling reversal… reverting to a younger state, neuroprotective antioxidant production boosted preserving vision, accelerated neurogenesis, etc. Now we know what all the GLP / GIP receptors in those tissues are for.'

These expert posters would often summarise and link to emerging scientific literature, and offer their interpretations of these studies for other forum users. A clear example of this can be seen in a debate regarding the extent to which the beneficial effects of GLPs for anti-ageing were a direct result of the medicines themselves, or a secondary effect of reversing obesity and diabetic or pre-diabetic conditions among clinical participants. Asked whether Tirzepatide would offer anti-ageing effects if 'micro-dosed' by a non-obese, non-diabetic person, one of forum 2's main 'expert' posters replied with his summary of the existing research he had read:

'Very, very likely. One weakness of current research is that most participants have been diabetic or obese. They're just now starting to untangle the benefits resulting from weight loss, and those directly coming via receptor activation. … In one of the first human trials specifically including "normal BMI" subjects and the repair of cardiac tissue [they noted]: "in

[1] Bodybuilders will frequently use the term 'TRT dose' to indicate any administration of Testosterone under 250mg/week, despite this amount being significantly higher than clinical doses of 250mg/3 weeks for androgen deficiency treatment offered in the UK (BNF, 2025).

patients with normal or low BMI, GLP-1RA may directly improve atrial remodelling through GLP-1 receptors.'

Similar to its benefits to insulin sensitivity when insulin resistance is an age associated risk, the potential for GLPs to be beneficial to heart health would be significant for those interested in anti-ageing, and the poster linked to the study in question (Xu & Zhu, 2024) to highlight the evidence in favour of this suggestion. Indeed, regardless of whether the improvement in heart health truly was an effect of the GLPs or due to weight loss (given he only found a single study that explored patients in the 'normal' BMI range), this expert poster highlighted that weight control (energy expenditure) was affected by age and genetics, and that GLPs would be useful for anti-ageing from this perspective regardless of precise mechanism of action when it came to heart health.

Indeed, this particular 'expert' user – an established and prolific forum member – would routinely post links to studies illustrating his claims, so that other forum members could follow up on this research for themselves. With regards to the claim that "*clear clinical improvements have been observed in patients with severe neurological disease treated with GLPs*", he posted a link to an article in the *British Journal of Pharmacology* (Hölscher, 2022) outlining treatment outcomes in patients with Parkinson's, Alzheimer's, and diabetes-related memory loss, highlighting how GLP/GIP medicines like Tirzepatide seem to have neuroprotective effects, thus would be valuable as anti-ageing medicines in at-risk populations.

4.4. Perceived safety; comparison to other lifestyle drugs

The final theme related to GLPs' utility for anti-ageing related to comparisons with drugs used more traditionally for anti-ageing among older bodybuilders. Prior research on forums has noted the use of Human Growth Hormone (HGH) and a range of experimental peptides for anti-ageing purposes, which may come with significant or unknown risks (Turnock, 2022; Turnock & Hearne, 2024; Van Hout & Hearne, 2016). With the explosion in GLP-related posts on the forums, however, there was increased scrutiny placed on these other lifestyle drugs, and several posters discussed how GLPs were much safer alternatives, given the potential harms of drugs such as HGH:

'No one is claiming bodybuilding dose GH is healthy or is good for longevity. We know it's risky and stupid.'

Indeed, even among those who felt HGH had benefits for anti-ageing, the risks were also important to highlight, with one poster cautioning another that '*Anti-aging and longevity are not the same thing*': Despite HGH offering subjective feelings of youthfulness, it posed greater potential harms for longer-term health, and could thus negatively impact on healthy lifespan.

While HGH use would have to be carefully monitored with regular health checks given its potential for harm, GLPs were increasingly regarded as much safer, while offering similar benefits (or greater) for anti-ageing when used in standard clinical (for weight-loss) doses. Expert posters explained how the degree of clinical testing conducted on GLPs marked them as potentially the safest anti-ageing lifestyle drugs available:

'Semaglutide has over a decade worth of research behind it. It's safe.'

Importantly, one poster noted that the harms linked to HGH also applied to all the other growth hormone secreting peptides commonly used for anti-ageing like GHRP-2, CJC-1295 and Sermorelin, but that this was often not discussed when recommending them, as has become increasingly common in online bodybuilding spaces (see Turnock & Hearne, 2024):

'But the same applies for GH and almost ALL the secretagogues but no one's talking about it because half of the bodybuilding community is on them.'

While this poster noted that the potential risks of peptides were often under-discussed on forums, the transition towards recommending GLPs for joint pain, inflammation and other anti-ageing purposes was informed by an understanding that growth hormone and experimental peptides came with risks that GLPs did not, with long term clinical data supporting GLPs being safer. This illustrates the risk vs reward calculation that many engaging in off-label drug use make when looking to balance the benefits of use with potential harms (Akrigg *et al.*, 2025; Underwood, 2024). Further, the fact that discussion of growth hormone secreting peptides was now becoming more critical as alternative anti-ageing drugs grew to prominence, highlights how certain risks will be neutralised when there are no perceived better alternatives. While forum folk pharmacologies could encourage the use of potentially harmful drugs, they would also adapt to understandings of risk based on the advice offered by more informed posters, leading many to transition towards recommending 'safer' drugs when anti-ageing or fat-loss threads were posted.

Potential harms of GLPs were often addressed by the forum's expert users, who would draw on their knowledge of relevant studies to explain how these could be mitigated. This is clearly seen in the following response to a poster's concerns regarding GLP-associated anaemia, which one of the expert users highlighted was unlikely to be a risk to those eating nutritious foods (like posters on a bodybuilding forum):

'I don't think there's anything mysterious or concerning that happens to digestion impacting iron levels … they eat less, and by not choosing foods high in protein and proper nutrients, they end up suffering the effects of deficiencies of both.'

While GLPs were generally regarded as safer alternatives to existing compounds, however, it is important to highlight that GLPs were often used in conjunction with other lifestyle medicines as part of a broader anti-ageing polydrug routine. The 'stacking' of various compounds to achieve a desired polypharmic effect is common in bodybuilding cultures, where numerous steroids and fat burners or peptides may be used in conjunction (Sagoe *et al.*, 2015). With bodybuilders at the forefront of much experimental lifestyle drug use (McVeigh *et al.*, 2021), it was therefore common to see a similar approach to combining drugs in an anti-ageing 'stack':

'Doing HRT and TRT to help me reduce my physical pain from heavy exercise at age 40 as well as the anti-aging/biohacking benefits. I've been doing the 2–4 IU HGH for about 6 weeks and I have noticed some benefits such as less knee pain and better rest at night. I've been holding at the 10 mg *Tirz for 3 months while slowly adding the Cagri [Cagrilintide] to maintain the appetite suppression.'*

This is important to note, since although GLPs appear less harmful than other enhancement drugs, the 'stacking' of multiple substances may lead to potential synergistic effects between them. Particularly with steroids and GLPs both being insulin sensitising, there is a risk of hypoglycaemia from uninformed polysubstance use (Turnock *et al.*, 2025). Despite this, recommendations for GLPs alongside Testosterone and other steroids were commonplace in anti-ageing threads, pointing to a potential risk behaviour among this population.

5. Discussion & conclusion

These netnographic findings present an original contribution to our understanding of the use of GLP-1 peptides for anti-ageing purposes, which has to date gone undiscussed in the IPED/public health literature. As with the use of other novel peptide drugs (Turnock & Hearne, 2024; Van Hout & Hearne, 2016), GLP use among older individuals appears to be driven by desires to appear more youthful looking and be as physically fit and active as when they were younger, as well as off-set perceived negative health conditions associated with age and enhance their general feelings of subjective wellbeing. It is important to understand the drivers and motivations for the use of GLP-1 peptides by older

populations as a group, whose needs likely differ from the stereotypical young male bodybuilder or a young woman looking to lose fat for aesthetic reasons, so that age-appropriate healthcare and policy responses can be delivered. Hearne et al. (2024) recommend this in their review of AAS use by older men and also suggest that researchers should acknowledge, distinguish, and separately analyse older males in future studies so as to age-appropriately inform their recommendations. Our findings illustrate the importance of adopting such an approach to understanding GLP weight-loss medicine use to both research and health policy.

We highlight a shift in the use of enhancement drugs from the need to be 'better than well' (Evans-Brown et al., 2012; McVeigh et al., 2012) to simply 'well', with the use of these substances by forum posters for everyday wellbeing and for protection against age-related impaired wellbeing. This phenomenon was supported within the findings by a multiplicity of 'expert' posters who enhanced forum members' understanding of GLP-1 applications through dissemination of emerging scientific research and responding to posters' queries relating to anti-ageing. The integration of this scientific research into the communal folk pharmacology of forum spaces through 'expert' users reading and summarising academic research articles naturally has the potential to mean bodybuilders are at the forefront of emergent forms of use, prior to them becoming widespread in clinical practice. Indeed, the very first GLP-related thread on forum 2 was posted in 2012, long before the first clinically approved GLP-1 agonist (Liraglutide / Saxenda) was approved as a prescription medicine for weight loss in the UK in 2020 (Kahal *et al.*, 2021). While this potentially means older bodybuilders are at the cutting edge of anti-ageing therapy use, it is important to acknowledge that, as Underwood (2024) notes, such knowledge is still dependent on the ability of the poster and reader to correctly interpret and summarise the findings they are posting, and that this may increase harmful behaviours if scientific studies are incorrectly interpreted, or initial clinical indications are followed before long-term harms are fully understood. However, the rising norm of 'expert' posters linking to scientific studies, and forum moderators encouraging scientific debate among members, means that understandings of the potential uses of these drugs are likely more informed than in other IPED user cultures, such as social media-oriented young male trainers (see Christiansen *et al.*, 2017; L.A. Turnock & Gibbs, 2023b).

In addition to the possibility that research may be wrongly interpreted (Underwood, 2024), it is important to acknowledge that there is also a degree of risk associated with off-label medicine use, despite the prevalence of discussions linking to clinical studies and research. Notably, the prevalence of polysubstance use, or drug 'stacking', can create synergistic effects between the various compounds, resulting in harm to the individual such as hypoglycaemia (Turnock *et al.*, 2025). Stacking is not an uncommon trend amongst IPED using populations (Sagoe *et al.*, 2015), however, the risk of adverse effects is exacerbated by the possibility that many GLP-1 medicines acquired off-label through the illicit market may be counterfeit or substandard quality, meaning they come with the risks of incorrect dosing or substitution seen for other illicit lifestyle medicines, posing greater risks of overdose or potentiating synergistic effects (Ashraf *et al.*, 2024; Turnock, Hearne & Lazuras, 2024). With most bodybuilders sourcing their 'generic' peptides, including GLPs, through Chinese manufacturers (see Turnock & Hearne, 2024), this risk must be acknowledged in relation to the users studied in the present research.

However, the shifting of folk pharmacology of forum spaces to one that is increasingly recommending GLP-1 medicines for anti-ageing, in contrast to the rise in growth hormone secretagogues that occurred through the 2010s when those were the emergent novel anti-ageing drugs (Turnock & Hearne, 2024; Van Hout & Hearne, 2016), indicates that indigenous harm reduction practices are still at the fore of discussions within these digital spaces (see Turnock & Townshend, 2022). It is a novel and important finding that these indigenous practices are now reaching older populations of people on bodybuilding and steroid forums who may be at increased risk of harms due to age and age-related health harms. The fact that our research documented several older (40+) users who were returning to training having not been regular bodybuilders for some years, but who were engaging with the knowledge exchange practices of forum culture, illustrates the importance of understanding forums and forum folk pharmacology as tools for enabling effective harm reduction in IPED using populations more broadly, and not solely as sites for misinformation (Underwood, 2024).

Building on this observation, it is important to acknowledge that there is a clear demand from these GLP users to be informed regarding their effects and risks, leading to the prominence of forum 'experts' advising on use, even including the moderator on forum 2 'pinning' particular threads with links to relevant scientific studies. This desire to be informed while still relying on the communal folk pharmacology of forums speaks to the common perception that the medical community is not sufficiently interested in helping IPED users who wish to take these drugs outside of clinical guidelines, meaning few authoritative sources can advise on emerging forms of use. This has previously been observed for TRT, where Doctors were felt by IPED users to be either unwilling to help, or lacking knowledge regarding Testosterone's effects (Underwood *et al.*, 2021; Turnock, 2022), and was observed in relation to anti-ageing peptide use by Turnock and Hearne (2024). With many IPED users perceiving healthcare professionals as stigmatising, lacking knowledge, or unwilling to support their drug use outside of accepted clinical guidelines (Richardson *et al.*, 2024), authors like Fraser *et al.* (2020) have discussed the need for healthcare practitioners to work more closely with IPED 'connoisseurs' in co-creating knowledge. Underwood (2024) recommends an 'allied harm reduction' approach that joins these community-embedded harm reduction actors with professionals who can evaluate community harm reduction advice (see also Turnock *et al.*, 2023), and it is clear that public health must look to look to 'professionalise' IPED harm reduction by building on these existing cultural experts' roles. In doing so, healthcare professionals must be aware of developing trends in IPED use, such as anti-ageing use of GLP medicines and other peptides.

Despite the clear contributions of the research, however, it is important to note that our focus on bodybuilding forums resulted in the vast majority of data being gathered from men, with older women's experiences of GLP use for anti-ageing comparatively under-explored. While understanding older men's enhancement drug use specifically is important in developing effective public health policy that addresses the needs of this particular population (Hearne *et al.*, 2024), it is clear that women's use for these purposes is also important to study as awareness of GLPs' potential for anti-ageing spreads beyond the confines of bodybuilding culture. Reflecting this, further research looking at women's forums to understand how GLP use is negotiated by older women specifically is needed, and contribute to the knowledge base established by this article.

Additionally, research into other platforms and cultural spaces is needed to understand the anti-ageing use of these drugs beyond the contexts of bodybuilding subculture. While bodybuilding forums are often at the forefront of experimental drug use discussions, platforms such as Reddit and other non-subculturally bounded spaces (e.g. social media sites) must be explored to see how the anti-ageing use of GLPs is navigated and discussed in broader communities.

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CRediT authorship contribution statement

Luke A. Turnock: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Jennifer Germain: Writing – review & editing, Writing – original draft, Validation, Formal analysis. **Mikey Hirst:** Writing – review & editing, Writing – original draft, Formal analysis. **Evelyn Hearne:** Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors have no competing interests to declare.

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References

Akrigg, K., Cox, L., Turnock, L., Richardson, A., & Piatkowski, T. (2025). If you find me on the floor, stick some sugar in my mouth: The social production (and protection) of insulin risk among image and performance enhancing drug communities. *Drugs: Education, Prevention & Policy*. https://doi.org/10.1080/09687637.2025.2481292

Andreasson, J., & Henning, A. (2023). *Online doping: The digital ecosystem and cyborgification of drug cultures*. Springer Nature.

Ashraf, A. R., Mackey, T. K., Vida, R. G., Kulcsár, G., Schmidt, J., Balázs, O., & Fittler, A. (2024). Multifactor quality and safety analysis of semaglutide products sold by online sellers without a prescription: Market surveillance, content analysis, and product purchase evaluation study. *Journal of Medical Internet Research, 26*, Article e65440. https://doi.org/10.2196/65440

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706QP063OA

BNF. (2025). *Testosterone decanoate, isocaproate, phenylpropionate and propionate*. British National Formulary, National Institute for Health and Care Excellence. Available from: Https://bnf.nice.org.uk/drugs/testosterone-decanoate-isocaproate-phenylpropionate-and-propionate/ [Retrieved 10th Mar 2025].

Brennan, R., Wells, J. S., & Van Hout, M. C. (2018). Raw juicing"–an online study of the home manufacture of anabolic androgenic steroids (AAS) for injection in contemporary performance and image enhancement (PIED) culture. *Performance Enhancement & Health, 6*(1), 21–27. https://doi.org/10.1016/j.peh.2017.11.001

Cederström, C., & Spicer, A. (2015). *The wellness syndrome*. Polity Press.

Christiansen, A. V., Vinther, A. S., & Liokaftos, D. (2017). Outline of a typology of men's use of anabolic androgenic steroids in fitness and strength training environments. *Drugs: Education, Prevention and Policy, 24*(3), 295–305. https://doi.org/10.1080/09687637.2016.1231173

Cox, D. (2024). *How ozempic became the new wonder drug*. The Telegraph, 12th July. Retrieved 26th Oct 2024 from: Https://www.telegraph.co.uk/health-fitness/diet/weight-loss/ozempic-wegovy-potential-health-benefits-heart-attack/.

Dunn, M., Mulrooney, K. J., Forlini, C., van de Ven, K., & Underwood, M. (2021). The pharmaceuticalisation of 'healthy' ageing: Testosterone enhancement for longevity. *International Journal of Drug Policy, 95*, Article 103159. https://doi.org/10.1016/j.drugpo.2021.103159

Duff, C. (2010). Enabling places and enabling resources: New directions for harm reduction research and practice. *Drug & Alcohol Review, 29*(3). https://doi.org/10.1111/j.1465-3362.2010.00187.x

DHSC. (2023). *Accessing wegovy for weight loss: Everything you need to know*. Department of health and Social Care, 4th Sept. retrieved 8th Apr 2024 from Https://healthmedia.blog.gov.uk/2023/09/04/accessing-wegovy-for-weight-loss-everything-you-need-to-know/.

Enghoff, O., & Aldridge, J. (2019). The value of unsolicited online data in drug policy research. *International Journal of Drug Policy, 73*, 210–218. https://doi.org/10.1016/j.drugpo.2019.01.023

Evans-Brown, M., McVeigh, J., Perkins, C., & Bellis, M. A. (2012). *Human enhancement drugs: The emerging challenges to public health*. Liverpool John Moores University Centre for Public Health.

Fraser, S., Fomiatti, R., Moore, D., Seear, K., & Aitken, C. (2020). Is another relationship possible? Connoisseurship and the doctor–patient relationship for men who consume performance and image-enhancing drugs. *Social Science & Medicine, 246*, Article 112720. https://doi.org/10.1016/j.socscimed.2019.112720

Gamble, L., & George, M. (1997). Really useful knowledge': The boundaries, customs, and folklore governing recreational drug use in a sample of young people. In P. Erickson, D. Riley, Y. Cheung, & P. O'Hare (Eds.), *Harm reduction: A new direction for drug policies and programs* (pp. 341–362). University of Toronto Press.

Germain, J., McLean, C., & Leavey, C. (2019). One size does not fit all: Tackling the issue of weight-loss drug use. In K. Van de Ven, J. Mulrooney, & J. McVeigh (Eds.), *Human enhancement drugs* (pp. 313–323). Routledge.

Gibbs, N. (2023). *The muscle trade: The use and supply of image and performance enhancing drugs*. Policy Press.

Hall, A. (2019). Lifestyle drugs and late capitalism: A topography of harm. In T. Raymen, & O. Smith (Eds.), *Deviant leisure: Criminological perspectives on leisure and harm* (pp. 161–186). Palgrave.

Hall, A., & Antonopoulos, G. A. (2016). *Fake meds online: The internet and the transnational market in illicit pharmaceuticals*. Springer.

Han, S. H., Safeek, R., Ockerman, K., Trieu, & Sorice-Virk, S. (2024). Public interest in the off-label use of glucagon-like peptide 1 agonists (Ozempic) for cosmetic weight loss: A Google trends analysis. *Aesthetic Surgery Journal, 44*(1), 60–67. https://doi.org/10.1093/asj/sjad211

Hancock, A. (2024). *Ozempic could delay ageing, researchers suggest*. BBC News, 31st Aug. Retrieved 27th Oct 2024 from: Https://www.bbc.co.uk/news/articles/ce81j919gdjo.

Harvey, O., Parrish, M., van Teijlingen, E., & Trenoweth, S. (2022). Libido as a motivator for starting and restarting non-prescribed anabolic androgenic steroid use among men: A mixed-methods study. *Drugs: Education, Prevention and Policy, 29*(3), 276–288. https://doi.org/10.1080/09687637.2021.1882940

Hearne, E., & Van Hout, M. C. (2016). Trip-sitting" in the black hole: A netnographic study of dissociation and indigenous harm reduction. *Journal of Psychoactive Drugs, 48*(4), 233–242. https://doi.org/10.1080/02791072.2016.1207827

Hearne, E., Atkinson, A., Boardley, I., McVeigh, J., & Van Hout, M. C. (2024). Sustaining masculinity': A scoping review of anabolic androgenic steroid use by older males. *Drugs: Education, Prevention and Policy, 31*(1), 27–53. https://doi.org/10.1080/09687637.2022.2132135

Henning, A., & Andreasson, J. (2021). "Yay, another lady starting a log!": Women's fitness doping and the gendered space of an online doping forum. *Communication & Sport, 9*(6), 988–1007. https://doi.org/10.1177/2167479519896326

Hirst, M., & Turnock, L. A. (2024). Semaglutide, testosterone and sildenafil advertising on Social Media: The normalisation of lifestyle enhancement drugs. *Performance Enhancement & Health*. , Article 100303. https://doi.org/10.1016/j.peh.2024.100303

Hölscher, C. (2022). Protective properties of GLP-1 and associated peptide hormones in neurodegenerative disorders. *British Journal of Pharmacology, 179*(4), 695–714. https://doi.org/10.1111/bph.15508

Kahal, H., Mohammed, K., Lonnen, K., Sathyapalan, T., & Walton, C. (2021). Liraglutide (Saxenda®) for the treatment of obesity: A commentary on NICE Technology Appraisal 664. *British Journal of Diabetes, 21*(1), 120–122. https://doi.org/10.15277/bjd.2021.298

Kolovos, B. (2022). *'Shortage of diabetes medication ozempic after tiktok users promote drug for weight loss'*. The Guardian, 31st May 2022. Retrieved 11th Dec 2023 from Https://www.theguardian.com/australia-news/2022/may/31/shortage-of-diabetes-medication-ozempic-after-tiktok-users-promote-drug-for-weight-loss.

Kozinets, R. (2010). *Netnography: Doing ethnographic research online*. Sage.

Lesh, M. (2024). *Let's be honest: 'miracle drug' ozempic will be a game-changer on obesity*. City AM, 16th May. Retrieved 26th Oct 2024 from: Https://www.cityam.com/lets-the-honest-ozempic-not-taxes-or-regulation-can-solve-obesity/.

MacLean, S. J., Riddell, O., Herold, M. D., & Frank, V. A. (2022). Becoming a nitrous oxide user on social media: Learning to maximise pleasures and minimise harms. *International Journal of Drug Policy, 109*, Article 103861. https://doi.org/10.1016/j.drugpo.2022.103861

Maloff, D., Becker, H. S., Fonaroff, A., & Rodin, J. (1979). Informal social controls and their influence on substance use. *Journal of Drug Issues, 9*(2), 161–184. https://doi.org/10.1177/002204267900900203

McKie, R. (2024). *Weight-loss drugs 'slow down the ageing process', scientists suggest*. The Guardian, 31st Aug. Retrieved 9th Jan 2025 from: Https://www.theguardian.com/science/article/2024/aug/31/weight-loss-drugs-ozempic-slow-down-ageing-process-study.

McVeigh, J., Evans-Brown, M., & Bellis, M. A. (2012). Human enhancement drugs and the pursuit of perfection. *Adicciones, 24*(3), 185–190.

McVeigh, J., Salinas, M., & Ralphs, R. (2021). A sentinel population: The public health benefits of monitoring enhanced body builders. *International Journal of Drug Policy, 95*, Article 102890. https://doi.org/10.1016/j.drugpo.2020.102890

MHRA. (2017). *MHRA reclassifies viagra connect tablets to a pharmacy medicine. Medicines and Healthcare products Regulatory Agency (28th Nov.)*. https://www.gov.uk/government/news/mhra-reclassifies-viagra-connect-tablets-to-a-pharmacy-medicine.

Piatkowski, T., Cox, L., Gibbs, N., Turnock, L., & Dunn, M. (2024). The general concept is a safer use approach': How image and performance enhancing drug coaches negotiate safety through community care. *Drugs: Education, Prevention and Policy*, 1–9. https://doi.org/10.1080/09687637.2024.2352442

Rhodes, T. (1996). Culture, drugs and unsafe sex: Confusion about causation. *Addiction, 91*(6), 753–758. https://doi.org/10.1080/09652149639970

Richardson, A., Kean, J., Fleming, L., Hudson, J. I., Kanayama, G., & Pope, H. G., Jr (2024). Attitudes of anabolic steroid users and non-users towards general practitioners in the United Kingdom. *Performance Enhancement & Health, 12*(4), Article 100304. https://doi.org/10.1016/j.peh.2024.100304

Sagoe, D., McVeigh, J., Bjørnebekk, A., Essilfie, M. S., Andreassen, C. S., & Pallesen, S. (2015). Polypharmacy among anabolic-androgenic steroid users: A descriptive metasynthesis. *Substance Abuse Treatment, Prevention, and Policy, 10*, 1–19. https://doi.org/10.1186/s13011-015-0006-5

Sky News. (2024). Ozempic: Weight-loss drug could slow down ageing and offer benefits 'far beyond' previously thought', 31st Aug 2024. Retrieved 25th Oct 2024 from: Https://news.sky.com/story/ozempic-weight-loss-drug-could-slow-down-ageing-and-offer-benefits-far-beyond-previously-thought-13206462.

Sokary, S., & Bawadi, H. (2025). The promise of tirzepatide: A narrative review of metabolic benefits. *Primary Care Diabetes*. https://doi.org/10.1016/j.pcd.2025.03.008

Southgate, E., & Hopwood, M. (2001). The role of folk pharmacology and lay experts in harm reduction: Sydney gay drug using networks. *International Journal of Drug Policy, 12*(4), 321–335. https://doi.org/10.1016/S0955-3959(01)00096-2

Taktaz, F., Fontanella, R. A., Scisciola, L., Pesapane, A., Basilicata, M. G., Ghosh, P., & Barbieri, M. (2024). Bridging the gap between GLP1-receptor agonists and cardiovascular outcomes: Evidence for the role of tirzepatide. *Cardiovascular Diabetology, 23*(1), 242. https://doi.org/10.1186/s12933-024-02319-7

TGA. (2024). *New semaglutide product becomes available*. Therapeutic Goods Administration, Australian Government Department of Health and Aged Care, 2nd August. Available from: Https://www.tga.gov.au/safety/shortages/medicine-shortage-alerts/new-semaglutide-product-becomes-available [Retrieved 19th Dec 2024].

Tighe, B., Dunn, M., McKay, F. H., & Piatkowski, T. (2017). Information sought, information shared: Exploring performance and image enhancing drug user-facilitated harm reduction information in online forums. *Harm Reduction Journal, 14*, 1–9. https://doi.org/10.1186/s12954-017-0176-8

Turnock, L. (2021). *Supplying steroids online: The cultural and market contexts of enhancement drug supply on one of the world's largest fitness & bodybuilding forums*. Plymouth Policy Research Institute.

Turnock, L. A. (2022). Exploring user narratives of self-medicated black market IPED use for therapeutic & wellbeing purposes. *Performance Enhancement & Health, 10*(2), Article 100207. https://doi.org/10.1016/j.peh.2021.100207

Turnock, L., & Gibbs, N. (2023a). Click, click, buy: The market for novel synthetic peptide hormones on mainstream e-commerce platforms in the UK. *Performance Enhancement & Health, 11*(2), Article 100251. https://doi.org/10.1016/j.peh.2023.100251

Turnock, L. A., & Gibbs, N. (2023b). Exploring the normalisation of image and performance enhancing drugs (IPEDs) in British gyms and its connectivity with social media. In J. Morgan, T. F. Søgaard, & A. Uhl (Eds.), *Normalisation re-visited: Drugs in Europe in the 21st century* (pp. 40–59). Pabst Science.

Turnock, L., Gibbs, N., Cox, L., & Piatkowski, T. (2023). *Big* business: The private sector market for image and performance enhancing drug harm reduction in the UK. *International Journal of Drug Policy, 122*, Article 104254. https://doi.org/10.1016/j.drugpo.2023.104254

Turnock, L. A., & Hearne, E. (2024). Novel wellbeing and repair peptide use in the UK: Netnographic findings. *Performance Enhancement & Health.* , Article 100293. https://doi.org/10.1016/j.peh.2024.100293

Turnock, L. A., Hearne, E., & Lazuras, L. (2024). Made in China: The international supply of illicit semaglutide and weight-loss medicines online. *Emerging trends in drugs. Addiction and Health, 5*, Article 100169. https://doi.org/10.1016/j.etdah.2024.100169

Turnock, L. A., Hearne, E., Germain, J., Hirst, M., Townshend, H., & Lazuras, L. (2025). Off-label Ozempic & GLP-1 weight-loss medicine use among online bodybuilders: Folk pharmacology, risk and harm reduction. *International Journal of Drug Policy, 142*, Article 104854. https://doi.org/10.1016/j.drugpo.2025.104854

Turnock, L. A., & Townshend, H. D. (2022). How digital fitness forums shape IPED access, use, and community harm reduction behaviours. In J. Andreasson, & A. Henning (Eds.), *Doping in sport and fitness* (pp. 155–179). Emerald Publishing Limited.

Underwood, M. (2017). Exploring the social lives of image and performance enhancing drugs: An online ethnography of the Zyzz fandom of recreational bodybuilders. *International Journal of Drug Policy, 39*, 78–85. https://doi.org/10.1016/j.drugpo.2016.08.012

Underwood, M. (2024). From 'bro, do you even lift? 'to 'bro, do you even science?': How the relationship between science and broscience can inform the development of allied image and performance enhancing drug harm reduction. *Performance Enhancement & Health.* , Article 100291. https://doi.org/10.1016/j.peh.2024.100291

Underwood, M., van de Ven, K., & Dunn, M. (2021). Testing the boundaries: Self-medicated testosterone replacement and why it is practised. *International Journal of Drug Policy, 95*, Article 103087. https://doi.org/10.1016/j.drugpo.2020.103087

Van Hout, M. C., & Hearne, E. (2015). Word of mouse": Indigenous harm reduction and online consumerism of the synthetic compound methoxphenidine. *Journal of Psychoactive Drugs, 47*(1), 30–41. https://doi.org/10.1080/02791072.2014.974002

Van Hout, M. C., & Hearne, E. (2016). Netnography of female use of the synthetic growth hormone CJC-1295: Pulses and potions. *Substance Use & Misuse, 51*(1), 73–84. https://doi.org/10.3109/10826084.2015.1082595

Walley, T. (2002). Lifestyle medicines and the elderly. *Drugs & Aging, 19*, 163–168. https://doi.org/10.2165/00002512-200219030-00001

Walters, J. (2024). *'Fountain of youth!' miracle drug found to 'stop ageing process' in huge scientific breakthrough*. GB News, 31st Aug 2024. Retrieved 26th Oct from: Https://www.gbnews.com/health/ozempic-news-scientific-breakthrough-miracle-drug-ageing.

Xu, L., & Zhu, D. (2024). GLP-1RA may have varying effects on cardiac structure in patients with ASCVD depending on BMI. *Frontiers in Endocrinology, 15*, Article 1355540. https://doi.org/10.3389/fendo.2024.1355540

Zeman, N. (2012). *Hollywood's vial bodies*. Vanity Fair. Feb 24th. Retrieved 27th Oct 2024 from: Https://www.vanityfair.com/style/2012/03/human-grown-hormone-hollywood-201203.