# Managing risks and harms associated with the use of anabolic steroids

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# MANAGING RISKS AND HARMS ASSOCIATED WITH THE USE OF ANABOLIC STEROIDS


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# Abstract

**Background:** People using AAS may adopt a range of strategies to prevent and treat adverse health conditions potentially associated with the use of these substances (AAS-HC). These strategies include seeking support from physicians, using the needle and syringe exchange programme (NSP) and seeking support from informal sources such as coaches and online forums. The process of identifying risks and harms, adopting and modifying health-related strategies is similar to the methods of risk-management employed in other fields of human activity. This approach recognises the importance of the informal body of knowledge produced by decades of AAS-related folk-pharmacology and seeks to understand harm-reduction from the users' perspective.

**Objectives:** The primary objective of this thesis is to investigate the strategies adopted by people using AAS to prevent and treat AAS-HC. Secondary objectives include to explore the factors associated with the adoption of health strategies and the occurrence of AAS-HC, as well as the barriers and facilitators experienced by AAS users when accessing health services and other sources of support.

**Methods:** To achieve the objectives above, three work packages (WP) were produced as part of a mixed-methods research design. **WP1** is a systematic review and meta-analysis of the prevalence of AAS users seeking support from physicians. **WP2** is a cross-sectional online survey that identified AAS-HC, risk factors and health-related strategies adopted by AAS users in the UK. **WP3** is a qualitative study based on in-depth interviews to discuss the experiences of AAS users and their risk-management strategies (RMS).

**Results:** The estimated overall prevalence of AAS users seeking support from physicians is 37.1%. Higher prevalence rates were observed in studies from Australia (67.3%) and amongst clients of the NSP (54.1%), whilst the lowest was observed among adolescents (17.3%). The health conditions most commonly reported by the 883 participants of the online survey were insomnia (33.3%) and anxiety (32.2%). Most participants adopted preventive strategies such as having blood tests in the last 12 months (86.2%) and seeking a GP to treat AAS-HC (55.0%). Those who sought a GP for AAS-related information were 76% less likely to report an AAS-HC in the last 12 months. The interviews described AAS users' RMS as a continuous process of awareness and behavioural changes. Participants described an extensive use of private health services and other sources of support to bypass the barriers experienced by AAS users engaging with the public health system.

**Conclusion:** A large number of AAS users refrain from seeking support from physicians. Health professionals should be trained to recognise and manage the most common AAS-HC and help users improve their RMS. Further studies should investigate the efficacy of AAS-related RMS and the subpopulations of AAS users more likely to experience AAS-HC and less likely to engage with health services.

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| | | | | | |
|---|---|---|---|---|---|
| **5HT** | 5-hydroxytryptamine | **EPO** | erythopoietin | **LSD** | lysergic acid diethylamide |
| **A&E** | accident and emmergency | **FFMI** | free-fat mass index | **MAI** | myotrophic-androgenic index |
| **AAS** | androgenic-anabolic steroids | **FSH** | follicle-stimulating hormone | **MD** | muscle dysmorphia |
| **AAS-HC** | adverse health conditions potentially associated with AAS | **GABA** | gamma-aminobutyric acid | **MDMA** | 3,4-Methylenedioxy methamphetamine |
| **AAS-years** | number of years since the first use of AAS | **GDPR** | General Data Protection Regulation | **NSP** | needle and syringe programme |
| **AI** | active ingredient | **GGT** | gamma-glutamyl transferase | **PCT** | post-cycle therapy |
| **AISH** | AAS-induced hypogonadism | **GHB** | gamma-hydroxybutyrate | **PEP** | post-exposure prophylaxis |
| **ALT** | alanine transaminase | **GnRH** | gonadotropin-releasing hormone | **PREP** | pre-exposure prophylaxis |
| **AP** | alkaline phosphatase | **GP** | general practitioner | **pro-ANP** | pro-atrial natriuretic peptide |
| **AR** | androgen receptor | **GRF** | glomerular filtration rate | **PSA** | prostate-specific antigen |
| **AST** | aspartate transaminase | **GUM** | genitourinary medicine | **PSU** | pilosebacous unit |
| **ATP** | adenosine triphosphate | **HCA** | hepatocellular adenoma | **RMS** | risk-management strategy |
| **BaC** | blast-and-cruise | **HCC** | hepatocellualr carcinoma | **ROS** | reactive oxygen species |
| **BBV** | blood-borne virus | **HCG** | human chorionic gonadotropin | **SARMs** | selective androgen receptor modulators |
| **BPH** | bening prostatic hyperplasia | **HDL** | high density lipoprotein | **SHBG** | sex-hormone binding globulin |
| **CGL** | Change Grow Live | **hGH** | human growth hormone | **SRH** | sexual and reproductive health |
| **CK** | creatine kinase | **HTGL** | hepatic triglyceride lipase | **STI** | sexually transmitted infections |
| **CNS** | central nervous system | **IGF-1** | insulin-like growth factor 1 | **SUD** | substance use disorder |
| **CofP** | community of practice | **IM** | intramuscular | **TRP** | L-tryptophan |
| **CSEW** | Crime Survey for England and Wales | **IPED** | image and performance-enhancing drugs | **UGL** | underground laboratory |
| **CVD** | cardiovascular disease | **IV** | independent variable | **UK** | United Kingdom |
| **DHEA** | dehydroepiandrosterone | **LDH** | lactate dehydrogenase | **VAT** | visceral fat tissue |
| **DHT** | dihydrotestosterone | **LDL** | low density lipoprotein | **WADA** | World Anti-Doping Agency |
| **DNP** | 2,4-Dinitrophenol | **LGBTQIA+** | lesbian, gay, bisexual, transgender, intersex, queers/questioning, asexuals and other sexual identities | **WP** | work package |
| **DV** | dependent variable | **LH** | luteinising hormone | **YOLO** | you only live once |

# 1. Introduction

Anabolic-androgenic steroids (AAS) are synthetic androgens used to treat health conditions such as hypogonadism, cachexia and depression (Nieschlag & Behre, 2016; Walther et al., 2019), and also used as image and performance-enhancing drugs (IPEDs) to increase muscle mass and strength (Begley et al., 2017; Evans-Brown et al., 2012). The estimated global prevalence of AAS use is 3.3% (Sagoe et al., 2014). In the UK, the Crime Survey for England and Wales (CSEW) reported that 69,000 people aged 16 to 59 years had used AAS in the last 12 months – a prevalence of 0.2% (ONS, 2022), which is considered an underestimation by many researchers (McVeigh & Begley, 2017; Mullen et al., 2020) and the UK Anti-Doping organisation (UKAD, 2020). Recently, a panel of specialists estimated that, amongst people aged 15 to 64 years in the UK, between 328,000 to 687,000 men (central value 447,000) and between 17,000 to 76,000 women (central value not provided) used AAS in the last 12 months (Hope et al., 2022). The socioecological context of AAS use can be described as a dynamic risk environment of interrelated factors that enable and prevent the use of these drugs, ranging from individual practices and networks of mutual support to institutional and cultural norms (Bates et al., 2019a). The use of AAS can increase the risk of several health conditions, including acne, testicular atrophy, gynecomastia, clitoromegaly, hypomania, anxiety, and dyslipidaemia (Pope et al., 2014). People using AAS adopt several strategies to prevent and treat adverse health conditions potentially associated with the use of AAS (AAS-HC), such as having blood tests to monitor their health, use the services of the needle and syringe exchange programme, and seek support from physicians, friends,

coaches and online forums (Bates et al., 2019; Harvey et al., 2019; Van de Ven et al., 2018).

This thesis' overarching aim is to investigate the strategies adopted by people using AAS to manage the risks, prevent and treat the harms associated with the use of AAS. Following an overview of the unprescribed use of AAS, its epidemiology and risk environment in chapter 1, chapter 2 describes the development of synthetic androgens and the pharmacological properties of AAS. Chapter 3 presents a physiological analysis of the main effects of AAS and chapter 4, a discussion on the strategies adopted by people using these substances to prevent and treat harm. Chapters 5 presents the objectives and methods of this research, followed by the description of three work packages (WP). WP1 (chapter 6) is a systematic review and meta-analysis estimating the prevalence of AAS users seeking support from physicians (Amaral, Kimergård, et al., 2022). WP2 (chapter 7) describes an online survey investigating adverse health conditions, sources of information and harm-reduction strategies adopted by 883 people using AAS in the UK. WP3 (chapter 8) describes a qualitative analysis of in-depth interviews discussing the health-related behaviours of people using AAS as a continuous and dynamic process of risk-management, sign-posting opportunities for health-related interventions. Finally, chapter 9 summarises the contributions, strengths and limitations of the work carried out.

## 1.1 The unprescribed use of AAS by the general population

Soon after the first synthesis of testosterone in 1935 (Butenandt & Hanisch, 1935; Ruzicka & Wettstein, 1935), AAS' properties drew the attention of people willing to enhance athletic performance and muscularity. By the late 1940s, as cheaper

manufacturing increased the accessibility to AAS (Millard, 2011) and publications such as *The Male Hormone* (De Kruif, 1945) praised the human-enhancing potential of testosterone, the use of AAS grew in popularity amongst bodybuilders and strength athletes (Kanayama & Pope, 2018). The dawn of AAS represented a flourishing market for pharmaceutical companies, who develop an array of injectable and oral compounds still used nowadays, such as Deca-Durabolin© (nandrolone decanoate), Winstrol© (stanozolol) and Anavar© (oxandrolone; Millard, 2011). Throughout the second half of the 20th Century, the use of AAS spread from the world of elite sport into the general population, becoming a phenomenon that redefined the ideals of masculine body image and influenced many aspects of Western culture (Evans-Brown et al., 2012; Kanayama & Pope, 2018; Pope, Phillips, et al., 2000a), as exemplified in Figure 1.

Figure 1: Examples of enhanced muscularity in popular culture

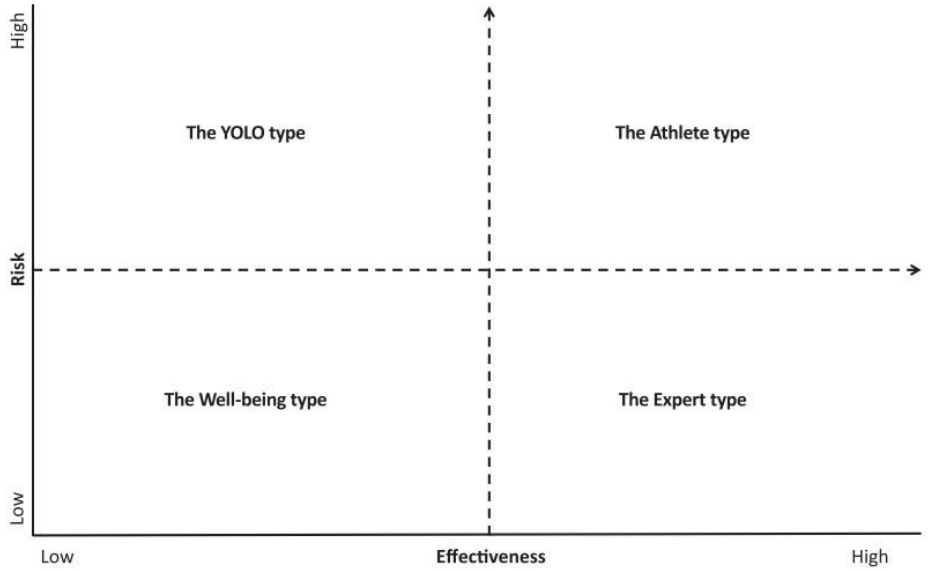

From the top left: Professional bodybuilders before (1900) and after (1970, 2010) the synthesis of AAS. Changes in body image observed in the GI-Joe action toy from the 1960s to the 1980s (Pope, Phillips, et al., 2000b). Other examples of toys and a child's costume displaying enhanced muscularity.

## 1.2 Subpopulations of AAS users

The widespread use of AAS happened in parallel – although and association can be inferred – with the popularisation of physical training in the 1980s and a sharp increase

in the number of gyms and fitness centres in many countries (Stern, 2008). In addition to elite athletes and bodybuilders, AAS started being used by a variety of people with different purposes and degrees of risk exposure (Christiansen et al., 2017; Kanayama & Pope, 2018; Zahnow et al., 2018). These subpopulations can be described based on demographic criteria and general motivations for using AAS, and include potentially overlapping populations such as professional athletes, male and female gym goers, strength athletes (i.e., weightlifters, bodybuilders, powerlifters, and strongmen), adolescents, older men, and occupational users (i.e., those using AAS to improve their performance at work; Amaral et al., 2022; Dennington et al., 2007; Havnes et al., 2019; Monaghan, 1999; Sagoe et al., 2014; Sagoe & Pallesen, 2018). Some patterns of drug use and health strategies observed inside these groups include a lower engagement with physicians amongst younger AAS users (Amaral et al., 2022; Zahnow et al., 2017) and higher doses and number of different AAS used simultaneously by bodybuilders (Amaral, et al., 2022b; Macho et al., 2021; McVeigh et al., 2021; Monaghan, 2002; Underwood & Olivardia, 2022). Christiansen et al. (2017) described four ideal types of AAS users, according to their approach to AAS-related risk and effectiveness, i.e., the extent of drug-assisted body transformation sought (Figure 2).

Figure 2: The four ideal types of AAS users




Adapted from (Christiansen et al., 2017). YOLO: you only live once.

Under this framework, the 'well-being type' is characterised by lower risk exposure, the use of smaller doses of AAS and frequent health monitoring, whilst pursuing a lean and fit appearance instead of a hyper-muscular physique. AAS users of the 'you only live once' (YOLO) type would also have modest goals of body-transformation, but with higher degrees of risk exposure and little knowledge about the drugs. The 'expert' type sees the use of AAS as part of a long-term project of research and body enhancement, seeking high drug effectiveness associated with constant health monitoring. Finally, the 'athlete' type would be willing to assume greater risks whilst seeking higher effectiveness of AAS to achieve supraphysiologic levels of muscularity and performance.

As discussed in WP1 (Amaral, et al., 2022b), health behaviours vary widely across different subpopulations of AAS users, highlighting the importance of tailored measures to understand and support users with distinct motivations and levels of risk exposure.

## 1.3 The epidemiology of AAS use

Attempts to estimate the prevalence of unprescribed use of AAS are frequently challenged by the stigma associated with AAS use, a relatively low prevalence of AAS user when compared to other drugs such as alcohol and cannabis, and the disparity of prevalence rates in different settings (Abrahin et al., 2011; Hope et al., 2022). Based on 271 studies from different countries, a meta-analysis estimated a global prevalence of AAS use of 3.3% (95% CI = 2.8 to 3.8), with 6.4% (95% CI = 5.3 to 7.7) amongst males and 1.6% (95% CI = 1.3 to 1.9) amongst females (Sagoe et al., 2014). As seen in Figure 3, that study observed great variability in prevalence across locations and subpopulations of AAS users, as well as a paucity of data from Asia (n = 1), the Middle East (n = 7), and some subpopulations of AAS users.

Figure 3: Global prevalence of AAS use, by regions and subpopulations

Regional prevalence rates, 95% CIs, and heterogeneity statistics

| | N | p% | 95% CI | Q | df (Q) | $I^2$ |
|---|---|---|---|---|---|---|
| Middle East | 7 | 21.7 | 13.5–32.9 | 138.8* | 6 | 95.7 |
| Trans-Region | 2 | 6.0 | 0.1–79.5 | 281.4* | 1 | 99.6 |
| South America | 5 | 4.8 | 1.2–16.7 | 397.0* | 4 | 99.0 |
| Europe | 81 | 3.8 | 2.4–5.8 | 60009.6* | 80 | 99.9 |
| North America† | 126 | 3.0 | 2.7–3.4 | 14752.7* | 125 | 99.2 |
| Oceania† | 38 | 2.6 | 2.1–3.3 | 2705.0* | 37 | 98.6 |
| Africa† | 11 | 2.4 | 1.2–4.8 | 208.7* | 10 | 95.2 |
| Asia | 1 | 0.2 | 0–3.5 | 0ns | 0 | 0 |

df (Q) = Q's degrees of freedom; $I^2$ = heterogeneity index; N = number of studies; ns = not significant; p% = prevalence (%); Q = heterogeneity statistic.
* $P < .001$.
† p% is significantly lower than p% in the Middle East ($P < .05$).

Prevalence rates, 95% CIs, and heterogeneity statistics for sample type

| | N | p% | 95% CI | Q | df (Q) | $I^2$ |
|---|---|---|---|---|---|---|
| Recreational sportspeople | 18 | 18.4 | 11.2–28.6 | 1125.0* | 17 | 98.5 |
| Athletes | 48 | 13.4 | 9.7–18.2 | 4484.7* | 47 | 99.0 |
| Prisoners and arrestees | 6 | 12.4 | 5.8–24.7 | 114.7* | 5 | 95.6 |
| Drug users | 20 | 8.0 | 3.6–16.8 | 2417.2* | 19 | 99.2 |
| High school† | 109 | 2.3 | 2.1–2.5 | 7930.1* | 108 | 98.6 |
| Non-athletes‡ | 70 | 1.0 | 0.7–1.3 | 9818.0* | 69 | 99.3 |

df (Q) = Q's degrees of freedom; $I^2$ = heterogeneity index; N = number of studies; p% = prevalence (%); Q = heterogeneity statistic.
* $P < .001$.
† p% is significantly lower than p% in recreational sportspeople ($P < .001$); p% is significantly lower than p% in athletes ($P < .001$); p% is significantly lower than p% in prisoners and arrestees ($P < .001$); p% is significantly lower than p% in drug users.
‡ p% is significantly lower than p% in high school ($P < .001$).

Adapted from (Sagoe et al., 2014).

In the UK, data from the Crime Survey for England and Wales (CSEW) estimated that 69,000 people aged 16 to 59 years – a prevalence of 0.2% –nused AAS in the last 12 months (Office for National Statistics, 2022), a large variation when compared with data from 2020 (31,000 people; Office for National Statistics, 2020) and 2019 (62,000 people; Office for National Statistics, 2019). These figures are in a stark contrast with the estimated prevalence of AAS use in Europe (3.8%; Sagoe et al., 2014), and the soaring

numbers of AAS users amongst clients NSP clients in the UK (Department of Health, 2010; Hope et al., 2013; Kimergård & Mcveigh, 2014; McVeigh & Begley, 2017; Northern Ireland Public Health Agency, 2019; Turner et al., 2018). Recently, a panel of experts used the Delphi method of sequential questionnaires and consensus (Hsu & Sandford, 2007) to produce a theoretical estimate of the prevalence of AAS use in the UK. The group considered that amongst people aged 15 to 64 years in the UK, between 328,000 to 687,000 men (central value 447,000) and between 17,000 to 76,000 women (central value not provided) used AAS in the last 12 months (Hope et al., 2022).

## 1.4 The risk environment of AAS use in the UK

The use of AAS can be seen as part of a socioecological system of beliefs, behaviours, relationships, cultural norms and policies in which individual characteristics and social influences interact to increase or reduce the likelihood of drug-related harm (Bronfenbrenner, 1986). As highlighted by Kimergård & Mcveigh (2014):

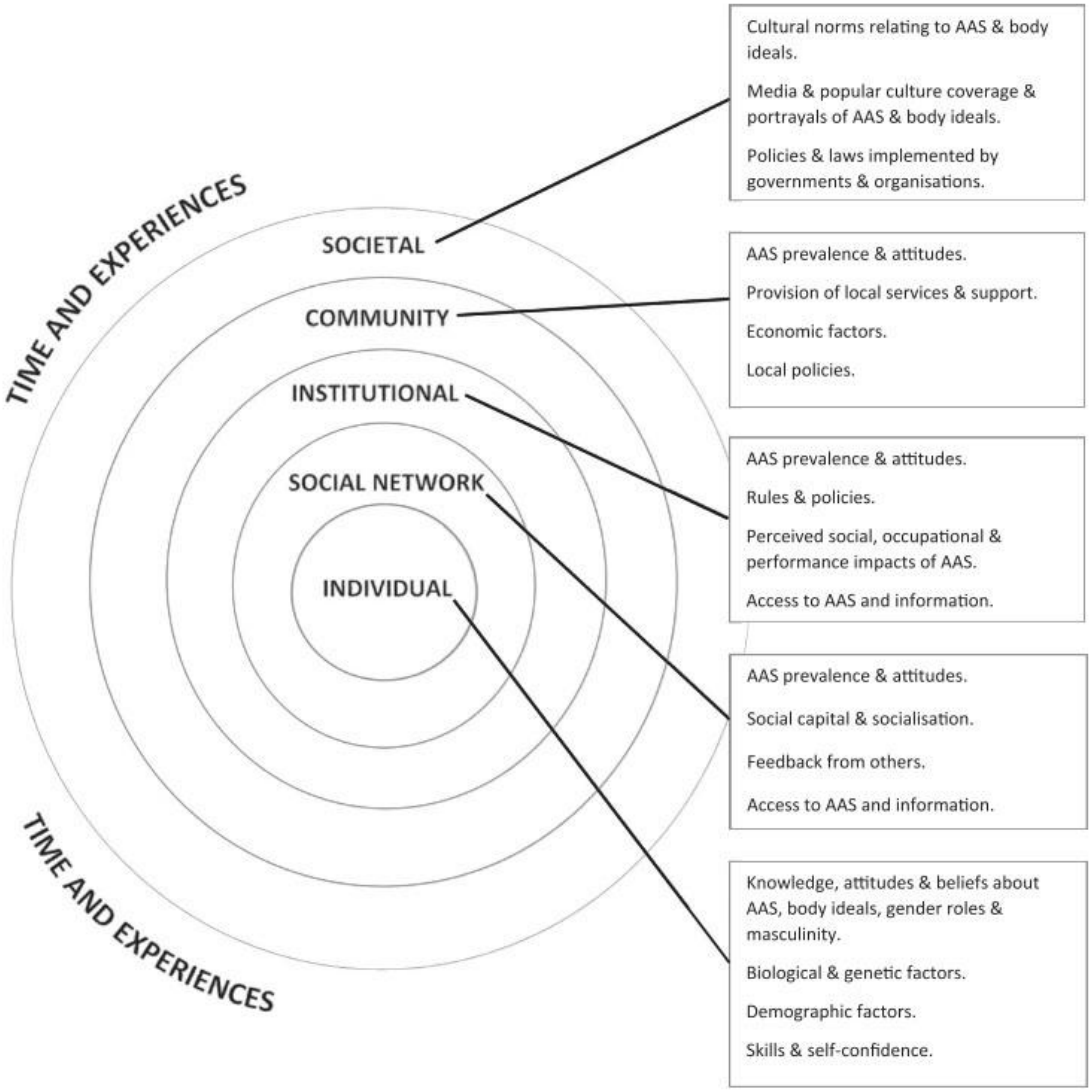
> The potential harms of anabolic steroids are not only the result of their pharmacological active substances or route of administration, but also the result of numerous factors that are situationally and structurally dependent on the environment in which the use of anabolic steroids occur.

The risk environment challenges the notion that people using illicit substances represent a dysfunctional exception in an otherwise healthy society (Rhodes, 2002). Not overlooking the importance of individual agency, this framework can be used to explore environmental pressures and power inequalities in risk negotiation that can influence *if* and *how* someone uses AAS. In that context, interventions that acknowledge the risk environment can be more effective because simultaneous risk factors can be addressed

and synergistically minimised (Golden & Earp, 2012; Rhodes, 2009; Sallis & Owen, 2015). For instance, providing AAS-related education to General Practitioners – as recently described by Eu et al. (2023) in Australia – can potentially improve the quality of health services, reduce stigma and increase the engagement of AAS users with physicians, therefore impacting different levels of the risk environment simultaneously.

As outlined by Bates et al. (2019), the risk environment of AAS use rises from the interaction between five levels of influence (Figure 4):

Figure 4: The risk environment of AAS use




Adapted from (Bates, Tod, et al., 2019).

- **Individual:** Peoples' biological and demographic characteristics, as well as beliefs and experiences that contribute to decisions about AAS use, response to the effects of the substances and susceptibility to adverse effects.
- **Social network:** The contact (physical and/or virtual) with other AAS users and suppliers normalises the use of the substances and facilitates the access to drugs, information and support. Pressure from peers and the social benefits of using AAS and having an enhanced physique can influence initiation and continued use. Belonging to a group with similar values and beliefs increases the perception of safety, leading to rationalisation and acceptance of risk. Online communities can normalise the use of AAS and provide peer-support to its members, including those whose 'real-life' social environment is unsympathetic to the use of the substances.
- **Institutional:** Social environments where the use of AAS is seen as normal and acceptable can influence the use of the substances and facilitate interactions between users and/or suppliers. Within settings such as prisons, weight training facilities, some gyms and work environments (such as security and entertainment-related), the perceived benefits of using AAS may outweigh the risks.
- **Community:** People and institutions exist in the context of communities, where the prevalence of AAS use, the access to substances and healthcare services can influence health behaviours and the use of AAS. Examples include the increased prevalence of bodybuilding gyms in economically deprived areas, and the access to harm-reduction sources such as the needle and syringe programme (NSP).

- **Societal:** These include norms and expectations associated with body image and gender stereotypes, as well as the role of media and cultural influences promoting muscularly enhanced physiques. This level also encompasses the legal framework regulating the possession, use, trade and medical prescription of AAS. Furthermore, public policies, educational campaigns, and training of health professionals targeting AAS use may influence the prevalence of use and AAS-related harm.

The factors inside a risk environment can influence each other, change through time and affect different socioecological systems, creating dynamic risk environment of AAS use (Golden & Earp, 2012; Van Hout & Kean, 2015). An example of the relationship between global levels of the risk environment can be seen in the response to changes in the legal framework regulating the use of AAS in the UK. Since 1996, AAS are described as Class C substances with Schedule 4 (ii) status under the Misuse of Drugs Act 1971, meaning that it is not an offence to possess AAS for personal use, but it is illegal to manufacture and supply these substances in the UK without a license (UK Legislation, 1996). In 2012, an amendment in the Misuse of Drugs Act 1971 made it illegal to import AAS through the postal service – although people are still allowed to bring them from abroad for personal use – following a recommendation of the Advisory Council on the Misuse of Drugs (ACMD, 2011). Although the goal of the new legislation was to curb the importation of AAS in quantities beyond what could be considered as for 'personal use', some health professionals working with AAS users believe that this measure might have increased the risks of AAS use:

> A lot of clients we worked with would import pharmaceutical products, pharmaceutical steroids mainly. (…) When they started to tighten up the regulations and made it illegal to import steroids through the mail system even for personal use, then I think it was a bit of a golden handshake to the underground labs as they started producing more underground products and they started competing with each other. So we started seeing higher concentrations… I don't think it was the smartest move, to be honest (John Campbell, as cited by Henning & Andreasson, 2022).

The outbreak of the COVID-19 pandemic also impacted the risk environment of AAS use, as many AAS users changed their routines due to the closure of gyms and disruptions of supply chains, as observed in UK-based (Gibbs, 2021) and trans-regional studies (Dores et al., 2021; Carter et al., 2021). In another level of the risk environment, social media platforms and online bodybuilding forums can be considered enablers of AAS use, as they normalise the use of these substances and reduce the perception of risk associated with their use (Andreasson & Johansson, 2016; Griffiths et al., 2018). From a bottom-up perspective, the body of knowledge produced by the community of AAS users and their support network can impact broader levels of the risk environment by influencing the demand for health services, scientific research – such as this PhD thesis – and changes in legislation. Traditionally downplayed and overlooked as 'bro science', the folk pharmacology and risk-management strategies developed and adopted by AAS users have been increasingly recognised as an important source of knowledge about these drugs (Andreasson & Johansson, 2016; Monaghan, 1999; Underwood et al., 2021).

As suggested by Underwood (2017): 'by investigating how IPEDs are actually used we could attempt to turn bro science from folk pharmacology into ethnopharmacology[1]'. Regional risk environments can also influence each other, such as when people from different locations and countries share information, trade AAS or seek and provide health support, therefore bypassing local drug and health regulations. This global communication of body-image ideals and AAS-related information translates into a global risk environment co-created by regional and local dynamics. The deep-web drug market known as 'Silk Road' exemplifies the trans-regionalism of drugs networks, where the use of cryptocurrencies is used to circumvent the control of currency exchange and the identification of traders (Barratt et al., 2014; Martin, 2014; Van Hout & Bingham, 2013). Finally, people using AAS will move through different environments in their lifetime, experiencing changes in their bodies, interests and social networks (Bates, Tod, et al., 2019). Although ecological models of health behaviour such as the risk environment do not specify which factor(s) have greater impact on the prevalence of AAS-related harm, they highlight the dynamic complexity of AAS use and offer opportunities for intervention beyond the change of individual behaviours (Sallis & Owen, 2015).

[1] 'Ethnopharmacology' involves the pharmacological– toxicological study of these drugs, not just the description of their local uses (Heinrich, 2015, as cited by Underwood, 2017).

# 2. The pharmacology and properties of AAS

The effects and properties of AAS are intimately related to the nature of androgenic hormones, as AAS are synthetic versions of those substances. This chapter describes the pharmacological properties of endogenous androgens and how AAS were created.

## 2.1 Androgens and the androgen receptor

Androgens – molecules able to bind to the intracellular androgen receptor (AR) – are hormones synthesised from cholesterol in the Leydig cells of the male's testis, the female's ovarian thecal cells and the adrenal cortices of both human sexes (Tobiansky et al., 2018). The steroidal and lipophilic structure of androgens – four rings of carbon atoms – allows them to cross the cellular membrane and activate the AR. Once activated, the AR-androgen complex can translocate into the cell's nucleus, interact with the cell's DNA to regulate protein synthesis and cell differentiation, and also modulate cellular functions via non-genomic pathways (Weigel & Moore, 2007), ultimately leading to the androgenic (i.e., effects on reproductive systems and virilisation) and anabolic (i.e., protein synthesis and hypertrophy) effects of androgens. Whilst all the endogenous androgens are steroids with androgenic and anabolic properties, the term AAS will be used in this thesis as a synonym for synthetic androgens.

The interaction between androgens and the AR is modulated by four main factors. The first is the **presence and concentration of ARs** in the tissues affected by androgens, such as the reproductive, musculoskeletal, cardiovascular, immune, neural and haematopoietic systems (Davey & Grossmann, 2016). The ubiquity of tissues expressing ARs is associated with the diversity of effects and functions of androgens. Secondly,

proteins known as AR's **co-regulators** – such as the androgen co-activator FHL2, predominantly expressed in the cardiac muscle (Müller et al., 2000) – can modulate the effects of androgens by affecting the transcriptional properties of the AR (Kicman, 2008). Thirdly, **enzymes** such as 5α-reductase and CYP19 aromatase can increase or reduce the affinity of androgens to the AR, regulating the effects of androgens in different tissues. The enzyme 5α-reductase converts testosterone – the most abundant androgen in men – to dihydrotestosterone (DHT), the endogenous androgen with greater binding affinity to the AR. In animal models, higher concentrations of 5α-reductase were found in the prostate, liver and skin; the enzyme is rare in the skeletal muscle (Borst et al., 2007). The enzyme 5α-reductase can also reduce the affinity of some androgens to the AR. For instance, 5α-reductase converts 19-nortestosterone – an AAS known as nandrolone – to dihydro-19-nortestosterone, a molecule with lesser binding affinity to the AR (Tóth & Zakár, 1982). Because 5α-reductase is more abundant in reproductive tissues than in the skeletal muscle, this conversion can reduce the androgenic properties of nandrolone. The CYP19 aromatase, abundant in the fat tissue, irreversibly converts testosterone to estradiol, which binds to the estrogen receptor (Tobiansky et al., 2018). AAS that do not bind to CYP19 aromatase – such as stanozolol, also known as Winstrol, and trenbolone – would be, therefore, less likely to cause estrogen-related effects such as gynecomastia. Another enzyme, the 3α-hydroxysteroid-dehydrogenase – which is highly active in the skeletal muscle and cardiac tissue – converts DHT to the weaker androgen 3α-androstanediol (Smith et al., 1980), explaining why testosterone, and not DHT, is the main responsible for the muscular-anabolic effects of androgens. Other interactions between androgens and these enzymes and their distribution in the human body go beyond the goals of this thesis and were described in detail by Azzouni et al. (2012).

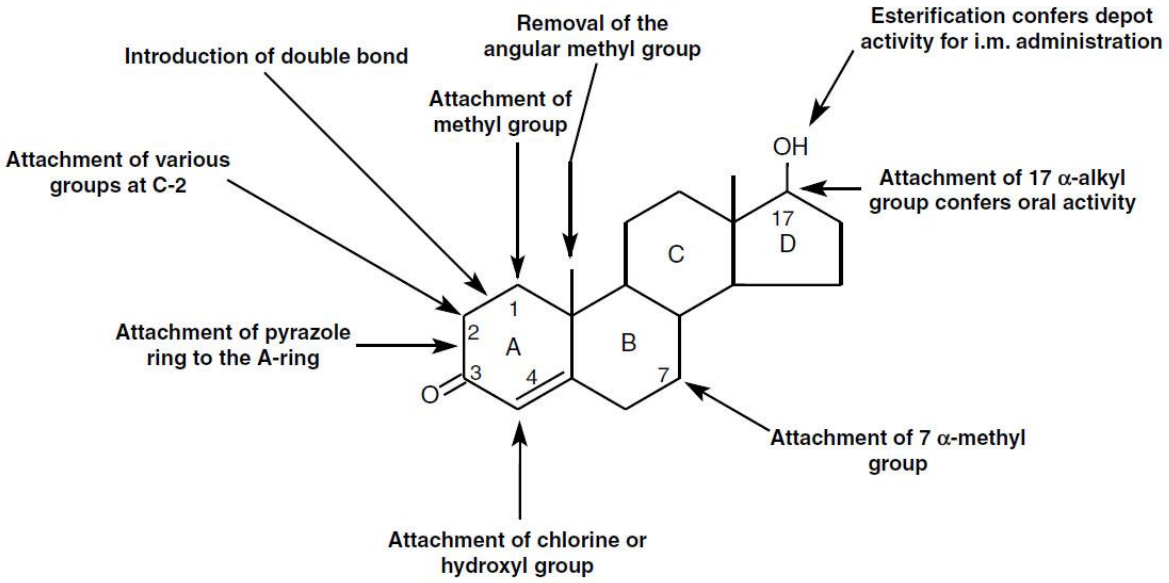
Fourthly, the interaction of androgens with the AR is modulated by **albumin and the sex hormone-binding globulin (SHBG),** molecules that bind to androgens and prevent their interaction with the AR, therefore regulating the bioavailability of androgens. Albumin, a globular protein produced in the liver and the most abundant plasma protein, binds non-specifically and with low affinity to androgens, preventing their action but also prolonging their biological half-life (Baker, 2002). The SHBG – which is mainly produced in the liver, but also in the brain and uterus – has its production increased by high levels of estrogen and thyroxine and decreased by high levels of insulin, growth hormone, insulin-like growth factor 1 (IGF-1), androgens and prolactin (Hammond & Bocchinfuso, 1996). The levels of SHBG are 50% higher in women than in men, which is considered a mechanism to prevent the virilisation of females' tissues by androgens (Hammond & Bocchinfuso, 1996). In response to follicular-stimulating hormone (FSH), the Sertoli cells in the testis produce a different type of SHBG named androgen-binding protein (ABP), which binds specifically to testosterone, DHT and 17-beta-estradiol (Hansson et al., 1976). Apart from sequestering androgens, the SHBG also seems to deliver its ligands to target tissues and to have signalling potential itself, although these functions remain poorly understood (Hammond, 2011).

## 2.2 The development of AAS

An association between masculine characteristics and testicular function has been observed for hundreds of years, as seen in the works of Aristotle (384-322 B.C.) and the reports of male castration for therapeutic and artistic purposes in early Western and Eastern societies, as castrated boys could maintain a high-pitch singing voice throughout adulthood (Nieschlag & Nieschlag, 2019). Likewise, since antiquity, the belief that the

ingestion of animals' testicles could improve sexual and physical performance led to the creation of countless preparations and compounds, some of them still available in the mid-20th century (Nieschlag & Nieschlag, 2019). This practice received renewed attention in the late 19th century, when Charles-Édouard Brown-Séquard described his experiments with a compound containing blood from testicular veins, semen and the 'juice extracted from a testicle, crushed immediately after it has been taken from a dog or a guinea-pig' (Brown-Séquard, 1889). After a series of subcutaneous injections, the 72 years-old scientist described 'a considerable gain in energy, muscle strength, and increased jet of urine and power in defecation'. These findings, based in many controversial theories – including the weakening of body and mind caused by the waste of semen through masturbation – were never adequately reproduced, and are now considered a classical example of the placebo effect (Cussons et al., 2002). About forty years after Brown-Séquard's experiments, the first androgens – androsterone (Butenandt, 1931) and testosterone (David et al., 1935) – were isolated and described. Also in 1935, testosterone was firstly synthesised (Butenandt & Hanisch, 1935; Ruzicka & Wettstein, 1935), giving origin to the first AAS. Soon after the isolation of testosterone, hundreds of AAS were developed as derivatives of testosterone (Kanayama & Pope, 2018). The changes in testosterone's molecule aim to increase its anabolic potential, reduce androgenic effects and modulate its absorption, metabolism and excretion, therefore allowing AAS to be used orally, via short or prolonged-effect intramuscular injections or via transdermal creams (Kicman, 2008). Figure 5 shows the testosterone molecule and some of the regions targeted in the development of AAS.

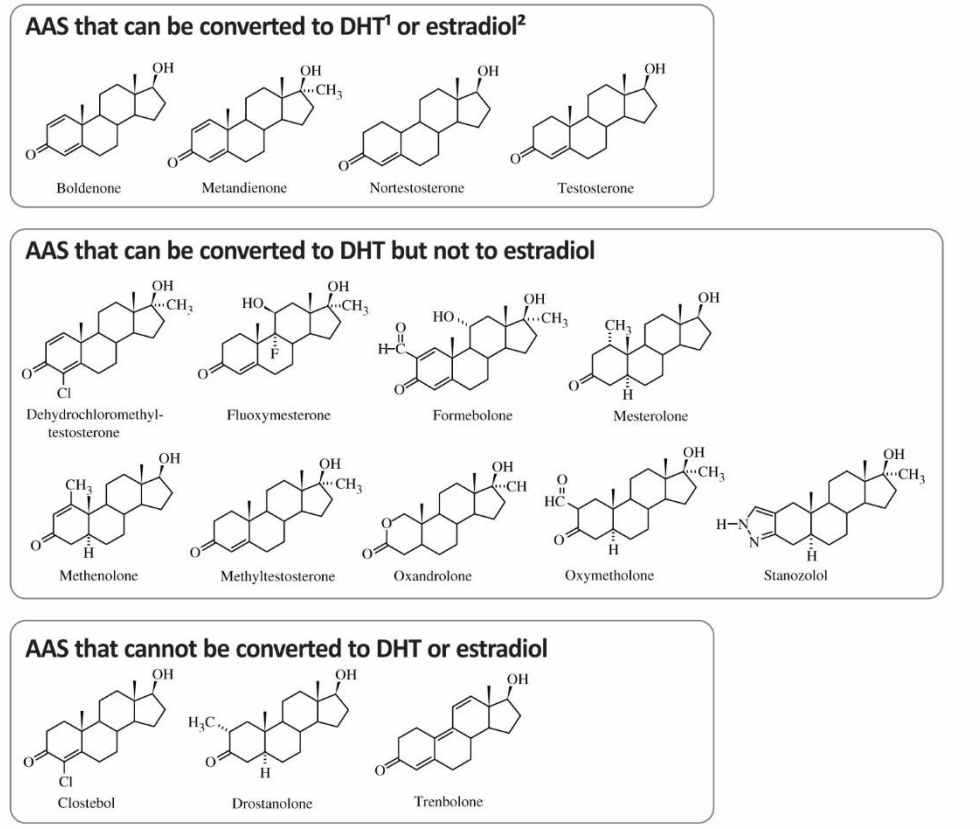
Figure 5: Structural modifications to the molecule of testosterone




Adapted from Kicman, 2008. i.m.: intramuscular.

Structural changes made in attempts to modulate the androgenic and anabolic properties of AAS aim to affect their affinity to the AR, to regulating enzymes and transport molecules, as well as the interactions between the AR-AAS complex and the co-regulators of gene transcription. Figure 6 shows some AAS that can be converted to DHT by 5α-reductase and/or converted to estradiol by CYP19 aromatase.

Figure 6: Examples of AAS that can be converted to DHT and/or estradiol




Adapted from Nieschlag & Vorona (2015). DHT: dihydrotestosterone. 1: Conversion to DHT by 5α-reductase. 2: Conversion to estradiol by CYP19 aromatase.

## 2.3 Methods of use of AAS

Synthetic versions of testosterone for clinical use are available as oral, sublingual, nasal, rectal, intramuscular, subdermal and transdermal preparations (Behre & Nieschlag, 2012). Amongst people using AAS for enhancement purposes, the most common compounds are those used via intramuscular injections, oral tablets and transdermal creams (Chandler & McVeigh, 2014; Mullen et al., 2020; Zahnow et al., 2017). The majority of AAS users seem to make combined use of injectable and oral compounds (Chandler & McVeigh, 2014; Korkia & Stimson, 1997; Parkinson & Evans, 2006), although there is some evidence suggesting that about one third of them uses only oral compounds (Zahnow et al., 2017). The exclusive use of oral AAS is more common

amongst new and female users (Abrahin et al., 2017; Chandler & McVeigh, 2014; Gruber & Pope, 2000; Ip et al., 2010). A higher prevalence of injectable AAS is reported amongst males and experienced users, who perceive these compounds as safer and more effective than oral AAS (Cohen et al., 2007; Ip et al., 2011; Perry et al., 2005). Both oral and injectable AAS are frequently used in long-term routines of intermittent cycles or continuous use of AAS, the latter known as the blast-and-cruise (BaC) regimen (Badawy, 2018). The cycling regime is usually composed of 6 to 12 weeks of AAS administration, in a sequence of increasing-and-decreasing doses (i.e., pyramiding), and/or the combination of different AAS (i.e., stacking), followed by an 'off-phase' of similar duration, where the use of AAS is suspended in an attempt to allow the body to restore its natural production of testosterone (Guerra et al., 1999; Korkia & Stimson, 1997; Santos & Coomber, 2017). In BaC, the off-phase is replaced by a relative reduction in the dose of AAS, aiming to prevent the loss of muscle mass and withdrawal symptoms sometimes observed during the off-phase (Underwood, 2017; Underwood et al., 2021). A recent transregional survey reported a high prevalence (47.2%) of the BaC regimen amongst AAS users, despite the greater risks of continuous exposure to AAS (Bonnecaze et al., 2020).

# 3. The effects of AAS and mechanisms of action

The effects of AAS can be described according to their mechanisms of action in different body systems such as the endocrinological, skeletal muscle, and other organs and structures such as the cardiovascular and central nervous systems (CNS; Kicman, 2008; Nieschlag & Nieschlag, 2019).

## 3.1 Measuring androgenic and anabolic properties of AAS

The myotrophic-androgenic index (MAI), a method used to measure the androgenic and anabolic properties of AAS based on the comparison between AAS-induced hypertrophy of tissues from skeletal muscle and reproductive organs of mice – respectively the levator ani muscle and the ventral area of the prostate (Hershberger et al., 1953). AAS that cause greater hypertrophy of the levator ani when compared to the hypertrophy of the prostate have a higher MAI, and are therefore considered to have greater anabolic than androgenic activity. A comparison between the relative binding affinity between different AAS and the AR in the skeletal muscle and prostate can also be used to estimate the androgenic-anabolic ratio of AAS (Saartok et al., 1984). Although these methods have contributed to a greater knowledge about the AAS' mechanisms of action, the MAI is criticised for being based on animal models and in vitro analysis, and for not taking into consideration the complex interactions between AAS, regulating enzymes and transcriptional co-regulators (Bond, 2021). Besides, some effects described as androgenic are consequences of anabolic properties of AAS – i.e., nitrogen retention through the stimulation of protein synthesis and tissue development taking place in reproductive tissues (Wilson, 1988) – challenging the dichotomy between androgenic

and anabolic properties. Similarly, the distinction between beneficial and adverse effects of AAS is not always clear. Although some effects of AAS are clearly detrimental (e.g. cardiomyopathy and liver damage) this distinction might depend on the objectives of different AAS users and the intensity of these effects. The growth of facial hair, for instance, can be considered beneficial for a transgender man looking for the virilising effects of AAS (Unger, 2016), whilst an increase in libido is frequently considered a desirable effect of AAS use – unless the enhanced sexual drive is perceived as excessive (Smit et al., 2021). To avoid confusion between these categories, this thesis will describe the effects of AAS focusing on the tissues and biological systems affects by these substances.

## 3.2 Hypogonadism and disruption of testicular function

The production of testosterone in the testis is stimulated by higher levels of luteinizing hormone (LH), produced in the adenohypophysis of the pituitary gland. Via negative feedback, AAS suppress the hypothalamic production of gonadotropin-releasing hormone (GnRH), inhibiting the production of LH and testicular synthesis of testosterone. The decrease in testicular function leads to testicular hypotrophy, reducing spermatogenesis and sperm production (Nieschlag & Vorona, 2015b). Although the endogenous production of testosterone and spermatogenesis might return to pre-AAS use levels after the cessation of the drugs, some users can experience permanent impairment of testicular function (Smit et al., 2021). AAS-induced hypogonadism (ASIH) use can cause symptoms of depressive mood, low libido and erectile dysfunction (Nieschlag & Vorona, 2015b). In attempts to reduce the symptoms of ASIH and accelerate the normalisation of testicular function, some AAS users recur to

post-cycle therapy (PCT), drug regimens lasting for four to twelve weeks – usually the same length as the previous AAS cycle. The PCT regimens are empirically defined by AAS users, and might contain different doses of drugs such as human chorionic gonadotropin (HCG) – which stimulates the testicular Leydig cells to produce testosterone – clomiphene (Clomid®) – to stimulate the production of LH – and antiestrogens, e.g. tamoxifen (Novaldex®) or exemestane (Aromasin®). Although the effects of PCT were not considered significant in a controlled study (Smit et al., 2021), many AAS users share the perception that PCT is not only beneficial but necessary to prevent the symptoms of ASIH. Due to lack of access to PCT, and also for fear of losing muscle gains, some AAS users decide to prevent ASIH by using AAS continuously – via BaC or by using regular low doses of AAS in what has been known as testosterone replacement therapy (TRT; Griffiths et al., 2017).

### 3.3 Prostate hyperplasia and prostate cancer

There is limited evidence of an association between the use of AAS and the occurrence of benign prostatic hyperplasia (BPH) and prostate cancer, despite the androgen-dependent characteristic of prostate growth (Nieschlag & Vorona, 2015b). In trials where doses of up to 600mg/week were administered to healthy males for up to 20 weeks, prostate-specific antigen (PSA) and prostate volume remained unchanged (Bhasin et al., 2001, 2005, 2012; Cooper et al., 1988). However, a study with 100 participants using an average of 898 mg/week of different AAS for up to 52 weeks observed a small but significant increase in their PSA levels, suggesting that higher doses and prolonged exposure to AAS might be associated with BPH (Smit et al., 2021). Regarding prostatic cancer, the literature is limited to the best of our knowledge to the

case report of one bodybuilder who developed prostatic adenocarcinoma after using AAS for 18 years (Roberts & Essenhigh, 1986), and to one of the interviewees described in WP3 of this thesis. An explanation for the apparent dissociation between exposure to high levels of AAS and prostate cancer was proposed by the model of AR's saturation (Morgentaler & Traish, 2009), suggesting that prostate growth is sensitive to low concentrations of androgens but becomes insensitive once the maximal androgen-AR binding is reached.

## 3.4 Virilisation

The most commonly reported virilising effects of AAS are hirsutism, pattern alopecia and deepening of the voice (Abrahin & Sousa, 2013; Andrews et al., 2018). Hirsutism is defined as a masculine-distributed growth of terminal body hair, namely on the upper lip, areola, lower abdomen, arms, and upper aspects of the thighs; its occurrence is associated with a greater expression of 5α-reductase in these area's hair follicles, which increases their sensitivity to androgens (Bienenfeld et al., 2019). Pattern alopecia is characterised in men by hair loss over the crown, frontal and temporal scalps, and in women, by thinning and loss of hair in the crown area of the scalp (Deplewski & Rosenfield, 2000). These patterns are associated with a large concentration of the enzyme 5α-reductase in these areas, leading to a greater conversion of androgens to DHT, which disrupts the maintenance of hair growth in the scalp, inducing apoptosis of dermal papilla cells (Bienenfeld et al., 2019). This paradoxical effect of DHT on scalp hair is likely caused by genetically-determined differences in androgen responsiveness and DHT's metabolism in these areas (Deplewski & Rosenfield, 2000). Finally, the irreversible

deepening in voice induced by AAS is caused by hypertrophy of the larynx and vocal folds (Hari Kumar et al., 2016).

## 3.5 Effects of AAS on skeletal muscle growth

AAS can enhance muscle growth via several mechanisms, including muscle hypertrophy – i.e. enlargement of contractile muscle elements and expansion of the extracellular matrix – and muscle hyperplasia – i.e. increase in the number of muscle fibres (Schoenfield, 2010). Regardless of AAS, hypertrophy of skeletal muscle in response to resistance training is initiated by mechanical tension, as the muscle shortens (concentric contraction) and lengthens (eccentric contraction) to generate force (Vanderburgh, 1987). The mechanical tension produces microscopic tears in contractile proteins of the muscle cells, the sarcolemma, basal lamina, and supportive connective tissue (Vierck et al., 2000). This micro trauma leads to the release of inflammatory and growth markers, nitrogen retention and an increase in muscle protein synthesis (Evans, 2002). AAS enhance the process of muscle hypertrophy by stimulating the genetic transcription of contractile proteins; increasing the utilisation of intracellular amino acids; and promoting myonuclear accretion (Ferrando et al., 2002). The AAS-induced increased number of myonuclei facilitates the hypertrophy of muscle fibres because each myonucleus sustains protein synthesis over a limited volume of cytoplasm, known as a myonucleus' nuclear domain (Kadi et al., 2000). The addition of new myonuclei into the hypertrophying muscle fibre occurs due to the activation of satellite cells – stem cells of skeletal muscle – located between the basal lamina and the plasma membrane of muscle fibres (Mauro, 1961). AAS can promote the entry of satellite cells into the cell cycle, leading to their differentiation and fusion with the myofibre, thus becoming

additional myonuclei (Sinha-Hikim et al., 2003; Vierck et al., 2000). AAS can also cause satellite cells to generate new muscle fibres, therefore increasing muscle size through the hyperplasia of muscular tissue (Kadi, 2000). Histochemical studies with human skeletal muscle cells indicate that the satellite cells – and not the myonuclei of mature muscle cells – are the predominant locus of increased AR expression in some muscle groups (Sinha-Hikim et al., 2004). Studies with animal models suggest that AAS can also promote muscle hyperplasia by committing the differentiation of mesenchymal pluripotent cells into muscle cells, whilst inhibiting their differentiation into fat tissue cells (Singh et al., 2003). In addition, AAS can stimulate the upregulation of AR in skeletal muscle and other tissues, increasing the sensitivity of androgens (Kadi et al., 2000). The density of AR expression – and therefore, androgen-responsiveness – seems to be unequally distributed across humans' muscle groups – e.g., higher concentrations and responsiveness to AAS-induced AR upregulation were seen on the trapezius when compared to the vastus lateralis (Kadi et al., 2000). This phenomenon can explain the empirical observations of a disproportional growth of specific muscles as suggestive of AAS use – such as those in the trapezius, chest, upper arms and shoulder (Hartgens & Kuipers, 2004; Pope et al., 1999).

The AAS-induced upregulation of ARs seems to reach a steady-state adaptation, with the return of AR expression returning to pre-treatment values after six months of continuous AAS administration – suggesting that lesser and cyclical doses of AAS could produce similar anabolic outcomes whilst reducing the risk of adverse effects (Ferrando et al., 2002). Some studies suggest that AAS can also induce the production of growth factors in muscle cells through an AR-independent pathway, via activation of a G-protein-linked receptor leading to early but transient activation of transcription factors

(Estrada et al., 2003). The use of AAS can indirectly enhance muscle hypertrophy, by stimulating the production of insulin-like growth factor 1 (IGF-1), a hormone with important anabolic properties (Hobbs et al., 1993) and by increasing the capilarisation around muscle fibres, therefore enhancing the blood supply of grown muscles (Yu et al., 2014). AAS also have considerable anti-catabolic properties, which seem to occur via the occupation of muscles' cortisol receptor, leading to anti-glucocorticoid effects and preventing protein breakdown and loss of muscle mass (Kicman, 2008; Souza & Hallak, 2011).

### 3.6 Reduction of body fat

The use of AAS can stimulate lipolysis and increase triglyceride turnover by increasing the number of β-adrenoreceptors and hormone-sensitive lipase activity in the visceral fat tissue (VFT), therefore enhancing fat tissue's response to catecholamines – i.e. noradrenaline and adrenaline (De Pergola, 2000; Xu et al., 1990). AAS also regulate VAT's metabolism of carbohydrates, proteins and fat, reduce adipocyte dysfunction, and stimulate the expression of insulin-regulated glucose transporter channel GLUT4 and GLUT4 membrane translocation, increasing VFT's sensitivity to insulin (Maneschi et al., 2012). In ageing men with subnormal bioavailable testosterone, AAS have improved lipid oxidation by enhancing mitochondrial function (Petersson et al., 2014). The testosterone-precursor dehydroepiandrosterone (DHEA) seems to prevent the accumulation of body fat by increasing the resting metabolic rate (Mohan & Cleary, 1988). AAS can reduce the formation of fat tissue as the signalling molecule β-catenin binds to the AAS-activated AR and is translocated to the nucleus and interacts with transcription factors to inhibit adipogenesis (Singh et al., 2006). Indirectly, AAS can

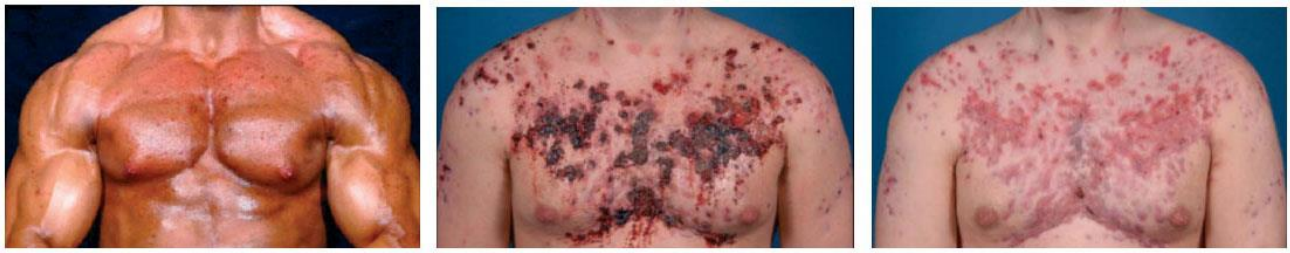
reduce body fat by increasing seric levels of growth hormone (GH; Keenan et al., 1993), which stimulates lipolysis in the adipose tissue and triglyceride uptake in the muscle and liver (Vijayakumar et al., 2010). Some effects of AAS on fat tissue seem to be sex-specific, as high levels of androgens in women can induce muscle insulin resistance (Diamond et al., 1998) and an increase in VFT (Evans et al., 1988). It can be argued that the improved motivation, energy and reduced fatigue associated with the use of AAS can contribute indirectly to weight loss and control of body fat (Behre et al., 2012; Traish, 2014). Because AAS can reduce body fat whilst inducing supra-physiologic levels of muscle growth, a free-fat mass index (FFMI) above 25.0 has been considered suggestive of AAS use (Kouri et al., 1995). Due to their VFT-reducing properties, AAS are been studied as potential treatments for obesity and type 2 diabetes in men (Fink et al., 2018).

### 3.7 Acne, striae and injection-related injuries

Acne is a multifactorial skin disorder involving abnormal keratinization, infection and hormonal influences on the pilosebaceous unit (PSU; Lucky, 1995). The PSU is formed by a piliary and a sebaceous component, and during puberty, the increasing levels of androgens stimulate the differentiation of the PSU into hair follicles in sexual hair areas or into sebaceous glands in sebaceous areas (Lucky, 1995). The use of AAS can cause hypertrophy of sebaceous glands, increased synthesis of sebum and skin surface lipids (Rosenfield, 1986), increasing the amount of desquamated cells on the glands' follicle and interrupting the normal process of discharge through the follicular orifice, leading to the formation of a hyperkeratotic plug (Deplewski & Rosenfield, 2000). The accumulated sebum in the obstructed gland creates an anaerobic environment favourable to infection by *Propionibacterium acnes*, a normal constituent of the

cutaneous flora that populates the AAS-stimulated sebaceous follicle (Deplewski & Rosenfield, 2000). The higher concentrations of the enzymes 5α-reductase (which converts testosterone into DHT) and 17β-hydroxysteroid (which converts DHEA into testosterone) in the skin areas of the face, chest and back increase their responsiveness to androgens and the likelihood of AAS-induced acne in these areas (Thiboutot et al., 1999). Acne is one of the most common adverse health conditions associated with AAS use (Eklöf et al., 2003; Melnik et al., 2007; Smit et al., 2021), and its manifestation might vary from mild to severe cases of acne conglobata (cutaneous and subcutaneous interconnected abscesses) and *acne fulminans* (a severe immunologic reaction to *P.acne*'s infection), leading to the destruction of skin's tissue and scar formation (Collins & Cotterill, 1995; Heydenreich, 1989; Melnik et al., 2007; Michelson & Allen, 1931; Walker & Adams, 2009). An example of AAS-induced acne conglobata and the subsequent scarred tissue can be seen in Figure 7.

Figure 7: AAS-induced acne conglobata



Adapted from Gerber et al. (2008).

Striae distensae, also known as stretch marks, are linear marks caused by tearing of the underlying skin tissues by over-stretching or rapid growth(Coelho, 2019). These marks firstly present with a pink or violaceous colour – therefore named striae rubra – evolving over several months into white or flesh-coloured scar-line lines – or striae alba – of

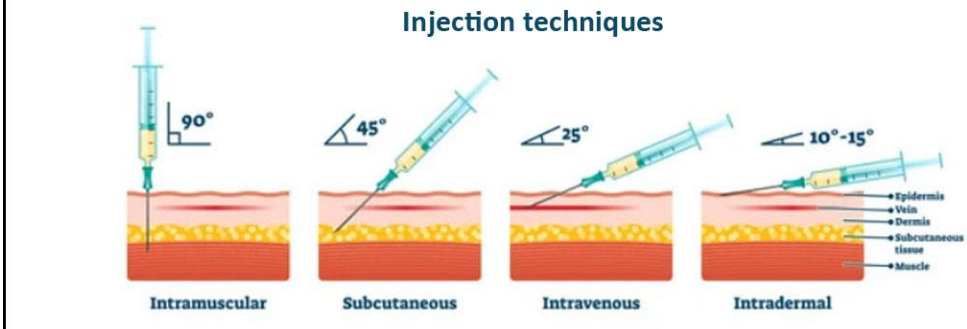
thinned and depressed skin (Coelho, 2019). Striae can appear due to several conditions, such as pregnancy, obesity, conditions of hypercortisolism – e.g. Cushing's syndrome – and after the use of topical corticosteroids (Adam & Craig, 1965; Burrows & Lovell, 2004; Singh & Kumar, 2005). Irreversible AAS-induced striae are formed when the skin does not expand at a proportional rate to the underlying skeletal muscle (Scott 3rd & Scott, 1992). This phenomenon may be aggravated by AAS' negative impact on collagen's biosynthesis, which reduces skin's elasticity making it prone to stretch marks (Evans, 2004; Karpakka et al., 1992; Shuster, 1979).

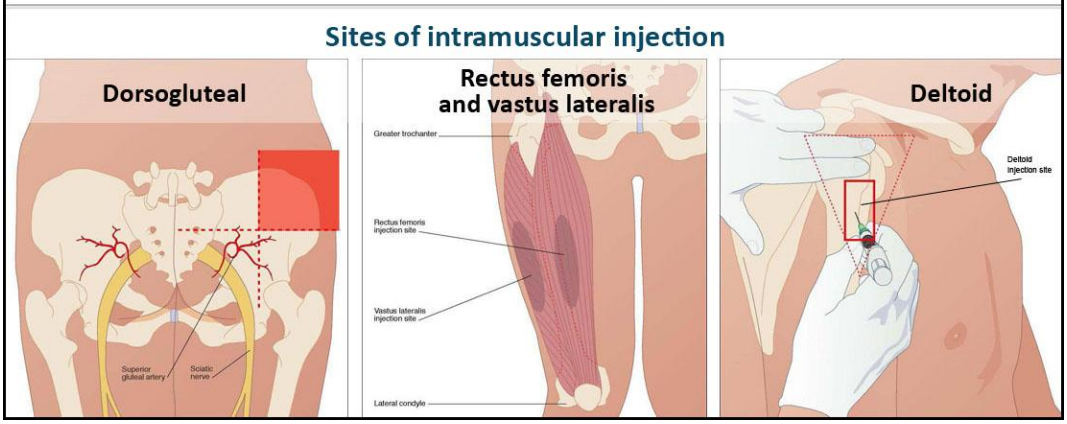
Injection-related health conditions associated with the use of AAS can be divided into two groups: (i) Local injuries and infections and (ii) systemic bacterial and viral infections. Local injuries after injection are one the most common conditions experienced by users of injectable AAS (Hope et al., 2015a), and can include redness, tenderness and swelling at the injection site, as well as abscesses, open wounds and cellulitis – a dermal infection most commonly caused *Staphylococcus aureus* and group A β-haemolytic *Streptococcus* (Del Giudice, 2004; Hope et al., 2015b). Additionally, substances produced in home-based and underground laboratories are more likely to be contaminated due to improper sanitization and storage, increasing the risk of injection-related infections (Hope et al., 2015a; Kimergård et al., 2014). Injection-site injuries are frequently associated with poor injection practices, such as failing to sterilise the equipment and injection site, utilising inaccurate injection techniques and inadequate needles, and re-using and sharing injection equipment (Hope et al., 2015a; Kimergård & Mcveigh, 2014). Improper injection techniques might include 'spot injections' into small muscle groups such as the biceps and calves in the belief that this will promote localised muscle growth (Larance et al., 2008), using shorter needles to reduce the discomfort of injection or

breaking the needle during injection (Kimergård & McVeigh, 2014). Injuries can occur if AAS users correctly identify the target large muscle groups for intramuscular injection on the buttocks (dorsogluteal), thighs (rectus femoris and vastus lateralis) and shoulders (deltoid), but inject near nervous or vascular structures, fail to rotate sites to aid the healing of injection locations or inject AAS in adjacent structures such as the knee joint, leading to septic arthritis (Evans, 1997). Figure 8 contains information on intramuscular injection needles and techniques, adapted from NHS training material (NHS, 2017) and harm-reduction services (Campbell et al., 2016).

Figure 8: Intramuscular injection needles, technique and anatomical sites

| NEEDLE SIZE | LENGTH | USES |
|---|---|---|
| Green 21G | 40 mm / 1.5" | Drawing up oil. Can be used for glutes (upper outer section of buttock) |
| Blue 23G | 30 mm / 1.25" | Glutes (upper outer section of buttock) |
| Blue 23G | 25 mm / 1" | Quads (lateral thigh), deltoids (side shoulder) |
| Purple 24G | 25 mm / 1" | Can be used for IM injection of water based steroids |
| Orange 25G | 25 mm / 1" | Can be used for IM injection of water based steroids |
| Fixed 1 ml syringe 27, 29 or 30G | 12 mm | All subcutaneous (under the skin) injections – insulin / GH etc. |




IM: Intramuscular. GH: growth hormone.

Shared and re-used needles also increase the risk of bacterial endocarditis amongst AAS users (Lovelock et al., 2021), although the prevalence of this condition in that population remains unknown. See item 3.15 for more information about the association between AAS use and blood-borne viral infections.

## 3.8 Musculoskeletal injuries

People using AAS seem to be at higher risk of experiencing musculoskeletal injuries when compared with non-AAS users (Horn et al., 2009). Three non-exclusive factors were proposed to explain the high prevalence of musculoskeletal injuries amongst AAS users: (i) Unsafe physical training routines; (ii) excessive strain applied on adjacent structures by overdeveloped muscles; and (iii) AAS-induced biochemical changes in musculoskeletal tissues that increase the risk of structural damage. As observed by Christiansen et al. (2017), some people can be motivated to use AAS by a desire to achieve a muscular physique in unrealistic short periods. This impatience, combined with a tendency to reckless behaviour observed in some AAS users (Rashid et al., 2007; Trenton & Currier, 2005) could lead to unsafe, overloaded or poorly executed training routines, increasing the risks of accidental muscle and joint lesions. AAS users might be more likely to experience musculoskeletal injuries also because of an excessive strain on tendons, ligaments and cartilaginous tissues. Tendons are connective tissue structures responsible for transferring force from the contracting muscle to the skeletal system in order to produce movement (Magnusson & Kjaer, 2019). A comparison between AAS-using and non-using weightlifters observed a higher prevalence of upper body tendon ruptures (namely biceps brachii and triceps brachii muscles) amongst AAS users, but no significant difference in the prevalence of lower body tendon ruptures, possibly due to

the pronounced effect of AAS on upper body muscle groups (Kanayama et al., 2017). The diversity of musculoskeletal injuries associated with AAS use is exemplified by a study with more than two thousand retired professional American football players, where a higher prevalence of disc herniations, knee ligamentous or meniscal injury, elbow injuries, neck stingers, spine injury, and foot/toe/ankle injuries – but not of tendon ruptures – was observed amongst athletes with a history of AAS use (Horn et al., 2009). The results of that study corroborate the hypothesis that supporting structures such as cartilaginous joints might be unable to adapt to the AAS-induced hypertrophy and the increased strength output of skeletal muscles. Although studies with animal models have described collagen dysplasia and stiffening of tendons secondary to AAS exposure (Inhofe et al., 1995; Karpakka et al., 1992; Marqueti et al., 2006), studies with humans found no evidence of ultrastructural abnormalities or functional limitations in tendons of AAS users (Evans et al., 1998; Seynnes et al., 2013). Although studies with animal models have described collagen dysplasia and stiffening of tendons secondary to AAS exposure (Inhofe et al., 1995; Karpakka et al., 1992; Marqueti et al., 2006), the ultrastructural abnormalities and functional limitations in human tendons associated with AAS use remain poorly understood (Evans et al., 1998; Jones et al., 2018; Seynnes et al., 2013). In contrast, some studies reported the potential of AAS to improve muscle recovery after injuries (Grace et al., 2001; Horn et al., 2009; Rashid et al., 2007). This effect might be explained by the AAS-induced growth of muscle fibres during the later stages of muscle regeneration due to increased production of IGF-1 (Beiner et al., 1999; Ferry et al., 2000; Souza et al., 2007), which accelerates muscle growth and recovery from tendon injury (Kurtz et al., 1999; Menetrey et al., 2000) – or to AAS' antagonism to

cortisol in skeletal muscle receptors, preventing muscle breakdown and improving recovery (Fahey, 1998).

An additional potential effect of AAS on skeletal tissue is the risk of early epiphyseal closure, leading to dysfunctional growth and reduced height due in children and adolescents exposed to these substances (Goldman et al., 2019; Karpakka et al., 1992; Larance et al., 2005). The epiphyseal growth plate is a layer of cartilaginous tissue located at both extremities of long bones. During the stage of bone longitudinal growth, cartilage is formed in that area by the proliferation and hypertrophy of cells and synthesis of extracellular matrix; the cartilage is then calcified and replaced by osseous tissue (Pines & Hurwitz, 1991). During early puberty, low doses of estrogen boosts bone growth, whilst high doses of this hormone in late puberty – when the proliferative capacity of growth place chondrocytes is exhausted – contribute to epiphyseal fusion (Shim, 2015). Similarly, androgens such as DHT can stimulate bone growth until higher concentrations of this hormone are aromatised to estrogen in late puberty, leading to the closure of the epiphyseal growth plate. The clinical association between precocious puberty and short stature also indicates that early exposure to sexual hormones can lead to epiphyseal closure and dysfunctional growth (Shim, 2015). Although animal studies have found conflicting evidence of AAS's ability to promote early epiphyseal closure (Karpakka et al., 1992; Lok, 2015), the known effects of sexual hormones on human growth suggests a potential risk of permanent growth dysfunction associated with the use of AAS by adolescents (Dawson, 2001; Larance et al., 2005; Nelson, 1989; Nieschlag & Behre, 2016; Pope et al., 2014).

## 3.9 Cardiovascular effects

The use of AAS can increase the risk of cardiovascular disease (CVD) due to dyslipidaemia, hypertension, hypertrophic cardiomyopathy, polycythaemia, direct damage on blood vessels and metabolic syndrome (Achar et al., 2010; McCullough et al., 2021). Dyslipidaemia is a condition characterised by high levels (> 3.0 mmol/L) of low density lipoprotein cholesterol (LDL), high levels (> 2.3 mmol/L, non-fasting) of triglycerides and low levels (< 1.0 mmol/dL for males and < 1.2 mmol/dL for females) of high density lipoprotein cholesterol (HDL; Arnett et al., 2019). AAS-induced dyslipidaemia occurs due to a disturbance in lipid metabolism via upregulation of hepatic triglyceride lipase (HTGL), an enzyme that catabolises HDL and removes it from plasma whilst converting intermediate-density lipoproteins into LDL (Glazer, 1991). It remains unclear if AAS use can increase plasma triglycerides (Moffatt et al., 1990). Dyslipidaemia is an important risk factor for CVD, as it ultimately leads to atherosclerosis (Achar et al., 2010). Early studies observed no detrimental effects of AAS in blood pressure (BP) during 24-hour monitoring (Kuipers et al., 1991; Palatini et al., 1996). However, recent experiments described higher systolic BP, higher aortic stiffness, decreased proatrial natriuretic peptide (pro-ANP, a mediator of BP homeostasis that induces vasodilation and relaxation of smooth muscle in vasculature) levels, and increased myocardial function abnormalities in current AAS users when compared with former AAS users and sedentary controls (D'andrea et al., 2018; Rasmussen et al., 2018). Some AAS can cause hypertension due to sodium-retaining effects on kidneys (Kutscher et al., 2002; Rockhold, 1993). Whilst some AAS users experience a return to normal BP after a few weeks of AAS discontinuation (Urhausen et al., 2004), others can display a persistent high BP for many months after the interruption of AAS (Lenders et al., 1988).

Bodybuilding athletes using AAS might present with increased aortic stiffness (Rasmussen et al., 2018) and impaired left atrial myocardial function (as measured by reduced indexes of booster pump function and passive deformation) when compared with non-AAS using bodybuilders and controls (D'andrea et al., 2018). The effects of AAS on vascular and myocardial structures might be mediated by AR in the heart and major arteries (Bergink et al., 1985). Although physiological levels of testosterone might have a vasodilator response on coronary arteries – via endothelial release of nitric oxide (Rosano et al., 2005; Wynne & Khalil, 2003) – high doses of AAS seem to reverse this effect and lead to hypertrophic cardiomyopathy and apoptotic cell death (Ferrer et al., 1994; Zaugg et al., 2001) – via membrane receptor-second messenger cascades of $Ca^{2+}$, reduced mitochondrial permeability and subsequent release of apoptogenic factors (Kroemer et al., 1998). AAS-induced apoptosis of cardiac muscle cells might to explain clinical observations of ventricular remodelling, cardiomyopathy, myocardial infarction and sudden cardiac death amongst AAS users without hypertension, coronary thrombosis or atherosclerosis (Kennedy & Lawrence, 1993; Maron et al., 1980). AAS can stimulate haematopoiesis, increasing levels of haemoglobin and the number of blood red cells (Hero et al., 2005). These effects led to an extensive use of AAS in the treatment of aplastic and nephrotic anaemia, namely before erythropoietin (EPO) and its analogues were available for clinical use (Nieschlag & Vorona, 2015a). AAS directly induce haematopoiesis by stimulating the formation of erythroid precursors in the bone marrow and converting uncommitted bone marrow cells into EPO-responsive cells (Moriyama & Fisher, 1975). AAS can increase the synthesis and secretion of EPO, indirectly inducing haematopoiesis, as they bind to renal cytoplasmic receptors and increase RNA polymerase activity (Paulo et al., 1974; Rishpon-Meyerstein et al., 1968).

The unsupervised use of AAS, however, increases the risks of erythrocytosis – namely with an haematocrit above 52% (Lippi & Banfi, 2011) – leading to elevated blood viscosity and subsequent vascular events such as myocardial infarction, stroke and transient ischemic attacks (Shahani, 2009). AAS can also increase the levels of blood coagulation factors, plasminogen (Kahn et al., 2006), and the activity of thromboxanA2-receptors and thrombocyte aggregation, elevating the risk of thrombosis (Ferenchick et al., 1995; Shapiro et al., 1999). An association between the use of AAS and the risk of thromboembolism was described in several case reports of cerebral brain thrombosis (Chu et al., 2001; Sahraian et al., 2004; Saraiva et al., 2016; Sveinsson & Herrman, 2013) and pulmonary embolism (Liljeqvist et al., 2008; Sîrbu et al., 2014). Although clinical doses of androgens seem to have fibrinolytic properties (Ansell et al., 1993), people with a history of thrombophilia are apparently more likely to develop clotting abnormalities following the use of AAS (Glueck et al., 2014). Finally, the combination of metabolic and cardiovascular abnormalities associated with the use of AAS can lead to metabolic syndrome, when several of these conditions present themselves simultaneously. As observed by McCullough et al. (2021), even though the majority of people using AAS are physically active, the presence of metabolic syndrome can lead to a risk of cardiovascular disease similar of obese and sedentary populations.

## 3.10 Effects on the liver

Adverse effects of AAS on the liver are mainly associated with the use of orally active substances such as dehydrochlorometyl-testosterone (Oral Turinabol©), fluoxymesterone (Halotestin©), formebolone (Hubernol©), methandienone (Dianabol), methyltestosterone (Android©), oxandrolone (Anavar©), oxymetholone (Anadrol©)

and stanozolol (Winstrol©; Nieschlag & Vorona, 2015b). In a process known as 17α-alkylation, the 17α-hydrogen of the steroid nucleus is replaced by a methyl or ethyl group (see Figure 1), preventing deactivation of the steroid by first-pass hepatic metabolism and allowing these AAS to be used orally (Kicman, 2008). The slower hepatic clearance of 17α-alkylated AAS, however, leads to a higher production of reactive oxygen species (ROS) and subsequent oxidative stress on hepatocytes (Nieschlag & Vorona, 2015a). Four distinct forms of direct liver injury are associated with the use of AAS: transient elevation of liver enzymes, acute cholestatic syndrome, chronic vascular liver injury (peliosis hepatis), and hepatic tumours such as adenomas and hepatocellular carcinomas (Niedfeldt, 2018).

The use of AAS if frequently associated with an increase in plasma concentrations of enzymes that are normally present inside hepatocytes – therefore used as markers of hepatocellular damage: aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (AP), lactate dehydrogenase (LDH), creatine kinase (CK) and gamma glutamyl transpeptidase (GGT; Hartgens & Kuipers, 2004). However, elevations of AST, ALT and CK (enzymes also present in skeletal muscle cells) might be due to mild rhabdomyolysis secondary to physical exercise, rather than AAS-induced liver damage (Dickerman et al., 1999). As most people using AAS follow intense resistance training programmes, a diagnosis of AAS-induced elevation of liver enzymes should only be considered in the presence of GGT elevation, a more specific marker of hepatic damage (Hakkinen & Alen, 1989).

The use of AAS has been associated with a particular form of acute intrahepatic cholestasis, apparently caused by the biding of 17α-alkylated AAS to canalicular

membrane transporters, leading to the accumulation of toxic bile acids (Hymel et al., 2013). This form of bland cholestasis is characterised by a significant elevation of AP and conjugated bilirubin, but a mild elevation of AST and ALT, indicating minimal hepatocellular injury (Zimmerman, 1999). This condition usually has an insidious onset, noted within one to four months after the use of 17α-alkylated AAS (Hymel et al., 2013) – although it might be delayed as long as 24 months (Singh et al., 1996). The symptoms include nausea, fatigue, pruritus and jaundice, and are frequently reversible after discontinuation of AAS, but severe cases of prolonged jaundice and pruritus requiring hospitalisation have been reported (Elsharkawy et al., 2012).

Peliosis hepatis is a rare form of chronic vascular injury in the liver, characterised by hypervascular lesions, multiple blood-filled cavities and cysts (Solimini et al., 2017; Tsirigotis et al., 2007). Patients might be asymptomatic or present symptoms that range from abdominal discomfort and hepatomegaly to sudden abdominal pain and vascular collapse secondary to hepatic rupture and hemoperitonium (Choi et al., 2009; Tsirigotis et al., 2007). AAS-induced peliosis hepatis can be diagnosed as an incidental finding in image exams, abdominal surgery or autopsy (Solimini et al., 2017), and the condition is considered at least partially reversible after cessation of AAS use (Simon et al., 1988; Tsirigotis et al., 2007).

The hepatotoxic effects of AAS, combined with the presence of androgen receptors in the liver's parenchyma, makes the organ sensitive to the occurrence of AAS-induced tumours such as benign hepatocellular adenoma (HCA) and malignant hepatocellular carcinoma (HCC; Niedfeldt, 2018). Although the majority of AAS-related liver tumours seem to be associated with the use of 17α-alkylated AAS, parenteral AAS use might also

lead to these conditions (Velazquez & Alter, 2004). Tumours are usually identified after long-term use of AAS, but cases of hepatic neoplasia after shorter periods of use have been described (Socas et al., 2005; Stoot et al., 2010). Whilst the occurrence of liver tumours might be associated with other factors such as the use of oral contraceptives (due to the presence of hepatic estrogen receptors), chronic liver disease and cirrhosis, both HCA and HCC were described in AAS users with no other evidence of liver disease (Gorayski et al., 2008; Socas et al., 2005; Velazquez & Alter, 2004). The use of AAS seems to increase the risk of non-alcoholic fatty liver disease (NAFLD), although the mechanism of AAS-induced steatohepatitis remains unclear (Schwingel et al., 2011). Finally, sharing injection equipment is a considerable risk factor for hepatitis C and hepatitis B amongst users of injectable AAS (Aitken et al., 2002; van de Ven et al., 2018). The prevalence of hepatitis and other blood-borne viruses amongst AAS users is presented in item 3.15.

## 3.11 Rhabdomyolysis and kidney injury

The adverse outcomes of AAS use on the kidneys can be divided into indirect and direct effects. Indirectly, the use of AAS can lead to acute renal injury secondary to rhabdomyolysis – the breakdown of striated (skeletal) muscle cells and consequent leakage of muscle-cell contents such as myoglobin, electrolytes and intracellular enzymes such as AST, ALT, AP, LDH and CK (Bosch et al., 2011). Rhabdomyolysis itself can be indirectly related to the use of AAS – due to the high-intensity resistance training routines potentialized by AAS use (Pertusi et al., 2001) – or directly caused by a myotoxic effect of AAS on skeletal muscle (Abu-Shakra et al., 1997; Hughes & Ahmed, 2011). As previously discussed in this thesis, any physical exercise causes mechanical injury in muscle cells, which leads to muscle hypertrophy (Vierck et al., 2000) and probably some

degree of rhabdomyolysis (Byrnes et al., 1985). Adverse consequences of rhabdomyolysis occur when the levels of released muscle cells' contents exceed the organism's ability to metabolise or excrete those substances – namely myoglobin and CK (Hamer, 1997). Myoglobin is a pigmented protein that strongly binds to oxygen, making it quickly available for rapid muscle contraction and its presence in urine, i.e. myoglobinuria, is an unequivocal sign of severe rhabdomyolysis – as only when serum levels of myoglobin exceed 100 mg/dL, reddish-brown urine becomes grossly visible (Bosch et al., 2011). The pathophysiological mechanisms of rhabdomyolysis-induced acute kidney injury can be summarised as follows.

> Fluid sequestration in injured muscle induces volume depletion and consequent activation of the sympathetic nervous system, antidiuretic hormone, and the renin–angiotensin system, all of which favour vasoconstriction and renal salt and water conservation. In addition, myoglobin-induced oxidative injury increases vasoconstrictors and decreases vasodilators. Kidney injury results from a combination of ischemia due to renal vasoconstriction, direct tubular toxicity mediated by myoglobin-associated oxidative injury, tubular damage due to ischemia, and distal tubule obstruction due to precipitation of the Tamm–Horsfall protein–myoglobin complex (Bosch et al., 2011).

Elevated serum levels of CK (above 308 U/L in males, and above 192 U/L in females; Morandi et al., 2006) are the most sensitive indicator of muscle injury (Hamer, 1997). Although the CK enzyme does not seem to have any nephrotoxic effect in itself, the risks of kidney injury are considered high if CK levels are above 15,000 to 20,000 U/L (de Meijer et al., 2003). An additional risk factor of indirect AAS-related rhabdomyolysis is

the intensive practice of resistance training (Braseth et al., 2001), as eccentric exercises (i.e. done when muscle fibres lengthen) produce increased muscle damage, aiming for the development of strength and hypertrophy (Fridén et al., 1983). For instance, marathon runners might have an increase in CK of up to 5,000 U/L 24h after the event, while bodybuilders can present CK levels of up to 200,000 U/L, usually peaking 5 to 6 days after exercise (Hamer, 1997). The reasons for the delayed increase in CK after eccentric exercise-induced rhabdomyolysis are unknown, but this effect was observed in cases of rhabdomyolysis amongst people using AAS (Benjamin et al., 2020; Gruber & Pope, 2000; Pope & Katz, 1994).

In addition to indirectly-AAS-induced rhabdomyolysis (due to excessive exercise-induced muscle injury) studies in vitro and with animal models have described myotoxic properties of AAS, leading to rhabdomyolysis and muscle cell apoptosis independently of exercise-induced injury (Abu-Shakra et al., 1997; Abu-Shakra & Nachtman, 1995), as well as the existence of a commitment point of AAS exposure, where cells are destined to undergo apoptosis even if the AAS are withdrawn (Abu-Shakra et al., 1997). These findings might be useful to explain the reports of rhabdomyolysis and acute kidney injury observed soon after the start of or changes in AAS use routines (Gnanapandithan et al., 2019; Hughes & Ahmed, 2011) and of severe rhabdomyolysis in the injection site of AAS (Adamson et al., 2005). Another potential effect of AAS in the kidneys is the onset of focal segmental glomerulosclerosis, proteinuria and nephrotic syndrome, as described in a report with a cohort of 10 long-term AAS-using bodybuilders (Herlitz et al., 2010). That report highlights that, although some characteristics of their sample could contribut to an overload in glomerular filtration and disturbances in renal hemodynamics – such as increased body mass (despite low body fat), high protein diets,

use of creatine and other supplements – AAS can have a direct toxic effect on glomerular cells, induce oxidative stress and upregulate components of the renin-angiotensin system (Iliescu et al., 2007; McGuire et al., 2007). Finally, a few studies have described the occurrence of renal cell carcinomas in AAS users (Bryden et al., 1995; Martorana et al., 1999). Authors of these studies hypothesised that – in susceptible individuals and those with a pre-existing renal adenoma – a hypertrophic effect of AAS in the kidneys and increased oestrogen levels (due to excessive androgen aromatisation) might contribute to the malignant transformation and proliferation of renal neoplasms.

## 3.12 Neuropsychiatric effects

The neuropsychiatric effects of AAS have been explored since these substances were used in the treatment of depression and melancholia in the 1940s (Altschule & Tillotson, 1948). AAS seem to have beneficial effects on the CNS, such as reducing depressive symptoms (Amiaz & Seidman, 2008; Walther et al., 2019), increasing focus, motivation and general wellbeing (Smit et al., 2021). Moderate doses of AAS combined with physical exercise seem to enhance mood and decrease anxiety due to increased availability of L-tryptophan (Trp) to the brain (via albumin-binding displacement and inhibition of Trp-degrading enzymatic pathways), leading to an increase of indolylamine 5-hydroxytryptamine (5-HT or serotonin; Badawy, 2018).

However, the use of AAS has been associated with many adverse neuropsychiatric conditions such as insomnia, hypomania, increased aggressiveness, anxiety and withdrawal-related depression (Chegeni et al., 2021; Hall et al., 2005; Hauger et al., 2021; Kanayama et al., 2008; Oberlander & Henderson, 2012; Piacentino et al., 2015). Possible mechanisms for the adverse neuropsychiatric effects of AAS include binding to

and modulating the expression of the AR in different areas of the CNS (Kicman, 2008; Penatti et al., 2009), and interfering with the biosynthesis of neurotransmitters and endogenous neurosteroids (Oberlander et al., 2012). Studies with animal models showed that chronic exposure to AAS can affect the expression of peptides involved in the manifestation of anxiety (Costine et al., 2010) such as the corticotrophin-releasing factor (Oberlander & Henderson, 2012), brain-derived neurotrophic factor (Matrisciano et al., 2010) and neuropeptide Y (Kash & Winder, 2006). AAS can also lead to neuronal oxidative stress (Pomara et al., 2015) and affect the expression of neurotransmitters such as gamma-aminobutyric acid (GABA), glutamate, serotonin and dopamine (Ambar & Chiavegatto, 2009). These are neurotransmitters involved in the signalling pathways of the extended amygdala – a neuronal circuit in the limbic system comprising the central amygdala, nucleus accumbens and the adjacent nucleus of stria terminalis – whose dysfunction has been associated with the manifestation of anxiety (Davis et al., 2010), which is defined as a sustained manifestation of apprehension, tension, fears, sleep disturbances, difficulties in concentration and somatic symptoms such as tachycardia, gastrointestinal disturbances and headaches (Hamilton, 1959). AAS also seem to impact serotonergic, glutamatergic and dopaminergic signalling pathways in the lateral hypothalamic area and other limbic structures related to aggressiveness (Melloni & Ricci, 2010; Schwartzer et al., 2009; Toth et al., 2010). Aggressiveness can be described in humans as a combination of reduced impulse control manifested as physical and verbal aggressiveness, anger and hostility (Bryant & Smith, 2001; Buss & Perry, 1992). The term ‘roid rage’ has been used to describe bursts of hostility and violence attributed to the use of AAS, such as the episodes of assault, fights and attempted murder described by Pope and Katz (1994). A strong body of literature, however, shows a more

complex association between aggressiveness and the use of AAS (Chegeni, Notelaers, et al., 2021; Santos & Coomber, 2017), with polypharmacy and personality traits frequently described as potential confounders in the investigation of violence associated with the use of AAS (Amaral et al., 2021; Lundholm et al., 2015; Petersson et al., 2006; Thiblin & Petersson, 2005). In-depth interviews with AAS users (Kimergard, 2015; Monaghan, 1999) also suggest that mild and transient feelings of impatience, anger and hostility – not necessarily leading to violent actions – are more common than the stereotypical 'roid rage'. Moreover, different AAS seem to have distinct likelihoods to induce aggressiveness. For instance, stanozolol has shown to reduce aggressive behaviour in animals (McGinnis et al., 2002), whilst many users associate the use of trenbolone with increased aggressiveness, insomnia and vivid nightmares (Underwood et al., 2021).

Controlled studies have described a dose-dependent association between AAS use and the onset/severity of psychiatric symptoms (Gruber & Pope, 2000; Pagonis et al., 2006; Pope & Katz, 1994). However, this association can be absent in ecological observations of AAS use due to many factors, such the use of ancillary drugs to prevent or reduce adverse effects of AAS, the use of AAS with distinct risk profiles, personality traits and polypharmacy (Dodge & Hoagland, 2012; Piacentino et al., 2015; Porcerelli & Sandler, 1998; Sagoe et al., 2015). Another example of these factors can be seen in a study recently published by the author of this thesis, describing the prevalence of psychiatric symptoms amongst a cohort of 103 bodybuilders whose use of AAS was confirmed by the analysis of urinary androgens and seric hormonal concentrations (Amaral, Deslandes, et al., 2022). That study observed a high prevalence of symptoms of insomnia, aggressiveness, agitation and/or depression amongst the participants, and

about one-third of them presented moderate to severe symptoms of anxiety. However, these symptoms were not associated with the reported doses of AAS, possibly meaning that lower doses are sufficient to trigger adverse effects in highly susceptible individuals (Pagonis et al., 2006). That study highlights that symptoms such as insomnia and anxiety could also be associated with other characteristics shared by the participants such as intensive training routines and the use of other IPEDS as previously described in studies with bodybuilders using AAS (Christiansen & Flegal, 2020; Macho et al., 2021; Monaghan, 2001; Underwood, 2013; Underwood et al., 2021).

Reviews of human and animal studies have hypothesized the occurrence of structural changes in the brain secondary to prolonged exposure to AAS, potentially increasing the risk of dementia (Kaufman et al., 2019) and cognitive deficits (Scarth & Bjørnebekk, 2021). Likewise, studies based on questionnaires and interviews described associations between AAS dependence and memory deficits (Heffernan et al., 2015), reduced cognitive performance (Hauger, Sagoe, et al., 2019; Hildebrandt et al., 2015; Kanayama et al., 2013; Scarth et al., 2022), and impaired emotion recognition – potentially contributing to behavioural problems and antisocial behaviour (Hauger, Sagoe, et al., 2019). Some of these findings were corroborated by analyses utilizing functional and multimodal magnetic resonance imaging, in which long-term use of AAS and the severity of AAS dependence were associated with cognition abnormalities (Bjørnebekk et al., 2019; Kaufman et al., 2015) and abnormal brain aging (Bjørnebekk et al., 2021). Furthermore, these studies have described structural changes in the brain of long-term AAS users, such as volumetric abnormalities in the amygdala and compromised connectivity with the frontal, striatal, limbic, hippocampal, and visual cortical areas (Kaufman et al., 2015); reduced thickness in several brain regions including total gray

matter, putamen, frontal, temporal and parietal cortex (Bjørnebekk et al., 2017; Hauger, Westlye, et al., 2019); and aberrant connectivity between key nodes involved in emotional and cognitive regulation (Westlye et al., 2017). Finally, serum analyses suggest that high-dose exposure to AAS might induce persistent changes in the expression of brain-derived neurotrophic factor, a growth factor involved in neuroplasticity, cognitive function and general mental health (Bjørnebekk et al., 2023)

## 3.13 AAS withdrawal syndrome and the risk of suicide

The discontinuation of AAS can lead to symptoms of depressive mood, apathy, insomnia, decreased libido, fatigue and suicidal ideation (Corrigan, 1996). Several mechanisms were proposed to explain the symptoms of AAS withdrawal, such as the perception (or anticipation) of losing muscle mass, strength and confidence (Rashid et al., 2007; Riem & Hursey, 1995). The psychological impact of AAS cessation can be proportional to the benefits perceived by different AAS users – such as professional athletes, occupational users, adolescents, recreational athletes, etc. (Brower, 2002; Pope et al., 2014). Another potential mechanism of acute AAS withdrawal syndrome is the onset of central noradrenergic hyperactivity soon after the interruption of AAS intake. In this case, the presence of symptoms of anxiety, irritability, insomnia, sweating, myalgia, nausea and tachycardia successfully treated with clonidine hydrochloride – a $\alpha_2$-agonist (Kashkin, 1989; Maravelias et al., 2005) – suggests an effect of AAS on dopaminergic, noradrenergic and GABA-stimulated systems, although further evidence is required to corroborate this hypothesis (Hochberg et al., 2003). Moreover, as the intake of exogenous androgens supresses the endogenous production of testosterone, the abrupt withdrawal of AAS leads to very low levels of seric testosterone (Nieschlag & Vorona,

2015b). This condition is known as AAS-induced hypogonadism (ASIH), with symptoms similar to those observed in other manifestations of hypogonadotropic hypogonadism, such as lean muscle loss, decreased cognitive functions, depression, fatigue and sleep disturbances (Tan & Scally, 2009). The abrupt fluctuation and decline in testosterone levels seems to induce withdrawal symptoms due to the impact of AAS on serotonin metabolism and function (Badawy, 2018; Pope et al., 2003). This hypothesis is supported by the good response to fluoxetine – a selective serotonin reuptake inhibitor (SSRI) – in the treatment and prevention of mood disorders associated with the use and withdrawal of AAS (Amaral et al., 2021; Malone & Dimeff, 1992). However, regardless of hypogonadism, only a minority of male AAS users seem to experience severe withdrawal symptoms (Smit et al., 2021). Furthermore, some women reported depressive mood following AAS cessation, even though the testosterone levels of female former-AAS users are usually above pre-exposure levels (Gruber & Pope, 2000), indicating that a fluctuation of testosterone levels and/or a combination of factors might be involved in the onset of psychiatric symptoms following AAS exposure and withdrawal in vulnerable individuals.

The use of AAS seems to increase the risk of suicide, either during the use of following AAS withdrawal (Hussain et al., 2022; Kanayama et al., 2016; Thiblin et al., 1999), although the available evidence is mostly composed by small sample size studies and case reports. In one study where the use of AAS was confirmed by urinary analysis, suicide ideation and suicide attempts were found to be more common amongst current and previous AAS users than amongst non-AAS users (Malone et al., 1995). Likewise, in a case report where the use, withdrawal and relapse of AAS was monitored by urinary tests over six months, a suicide attempt was described during an acute episode of

hypomania and aggressiveness during a cycle of AAS (Amaral et al., 2021). A study investigating the mortality of former Swedish elite power athletes (n = 174) identified suicide as the third most common cause of death (n = 21; Lindqvist et al., 2014). Although the history of AAS use in that study was not confirmed, the authors highlighted that during the time of the athletes' deaths (1960 – 1979) the use of AAS amongst power athletes (i.e., wrestling, weightlifting and throwing sports), was common and un-regulated by antidoping measures. Likewise, the post-mortem examination of eight confirmed AAS users who committed suicide confirmed that five suicides occurred during the use of AAS and two soon after the cessation of those drugs (Thiblin et al., 1999). Another forensic evaluation described suicide as the second most common cause of unnatural deaths in a cohort of 24 AAS users in Australia – confirmed by urine samples collected at autopsy (Darke et al., 2014). Whilst Sher (2013) hypothesises that both elevated and low levels of testosterone could increase the risk of suicide – due to impulsiveness, auto and hetero-aggressiveness or depressive symptoms, respectively – there is conflicting evidence of an association between testosterone levels and suicide. Stefansson et al. (2016) described higher of levels of cerebrospinal fluid (CSF) and plasma testosterone amongst male suicide attempters (but no such association amongst females), whilst the comparison between 112 men who attempted suicide and 37 controls showed no significant difference in the levels of seric testosterone (Perez-Rodriguez et al., 2011).

## 3.14 Muscle dysmorphia, exercise addiction and substance use disorder

The term muscle dysmorphia (MD) was proposed by Pope et al. (1997) as form of body dysmorphic disorder in which people are chronically concerned that they insufficiently

muscular. According to that authors' definition, people with MD would avoid expose their bodies and have impaired social functioning, such as avoiding beaches and swimming pools, using several layers of clothes to appear bigger and avoid intimate relationships. Furthermore, individuals suffering from MD would expend excessive time and resources with exercise, substances and meticulous diets to achieve their desire body image, at the expense of other aspects of their lives such as relationships, study and occupational opportunities. About 40% of participants with a proposed diagnosis of MD in that preliminary study – 15 gym-going men and 32 female bodybuilders – reported a history of AAS use; all females were using drugs to lower body fat such as amphetamines, ephedrine, thyroid hormones or beta agonists (Pope et al., 1997). As highlighted by Tod et al. (2016), although most of the existing knowledge about MD is based on case reports and small-sample studies (the majority composed only by male participants from Western countries), available data indicates that people with MD are more likely to consume illegal substances such as AAS in attempts to achieve their desired body image. It remains unclear if the use of AAS per se increases the risk of developing MD and/or contributes to aggravate underlying cases of MD (Cole et al., 2003; Rohman, 2009).

The use of AAS is also associated with exercise addiction/dependence, a compulsive behaviour firstly described by Veale (1987) which can be manifested either as a primary condition or secondary to other disorders. Primary exercise addiction is characterized by stereotyped and recurrent preoccupation with exercise, significant withdrawal symptoms in the absence of exercise (such as irritability and insomnia), preoccupation that causes clinically significant distress or impairment in physical, social or occupational areas and preoccupation with exercise that is not better accounted for by another

mental disorder (e.g. eating disorders, body dysmorphia). As observed by (Corazza et al., 2019), in contemporary cultures bodies are increasingly objectified and perceived as a machine that can be modified and manipulated at will. Although the pursue of ideals of physical beauty has been described since the antiquity, the emergence and increased access to AAS and other IPEDs exacerbated the perception in some individuals that chasing an 'ideal' body is not only a possibility but a requirement for social acceptance, potentially leading to appearance anxiety and other psychological conditions (Corazza et al., 2019). In this context, the use of AAS can also lead or contribute to psychological suffering due to objectified body consciousness (Boursier et al., 2020), a condition defined by three components: (1) body surveillance (persistent thinking and constant self-monitoring assuming an outside observer's perspective to comply with cultural body standards and avoid negative judgments); (2) body shame (due to the comparison with cultural standards and the perception of failure to meet them); and (3) appearance control beliefs (beliefs that individuals are responsible for their bodily look and that, with enough effort, their physical appearance can be controlled; (McKinley & Hyde, 1996). Despite causal relationships, these conditions are considered important risk factors for the development of AAS use disorder (Brower, 2015; Kanayama et al., 2010; Pope et al., 2010; Quaglio et al., 2009).

Unlike most recreational drugs, AAS are usually consumed to reach a delayed reward (i.e. body enhancement) rather than immediate satisfaction or 'high' (Grönbladh et al., 2016). The distinctions between the misuse AAS and other drugs led to many attempts to identify the criteria and mechanisms of AAS addiction. However, the majority of studies investigating the addictive potential of AAS describe symptoms of abuse and dependence as two distinct syndromes, based on criteria from the fourth edition of the

Diagnostic and Statistical Manual of Mental Disorders (DSM-4; American Psychiatric Association, 2000). In 2013, the DSM-5 (American Psychiatric Association, 2013) replaced the designations abuse and dependence with a single severity index, i.e. substance use disorder (SUD). Table 1 shows a summary of general criteria used to describe substance abuse, dependence, and SUD.

Table 1: Diagnostic criteria for substance abuse, dependence and SUD

| **Substance abuse (DSM-4)** | **Substance dependence (DSM-4)** |
|---|---|
| *A maladaptative pattern of use leading to clinically significant impairment or distress over a 12-month period.* | *Continued substance use despite behavioural impairment or distress over a 12-month period.* |
| **Diagnostic criteria:** | **Diagnostic criteria:** |
| At least **one** of the following: | At least **three** of the following: |
| 1. **Failure to fulfill major role obligations** at home, school, or work. | 1. **Tolerance**: Either a need for **increased amounts** of the substance to achieve the desired effect; or **diminished effects** with continued use of the **same amount** of the substance. |
| 2. Recurrent **use of the substance in hazardous situations** (e.g., driving an automobile while impaired). | 2. **Withdrawal**: Either a **withdrawal syndrome** or the substance is used to **relieve or avoid withdrawal symptoms**. |
| 3. Recurrent **legal problems** related to substance use. [1] | 3. The substance is often **taken in larger amounts** or over a longer period **than intended**. |
| 4. Persistent **use despite recurrent social or interpersonal problems** attributed to use. | 4. A persistent **desire or unsuccessful efforts to cut down** or control substance use. |
| | 5. A **great deal of time is spent in activities** necessary to **obtain** the substance, **use** the substance, or **recover** from its effects. |
| | 6. Important **social, occupational, or recreational activities are given up or reduced** because of substance use. |
| | 7. Persistent use despite **physical or psychological problems** attributed to use. |

**Substance use disorder (DSM-5)**

*A cluster of cognitive, behavioral, and physiological symptoms indicating that the individual continues using the substance despite significant substance-related problems over a 12-month period.*

**Diagnostic criteria:**

At least **two** of the following (**mild** = 2-3; **moderate** = 4-5; **severe** = 6 or more symptoms):

1. The substance is often **taken in larger amounts** or over a longer period **than intended**.[3]

2. A persistent **desire or unsuccessful efforts to cut down** or control substance use.[3]

3. A **great deal of time is spent in activities** necessary to **obtain** the substance, **use** the substance, or **recover** from its effects.[3]

4. **Craving**, or a strong desire or urge to use the substance.[1]

5. **Failure to fulfill major role obligations** at home, school, or work.[2]

6. Persistent **use despite recurrent social or interpersonal problems** attributed to use.[2]

7. Important **social, occupational, or recreational activities are given up or reduced** because of substance use.[3]

8. Recurrent **use of the substance in hazardous situations.**[2]

9. Persistent use despite **physical or psychological problems** attributed to use.[3]

10. **Tolerance** (as above).[3]

11. **Withdrawal** (as above).[3]

1: The criterion 'legal problems related to the use of the substance' is absent in the DSM-5. 2**:** Previously a criterion for substance abuse. 3: Previously a criterion for substance dependence. 4: The criterion 'craving for the substance' was introduced in the DSM-5.

As seen in Table 1, the DSM-5 does not recognise a hierarchy between symptoms or a distinction between abuse and dependence, combining them in a continuum where the severity of SUD is defined by the number of symptoms presented in a 12-month period (Kopak et al., 2014). Before the release of the DSM-5, Kanayama et al. (2009) highlighted that the existing criteria for abuse and dependence do not apply precisely to AAS, because:

> (…) unlike classical drugs of abuse, AAS are not ingested to achieve an immediate "high" of acute intoxication, but instead are consumed over a preplanned course of many weeks to achieve a delayed reward of increased muscularity (Kanayama et al., 2009).

In that paper, the authors suggested an adaptation of DSM-4 criteria to describe the AAS dependence syndrome (Figure 5). These criteria were not included in the DSM-5, where

AAS-related SUD is mentioned in the section 'Other (or Unknown) SUD', but to this date they remain as the only attempt to describe specific criteria for AAS addiction disorder.

Table 2: Proposed criteria for AAS dependence syndrome

| *DSM* Substance Dependence Criteria (**Shown in Bold**), Interpreted for Diagnosing AAS Dependence (Shown in Plain Text) |
|---|
| **A maladaptive pattern** of AAS use, **leading to clinically significant impairment or distress, as manifested by three (or more) of the following, occurring at any time in the same 12-month period**: |
| **1) Tolerance, as defined by either of the following**: |
| **(a) a need for markedly increased amounts of the substance to achieve intoxication or desired effect**; for AAS this progression to markedly larger doses may be related to dissatisfaction with the previous level of desired effect (e.g., level of muscle mass) |
| **(b) markedly diminished effect with continued use of the same amount of the substance** (e.g., failure to maintain the same level of lean muscle mass on a given dose of AAS) |
| **2) Withdrawal, as manifested by either of the following**: |
| **a) a characteristic withdrawal syndrome**, characterized for AAS by two or more of the following features: depressed mood, prominent fatigue, insomnia or hypersomnia, decreased appetite, and loss of libido |
| b) AAS are **used to relieve or avoid withdrawal symptoms**. |
| **3) The substance is often taken in larger amounts or over a longer period than was intended**. For AAS, this may be manifested by repeatedly resuming courses of AAS use after a shorter "off" period than the individual had originally planned, or by eliminating "off" periods entirely. |
| **4) There is a persistent desire or unsuccessful efforts to cut down or control substance use**. For AAS, this may be manifested by unsuccessful attempts to reduce or stop AAS use because of prominent anxiety about losing perceived muscular size. |
| **5) A great deal of time is spent in activities necessary to obtain the substance, use the substance, or recover from its effects**. For AAS, this may be manifested by extensive time spent participating in muscle-related activities surrounding AAS use (e.g., time spent in weight training, attending to diet and supplement use, and associating with other AAS users) in addition to actual time spent obtaining and administering AAS. |
| **6) Important social, occupational, or recreational activities are given up or reduced because of substance use**. For AAS, this may be manifested by giving up important outside activities because of an extreme preoccupation with maintaining a supraphysiologic AAS-induced level of muscularity (e.g., the individual relinquishes outside activities for fear that these activities will cause him to miss workouts, violate dietary restrictions, or compromise his ability to use of AAS). |
| **7) The substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance**. For AAS, this includes medical problems such as gynecomastia, sexual dysfunction, hypertension, dyslipidemia, and cardiomyopathy; or psychological problems such as dysphoric mood swings, severe irritability, or increased aggressiveness. |

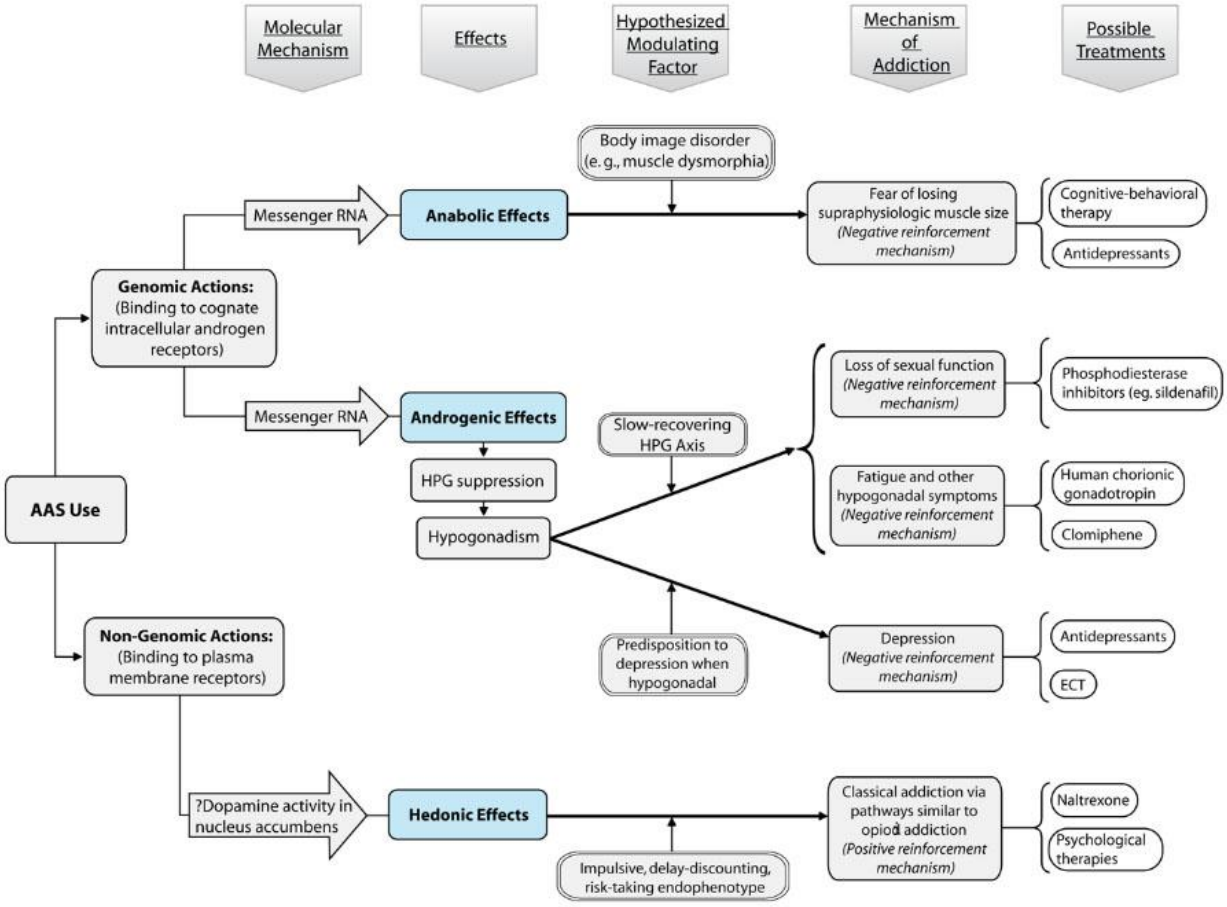
Adapted from Kanayama et al. (2009).

As seen in Table 2, the authors proposed that the features of AAS tolerance should be related to the users' body image dissatisfaction and/or failure to maintain the same levels of muscle mass, leading to increased use of AAS. Likewise, symptoms of AAS withdrawal were adapted to those previously described in this thesis as similar to male hypogonadism, such as depressive mood, fatigue and low libido. It could be argued, however, that this criterion does not take into consideration changes in AAS routine such as using compounds with different dosages and/or frequencies and routes of administration. Furthermore, it is not clear if the described symptoms of withdrawal

would be equally accurate for different subpopulations, such as female AAS users. According with the criterion number three – the shortening or absence of periods without the drugs, known as the 'off-phase' of the traditional AAS cycle – it is not clear if the 'blast-and-cruise' regime (in which the off-phase is replaced by lower doses of AAS to prevent loss of muscle mass and the onset of withdrawal symptoms; Chandler & McVeigh, 2014) should be considered a symptom of AAS dependence itself, especially if this is adopted as a planned AAS routine instead of a non-intentional increase in the amounts of AAS. Despite the scarcity of AAS users looking for help to stop using AAS (Kanayama, Hudson, et al., 2008; Pope et al., 2004), unsuccessful attempts to cut down or reduce the use of AAS (criterion four) were reported by people in treatment for SUD related to other substances when these attempts were actively investigated (Amaral & Cruz, 2017; Havnes et al., 2020; Scarth et al., 2022). Criteria five and six highlight the challenges of identifying activities associated with obtaining and using AAS as time-consuming and pathological, as AAS can be easily bought online (Antonopoulos & Hall, 2016; van de Ven & Koenraadt, 2017) and physical exercise is generally seen as a healthy habit (Mullen et al., 2020). Criterion seven describes the continued use of AAS regardless of physical and psychological harms associated with the use of the substances. As reported in numerous studies (Amaral, Deslandes, et al., 2022; Bates, Van Hout, et al., 2019; Harvey et al., 2019; Jacka et al., 2019; Kimergård & McVeigh, 2014), and discussed further in this thesis, AAS users frequently adopt a diversity of strategies to monitor and treat adverse effects – such as using ancillary drugs and having regular blood tests – to the extent that some adverse effects seem to be normalised and routinely managed by AAS users (Kimergard, 2015; Kimergård & Mcveigh, 2014). Finally, as the criteria proposed by Kanayama et al. were designed following DSM-4's structure for substance

dependence, it does not include three criteria used to diagnose SUD: Craving (added in DSM-5); failure to fulfill major role obligations at home, school, or work; and persistent use AAS despite recurrent social or interpersonal problems attributed to use (the latter two formerly considered criteria for substance abuse). A brain morphology analysis of AAS users who fulfilled the adapted DSM-IV criteria for AAS dependence shown thinner cortex in pre-frontal areas involved in inhibitory control and emotional regulation, compared with non-dependent AAS users (Hauger, Westlye, et al., 2019). No attempts to define the criteria for AAS-related SUD were published after the release of the DSM-5, stressing the importance of further studies in that field.

Figure 9: Mechanisms of addiction to AAS and possible treatments




Adapted from Kanayama et al. (2008).

Possible mechanisms of AAS addiction and treatment options were described by Kanayama et al. (2008) under the designation of AAS dependence (Figure 9). The addictive mechanisms of AAS would be based on three categories of effects: Anabolic, androgenic and hedonic, as illustrated in Figure 6. According to this hypothesis, each of these categories of effects would be modulated by a different factor which, if present, increases the risk of AAS addiction. Therefore, the presence of MD would increase the fear of losing the enhanced muscle mass provided by the anabolic effects of AAS; those with a slow-recovering gonadal function or predispose to depression when hypogonadal would be prone to severe symptoms of AAS withdrawal; and personality traits associated with addictive behaviour (e.g., impulsiveness and risk-taking) would increase the likelihood of AAS addiction via a classical disruption of reward-and-impulse control mechanisms due to the hedonic effects of AAS – e.g., enhanced wellbeing, energy and focus (Mędraś & Tworowska, 2001). A recent meta-analysis estimated a lifetime prevalence of 34.4% of AAS dependence amongst users (n = 1782), and that AAS dependence is associated with demographic inequalities and lower biophysical, cognitive, emotional, and psychosocial functioning (Skauen et al., 2023).

## 3.15 Blood-borne viral infections

Several studies investigated the prevalence of blood-borne viral (BBV) infections such as HIV and hepatitis B and C amongst users of injectable AAS. A study with NSP clients (n = 395) from England and Wales described a prevalence of HIV amongst male AAS injectors similar to that amongst users of psychoactive drugs (1.5%), and that HIV is associated with having injection site injuries and having sex with other men (Hope et al., 2013). The same study described 9.0% prevalence of hepatitis-B antibodies and 5.0% of hepatitis-C

antibodies, with only a minority of participants seeking diagnostic tests for BBV. A comparison between this study and previous surveys observed an increasing prevalence of HIV amongst users of injectable AAS (Hope et al., 2016). A study from Australia observed that AAS injectors who make use of psychoactive drugs, younger users and those who experienced recent injection-site injuries seem to be more likely to test positive for HIV and hepatitis C virus (van de Ven et al., 2018).

## 3.16 AAS use by women

Women might face unique challenges associated with AAS use. In addition to all sex-unspecific conditions, the effects of virilisation (such as deepening of the voice, hirsutism and baldness, described in item 3.4) tend to cause more discomfort to women. Female-specific AAS-HC include irreversible clitoromegaly, menstrual abnormalities and breast atrophy (Ainsworth et al., 2022; Christou et al., 2017; Nieschlag & Vorona, 2015b). Perhaps more importantly and equally under-studied are other aspects of AAS use by women, including distinct motivations for using AAS, patterns of drug use, support networks and gender-specific stigma. Women are more likely to use oral AAS (Abrahin et al., 2017; Henning & Andreasson, 2021; Ip et al., 2010; Korkia et al., 1996), which increase the risk of hepatotoxicity (Kicman, 2008). Reasons for women preferring oral AAS can include attempts to prevent androgenic effects of injectable compounds (Abrahin et al., 2017; Bunsell, 2013) and a perception that injecting AAS represents a threshold towards more 'serious' use of these drugs and the stigma of being seen as an 'injectable drug user' (Piatkowski et al., 2023). Some studies described that women's initiation in AAS use can be associated with previous episodes of physical and/or sexual abuse to which a muscular body is perceived as a protective factor (Havnes et al., 2021).

Women seem to be more likely to be initiated by a male partner who uses AAS and frequently represents their main source of support and information about these drugs (Börjesson et al., 2016; Havnes et al., 2021). As the majority of online communities of AAS-related peer support are predominantly populated by men, women might find themselves marginalised and uncomfortable to discuss their unique challenges (Henning & Andreasson, 2021). This segregation led to a proliferation of women-only AAS-related online communities and the dawn of 'sis(ter)-science', as opposed to the traditional 'bro-science' that dominates these environments (Andreasson & Henning, 2022). Female AAS users also suffer additional stigma associated with a gender-dominant perception that hyper-muscular physiques are 'inadequate' for women and transgressive to the traditional norms of femininity (Ainsworth et al., 2022; Fomiatti et al., 2023). Furthermore, women using AAS seem to be more susceptible to body-anxiety, body dissatisfaction, eating disorders and body objectification, namely when interacting with other AAS users in social media (Carrotte et al., 2017; Corazza et al., 2019; McKinley & Hyde, 1996).

## 3.17 AAS use by the LGBTQIA+ population

The population of AAS users is formed by a majority of cis-heterosexual adult males (Bonnecaze et al., 2020; Kanayama et al., 2020; Sagoe et al., 2014) and a crescent number of females, adolescents, and people with other sexual orientations and gender identities (Bolding et al., 1999; Börjesson et al., 2016; Sagoe & Pallesen, 2018; Unger, 2016). The use of AAS by lesbians, gays, bisexuals, transgenders, intersex, queers/questioning, asexuals and other sexual identities (LGBTQIA+) remains poorly understood. The prevalence of AAS use seems to be higher amongst men who have sex

with men (Bolding et al., 2002; Griffiths et al., 2021; Ip et al., 2019). There is a high prevalence of mental health problems (Chakraborty et al., 2011) and other clinical conditions among the LGBTQIA+ population (Bancroft et al., 2005; A. L. Roberts et al., 2013; Smalley et al., 2017), as well as greater levels of stigma experienced when accessing health services (Fish & Karban, 2015; A. Higgins et al., 2021; Whitehead et al., 2016). As highlighted by Hibbert et al. (2021), although the social pressure for having a lean an muscular body is ubiquitous, the men who have sex with men seem to experience higher body image demands associated with increased levels of objectification, weight stigma, and competition for sexual status (Filice et al., 2019; Griffiths et al., 2021; Pachankis et al., 2020). Furthermore, there seems to be a higher prevalence of recreational drug use – namely club drugs such as ecstasy and methamphetamine – amongst men who have sex with men when compared with heterosexual AAS users (Ip et al., 2017, 2019). The contemporary popularisation of chemsex – i.e., having sex under the influence of psychotropic and non-psychotropic sex-enhancing drugs – represents an additional motivation and an increased risk environment for the use of AAS (Marinelli et al., 2019).

## 3.18 Long-term effects of AAS

Until the early 2000s there was a relatively small number of people over the age of 45 with a long-term history of AAS use (Kanayama & Pope, 2018). In the absence of longitudinal studies with people exposed to AAS in their youth or continuously using AAS for decades, the discussion about longstanding effects AAS is mainly based on one of these three approaches: (i) An extrapolation on how the adverse effects of AAS – namely cardiovascular, endocrine and neuropsychiatric – could impact the health of AAS users

as they age (de Ronde & Smit, 2020; Kanayama et al., 2010; Kanayama et al., 2008; McVeigh et al., 2021); (ii) retrospective studies with former athletes who reported AAS use in their youth (Lindqvist et al., 2014; Lindqvist Bagge et al., 2017); and (iii) post-mortem analysis of AAS users (Darke et al., 2014; Frati et al., 2015; Paolo et al., 2005; Petersson et al., 2006). Although these studies describe cardiovascular and/or endocrine abnormalities potentially associated with AAS use, it is not possible to estimate the prevalence or irreversibility of harms caused by previous or continuous exposure to AAS after a determined number of years based on speculative observations. Studies investigating cognitive and brain abnormalities associated with the use of AAS reported poorer visual-spatial memory (Kanayama et al., 2013), structural changes in the amygdala and disruptions in the glutamine pathway and scyllo-inositol levels – potentially increasing the risk for β-amyloid toxicity and therefore dementia in long-term AAS users (Kaufman et al., 2015). The generalization of these findings is limited, however, due to the studies' small sample sizes (31 and 10 AAS users, respectively) and because, in both analyses, a small threshold of two years was utilized to define long-term AAS use.

## 3.19 Counterfeits and substandard AAS

The majority of AAS users obtain their drugs from illicit drug markets (Evans-Brown et al., 2012), whose lack of regulation can lead to the use of products of variable quality or unknown composition (Strang et al., 2012). Irregular substances are classified as counterfeits (a compound in which the active ingredient (AI) is either absent, substituted or adulterated) or substandard (a compound in which the concentration of the AI is

different from what is informed on its label), as detailed in Table 3 (Magnolini et al., 2022).

Table 3: Definitions of original, substandard and counterfeit substances

| Classification | Description and subclassification |
|---|---|
| Original | • Formulation detected fully matches the one declared on the label/ accurately labeled (qualitative)<br>• Levels of active pharmaceutical ingredients (AI) detected are between the defined range of the declared formulation defined by the individual study[a] (quantitative) |
| Substandard | • Formulation detected fully matches the one declared/ accurately labeled (qualitative)<br>• Levels of AI detected are not between the acceptable range defined for original products[a] (quantitative)<br>• Subclassification (quantitative):<br>- Over-concentrated: AI detected above defined range<br>- Under-concentrated: AI detected below defined range |
| Counterfeit[b] | • Formulation detected does not match the label/ not accurately labeled (qualitative)<br>• Subclassification (qualitative):<br>- Inert: no AI present<br>- Substituted: different AI than labeled present<br>- Adulterated: not all or more AI than the labeled AI present |

AI: Active ingredient. a: Specific range of 80–130% of the declared formulation. b: Neves & Caldas (2017). Adapted from Magnolini et al. (2022).

The adulteration of AAS might occur with substances of the same steroid class (e.g. different testosterone esters); AAS of different steroid classes (e.g. stanozolol instead of oxandrolone); completely different compound classes (e.g. an aromatase inhibitors instead of a testosterone ester); or completely different pharmaceuticals (e.g. an antimalarial drugs; Magnolini et al., 2022). Besides, even if their compositions matches the labels, AAS from illicit markets are frequently subject to irregular conditions of storage and transport, therefore increasing the risks of bacterial contamination (Graham et al., 2009; Neves et al., 2013). The unpredictability of effects and increased risk of adverse health conditions associated with the use of counterfeits and substandard AAS is a common concern amongst AAS users. Adverse effects may include bloating, injection-site pain, abscesses, infections and cardiovascular problems such as embolisms and phlebitis (blood vessel inflammation), as well as users' anxiety and frustration with

spending large sums of money on ineffective or contaminated products (Coomber et al., 2014; Frude et al., 2020).

As outlined by Evans-Brown et al. (2009), AAS from illicit markets come from three major sources: (i) products manufactured by pharmaceutical companies based in countries with poorly enforced drug regulations; (ii) products manufactured and/or packaged in clandestine laboratories outside the regulatory system; and (iii) legitimate products diverted to the illicit market through theft, unlawfully resold or dispensed as a result of fraud. According to a recent meta-analysis, more than one-third of illicitly commercialized AAS in European Countries are considered counterfeits (Magnolini et al., 2022). One of the strategies used to circumvent unreliable sources of AAS is the 'home brewing' of these substances, where raw powders of AAS are manipulated to produce injectable compounds. In online forums dedicated to AAS home brewing, users share their disappointment with the trial-and-error of the illicit AAS market:

> We are left to search the internet looking for shit. We know it's shit and put our ass on the line to get juice. 98% of the gear in circulation is some form of UGL [underground laboratory] or counterfeit. Pharma grade [i.e., AAS sourced from pharmaceutical companies] is very rare, expensive, and much lower dosed than UGL shit. Some type of juice like Tren is not even produced. The best I've ever seen is straight home cooked shit (Brennan et al., 2018a).

Whilst the raw powder for the production of AAS is also bought from illicit online sources (therefore equally subject to uncertain manufacturing practices), users involved in home brewing report a greater level of confidence in their final products, as they feel able to adjust the potency of their compounds even if the raw substance is under-dosed (Kraska

et al., 2009). Naturally, the production of AAS outside pharmaceutical standards, accompanied by a lack of adequate components and experimentation can lead to an array of adverse outcomes. It is unclear if the practice of AAS home brewing is an effective strategy to reduce the risks of counterfeits. As discussed in item 1.4, the prohibition to import AAS through the postal service in the UK (ACMD, 2011) might have had the undesired consequence of fostering 'underground labs' and increased the users' access to AAS with unknown potency and composition (Henning & Andreasson, 2022).

## 3.20 Polypharmacy and AAS users as a sentinel population

The use of AAS is frequently associated with other substances that contribute to the risks of adverse health conditions. A review of the literature estimated that the most common substances used concurrently with AAS are, in that order: Alcohol, cannabis, cocaine, human growth hormone (hGH) and human chorionic gonadotropin (Sagoe et al., 2015). These substances exemplify the three main groups of drugs used in combination with AAS (Table 4): Other IPEDs, recreational drugs and ancillary substances to treat or prevent adverse effects of AAS (Amaral, Deslandes, et al., 2022; Brennan et al., 2017; N. Evans, 1997a; Ip et al., 2017; Irwig et al., 2020).

Table 4: Examples of drugs used concurrently with AAS

| Other IPEDs | Recreational drugs | Ancillary drugs |
|---|---|---|
| • **hGH** (somatropin, hygetropin, etc.)<br>• **hGH releasers** (CJC-1295, CJC-1293, etc.)<br>• **Insulin**<br>• **SARMS**<br>• **Clenbuterol** (Spiropent, Ventolase, etc.)<br>• **DNP**<br>• **Stimulants** (ephedrine, caffeine, etc.)<br>• **Melanotan** | • **Alcohol**<br>• **Cannabis**<br>• **MDMA** (ecstasy)<br>• **Hallucinogens**<br>• **Heroin**<br>• **Methamphetamine** | • **hCG**<br>• **Anti-estrogens** (tamoxifen, arimidex, letrozole, etc.)<br>• **Clomid**<br>• **Analgesics / Opioids**<br>• **Sedatives**<br>• **Statins**<br>• **Angiotensin receptor blockers and conversion inhibitors**<br>• **Muscle relaxants** |

hGH: human growth hormone; SARM: selective androgen receptor modulator; DNP: 2,4-Dinitrophenal; MDMA: 3,4-Methyl enedioxymethamphetamine

The IPED known as DNP (2,4-Dinitrophenol) is a potent weight loss medication with elevated risk of acute toxicity. The metabolic effects of DNP are based on the disruption of adenosine triphosphate (ATP) production in mitochondria, an effect known as uncoupling of oxidative phosphorylation (Grundlingh et al., 2011). This process forces the cell to dissipate its energy into heat, leading to a rapid consumption of calories but – except on an extremely narrow therapeutic window – to uncontrolled hyperthermia and death (El-Guindy et al., 1981). As highlighted by McVeigh et al. (2021), the use of drugs such as DNP and gamma-hydroxybutyrate (GHB) – an anesthetic used to induce prolonged sleep with the intent to boost the production of hGH – was promoted amongst the enhanced bodybuilding community many years before these drugs were used by recreational athletes and other populations. In many ways, this phenomenon is similar to the pioneering adoption of AAS amongst bodybuilders followed by its widespread use by the general population (Kanayama & Pope, 2018). It underscores the importance of identify AAS users, namely enhanced bodybuilders, as sentinel populations able to signpost drug-using trends likely to become public health concerns in the near future (McVeigh et al., 2021). As suggested by the epidemiologic history of AAS (item 1.3), informal sources of AAS-related support (item 4.2) and WP3 of this thesis (chapter 7), people using AAS might be a sentinel population not only for drug-related trends, but also for trans-regional cultural tendencies, demands for healthcare and parallel support networks.

# 4. Preventing and treating harms associated with the use of AAS

In attempts to prevent, treat and reduce the harm of adverse health conditions potentially associated with the use of AAS (AAS-HC), people using AAS might adopt a diversity of health-related strategies (Bates et al., 2019; Harvey et al., 2019; Tighe et al., 2017). These strategies can include the selection of AAS providers, sources of information about AAS, planning of AAS routines, lifestyle changes, the treatment of AAS-HC and the use of harm-reduction services. The sources of support sought by people using AAS can be divided in formal (health professionals and harm-reduction services) and informal (websites, friends, on-line forums, coaches, etc.).

## 4.1 Formal sources of support and information

The formal sources of support for people using AAS are composed of health professionals and personnel trained in the prevention and treatment of drug use and other health conditions. This thesis will focus on the services available in the UK, such as primary care and specialized physicians, the needle and syringe exchange programme, steroid and sexual health clinics, and support services for people using drugs.

### 4.1.1 Physicians

As previously discussed in this thesis, the synthesis of AAS revolutionized the treatment of male hypogonadism and other health conditions, whilst simultaneously offering unrivaled means to improve muscularity and enhance body image. Despite the growing use of AAS by elite athletes and bodybuilders since the 1950s, only in 1987 the American College of Sports Medicine recognised some evidence that AAS were effective in improving muscle mass and athletic performance – although the effect was considered

small and limited to some individuals (American College of Sports Medicine, 1987). The failure of the medical community to acknowledge the enhancement properties of AAS has likely contributed to widening the gap between AAS users and physicians. In fact, many physicians admit a lack of training and experience in recognising and treating adverse effects of AAS, a phenomenon described both in UK-based (Dawson, 2001; Greenway & Greenway, 1997; Hill & Waring, 2019) and international studies (Gupta et al., 1997; Kanayama & Pope, 2018; Pope et al., 2004; Woods & Moyniham, 2009). Amongst other factors possibly influencing the prevalence of AAS seeking support from physicians in the UK and many other countries are the stigma experienced by AAS users' when engaging with health services, (Hill & Waring, 2019; Yu et al., 2015), concerns about having AAS use inscribed in their medical records, and the perception that some health problems can be managed without the help of a health professional (Hope et al., 2020; Zahnow et al., 2017). The legal status of AAS can also influence the service provided to AAS users by physicians (Fink et al., 2019). Even in countries where the unprescribed use of AAS is not illegal – such as in the UK – doctors are only allowed to prescribe AAS for the treatment of medical conditions, which could prevent them to prescribe these drugs for people seeking to reduce their dosages or to prevent the symptoms of AAS withdrawal and hypogonadism (Griffiths, Henshaw, et al., 2017).

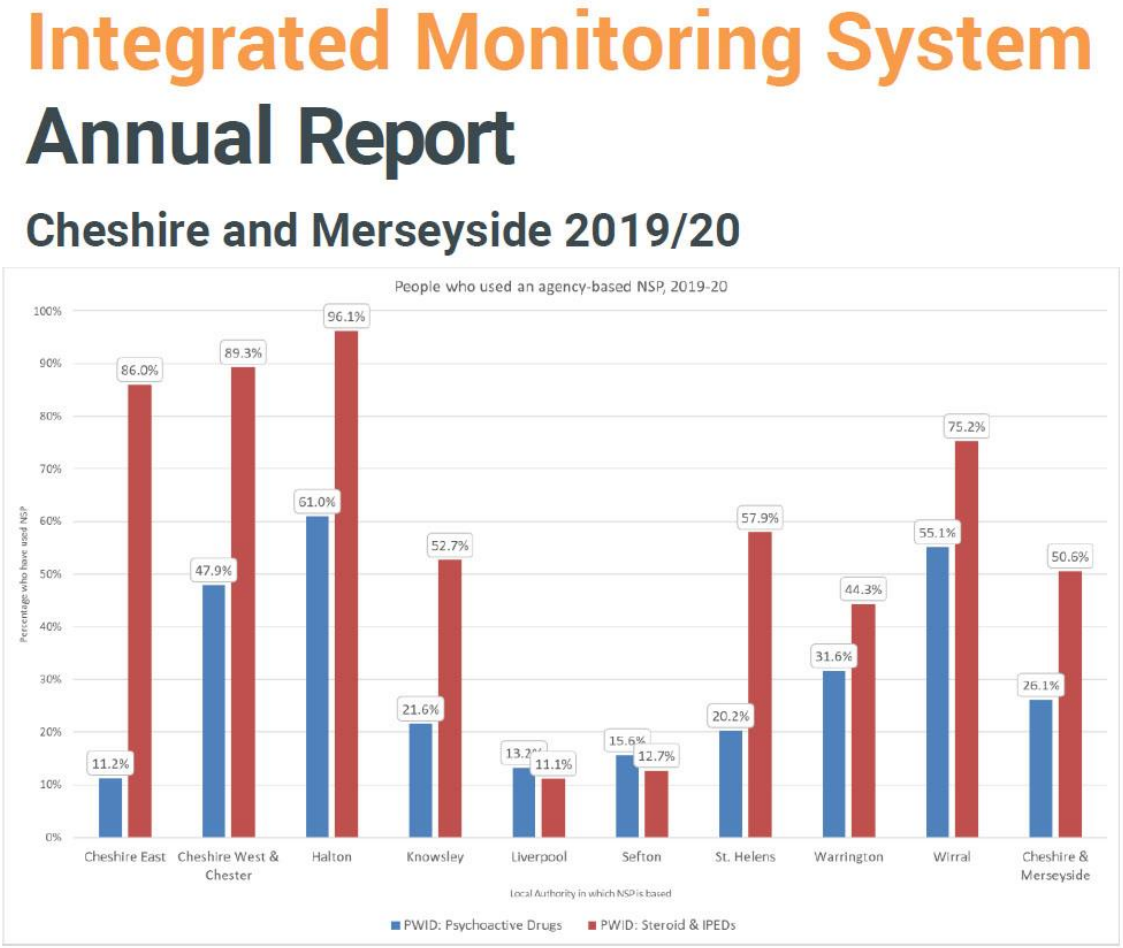
Recently, there seems to be growing number of private medical services in the UK offering TRT. The provision of these therapies is based on a loose interpretation of late onset hypogonadism, in which the treatment is recommended for men in experiencing symptoms such as fatigue, reduced cognitive performance, depressive mood and reduced sexual performance and decreased levels of testosterone – even if above the hypogonadal threshold of 300 ng/dl (Shin & Park, 2019). The proliferation of TRT clinics

is an under-studied phenomenon, and it is possibly associated with a greater demand for medically-supervised use of AAS.

### 4.1.2 The needle and syringe exchange programme

The epidemic of HIV infection and AIDS during the 1980s led to a paradigm shift in the UK's public health policies, as multi-level interventions started focusing on the health behaviour of people using injectable drugs instead of an exclusively prohibitionist approach to drug use (Ashton & Seymour, 1988). Those policies established harm reduction interventions such as outreach services for vulnerable populations and the creation of the needle and syringe exchange programme (NSP; Stimson, 1995). Although the provision of sterile needles is the primary role of the NSP, many services also provide other interventions including health education, screening for blood-borne viruses and advice on safe injection techniques (Kral & Bluthenthal, 2003). This approach aligns with the principles of harm reduction, which encompasses the practices aimed at reducing negative consequences without necessarily eliminating the harmful behaviour (Hawk et al., 2017). An increasing number of people using AAS can be found amongst NSP clients in the UK since the 1980s (Birtles & Bellis, 1997; Korkia & Stimson, 1993), with services in southeast England reporting a 2,000% increase of this prevalence between 1991 and 2006 (McVeigh & Begley, 2017). In some NSP units in Cheshire and Merseyside, the numbers of IPED/AAS-using clients has surpassed the number of users of psychoactive drugs (Withfield & Reed, 2021) – an epidemiologic trend also seen in Wales (Turner et al., 2018), Scotland (National Services Scotland, 2018) and Northern Ireland (Northern Ireland Public Health Agency, 2019), as shown in Figures 10 to 13.

Figure 10: NSP clients using AAS and psychoactive drugs in Cheshire and Merseyside, England.




PWID: people who used an injectable drug

Figure 11: NSP clients using AAS and other drugs in Wales, with a summary of the Aneurin Bevan area

**Demographics of all regular NSP attending individuals in 2017-18 by Health Board area**

| | Abertawe Bro Morgannwyg | Aneurin Bevan | Betsi Cadwaladr | Cwm Taf | Cardiff and Vale | Hywel Dda | Powys Teaching |
|---|---|---|---|---|---|---|---|
| Number of regular clients | *3297* | *2591* | *3826* | *2077* | *2132* | *1379* | *303* |
| Clients who report opioid use | *48.9%* | *37.8%* | *59.2%* | *28.8%* | *61.9%* | *45.3%* | *56.8%* |
| Clients who report stimulant use | *13.4%* | *13.6%* | *11.4%* | *27.9%* | *16.3%* | *14.8%* | *8.9%* |
| Clients who report IPED use | *56.7%* | *63.7%* | *51.2%* | *62.3%* | *37.0%* | *54.1%* | *45.5%* |

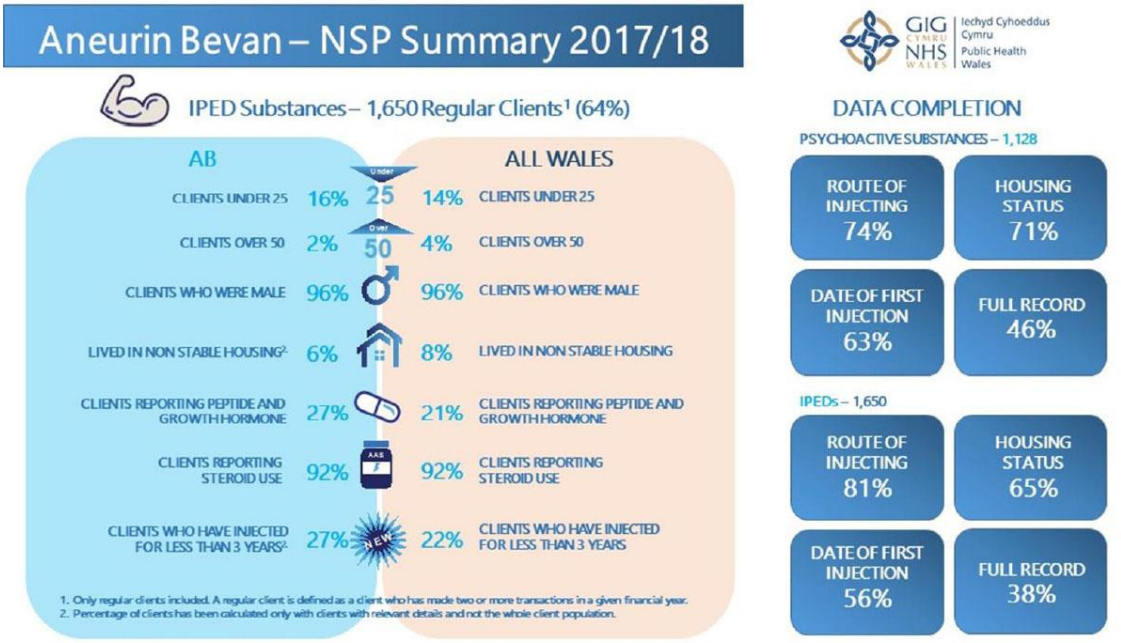



Figure 12: Types of drugs injected by NSP clients in Scotland

# Injecting Equipment Provision in Scotland 2016/17

NHS National Services Scotland

## Types of Drug Injected

Information on the type of drug injected by service users was collected by 273 (97%) of the 281 IEP outlets in 2016/17 (data not shown in tables). Of these:

- Almost all (99.6%, 272) outlets reported that one or more of their service users injected opiates;
- 93% (253) reported that one or more of their service users injected Image and Performance Enhancing Drugs (an increase from 91% of reporting outlets in 2015/16);
- 71% (195) reported that one or more of their service users injected stimulants; and,
- 35% (96) reported that one or more of their service users injected 'New' or 'Novel' Psychoactive Substances.

IEP: Injecting equipment provision

Figure 13: Number of NSP visits by drug of injection in Northern Ireland

**Northern Ireland**
**Needle and Syringe Exchange**
**Service Report**
**1st April 2018 - 31st March 2019**

HSC Health and Social Care Board

HSC Public Health Agency

**Number of visits by main drug of injection and Trust Area of Pharmacy**

| Main drug of Injection | Trust Area of Pharmacy | | | | | Total |
|---|---|---|---|---|---|---|
| | Belfast | Northern | South Eastern | Southern | Western | |
| Amphetamines | 53 | <20 | <20 | 65 | 13 | 145 |
| | 0% | 0% | 0% | 4% | 0% | 0% |
| Amphetamine + Opiates | <20 | 0 | <20 | <20 | <20 | 9 |
| | 0% | 0% | 0% | 0% | 0% | 0% |
| Insulin | 8 | <20 | 6 | <20 | <20 | 21 |
| | 0% | 0% | 0% | 0% | 0% | 0% |
| Opiates | 17314 | 3657 | 873 | 1072 | 637 | 23553 |
| | 83% | 57% | 40% | 71% | 22% | 69% |
| Opiates + Steroids | 20 | 23 | <20 | <20 | 17 | 78 |
| | 0% | 0% | 1% | 0% | 1% | 0% |
| Opiates + Tanning | <20 | <20 | <20 | <20 | 0 | 8 |
| | 0% | 0% | 0% | 0% | 0% | 0% |
| Steroid | 2563 | 2013 | 920 | 197 | 1694 | 7387 |
| | 12% | 31% | 42% | 13% | 59% | 22% |
| Steroid & Tanning | 58 | 100 | 98 | 10 | 42 | 308 |
| | 0% | 2% | 4% | 1% | 1% | 1% |
| Tanning | 453 | 342 | 179 | 60 | 137 | 1171 |
| | 2% | 5% | 8% | 4% | 5% | 3% |
| Not Recorded | 491 | 308 | 102 | 97 | 314 | 1312 |
| | 2% | 5% | 5% | 6% | 11% | 4% |
| Total Visits | 20969 (100%) | 6459 (100%) | 2199 (100%) | 1509 (100%) | 2856 (100%) | 33992 (100%) |

The NSP encompasses a diversity of services for people using injectable drugs, such as the provision of injectable equipment, mobile needle exchange in gyms (i.e., outreach services), and advice on safe injection techniques (NICE, 2014a). A few number of primary NSP units also offer programmes known as Steroid Clinics, including advice on intramuscular injection techniques, dietary advice, hepatitis B vaccinations, blood tests, and blood pressure monitoring (NTA, 2008). As described by Kimergård & Mcveigh (2014), there is a high variability in the services provided by different NSP units, highlighting the absence of a national 'best practice' for AAS-related harm reduction. Besides, only a few number of NSP units across the UK offer specialised advice of AAS users, as the service was primarily designed to support users of psychoactive drugs (Bates et al., 2021). Whilst some AAS users consider the NSP staff as knowledgeable and supportive, others refrain from seeking the NSP at all – including retail pharmacies – due

to concerns with being seen as drug users (Kimergård & McVeigh, 2014). Furthermore, users of non-injectable AAS are unlikely to seek the NSP for health advice, being therefore overlooked by this source of information and harm reduction (van de Ven, Zahnow, et al., 2020).

### 4.1.3 Steroid Clinics

Some Steroid Clinics operate separately from conventional NSP services in the UK (Kimergård & Mcveigh, 2014). However, there is a scarcity of information about the number and activity of these clinics. Such is the case of both the Drugs in Sport Clinic and Users' Support (DISCUS) and Smart Muscle, mentioned in the AAS report by the Advisory Council on the Misuse of Drugs (ACMD, 2010), and no longer active. An informal conversation with DISCUS' former coordinator, Dr Robert Dawson, revealed that the clinic operated in the county of Tyne and Wear for about 20 years, until the service was decommissioned. Regarding Smart Muscle, the clinic's website is longer active (FRANK, n.d.-b), and its telephone number leads to the social enterprise Turning Point, whose personnel is unaware of any specialised service related to the use of AAS. Likewise, the only Steroid Clinic mentioned on the National Institute for Health Care and Excellence (NICE) website – the Pump Clinic in Manchester (NICE, 2014b) – is no longer active.

In the absence of publications and official data, an informal internet search retrieved the existence of three active NHS-funded Steroid Clinics in the UK, located in Glasgow, Edinburgh and Sheffield, all of them open one evening per week.

Founded in 2010, the Glasgow IPED clinic (Scottish Drug Services, n.d.) offers the following services (Campbell, 2020):

- Basic assessment of AAS use and motivations.
- Identification and help with adverse health conditions.
- Blood tests (FSH, LH, estradiol, total testosterone, cholesterol, HDL cholesterol ratio, HDL, LDL, triglycerides, creatinine, glomerular filtration ratio (GFR), sodium, potassium, urea, liver enzymes (ALP, ALT, GGT), bilirubin, and screening for blood-borne viruses (HBV, HCV and HIV).
- Provision of injecting equipment.
- Advice and demonstration of AAS injection and storage.
- Discussion on dosages and dose-related risk.
- Discussion of specific IPEDs and preparations.
- Alternatives to IPED use.

The Edinburgh Steroid Clinic highlights on its website that 'all services provided are done confidentially and anonymously; therefore, no information is stored on medical records', and provides the following services (NHS Lothian, 2020):

- Harm reduction advice such as alternatives to steroid use, safer injecting, side effect minimisation, safer dosaging advice, advice around PCT drugs, and advice about individual steroids and other IPEDs.
- Provision of sterile injecting equipment.

- Blood tests and vaccinations for blood-borne viruses.
- Mid-cycle and post-cycle blood tests. The tests offered are to check hormone levels which can be negatively affected by steroid use such as testosterone, LH, FSH, and oestrogen, as well as blood tests for cholesterol levels, kidney, liver and prostate functions, and full blood counts. The clinic also provides a baseline blood test for those who are yet to use steroids.
- Free condoms.
- Counselling service.
- Support to stop using AAS.
- Assistance with physical health or mental health concerns.

Finally, the Juice Clinic in Sheffield provides advice and blood tests for users of AAS, melatonin, 'fat-burners' and other IPEDs (Sheffield Health and Social Care, 2022). It is relevant to mention that, since 2020, the Anabolic Steroids UK organisation shows on its website a list of Steroid Clinics and practitioners who offer specialised services for people using AAS (ASUK, 2020).

### 4.1.4 Sexual Health Clinics

The origin of contemporary Sexual Health Clinics in the UK dates back to 1964, with the opening in London of the Brook Advisory Centre (Rusterholz, 2022). Although the pioneering birth control clinic in Britain was created in 1921 (Debenham, 2018), Mary Brook's Centre was the first to offer sexual advice for 'unmarried young people'. In the year 2020, more than 2 million people accessed specialised Sexual Health – also known

as genitourinary medicine (GUM) or sexual and reproductive health (SRH) – Clinics in England (Stewart, 2022), looking for services such as the provision of contraceptive methods (including free condoms and emergency contraception), pregnancy testing, testing and treatment of sexually transmitted infections (STI), hepatitis B vaccination, abortion advice, pre-exposure and post-exposure prophylaxis (PREP and PEP, respectively) for HIV and support for victims of sexual assault (NHS, 2021). The use of AAS has been associated with a high prevalence of risky sexual behaviours, such as unprotected sex and multiple sexual partners (Hope et al., 2016, 2020; Korkia & Stimson, 1993; Midgley et al., 2000), which might lead AAS users to seek the support of Sexual Health Clinics for problems indirectly related to AAS.

### 4.1.5 Drug support services and helplines

The Consideration of the Anabolic Steroids (ACMD, 2010) remains, up to the writing of this thesis, the latest and more extensive report on the misuse of AAS produced by an advisory body in the UK. General guidance regarding the provision of prevention and treatment services for people using AAS are mentioned in England's latest Drugs Commissioning Guidance (Public Health England, 2018), Manchester's service specification for the NSP (Manchester Health & Care Comission, 2021), and the 'Orange Book' of drug misuse clinical management (Department of Health, 2017). Several suggestions to improve the service provided to people using AAS and other IPEDs were mentioned in the Public Health England's guidance published almost 10 years ago such as the screening of common health problems and the competences of staff working with IPED users (Public Health England, 2014), but to the best to our knowledge there are no specific guidelines to support AAS users (e.g. needles for intramuscular injection, risk

profiles of different AAS and other IPEDs, frequency and types of health monitoring, PCT etc.). The UK's government latest report 'From Harm to Hope' (HM Government, 2021) contains no mention to AAS or IPEDs. As described in item 4.1.3, to the best of our knowledge the only active NHS-funded Steroid Clinics are the ones located in Glasgow and Edinburgh. Change Grow Live (CGL), a charity providing addiction-related services across the UK (CGL, 2022) used to offer a dedicated webchat for IPED users (CGL, 2020), but the service was discontinued in September 2021 (CGL, 2021). According to the harm reduction worker who established CGL's IPED webchat:

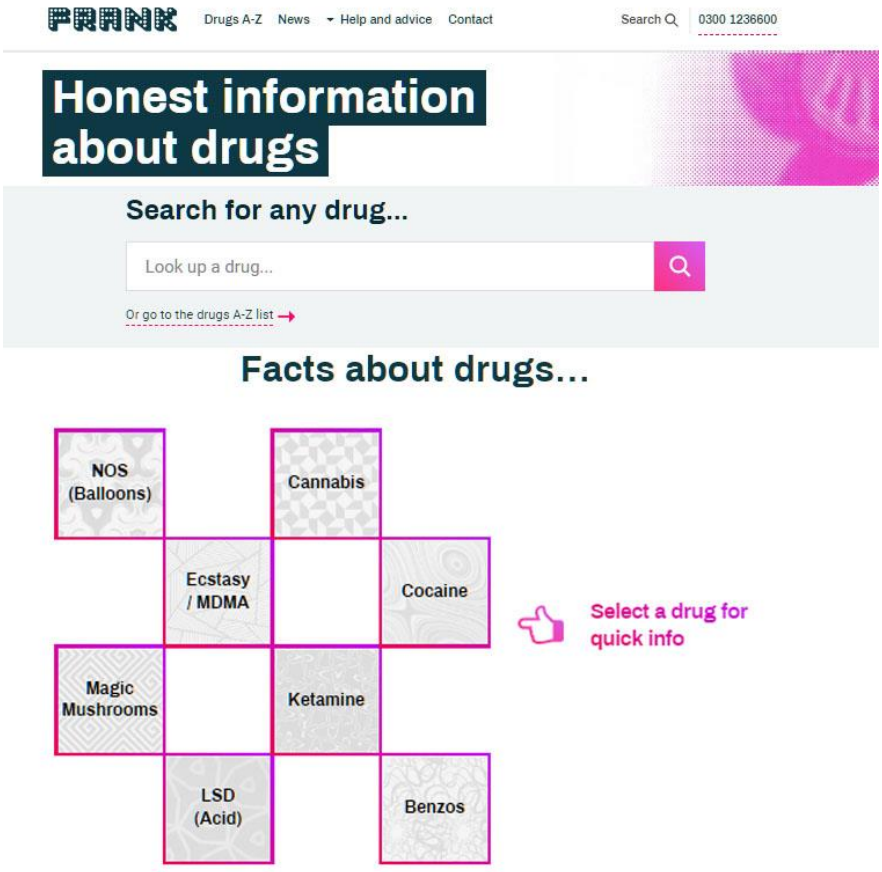
> We saw more people using [anabolic] steroids looking for the NSP in Norfolk. Then we decided to run the webchat as a pilot for four months, but only a couple of people logged in. I think it is hard to engage [anabolic] steroid users with drug services, because they don't consider themselves drug users, and they don't want to be seen like that (L.Chilvers, personal communication, July 25, 2022).

Some private services in the UK advertise treatment for AAS addiction (Castle Craig, 2022; Help 4 Addiction, 2022; UK Rehab, n.d.) and medically-supervised testosterone therapy (Harley Street MD, n.d.; Khan, 2020; Touliatos, 2021), but there is no information about the number of people seeking these services.

Regarding remote services, the first mental health helpline was created in England in 1953 – the Samaritans, established by the London-based Vicar Chad Varah – to help people with emotional problems and risk of suicide (Pollock et al., 2010; Samaritans, n.d.). Inspired by the Samaritan's model of an anonymous and free-of-charge telephone service, many organisations offer helplines for people using alcohol and drugs in UK,

including information about AAS in their websites. Examples include the Welsh charity Dan 24/7 (Dan 24/7, n.d.), Release (Release, n.d.) – focused on legal advice related to drug use – and FRANK (FRANK, n.d.), a national advisory service established by the UK's Department of Health and Home Office in 2003 (HM Government, 2010). Figure 14 shows the current homepage of FRANK, with quick access to information about commonly used drugs such as cannabis, cocaine and LSD.

Figure 14: FRANK's homepage




Adapted from FRANK (2022).

The few mentions to AAS amongst most drug-related services in the UK is congruent with the evidence that few people seek treatment for AAS-related SUD (Brower, 2015; Clancy & Yates, 1992; Kanayama et al., 2003). Nevertheless, studies performed in the US (Kanayama et al., 2003), Brazil (Amaral & Cruz, 2017) and Norway (Havnes et al., 2020)

showed a considerable – and often overlooked – prevalence of previous AAS use amongst people in treatment for the use of other drugs, highlighting the importance of training the staff of addiction services to recognise and discuss AAS use. In Norway, the experimental helpline SteroidLab reported an uptake of 232 AAS over four years (an average of one advice session per week), with 77.2% of participants expressing a desire for SUD treatment, aiming to stop using AAS (Havnes et al., 2019). In the UK, a helpline focused on the use of IPED in sport is provided by the UK Anti-Doping organisation (UKAD, 2022), but there is no information about the number or the kind of queries submitted by its users. Similar services were stablished in Sweden (Eklöf et al., 2003), Japan (Takahashi et al., 2007) and Denmark (Bojsen-Møller & Christiansen, 2010).

### 4.1.6 Stigma as a barrier to AAS users' access to health care

The stigma experienced by people using AAS is frequently mentioned as one of the main barriers in their engagement with the health system (Harvey et al., 2020; Henning & Andreasson, 2022; Hope et al., 2020; Kimergård & McVeigh, 2014; Santos & Coomber, 2017; Yu et al., 2015). Stigma is a complex phenomenon involving the devaluation of attributes and behaviours identified as less desirable, flawed and/or dangerous, leading to generally flawed identity of people with these characteristics (Goffman, 1963). Stigma might occur with the internalisation of negative views (individual stigma), in interpersonal relationships and structurally, with systematic or institutional stigma (Hatzenbuehler, 2016). The perception that people using illicit substances in general are morally flawed and associated with crime (or at least supporters of the illicit drug market), can reinforce institutional stigma, potentially leading to reduced support as a way to 'punish' those who 'chose to use drugs' (Biancarelli et al., 2019; Muncan et al.,

2020; Ventura et al., 2022). People using AAS (namely users of injectable compounds) can be perceived more negatively than users of other drugs (Griffiths et al., 2016; Yu et al., 2015). Some hypothesis to explain health professionals' stigmatised perception of AAS users include their identification as 'anti-doping-cheaters', 'vain', or simply having undervalued motivations and voluntarily using dangerous drugs in order to 'look good' (Hope et al., 2020; Seear et al., 2020). Furthermore, subpopulations of AAS users such as females (Ainsworth et al., 2022; Andreasson & Henning, 2022; Fomiatti et al., 2023) and LGBTQIA+ (Griffiths, Murray, et al., 2017) might experience increased stigma when seeking with health care – see items 3.17 and 3.18. As discussed in items 1.4 (The risk environment of AAS use in the UK) and 4.2.4 (Social media, social capital and fitspiration), the stigma against AAS users co-exists with the contemporary idealisation of lean and muscular bodies in entertainment and social media. Stigma and other barriers clearly contribute to AAS users' lower engagement with the health system, therefore fostering the pursue of informal and poorly regulated sources of support.

## 4.2 Informal sources of support and information

The practices adopted by people to share knowledge about drugs and mitigate harm were described by Schipstal et al. (2016) as *harm reduction from below* – a concept based on the notions of solidarity and bonding amongst people using drugs (Foster & Spencer, 2013; Kavanaugh & Anderson, 2008). Many harm reduction practices described amongst people using psychoactive drugs are similar to those adopted by people using AAS, such as sharing advice about reliable providers, injection techniques and strategies to maximise the desired effects of the substances whilst minimising and treating adverse effects (Cohen et al., 2007; Kimergard, 2015; Kimergård & Mcveigh, 2014). In addition,

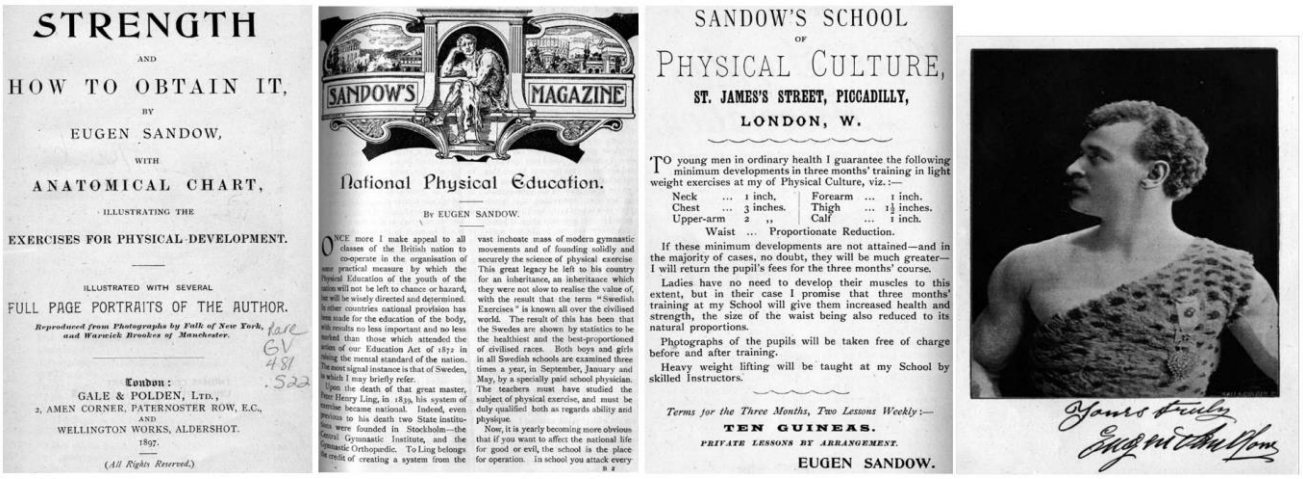
people using AAS might seek and share information about a variety of topics directly or indirectly associated with the use of AAS. These include the effects, dosages, frequency of administration and combinations of different AAS; the use of other IPEDs to maximise the desired enhancements in body image and performance; ancillary drugs to prevent and treat adverse effects; physical training and dietary routines; and recommendations of exams to monitor their health whilst using AAS (Tighe et al., 2017).

The network of AAS users also provides a space for its members to share concerns – such as relationship problems and disclosing the use of the substances – and common interests, such sports and bodybuilding competitions, aesthetics and events of everyday life (Woolf et al., 2014). Based on self-experimentation and research, these networks produce an informal body of knowledge constantly updated and shared between its members – either face-to-face or via publications, social media, websites and online forums (Hunt et al., 2009; Tighe et al., 2017).

### 4.2.1 Muscle and fitness magazines

Physical training books and magazines were the first vehicles used to share knowledge about how to enhance muscularity. These publications became popular in many countries long before the advent of AAS. Both the first book– *Strength and How to Obtain it* (1897) – and the first magazine dedicated to bodybuilding – *Sandow's Magazine of Physical Culture* (1898) – were authored by the Prussian and London-based strongman Eugene Sandow (1867-1925), who also organised the first British bodybuilding competitions in 1901 (Scott, 2008), as shown in Figure 15.

Figure 15: Eugene Sandow's publications on strength and physical culture



STRENGTH
AND
HOW TO OBTAIN IT,
BY
EUGEN SANDOW,
WITH
ANATOMICAL CHART,
ILLUSTRATING THE
EXERCISES FOR PHYSICAL DEVELOPMENT.
ILLUSTRATED WITH SEVERAL
FULL PAGE PORTRAITS OF THE AUTHOR.
Reproduced from Photographs by Folk of New York, and Warwick Brookes of Manchester.
London:
GALE & POLDEN, LTD.,
2, AMEN CORNER, PATERNOSTER ROW, E.C.,
AND
WELLINGTON WORKS, ALDERSHOT.
1897.
(All Rights Reserved.)

SANDOW'S MAGAZINE

National Physical Education.

By EUGEN SANDOW.

ONCE more I make appeal to all classes of the British nation to co-operate in the organisation of some practical measure by which the Physical Education of the youth of the nation will not be left to chance or hazard, but will be wisely directed and determined. In other countries national provision has been made for the education of the body, with results no less important and no less marked than those which attended the action of our Education Act of 1872 in raising the mental standard of the nation. The most signal instance is that of Sweden, to which I may briefly refer.

Upon the death of that great master, Peter Henry Ling, in 1839, his system of exercise became national. Indeed, even previous to his death two State institutions were founded in Stockholm—the Central Gymnastic Institute, and the Gymnastic Orthopædic. To Ling belongs the credit of creating a system from the vast inchoate mass of modern gymnastic movements and of founding solidly and securely the science of physical exercise. This great legacy he left to his country for an inheritance, an inheritance which they were not slow to realise the value of, with the result that the term "Swedish Exercises" is known all over the civilised world. The result of this has been that the Swedes are shown by statistics to be the healthiest and the best-proportioned of civilised races. Both boys and girls in all Swedish schools are examined three times a year, in September, January and May, by a specially paid school physician. The teachers must have studied the subject of physical exercise, and must be duly qualified both as regards ability and physique.

Now, it is yearly becoming more obvious that if you want to affect the national life for good or evil, the school is the place for operation. In school you attack every

SANDOW'S SCHOOL
OF
PHYSICAL CULTURE,
ST. JAMES'S STREET, PICCADILLY,
LONDON, W.

TO young men in ordinary health I guarantee the following minimum developments in three months' training in light weight exercises at my of Physical Culture, viz.:—

| | | | |
|---|---|---|---|
| Neck | 1 inch. | Forearm | 1 inch. |
| Chest | 3 inches. | Thigh | 1½ inches. |
| Upper-arm | 2 ,, | Calf | 1 inch. |

Waist ... Proportionate Reduction.

If these minimum developments are not attained—and in the majority of cases, no doubt, they will be much greater—I will return the pupil's fees for the three months' course.

Ladies have no need to develop their muscles to this extent, but in their case I promise that three months' training at my School will give them increased health and strength, the size of the waist being also reduced to its natural proportions.

Photographs of the pupils will be taken free of charge before and after training.

Heavy weight lifting will be taught at my School by skilled Instructors.

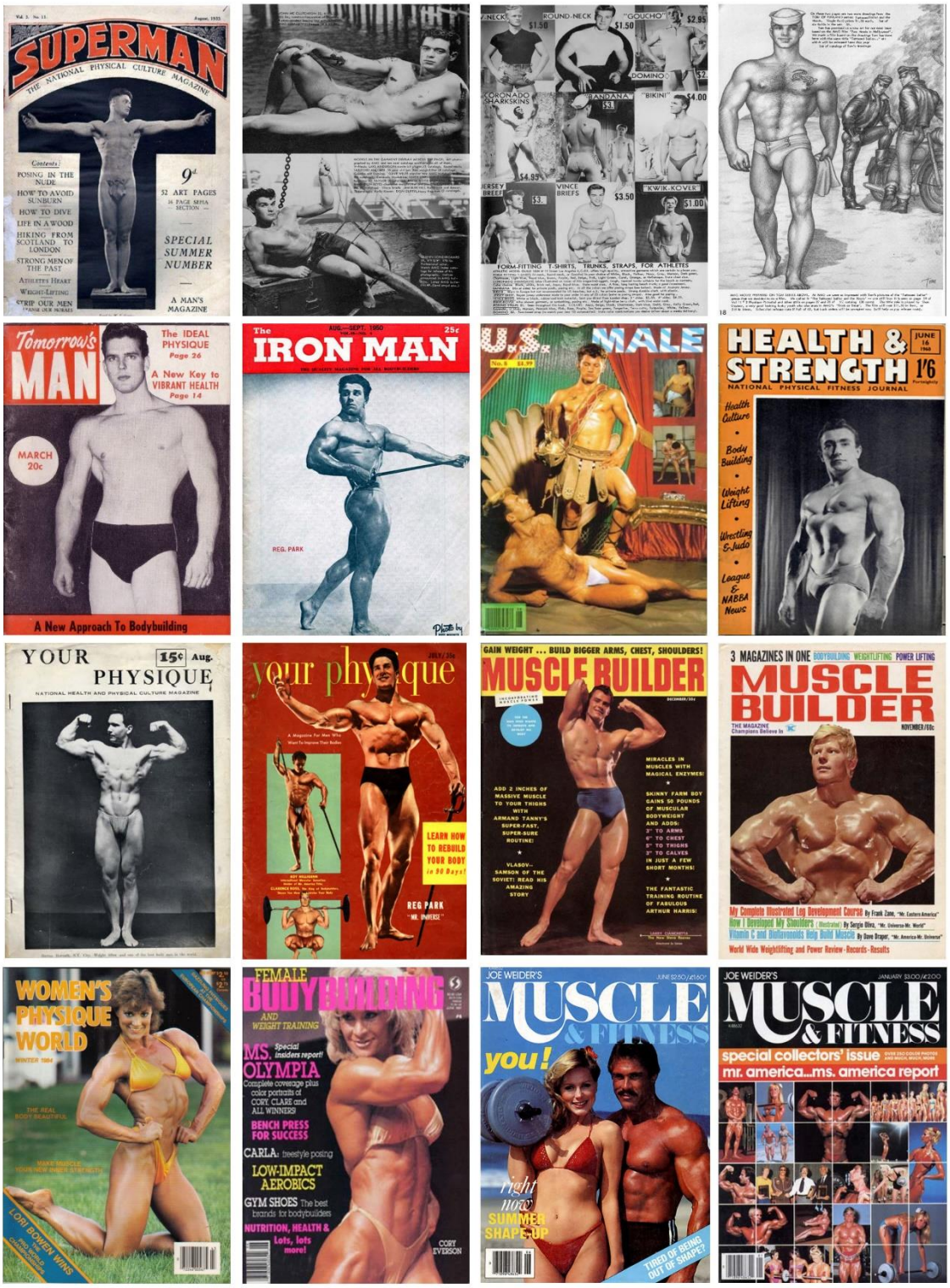
*Terms for the Three Months, Two Lessons Weekly:—*
TEN GUINEAS.
*PRIVATE LESSONS BY ARRANGEMENT.*
EUGEN SANDOW.



From the left: Title page from Strength and How to Obtain It (1897). From Sandow's Magazine of Physical Culture 6 (Jan-June 1901) Ad for Sandow's School of Physical Culture, from Strength and How to Obtain It (1897). Eugen Sandow, from Strength and How to Obtain It (1897). Images courtesy of the Rare Books & Special Collections, University of South Carolina (Scott, 2008).

Following the initiatives of Sandow and other pioneers such as Bernarr Macfadden (1868-1955) and Angelo Siciliano – also known as Charles Atlas (1892-1972) – muscle and fitness-related publications became increasingly popular in Europe and North America (Monteagudo, 2011). Meanwhile, publications portraying photographs of nude muscular models known as the 'beefcake' magazines – such as Tomorrow's Man, US Male and Superman – became landmarks of male gay imagery (D. K. Johnson, 2010; Mizer, 2016), as seen in Figure 16.

Figure 16: Early muscle and beefcake magazines




From the top left: Superman (1935); artwork from Physique Pictorial (1962); page from Physique Pictorial (1955); idem; Tomorrow's Man (1953); Iron Man (1950); U.S. Male (196?); Health & Strength (1960); Your Physique (1940); Your Physique (1952); Muscle Builder (1960); Muscle Builder (1967); Women's Physique World (1984); Female Bodybuilding (1987); Muscle & Fitness (1980); Muscle & Fitness (1981); (Fogarty, n.d.).

In parallel to the popularisation of AAS use amongst competitive bodybuilders in the second half of the 20th Century, these publications raised awareness about the possibilities of body enhancement achievable with the use of AAS (Pope, Phillips, et al., 2000a). Besides popularising bodybuilding in popular culture, muscle magazines were – and some still are – important source of information about exercise, fitness equipment, fashion, lifestyle and IPEDs, contributing to the normalisation of ultra-muscular bodies in Western societies and the creation of a group identity amongst people pursuing enhanced physiques (Murray et al., 2016; Pope, Phillips, et al., 2000a; Woolf et al., 2014). Despite the display of muscular physiques probably unachievable without the use of AAS (Pope, Phillips, et al., 2000a), most publications refrain from supporting the use of AAS or offering practical guidance on how to use the substances. Some early muscle and fitness magazines portrayed articles about the risks and adverse effects of AAS whilst advertising ergogenic substances and supplements, a trend still seen in current publications (see Figure 17). Nevertheless, muscle and fitness magazines became important sources of knowledge about several aspects of many AAS users' lifestyle – such as effective strength-training routines, functional diets, and ergogenic supplements – as well as the media for a thriving market of health and fitness products (Stern, 2008). The portraying of hyper-muscular physiques whilst publicly disapproving the use of AAS can be associated with the illegal nature of these substances in many countries, as well as by the general notion that even if not illegal, the use of AAS is harmful and morally wrong (Andreasson & Johansson, 2019; Fink et al., 2019). The advertisement of a body-enhancement lifestyle without endorsing the use of AAS can also be explained by a 'code of silence' established between AAS users (Richardson & Antonopoulos, 2019). According to this tacit agreement, the role of muscle magazines it to offer a legitimate

media for other subjects related to body-enhancement, whilst reinforcing a sense of community amongst people pursuing an enhanced physique.

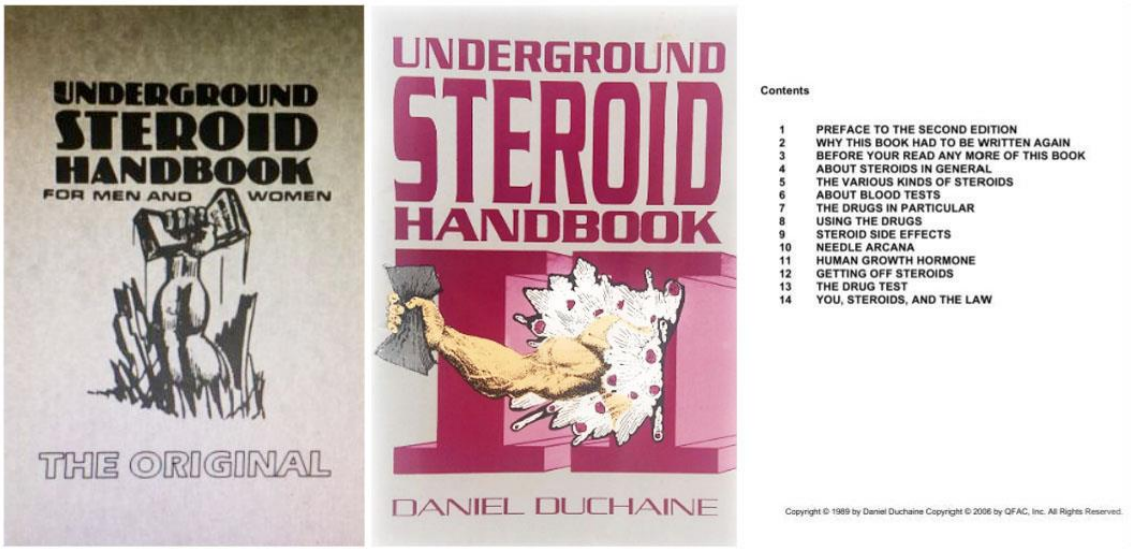
Figure 17: AAS and ergogenic substances in muscle and fitness magazines


From the left: Muscle & Fitness (1984); advertisement in Muscle & Fitness (1988); Natural Bodybuilding & Fitness (2006); Muscle Insider (2016).

### 4.2.2 The Underground Handbook and other books about AAS

Since the 1980's, guidance for using AAS and preventing adverse effects became openly available to the public. The publishing of Daniel Duchene's The *Original Underground Handbook of Anabolic Steroids for Men and Women* (Duchaine, 1981) is considered the first structured informal source of AAS-related information and a catalyst of AAS use amongst the general population (Kanayama & Pope, 2018) – see Figure 18.

Figure 18: The Underground Steroid Handbook




Cover of The Original Underground Steroid Handbook (Duchaine, 1981); cover and table of contents of the Underground Steroid Handbook's second edition (Duchaine, 1992).

In the words of its author, the Underground Steroid Handbook (USH) was an amateur publication that achieved unexpected success with thousands of people worldwide:

> [The original USH] was essentially a 'how to' course on steroids, written over a two week period under the influence of a megadose of Testosterone Cypionate. […] The USH crammed 18 pages with tiny, almost impossible to read type and tried to touch all the bases about the real-world use of anabolic/androgenic steroids as I know it then, in 1982. The pamphlet was easy to understand by the average athlete, combining medical research, anecdotal information, personal

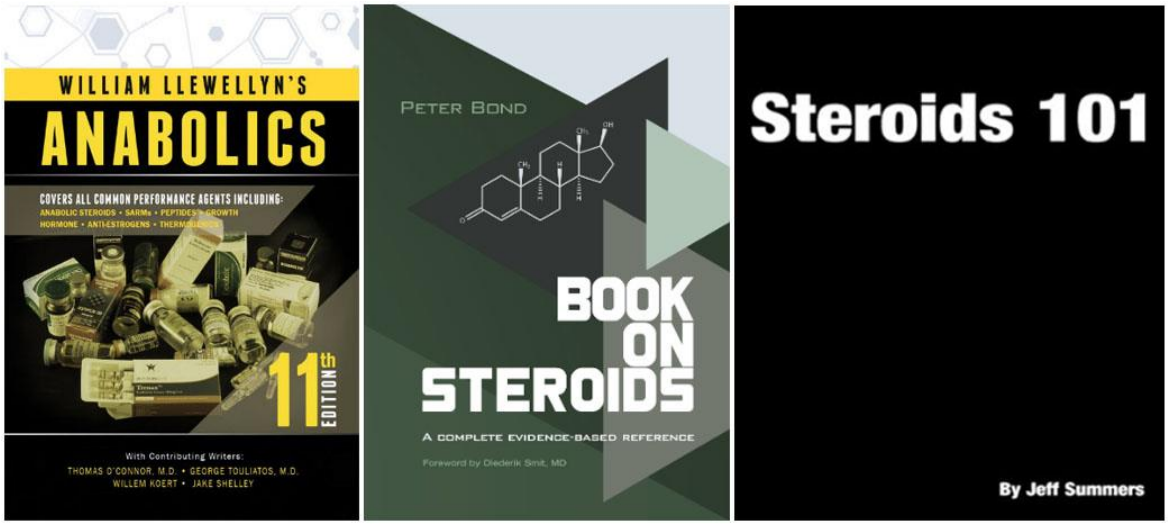
> experiences, and instinctive hypotheses, interspaced with cartoons in extremely poor taste. […] The book wasn't copyrighted and it was easy to photocopy. It was sold by direct mail order through specialty magazines and most of the magazines pulled the ad out as soon as it was apparent that the book was advocating drug use. […] I must have sold at least 40,000 copies over the years. […] It has been rewritten and passed around in France, Germany, Holland, and Sweden, along with bootleg copies sold mail order in two British bodybuilding magazines (Duchaine, 1992).

Described as an 'heroic initiative to reveal the truth about AAS' (Duchaine, 1992), the USH exemplifies the sharing of first-hand experience about AAS that is valued by people using the substances, as opposed to theoretical sources of information (Coomber et al., 2014; Fincoeur et al., 2015; van de Ven & Mulrooney, 2017):

> It could be an understatement to say that I have done exhaustive research on real world steroid use. For six years, I've gone up and down all 12 floors of UCLA [University of California, Los Angeles] Medical Library. I've interviewed hundreds of athletes, both male and female, from all over the world. I've queried and debated doctors and pharmacists. I've interviewed steroid dealers. I became a steroid dealer. I've been a consultant on designer steroid projects, their bottles, labels, even the shape of their tablets. I've been arrested, put in jail. I guess I know every minor authority on steroids, and have dealt with every major black market dealer. I go where no doctor or researcher ever goes: to the real world (Duchaine, 1992).

Since the publication of the USH, many other books providing guidance on the use of AAS and management of adverse effects were published, such as William Llewellyn's *Anabolics*, currently on its 11th edition (Llewellyn, 2017), Peter Bond's *Book on Steroids* (Bond, 2020) and Jeff Summer's *Steroids 101* (Summers, 2003), as shown in Figure 19.

Figure 19: Books containing guidance about the use of AAS




Covers of Anabolics (Llewellyn, 2017), Book on Steroids (Bond, 2020), and Steroids 101 (Summers, 2003).

Along scientific papers and other publications, books about the use of AAS provide theoretical support with different degrees of reliability for self-conduct research and experimentation by people using AAS. As highlighted by Kimergård & McVeigh (2014):

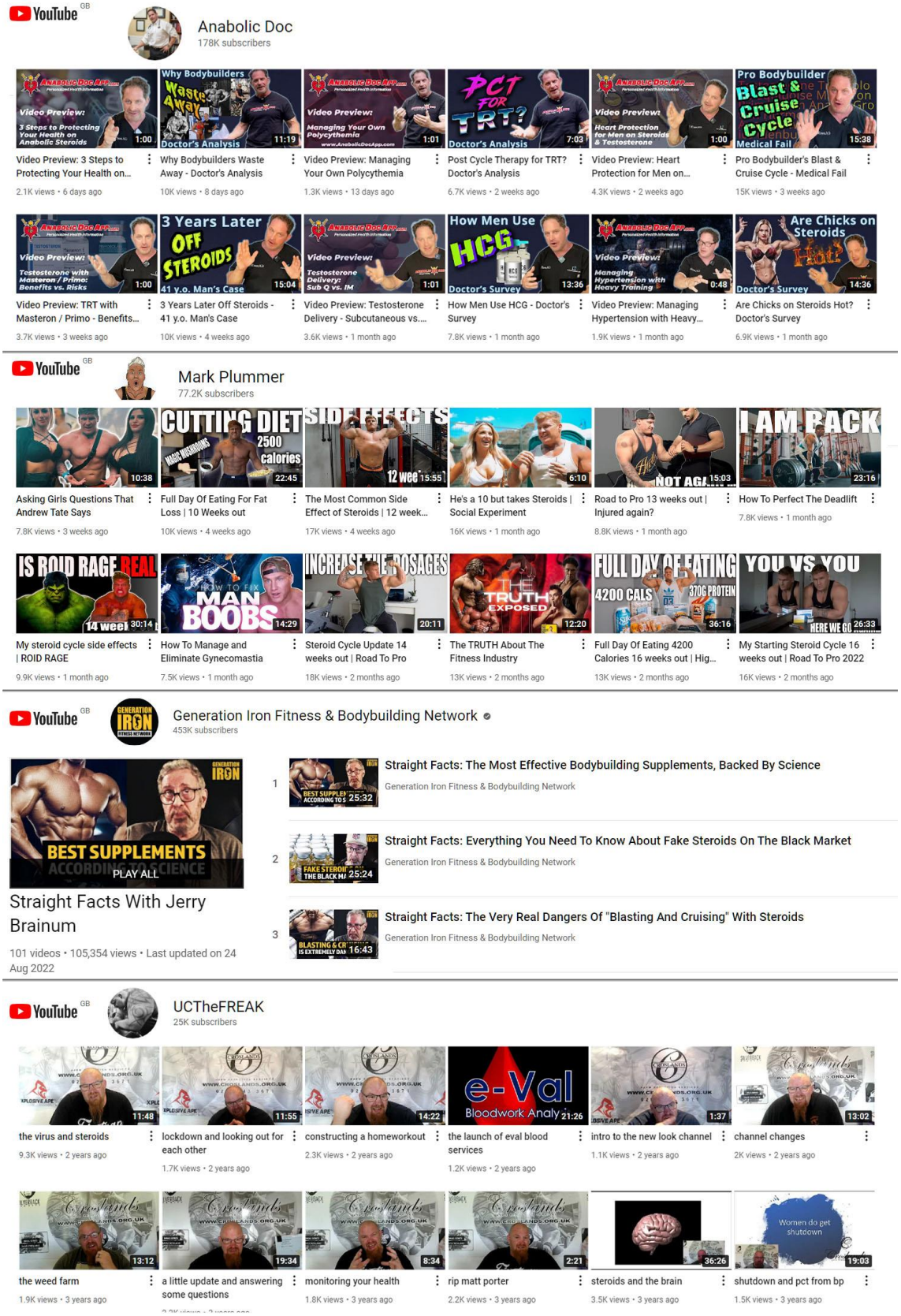
> The widely accepted anabolic steroid 'knowledge base', passed on from user to user, is largely derived from informal self-experimentations, along with users' interpretations of the 'literature' which, in many cases, was restricted to anecdotes and peer accounts of their respective self-experimentation. In instances where robust scientific evidence was considered this was normally via a third party's interpretation of findings. Here scientific studies, including animal or in vitro experiments, with limited findings can be wildly extrapolated

or findings 'cherry-picked' to support existing beliefs or rationalise perceived effects (Kimergård & McVeigh, 2014).

### 4.2.3 Websites and online AAS shops

By the end of the year 2000, 34% of households in the UK had home access to the internet (ONS, 2020). Nowadays, as up to 91% of adults in Great Britain goes online daily (ONS, 2020), the internet has become the main source of health-related information for millions of people (Zimmerman & Shaw, 2020). Similarly, many people using AAS make intensive use of online resources such as medical databases, video and social media platforms and online forums to buy and sell AAS, research and share information about AAS routines and strategies to prevent and treat adverse effects (Tighe et al., 2017). In addition to the factors stimulating online seeking of health-related data by the general population – such as immediacy, interactivity, accessibility, diversity of resources and sharing of individual experiences (Morahan-Martin, 2004) – online platforms offer the anonymity and transregional access to products and information that is frequently valued by users and providers of illegal substances (Belenko et al., 2009; van de Ven & Koenraadt, 2017). Examples of accessible online resources about AAS can be found in the YouTube video platform, where a large quantity of videos illustrate the different approaches about the drugs – see Figure 20. As suggested by Hassan (2008; as cited in Kimergård & McVeigh, 2014), the sheer volume of multiple sources of information may compromise the critical appraisal of these sources, making it difficult to assess the quality and trustworthiness of their information.

Figure 20: Examples of YouTube channels about AAS




Anabolic Doc (O'Connor, 2022); The Mark Plummer (Plummer, 2022); Straight Facts With Jerry Brainum (Brainum, 2022); UCTTheFREAK (Croslands, 2022). Adapted from YouTube.com.

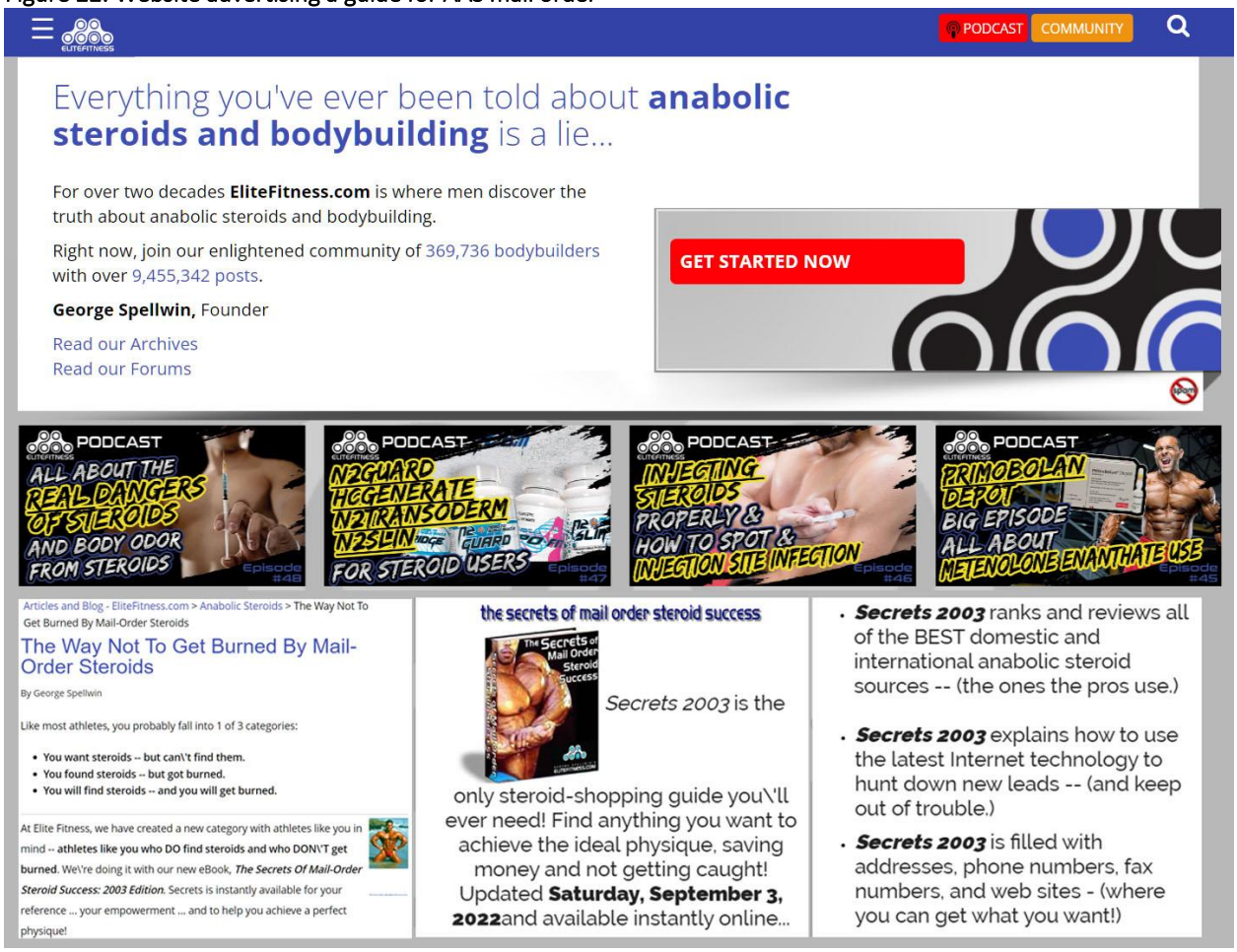
In addition to information, the internet – via websites and social media platforms – is also a major source for the commerce of drugs, including AAS (EMCDDA, 2016). Websites selling AAS frequently advertise their products as online pharmacies or bodybuilding supplement stores. There seems to be a great variability in the quality of the service provided by online sources of AAS, including 'ghost websites' that simply fail to deliver the advertised products (Cordaro et al., 2011; van de Ven & Koenraadt, 2017). Some examples of websites advertising AAS for sale are shown in Figure 21.

Figure 21: Examples of websites advertising the commerce of AAS


Adapted from Best Steroids London (2022) and Roid Shop (2022).

Illustrating the challenge of identifying reliable sources of substances and information online, one website sells a guide entitled *The Secrets of Mail Order Steroid Success*, as seen in Figure 22.

Figure 22: Website advertising a guide for AAS mail order



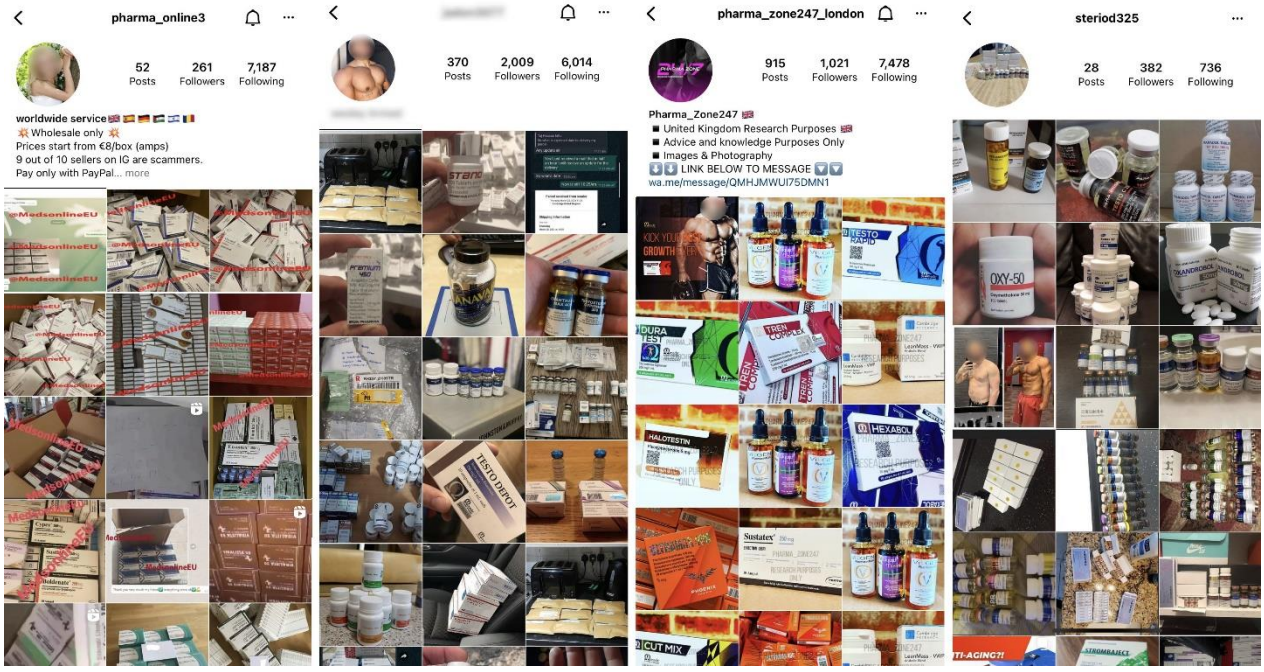

Adapted from Elite Fitness (2022).

Some online providers of AAS seem to establish support networks with their customers, advising them about the acquisition and use of the substances:

> Generally, I maintain good contact with my clients. I frequently receive all kinds of medical questions, like whether they can combine some pills with other medicines, in case of a disease or when they use other medicines for example. Some of the clients even keep me updated on their weight loss and inform me about their experiences (van de Ven & Koenraadt, 2017).

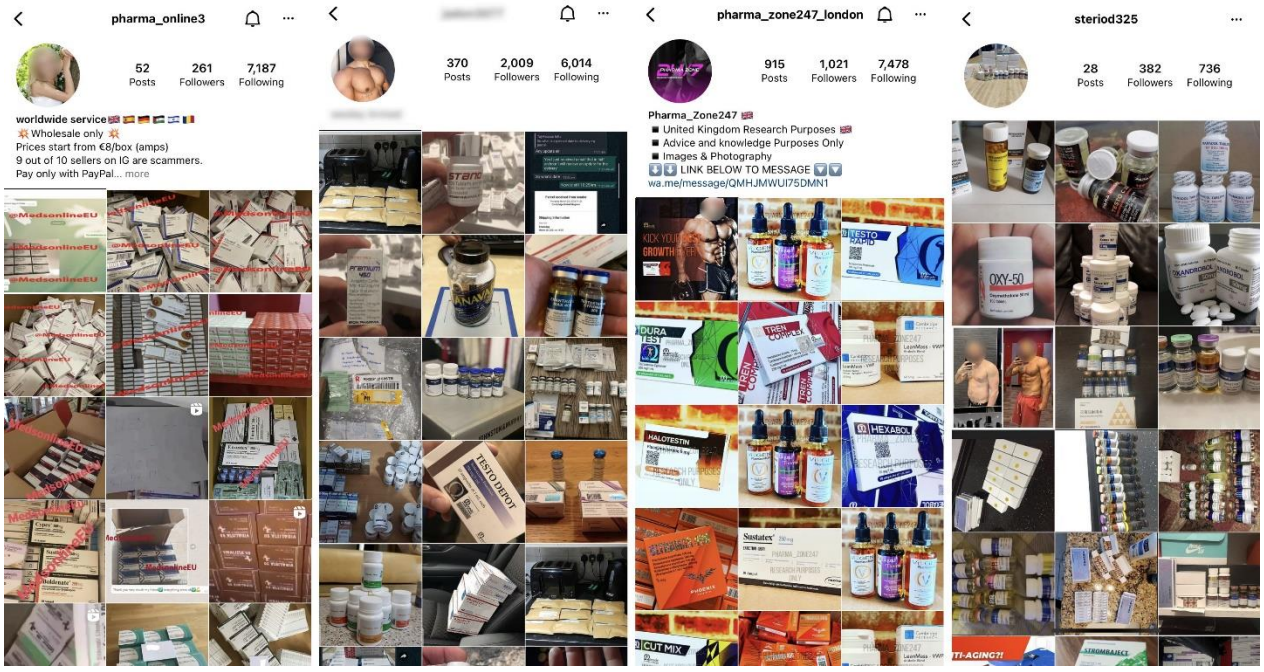
Providers of AAS, other IPEDS and ancillary drugs can also be found on social media platforms such as Instagram (Figure 23) and Telegram (Figure 24). A considerable part of the recruitment for this thesis' WP2 (online survey) was performed via Instagram, as discussed in chapter 7.

Figure 23: Instagram profiles advertising the commerce of AAS




Adapted from Instagram©. Personal profiles and faces were blurred to protect the users' privacy.

Figure 24: Telegram groups advertising the commerce of AAS




Adapted from Telegram©. Personal profiles and faces were blurred to protect the users' privacy

### 4.2.4 Social media, social capital and fitspiration

The relationship between the use of AAS and social media goes far beyond the access and advertisement of substances and coaching. It can be argued that image-focused social media platforms such as Instagram, Facebook and Snapchat represent nowadays a major source of social capital for recreational users of AAS and other body-enhancement drugs, particularly amongst young adults, adolescents and pre-teenagers (Cataldo et al., 2021). The social capital is represented by resources tied to relationships and membership in a specific group, which serve as credentials, sources of leverage and can ultimately be translated into primary (economic) capital (Bourdieu, 1986).

> The reproduction of social capital presupposes an unceasing effort of sociability (…) This work is not profitable or even conceivable unless one invests in it a specific competence and an acquired disposition to acquire and maintain this competence, which are themselves integral parts of this capital (Bourdieu, 1986).

For AAS users using social media platforms, this competence is mainly acquired by sharing images of body enhancement achievements, which warrant external validation in the form of 'likes/followers' that increased their representativeness in the community of users and give legitimacy to their advice on physical training and use of IPEDs (Tighe et al., 2017; Underwood, 2017).

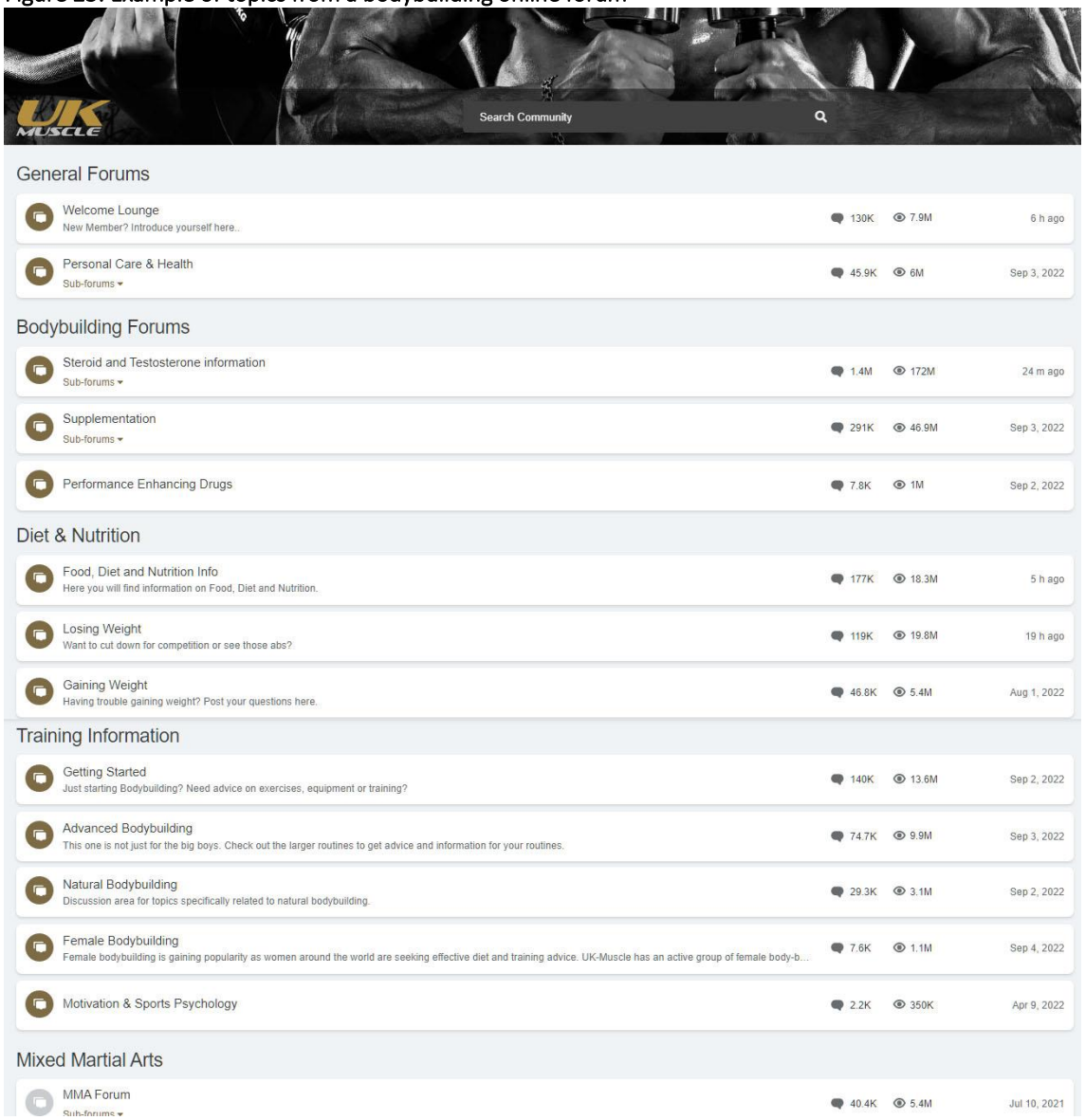
> [The 'like' button] is an instant endorphin rush. It's a pat on the back, it's approval you aren't getting elsewhere, it's validation that what you are doing is right. Everyone likes that, and anyone who says otherwise is a liar (A. Richardson et al., 2019).

The relationship between social media platforms and the use of AAS has also been studied from the perspective of 'fitspiration' and the risks of deleterious effects associated with excessive exposure to this form of remote social interaction. Fitspiration – the combination of fitness and inspiration – is a category of Instagram content (i.e., hashtags represented by the symbol #) consisting of images designed to motivate people to exercise and adopt fitness-related lifestyles (Tiggemann & Zaccardo, 2018). Although fitspiration can include positive messages supporting the pursue of healthier habits, the prolonged engagement with this type of content has been associated with decreased body satisfaction and increased negative mood (Carrotte et al., 2017), as well as exercise addiction, use of AAS and other IPEDs, eating disorders and appearance-related anxiety (Cataldo et al., 2021). As highlighted by Corazza et al. (2019) the increased access to IPEDs and comparison with peers (non-celebrities, whose body image is perceived as necessarily achievable) in social media can lead to a growing objectification of the body and exercise addiction. Studies performed during the COVID-19 pandemic observed an association between appearance anxiety, the excessive engagement with image-focused social media and the consumption of AAS and other IPEDs (Dores et al., 2021; Shibata et al., 2021). In that context, the relentless pursue of unrealistic standards of beauty and strength – aggravated by the use of AAS – might increase the risks of deleterious effects (Boursier et al., 2020; Mooney et al., 2017), namely amongst the majority of young adults and adolescents who make daily use of social media platforms (Blackstone & Herrmann, 2018).

### 4.2.5 Online forums

Online forums are landmarks of Web 2.0, a concept coined by DiNucci (1999) to define websites emphasising user-generated content, in contrast to more static websites created in the early years of internet. The Web 2.0 websites and platforms are considered a watershed in the history of mass media, allowing ordinary people to produce and disseminate content and bypass legitimation instances such as newspapers, scientific papers, book publishers, music labels, etc. (Atkinson et al., 2012). The decentralisation of authority and negotiation of trust amongst their members are essential features of online forums, namely those dedicated to illegal or stigmatised activities such as the use of AAS (Bilgrei, 2018). The pioneering use of AAS and production of knowledge about these substances amongst bodybuilding athletes led to the establishment – and continued importance – of bodybuilding online forums as sources of information about AAS (Rowe et al., 2017). In these forums, the authority and trustworthiness of the members are usually earned by seniority – identified with badges such as *Premium Member*, *Gold/Platinum Member*, etc. – and images of their own enhanced physiques – as testimonies of the alleged efficacy of their knowledge (Tighe et al., 2017). The topics discussed in bodybuilding forums – such as IPEDs routines and adverse effects, interpretation of test results, exercise and dietary routines, relationship issues, sports, etc. (see Figure 25) – illustrate the diversity of aspects involved in a body-enhancement lifestyle, in which the role of AAS can have different and transitory degrees of importance for each of its members (Andreasson & Johansson, 2016).

Figure 25: Example of topics from a bodybuilding online forum




Adapted from UK Muscle (2022).

The online forums can be seen as a virtual counterpart that helps understand the dynamics of AAS users' community of practice (CofP; Eckert & McConnell-Ginet, 1992; as cited by Andreasson & Johansson, 2016):

> An aggregate of people who come together around mutual engagement in an endeavour. Ways of doing things, ways of talking, beliefs, values, power relations – in short, practices – emerge in the course of this mutual endeavour. As a social

> construct, a CofP is different from the traditional community, primarily because it is defined simultaneously by its membership and by the practice in which that membership engages.

Members of the AAS' CofP are expected to adopt certain behaviours and observe hierarchies within the group, contributing to the internal cohesion and exclusion of discordant elements from the community (Andreasson & Johansson, 2016; Bilgrei, 2018). Furthermore, the nature of online interactions enable members of the bodybuilding forums to create virtual identities in some degree independent of their physical ones. Those identities allow members to talk freely about illegal and/or stigmatised activities, learn to navigate the dynamics of the CofP, build social recognition and status within the community, and create the basis for an alternative lifestyle experienced in both the virtual and physical worlds (Giles, 2006). As observed by Andreasson & Johansson (2016):

> [This CofP legitimates and normalises a lifestyle in which] the goal of transforming the body into something else, something perfect, could take precedence over other goals. In this process of transformation of the body through drug use practices, the distinctions between safe and unsafe, legal and illegal, healthy and unhealthy, and shameless and shameful can be partially destabilised or renegotiated.

People seeking and sharing knowledge about AAS in online forums can have different motivations for training and using IPEDs, distinct values and social interests. The diversity of subpopulations with a common interest in body enhancement – such as bodybuilders, adolescents, women, gay and transgender men, and occupational users –

is enabled by the virtual environment and the anonymity of the digital persona (Maycock & Howat, 2007). Furthermore, as the online CofP transcends geographical, ethnical, gender and age limits, it allows the sharing of information amongst individuals and groups which otherwise might never have the chance to meet. Nevertheless, the environment created by a majority of young, heterosexual and frequently misogynous males requires those deviating from the norm to negotiate the dominant perceptions in order to participate (Underwood, 2017). Some strategies include the creation of virtual personas aligned with the dominant demographics of bodybuilding forums and having male (or fictitious male) profiles interacting on behalf of their (real or fictitious) female partners (Henning & Andreasson, 2021). Another general tendency amongst bodybuilding online forums is a bias towards minimisation of the harms of AAS and other IPEDs, whilst supporting their users' self-experimentations and commitment to body-enhancement (Andreasson & Johansson, 2016; Bilgrei, 2018; Maycock & Howat, 2007; Tighe et al., 2017). Nevertheless, many members acknowledge the limitations of their own advice and recommend users to obtain exams to monitor their health and seek the support of physicians to prevent and treat adverse health conditions, therefore reinforcing the (albeit limited and controversial) harm-reduction potential of online forums for people using AAS. As suggested by Tighe et al. (2017), online forums represent an opportunity for health professionals to understand the dynamics of AAS use and interact with people using these substances using their own, non-medical language; similarly, high-ranking members may intermediate and foster the contact between AAS users and health services, increasing the engagement of that population with formal sources of support.

### 4.2.6 AAS suppliers and coaches

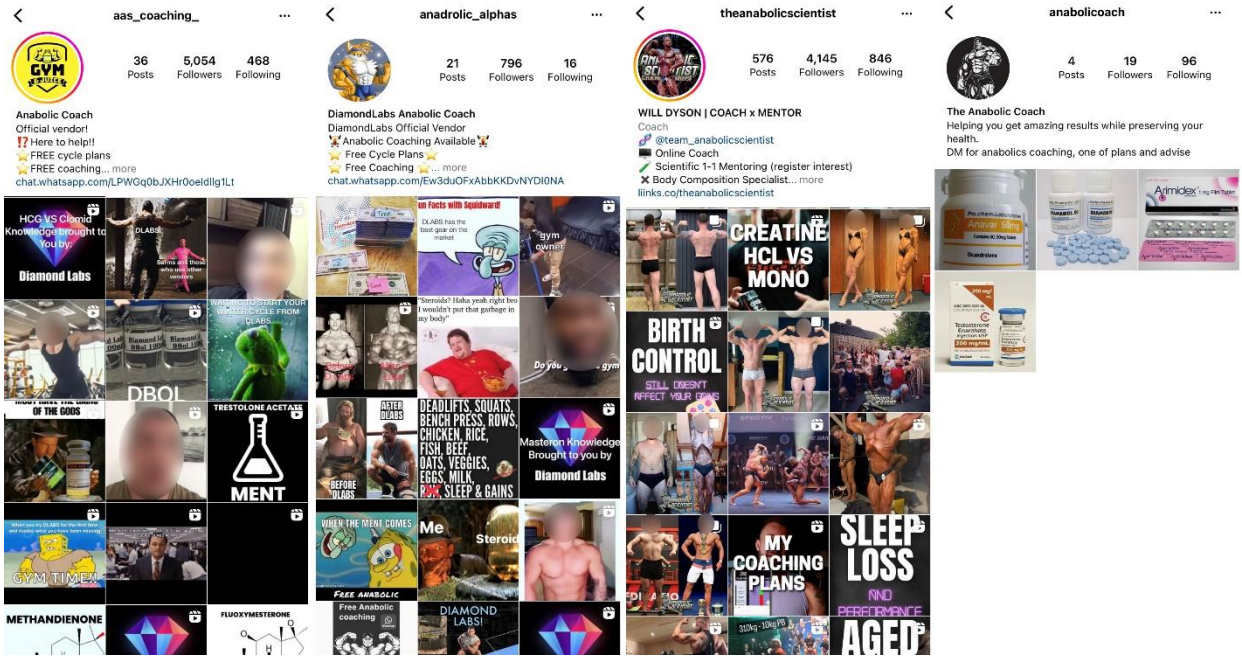
The complexity of AAS use and associated practices – a large number of different substances with different methods of administration, combinations with other IPEDs and ancillary drugs, the diversity of adverse effects, injection techniques, exercise and dietary routines, etc. – has likely contributed to a high demand for information and continuous support from AAS users (Gibbs et al., 2022). These variety of demands made to people supplying AAS might blurry the limits between dealers, coaches, 'steroid mentors' and gym buddies (Monaghan, 2002; van de Ven & Mulrooney, 2017). Therefore, suppliers are expected to have first-hand knowledge about AAS, i.e. being users or ex-users themselves, and to share their clients' values and practices (van de Ven & Mulrooney, 2017). As such, the provision of AAS requires the negotiation of trust in an environment where the use of these substances is normalised, such as some gyms and bodybuilding communities (Potter, 2009).

> At gyms you always knew one or multiple people who sell. Most people use themselves, and if approached in the right way, they are always prepared to do it [sell]. Maybe they have never sold before in their lives, but if you ask them they basically automatically drift into it [dealing IPEDs], calling it a 'service to friends'. (van de Ven & Mulrooney, 2017).

Similarly to what has been described as the establishment of health authority amongst personal trainers (Hutson, 2013), part of a AAS supplier's credibility is earned by their own appearance and physique, as being muscular is seen as a synonym of being knowledgeable – allowing the conversion of bodily capital into economic capital (van de Ven & Mulrooney, 2017).

As discussed above, the enormous flux of AAS-related information and commerce in the internet leads to virtual CofP of AAS users (Fincoeur et al., 2015) populated by suppliers and 'virtual gym buddies'. Likewise, people advertising 'AAS coaching' or 'mentoring' can be easily found on social medial platforms (Figure 26).

Figure 26: Instagram profiles advertising AAS coaching




Adapted from Instagram©. Faces were blurred to protect the users' privacy.

Several studies reported coaches as being those who recommended, first introduced people to the use of AAS and/or provided substances and support. The prevalence of users seeking coaches for AAS-related support ranges from 3.0% to 47.6%, with higher rates observed in studies published in the Middle East (Gilmore et al., 2021; Habeeb et al., 2012; Havnes et al., 2021; Larance et al., 2005; Raschka et al., 2013; Razavi et al., 2014; Stilger & Yesalis, 1999; Uddin et al., 2019).

The advertisement of AAS-coaching has become increasingly common in social media, mirroring the popularisation of online fitness lessons – namely after the COVID-19 pandemic, when the closure of gyms led to an increase of remote coaching (Gibbs et al.,

2022). AAS coaches usually offer support and guidance on the use of AAS and other IPEDs, including PCT and ancillary drugs, as part of a broad training programme or a stand-alone service. This type of service is advertised and perceived by many AAS users as a form of harm-reduction (Gibbs et al., 2022). Whilst some coaches openly advertise the commerce of AAS (see Figure 15), others deny this practice and recommend their clients not to seek advice from dealers:

> It's difficult to always put people in touch [with a reputable supplier] because a common thing you get is 'Dave down the gym says I should take this and this'. That's fine, but is Dave selling you this and this? Because if Dave's selling you this and this, he does not know what the fuck he's talking about nine times out of ten. He's probably bought it off a mate and is trying to make some money – he's trying to sell you X, Y and B, because he has not got Z (Gibbs et al., 2022).

The ethics of AAS coaching are controversial, especially when the coach is also a supplier of these drugs. These initiatives can also be seen as emic strategies of harm-reduction – i.e., based on elements belonging the CofP of AAS use, as opposed to external agents such as physicians and other health professionals (Gibbs et al., 2022). Arguably, this flourishing informal market of support for people using AAS is nourished by the disengagement of people using AAS with formal sources of healthcare (Amaral, Kimergård, et al., 2022; Hill & Waring, 2019; Kimergård & Mcveigh, 2014).

# 5. Objectives and methods

## 5.1 Aims

The primary aim of this thesis is to investigate the strategies adopted by people using AAS to prevent and treat adverse health conditions potentially associated with the use of AAS (AAS-HC). The thesis also aims to investigate the engagement of AAS users with physicians and other sources of formal and informal support, the occurrence of AAS-HC amongst AAS users in the UK, and their experiences related to AAS use.

## 5.2 Work packages and objectives

To achieve the aims described above, a mixed-methods approach was adopted, combining three interlinked work packages (WP).

### 5.2.1 WP1: Systematic review and meta-analysis

The primary objective of WP1 is to estimate the overall prevalence of AAS users seeking support from physicians. Secondary objectives are to compare this prevalence in different locations and among subpopulations of AAS users and discuss some of the factors that could have influenced the engagement of AAS users with physicians.

### 5.2.2 WP2: Online survey

The primary objective of this WP2 is to identify health-related behaviours associated with the likelihood of experiencing AAS-HC. The secondary objectives are to describe patterns of AAS use and compare the prevalence of AAS-HC and health-related strategies between subpopulations of AAS users.

### 5.2.3 WP3: In-depth interviews

The primary goal of this study is to describe and discuss the strategies adopted by a cohort of people to manage the risks associated with the use of AAS. The secondary objectives are to investigate the participants' experiences with health services and other sources of support, as well as identify opportunities for health interventions based on behavioural changes described by the participants.

## 5.3 Methods

This chapter describes the mixed-methods design of this thesis and the relationship between the three WPs. The methods of each WP are detailed in chapters 6, 7 and 8 respectively.

### 5.3.1 Theoretical framework

This research's investigation of unprescribed use of AAS is mainly based on the risk environment framework, as defined by Rhodes (2002) and detailed in item 1.4. Under this perspective, the use of AAS is approached as a socioecological phenomenon, where users negotiate the risks of obtaining and using these drugs in a multi-layered social environment of factors enabling and preventing the use of these drugs (Bates, Tod, et al., 2019; Rhodes, 2009). Secondarily, the research is informed by the biopsychosocial model of disease (Engel, 1981), the normalisation of recreational drug use (Parker et al., 2002) and the system theory (Von Bertalanfy, 1968). The biopsychosocial approach to AAS use is exemplified by the first four chapters of this thesis, in which the interaction of epidemiology, pharmacology, pathophysiology and social networks of formal and informal sources of support are used to describe the risks of AAS use and strategies adopted to manage them. The concept of normalisation permeates this exploration of

the risk environment of AAS use, as demonstrated in chapters 1 and 4 and explored in the qualitative study described in chapter 8. Currently in the UK, AAS use takes place in a society committed with social inclusion (Parker et al., 2002) and harm-reduction policies towards drug use (Stimson, 1995), amidst the growing popularisation of hyper-muscular physiques in entertainment, social media, work environments and other aspects of everyday life. Finally, system theory (Von Bertalanfy, 1968) is used to expand the concept of risk environment to an open global system formed by trans-regional and multi-dimensional levels of influence co-created by its agents and affecting individual decisions of drug use and risk management.

### 5.3.2 The mixed methods approach

The three WP of this thesis were developed with the purpose of investigate different aspects of the strategies adopted by AAS users to manage the risks of AAS use. These WPs were used to investigate the use of AAS from a broader perspective (WP1, a systematic review of studies performed in different times and locations) towards regional and individual analyses of AAS use in the UK (WP2 – a national-wide online survey, and WP3 – in-depth interviews). This approach benefits from the strengths of quantitative and qualitative methods of research (Johnson & Onwuegbuzie, 2004; Kelle, 2006) and capitalises on the synergy of subsequent analysis, as the findings and resources of each WP supported the next, contributing for a higher analytic density and integration of data (Fielding, 2012).

### 5.3.3 WP1: Systematic review and meta-analysis

As discussed in the first chapters of this thesis, people using AAS frequently report concerns regarding their engagement with formal sources of support and the health

system (Havnes et al., 2019; Kimergård & Mcveigh, 2014; van de Ven et al., 2018). Although many authors explored the engagement of AAS users with physicians (Dawson, 2001; Hill & Waring, 2019; Pope et al., 2004), no study to has estimated the prevalence of AAS users who seek support from medical doctors. To estimate this prevalence, the variations of prevalence rates amongst locations and subgroups of AAS users, and identify factors potentially involved in the results, a systematic review and meta-analysis of surveys with AAS users was performed as the first WP of this research. The study was published in the journal BMP Open (Amaral, Kimergård, et al., 2022) and can be found in Chapter 6.

As defined by Lasserson et al. (2022), a systematic review attempts to assemble all the empirical evidence regarding a research question, according to pre-specified eligibility criteria. This type of study can also highlight other gaps in the knowledge of the research topic and identify previous attempts to address similar questions, assuring the originality and necessity of a new study in the field (Macleod et al., 2014; Oxman & Guyatt, 1993). Furthermore, running a systematic review of the literature at the beginning of this research project had the benefits of building a database of surveys investigating the health behaviours of AAS users and signpost relevant topics addressed in the following WPs. A meta-analysis was performed after the systematic review to estimate the overall prevalence the investigated behaviour weighted by the sample size of the selected studies (Israel & Richter, 2011). As detailed in Chapter 6, the number of AAS users seeking medical support in each study was used to calculate effect size, and subgroup analysis estimated the prevalence of that behaviour in different locations and amongst subpopulations of AAS users. The study was registered on PROSPERO

(CRD42020177919), and as a review of the literature, it was exempt from ethical approval by King's College London Research Ethics Office.

### 5.3.4 WP2: Online survey

Based on the historical and trans-regional database built on WP1, an online survey was produced to investigate the current use of AAS in the UK. This approach is commonly used to reach a large and geographically dispersed population of AAS users (Bonnecaze et al., 2020; Cohen et al., 2007; Wellman, 1997a; Westerman et al., 2016). In addition, the large number of online communities related to bodybuilding and AAS in the UK (Andreasson & Johansson, 2016; Griffiths et al., 2018; Tighe et al., 2017) supported the decision of using an online survey in this study. Furthermore, this research was conducted during the social-distancing and travel-restriction measures taking place in the UK in response to the COVID-19 pandemic, making it unfeasible to physically reach its target population in a sensible timeframe. As detailed in chapter 7, the survey covered the following domains: (i) Demographics; (ii) use of AAS and other IPEDs; (iii) AAS-HC experienced in the last 12 months; (iv) preventive strategies; (v) sources of AAS-related information; (vi) strategies to treat AAS-HC. Ethical approval for the online survey and the in-depth interviews was obtained from King's College London Psychiatry, Nursing and Midwifery Research Ethics Subcommittee (Reference HR-20/21-22034).

### 5.3.5 WP3: In-depth interviews

Following the conclusion of WP2, in-depth interviews were performed to investigate the strategies adopted to prevent, treat and minimise harms associated with the use of AAS. The actions involved in this dynamic process of identifying, monitoring and controlling

risk are known as risk-management strategies (RMS; Wolke, 2017). Data from WP2 was used to identify and select AAS users willing to take part in the interviews, as well as to indicate risk factors associated with AAS and RMS that should be addressed in semi-structured interviews. As detailed in chapter 8, the interviews were composed of five domains: (i) The participants' first use of AAS; (ii) how the participants identify and prevent harm associated with the use of AAS; (iii) their engagement with the health system and informal sources of support; (iv) impact of the consequences of the COVID-19 pandemic in their use of AAS and RMS; (v) how to improve the support provided by people using AAS in the UK. All the interviews were performed online using Microsoft Teams, which also provided an automated transcript of each interview.

# 6. WP1 - Prevalence of anabolic steroid users seeking support from physicians: a systematic review and meta-analysis

This chapter contains the published version of WP1, a systematic review and meta-analysis estimating the prevalence of AAS users seeking support from physicians. The authour of this thesis was the first authour of the paper and responsible for planning the study and conducting the meta-analysis. Independent selection of studies and assessment of risk of bias were performed in collaboration with the second supervisor and co-author, Dr Andreas Kimergård. The first authour, Dr Kimergård and the first supervisor, Dr Paolo Deluca, reviewed and approved the final draft.

BMJ Open

# Prevalence of anabolic steroid users seeking support from physicians: a systematic review and meta-analysis

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## ABSTRACT

**Objectives** To estimate the overall prevalence of androgenic-anabolic steroids (AAS) users seeking support from physicians. Secondary objectives are to compare this prevalence in different locations and among subpopulations of AAS users, and to discuss some of the factors that could have influenced the engagement of AAS users with physicians.

**Design** Systematic review and meta-analysis.

**Data sources** MEDLINE, PsycINFO, Web of Science and SciELO were searched in January 2022.

**Eligibility criteria** Quantitative and qualitative studies reporting the number of AAS users who sought support from physicians, with no restrictions of language or time of publication.

**Data extraction and synthesis** Two independent reviewers extracted data and assessed the quality of studies, including publication bias. A random-effects meta-analysis was performed to estimate the overall prevalence of AAS users seeking support from physicians, followed by pooled prevalence rates by studies' location and the subpopulation of AAS users.

**Results** We identified 36 studies published between 1988 and 2021, involving 10 101 AAS users. The estimated overall prevalence of AAS users seeking support from physicians is 37.12% (95% CI 29.71% to 44.52%). Higher prevalence rates were observed in studies from Australia (67.27%; 95% CI 42.29% to 87.25%) and among clients of the needle and syringe exchange programme (54.13%; 95% CI 36.41% to 71.84%). The lowest prevalence was observed among adolescent AAS users (17.27%; 95% CI 4.80% to 29.74%).

**Conclusion** Our findings suggest that about one-third of AAS users seek support from physicians, with remarkable differences between locations and subpopulations of AAS users. Further studies should investigate the factors influencing the engagement of AAS users with physicians.

**PROSPERO registration number** CRD42020177919.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This review analyses 36 studies published between 1988 and 2021, involving 10 101 androgenic-anabolic steroids (AAS) users.
⇒ It compares the pooled prevalence rates of AAS seeking support from physicians between different locations and subpopulations of AAS users.
⇒ The R codes used in the meta-analysis and meta-regression are available in supplementary files, allowing quick reproducibility of the study.
⇒ Our results are based on studies from a small number of countries, with a limited representativeness of the subpopulations of AAS users.

## INTRODUCTION

Anabolic-androgenic steroids (AAS) are synthetic androgens with several potential effects. In clinical settings, AAS can be used to treat conditions such as male hypogonadism, pathological loss of muscle mass and anaemia,[1] with findings suggesting their efficacy in the treatment of depression[2] and conditions associated with type 2 diabetes.[3] Beneficial effects of AAS include the increasing of muscle mass, feelings of well-being and boosted energy, enhancement of body image and improvement of athletic and occupational performance.[4 5] However, the use of AAS can increase the risk of several adverse health conditions such as acne, testicular atrophy, gynecomastia, clitoromegaly, hypomania, anxiety, dyslipidaemia and high haematocrit—therefore, increasing the risk of myocardial infarction and stroke.[6] Despite the risks, many AAS users refrain from seeking physicians for AAS-related information or to treat health conditions potentially associated with the use of AAS.[7] Among factors possibly influencing the prevalence of AAS seeking support from physicians are the legal status of AAS, AAS users' engagement with health services and their perceptions of the services provided by physicians to people using AAS.[8] In countries where the possession of AAS without a medical prescription is illegal, it is reasonable to expect that some AAS users will refrain from disclosing the use of AAS to a physician.[9] The legal status of AAS can also influence the service provided to AAS users by physicians, as doctors are usually not allowed to prescribe AAS for the purposes of enhancement or to regulate hormonal levels after the use of AAS, a practice also known as postcycle therapy.[10] While physicians are trained to

treat the use of other illegal substances such as heroin and cocaine, many of them admit a lack of training and experience in recognising and treating adverse effects of AAS.[11–14] Another reason given by some AAS users to refrain from seeking medical support is the stigma and judgmental attitudes experienced in their contact with health professionals.[13 15] Due to these factors—and possibly others, such as the provision of health services in their locality, financial limitations, etc—some AAS users rely on self-conducted research to manage their use and adverse effects of AAS and/or seek the support of informal sources such as friends and online forums.[16 17] Finally, some AAS users reported not seeking physicians simply because they did not feel the need to do so, due to an absence of adverse effects or to a perception that these effects can be managed without the help of a medical professional.[13]

In addition to the legal status of AAS use and the access to health services in different countries, different help-seeking behaviours are seen across subpopulations of AAS users.[18] Younger AAS users, for instance, seem to be less likely to engage with health services.[19] Some strength athletes tend to rely on other athletes, who are perceived as knowledgeable about AAS,[20–22] while AAS users who are clients of the needle and syringe exchange programme (NSP) seem to be more likely to interact with health services.[23 24] However, to this date, no systematic comparison of the prevalence of AAS users seeking the support of physicians has been produced.

The objective of this study is to estimate the overall prevalence of AAS users seeking support from physicians by conducting a systematic review and meta-analysis of surveys and interviews with AAS users. The secondary objectives are to compare the prevalence of AAS users seeking support from physicians in different locations and among subpopulations of AAS users and discuss some of the factors that could have influenced their engagement with physicians' support.

## METHODS

### Overview

This systematic review and meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[25] As a review of the literature, this study is exempted from ethical clearance by King's College London research ethics office.

### Search strategy and selection criteria

A search strategy was designed to retrieve studies describing surveys and interviews with people using AAS. Searches were performed on MEDLINE, PsycINFO, Web of Science and SciELO in January 2022 with no restrictions on the date, location and language of studies. The search algorithm adapted to each database can be found in online supplemental material etable 1. A online supplemental search was performed on the reference lists of eligible studies. Two independent researchers (JMXA and AK) performed the screening, data extraction and assessed the risk of bias. Disagreements were resolved by discussion with the third researcher (PD).

Results of the searches were exported to Rayyan QCRI[26] for screening and removing of duplicates. Titles, abstracts and the full text of studies were screened for eligibility against our inclusion and exclusion criteria (table 1). A spreadsheet was used to summarise descriptive data of selected studies, that is, location of study, subpopulation of AAS users, the number of participants, number and gender of AAS users, and the number of AAS (nAAS) users who sought support from physicians.

### Risk of bias assessment

The risk of bias was assessed in two stages. Initially, the quality and internal validity of studies were evaluated

**Table 1** Inclusion and exclusion criteria

| Inclusion criteria | Exclusion criteria |
|---|---|
| Quantitative and qualitative studies with people using AAS for the purposes of image and performance enhancement. | Studies with patients using AAS for the treatment of medical conditions.<br>Studies with prisoners, who have limited access to external health services.<br>Studies with animal subjects and in vitro analysis of AAS' effects. |
| Studies informing the no of AAS users seeking physicians to receive information and prevent and treat AAS-related health conditions.<br>Studies where the source of support or information can be understood as being a physician (eg, doctor, medical doctor, health professional). | Studies not informing the no of AAS users in the sample who seek support from physicians.<br>Studies where the contact with the physician cannot be understood as the participant's choice, such as involuntary admissions, postmortem analysis and cohorts of patients selected for studies of specific health conditions. |
| Peer-reviewed studies.<br>Studies published at any time.<br>Studies published in any language, as long as it is possible to retrieve relevant data from the authors or articles. | 'Grey literature' (non-peer-reviewed studies and reports).<br>Case studies and interviews with a single AAS user. |

AAS, androgenic-anabolic steroids.

using the Mixed Methods Appraisal Tool (MMAT).[27] The MMAT is composed of five quality-assessment criteria : (1) Is the sampling strategy relevant to address the research question?; (2) Is the sample representative of the target population?; (3) Are the measurements appropriate?; (4) Is the risk of nonresponse bias low? and (5) Is the statistical analysis appropriate to answer the research question?. For the purposes of this review, studies with more than two negative or unknown responses to MMAT's assessment criteria were considered to have high risk of bias. In the second stage, studies were assessed for risk of publication bias. The risk of publication bias was assessed by visual inspection of asymetry in a funnel plot,[28] Egger's test for asymmetry[29] and a rank correlation test.[30]

### Data synthesis

The data synthesis for meta-analysis was performed extracting the nAAS users who reported seeking any kind of support from physicians in the selected studies. For the purpose of effect size calculations, the nAAS users in each study was used as the number of participants of interest, and the number of those who informed seeking a physician was used as the number of cases in each study. When a study informed more than one number or percentage of AAS users seeking support from physicians, the higher value of male AAS users seeking medical support was considered, as only a few studies included female participants.

A meta-analysis was performed to estimate the overall prevalence of AAS users seeking support from physicians. A random-effects model was chosen to better incorporate the dispersions of prevalence rates across studies and the different approaches to the research question.[31] Heterogeneity was measured using the $I^2$ index, which describes the percentage of variation of prevalence rates across a group of studies that is due to differences between studies (eg, different sample sizes, populations or methods).[32 33] A Baujat plot was produced to identify studies that could influence the overall result.[34] The secondary outcomes were measured by the prevalence rates of studies grouped by location and subpopulation of AAS users.

Univariate and multivariate meta-regressions were performed to measure the impact of study level moderators on the prevalence of AAS users seeking support from physicians. Based on the variables used by Sagoe *et al*,[35] four moderators were hypothesised to have an impact on the prevalence of AAS users seeking support from physicians (location of studies, subpopulation of AAS users, time of publication and study design). Additionally, two other moderators commonly used in prevalence studies[36 37] were included post hoc (sample size and risk of bias). The selection and coding of moderators followed consensus procedures. The time of publication was categorised as before and after the year 2000, as we hypothesised that the availability of the internet and on-line support communities of AAS users[16]—could impact the prevalence of AAS users seeking support from physicians. Risk of bias was categorised according to the number of negative or unknown responses to MMAT's assessment criteria.[27] For each moderator variable, the category with the highest number of studies was used as reference, and dummy variables were automatically generated. Statistically significant ($p<0.05$) variables were entered into a multivariable model. The meta-analysis and meta-regression were conducted in R[38] using the metaphor package.[39] A full description of the codes and a dataset with the coded variables can be found in online supplemental material.

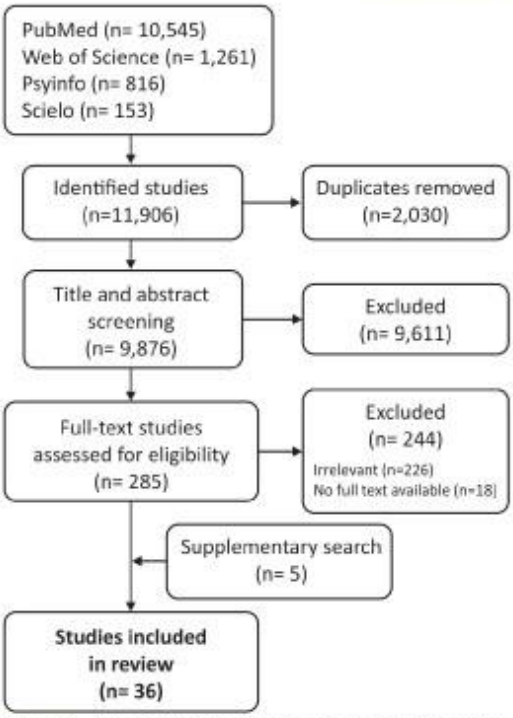


**Figure 1** Flow chart of the inclusion of studies in the review.

### Patient and public involvement

It was not appropriate to involve patients or the public in the design, conduct, reporting or dissemination plans of this study.

## RESULTS

The searches identified 11 906 studies. After the removal of duplicates, 9876 studies were screened by title and abstract. Among 285 full-text studies were assessed for eligibility, 31 were included in the review. A supplementary search on the reference list of included papers and previous reviews led to the inclusion of another five studies. A total of 36 studies were included in the review, as shown in the flow chart of figure 1.

Table 2 Summary characteristics of selected studies

| Authors, year | Location | Subpopulation | n | nAAS | nPhys n (%) |
|---|---|---|---|---|---|
| Yesalis *et al*[78] 1988 | USA | Strength athletes | 45 | 15 M | 8 (53.33) |
| Johnson *et al*[76] 1989 | USA | Adolescents | 853 | 95 M | 28 (29.47) |
| Kisling *et al*[77] 1989 | Denmark | Non-specific | 157 | 85 M | 21 (24.71) |
| Lindström *et al*[78] 1990 | Sweden | Strength athletes | 138 | 138 M | 12 (8.70) |
| Terney and McLain[67] 1990 | USA | Adolescents | 2113 | 94 (67 M/27 F) | 5 (5.32) |
| Tanner *et al*[69] 1995 | USA | Adolescents | 6930 | 184 (139 M/45 F) | 33 (17.93) |
| Korkia and Stimson[79] 1997 | UK | Non-specific | 1667 | 110 (97 M/13 F) | 39 (35.45) |
| Bolding *et al*[80] 1999 | UK | Non-specific | 1004 | 81 M | 25 (30.86) |
| Augé and Augé [43] 1999 | USA | Strength athletes | 17 | 17 (14 M/3 F) | 8 (47.05) |
| Peters *et al*[81] 1999 | Australia | Non-specific | 100 | 100 (94 M/6 F) | 42 (42.00) |
| Perry *et al*[82] 2005 | USA | Strength athletes | 207 | 207* | 46 (22.22) |
| Parkinson and Evans[83] 2005 | Trans-region | Non-specific | 500 | 500 (494 M/6 F) | 185 (37.00) |
| Pope *et al*[7] 2004 | USA | Strength athletes | 80 | 43 M | 16 (37.21) |
| Striegel *et al*[56] 2006 | Germany | Non-specific | 621 | 84 (75 M/9 F) | 47 (55.95) |
| Cohen *et al*[84] 2007 | USA | Non-specific | 1955 | 1955 M | 1290 (65.98) |
| Al-Falasi *et al*[85] 2008 | UAE | Non-specific | 154 | 34 M | 4 (11.76) |
| Larance *et al*[86] 2008 | Australia | Non-specific | 60 | 60 M | 46 (76.66) |
| Posiadała *et al*[87] 2010 | Poland | Non-specific | 50 | 18 M | 2 (11.11) |
| Gradidge *et al*[87] 2011 | South Africa | Adolescents | 100 | 4 M | 1 (25.00) |
| Ip *et al*[88] 2011 | Trans-region | Non-specific | 1277 | 506 M | 387 (76.48) |
| Santos *et al*[89] 2011 | Brazil | Strength athletes | 123 | 41 M | 4 (9.76) |
| Hope *et al*[23] 2013 | UK | NSP clients | 395 | 395 M | 178 (45.06) |
| Raschka *et al*[65] 2013 | Germany | Non-specific | 484 | 79 (62 M/ 17 F) | 30 (37.97) |
| Rowe *et al*[62] 2016 | Australia | NSP clients | 605 | 605 M | 382 (63.14) |
| Westerman *et al*[90] 2016 | Transregion | Non-specific | 231 | 231 M | 153 (66.23) |
| Mooney *et al*[91] 2017 | UK | Non-specific | 377 | 26* | 1 (3.85) |
| Zahnow *et al*[19] 2017 | Transregion | Non-specific | 195 | 195* | 68 (34.87) |
| Althobiti *et al*[92] 2018 | Saudi Arabia | Non-specific | 4860 | 476 M | 181 (38.00) |
| Hill and Waring[13] 2019 | UK | Strength athletes | 350 | 216* | 91 (42.00) |
| Jacka *et al*[41] 2019 | Australia | Non-specific | 267 | 267 M | 237 (88.76) |
| Macedo *et al*[93] 2019 | Brazil | Non-specific | 40 | 25 M | 9 (36.00) |
| Pany *et al*[94] 2019 | India | Strength athletes | 74 | 74 M | 24 (32.43) |
| Pereira *et al*[95] 2019 | Brazil | Non-specific | 719 | 194 (149 M/45 F) | 117 (60.31) |
| Uddin *et al*[40] 2019 | Pakistan | Non-specific | 841 | 512 M | 9 (1.76) |
| Bonnecaze *et al*[72] 2020 | Transregion | Non-specific | 2385 | 2385 M | 1047 (43.90) |
| Jokipalo and Khudayarov[96] 2021 | Finland | Strength athletes | 50 | 50 (42 M/8 F) | 15 (30.0) |

*Sex of AAS users not informed.
AAS, androgenic-anabolic steroids; F, females; M, males; nAAS, number of AAS users in each study; nPhys, number of AAS users who informed seeking support from physicians; NSP, needle and syringe exchange programme.

Table 2 shows the summary characteristics of the studies included in this review. The studies were published between 1988 and 2021, with a total nAAS users (nAAS)=10 101, being 9278 (91.85%) males, 179 (1.77%) females and 644 (6.38%) whose sex was not reported. Eight of the selected studies were located in the USA (nAAS=2610; 25.84%), six in continental Europe (nAAS=454; 4.49%), five in the UK (nAAS=828; 8.20%), four in Australia (nAAS=1032; 10.22%), three in Brazil (nAAS=260; 2.57%), five in Africa, Asia or the Middle East (nAAS=1110; 10.89%) and

five studies were trans-regional (nAAS=3817; 37.79%). The selected studies presented a wide range of nAAS (median=97.50; range=4–2385) and nAAS users seeking support from physicians (nPhy; median=31.50; range=1–1290). Regarding the subpopulation of AAS users, the most common were studies with non-specific AAS users such as gym users and recreational athletes (21 studies, nAAS=7923; 78.44%), followed by studies with strength athletes such as bodybuilders, powerlifters or weightlifters (9 studies, nAAS=801; 7.93%), studies with adolescents (4 studies, nAAS=377; 3.73%) and studies with NSP clients (2 studies, nAAS=1000; 9.90%).

A large proportion of studies with adolescents (three out of four) and strength athletes (four out of nine) were located in the USA, followed by a single study from different countries. The two studies with NSP clients were located either in the UK or Australia. All the five transregional studies were conducted with a non-specific subpopulation of AAS users.

### Risk of bias

According to the MMAT quality criteria, only seven (19.44%) studies did not present a risk of bias. The following number of studies had a negative or unknown response to MMAT assessment: Inappropriate or unclear sampling strategy (n=0); sample representativeness low or unclear (n=10; 27.78%); inappropriate or unclear measurements (n=14; 38.89%); high or unclear risk of nonresponse bias (n=19; 52.77%) and inappropriate or unclear statistical analysis (n=2; 5.56%). The main cause of inappropriate or unclear measurements in some studies was the fact that the nAAS seeking support from physicians was not clearly stated, requiring an extrapolation from the total number of participants. Ultimately, 12 studies (33.33%) were considered to have a high risk of bias (2 or more negative or unknown response to MMAT criteria). A full assessment of risk of bias can be found in online supplemental material etable 2. There was no evidence of publication bias, as indicated by visual inspection of the funnel plot (figure 2), Egger's test for asymmetry (bias coefficient=0.937, p=0.349, 95% CI 0.49 to 0.45), and a rank correlation test (τ=−0.086, p=0.4731).

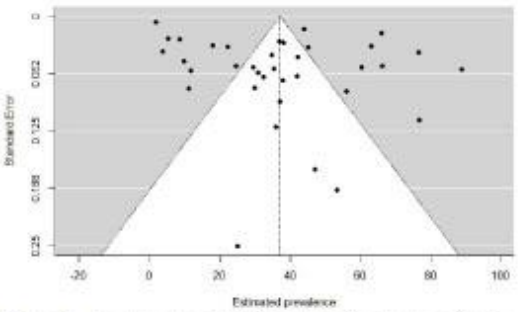


Figure 2 Funnel plot of studies included in the analysis with pseudo 95% CI.

### Meta-analysis of the overall prevalence of AAS users seeking support from physicians

The overall prevalence of AAS users seeking support from physicians obtained from 36 studies is 37.12% (95% CI 27.71% to 44.52%). The smallest prevalence rate (1.76%; 95% CI 0.61% to 2.91%; nAAS=512) was observed in a study with gym users in Pakistan.[40] The highest prevalence rate (88.76%, 95% CI 77.46% to 100.06%; nAAS=267) was reported in a study with non-specific AAS users in Australia.[41] Figure 3 shows a forest plot of prevalence rates, ordered by the effect sizes of all studies.

### Meta-analysis of prevalence rates of studies grouped by location

When grouped by the location of studies, the highest prevalence of AAS users seeking support from physicians was seen among studies taking place in Australia (67.27%; 95% CI 47.29% to 87.25%), followed by trans-regional studies (51.48%; 95% CI 35.26% to 67.71%). The lowest prevalence of AAS users seeking support from physicians was seen in studies located in Africa, Asia or Middle East (21.02%; 95% CI 5.26% to 36.79%). A forest plot of the prevalence rates of studies grouped by location is shown in figure 4.

### Meta-analysis of prevalence rates of studies grouped by subpopulation of AAS users

The highest prevalence of AAS users seeking support from physicians was seen among studies with NSP clients (54.13%; 95% CI 36.41% to 71.84%), followed by studies with non-specific AAS users (41.67%; 95% CI 31.23% to 52.12%) and studies with strength athletes (27.83%; 95% CI 17.97% to 37.69%). The lowest prevalence of AAS users seeking support from physicians was seen in studies with adolescents (17.27%; 95% CI 4.80% to 29.74%). A forest plot of the prevalence rates of studies grouped by subpopulation of AAS users is shown in figure 5.

### Meta-regression exploring the variability in the prevalence of AAS users seeking support from physicians

The results of the meta-regression analyses are shown in table 3. Univariable analyses showed that the prevalence of AAS users seeking support from physicians was significantly higher among studies located in Australia (β=0.35, 95% CI 0.11 to 0.58, p=0.005) and in studies utilising an online survey for data collection (β=0.19, 95% CI 0.04 to 0.34, p=0.014). These two variables were therefore eligible for inclusion in the multivariable regression analysis. An overall multivariable model with the variables was statistically significant ($\chi^2$ (8)=20.25, p=0.009). Only studies located in Australia (β=0.33, 95% CI 0.09 to 0.57, p=0.007) remained a significant predictor of the prevalence of AAS users seeking support from physicians, suggesting that the prevalence of this behaviour is higher in Australia compared with other studies' locations.

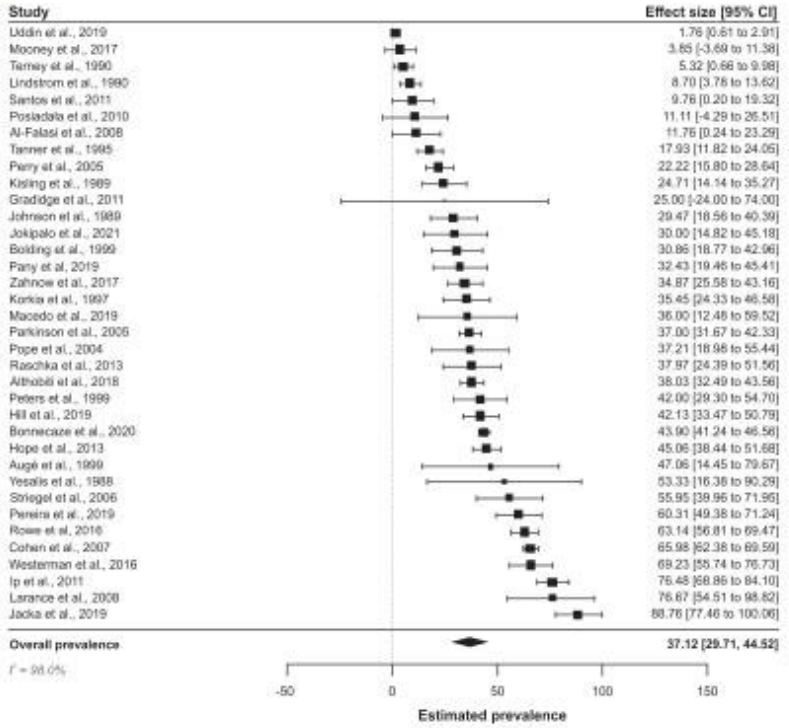


**Figure 3** Forest plot of the pooled prevalence of AAS users seeking support from physicians. AAS, androgenic-anabolic steroids.

## DISCUSSION

We conducted a systematic review and meta-analysis and pooled data from 36 studies to estimate that the overall prevalence of AAS users seeking support from physicians is 37.12%. Higher prevalence rates of AAS users seeking support from physicians were seen among studies located in Australia (67.27%) and studies with NSP clients (54.13%). Lower prevalence rates were seen among studies located in Africa, Asia or the Middle East (21.02%) and studies with adolescents (17.27%). One of the general factors possibly influencing the prevalence of AAS users seeking support from physicians is the fact that men, who represent the majority of AAS users,[35] are generally less likely to seek medical support[42] —a tendency corroborated by the only two studies comparing the prevalence of male and female AAS users seeking support from physicians.[19 43] Other potential factors include the legal status of AAS use,[9] the engagement of AAS users with health services,[8] AAS users' perceptions of the service provided by physicians[7 24 44] and the stigma experienced by AAS users.[13 15 45]

Our findings suggest that the legal status of AAS use is not always associated with AAS users' engagement with physicians' support. For example, studies located in Australia—where the possession of AAS is illegal[46]—showed the highest pooled prevalence of AAS users seeking support from physicians (51.13%). Besides, the estimated prevalence of AAS users seeking support from physicians in the US (32.91%)—where the possession of AAS is considered a federal crime[47]—was similar to the estimated prevalence in the UK (31.43%) and Brazil (35.23%), where the use and possession of AAS are not illegal.[48 49] Likewise, a low prevalence of AAS users seeking support from physicians was seen in studies from countries in Africa, Asia or the Middle East (21.02%), where anecdotal reports suggest loose enforcement of the prohibition of AAS use[50–53] or, in the case of India, where there are no laws regulating the use and commerce of AAS.[54] Two studies from German showed prevalence rates of AAS users seeking support from physicians of 37.97%[55] and 55.95%,[56] while a single study from Poland reported a prevalence of 11.11%,[57] despite the use of AAS not being illegal in both countries—unless, in the case of Germany, if AAS are used for the purpose of doping in sport competitions.[58 59] Nevertheless, the legal status of AAS use could have influenced the small prevalence of AAS users seeking support from physicians (8.70%) seen in a single study from Denmark, where the use of AAS is not only illegal but where gym users can be subject to urinalysis to screen for the use of AAS.[60] Therefore, it is

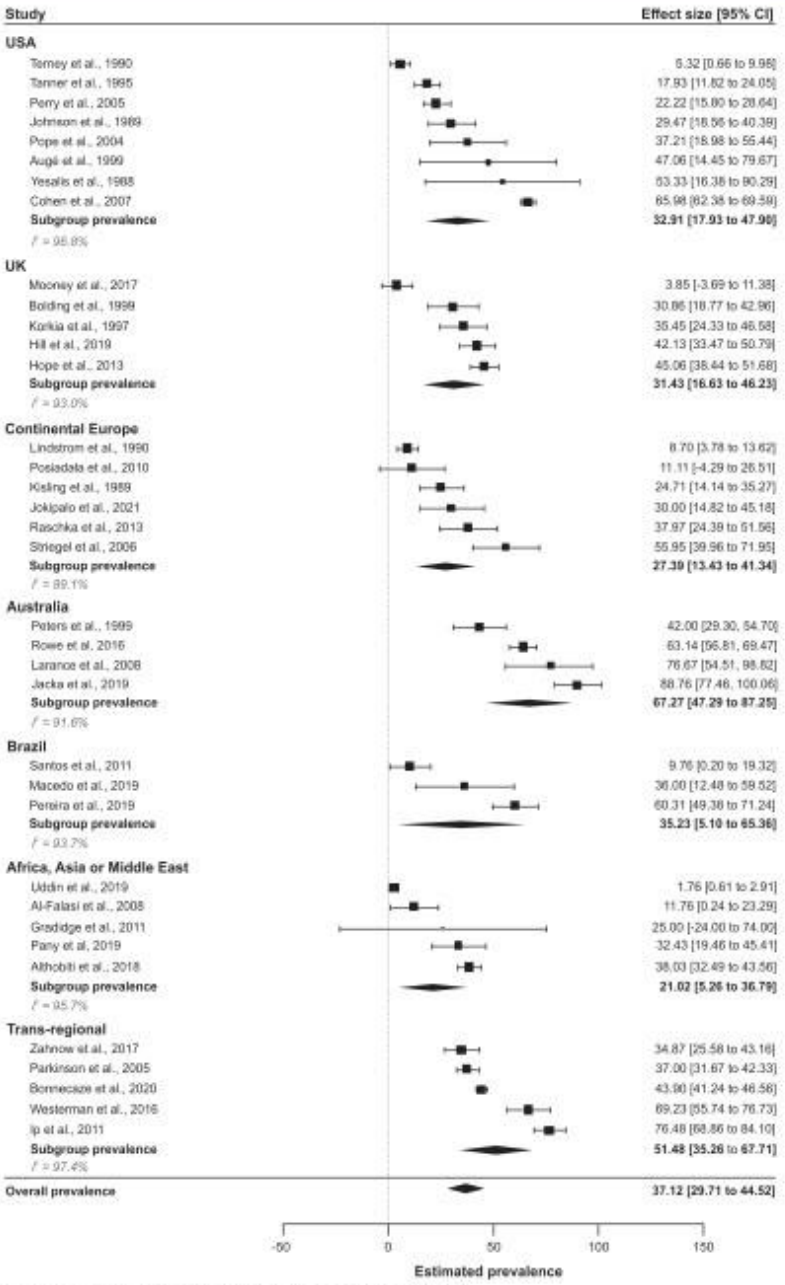


**Figure 4** Forest plot of prevalence rates of studies, grouped by location.

reasonable to assume that the existence of laws regulating the use of AAS might have an impact on the engagement of some AAS users with physicians' support, but their relevance is possibly influenced by other variables, such as the actual enforcement of regulations and cultural factors involving individuals' help-seeking behaviours.

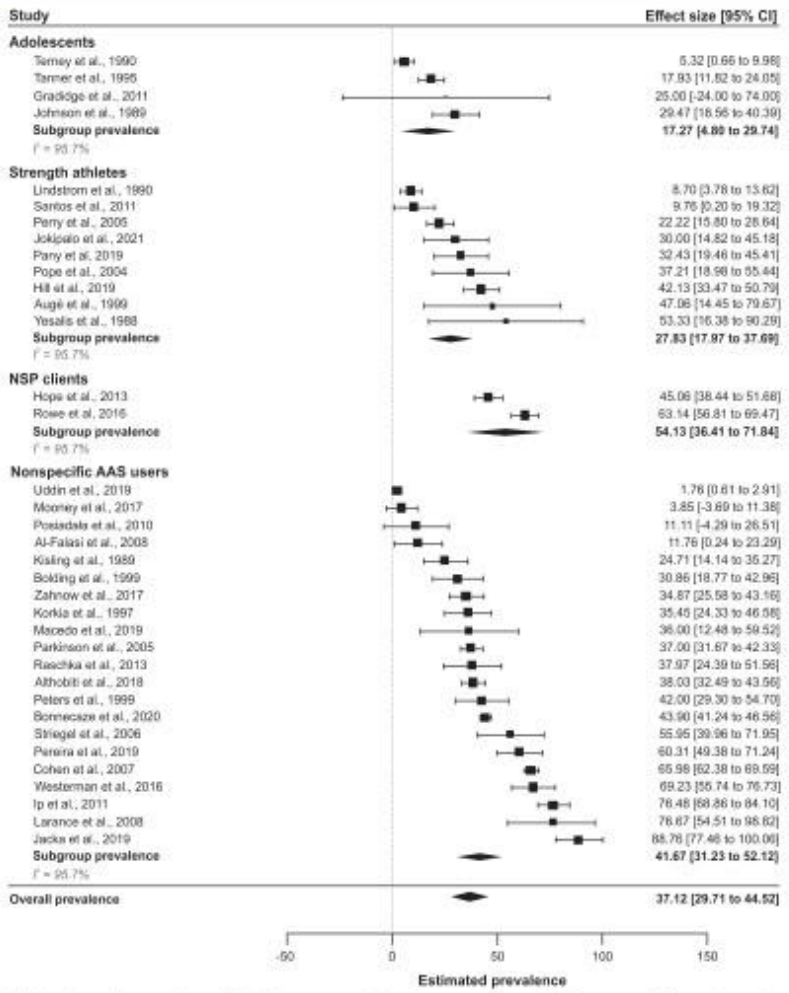


**Figure 5** Forest plot of prevalence rates of studies, grouped by subpopulation of AAS users. AAS, androgenic-anabolic steroids; NSP, needle and syringe exchange programme

Other factors might have influenced the prevalence of AAS users seeking support from physicians across the locations analysed by this study. In Australia, for example, there seems to be an active effort to educate physicians about the management of the non-prescribed use of AAS[61] which could reflect a willingness to discuss AAS use with the medical community. Although data from Australia was based on a small number of studies, results of the multivariate meta-regression analysis showed that the prevalence rate of studies published in Australia was the only variable with a statistically significant impact on the overall prevalence of AAS users seeking support from physicians estimated by this study.

The engagement of AAS users with health services could have influenced the comparatively high prevalence (54.13%) of AAS users seeking support from physicians seen among clients of the NSP—namely those assessing NSP services that provide information about injection practices and adverse effects of AAS.[23 62] Among NSP clients, those seeking support from physicians are more likely to have diagnostic screening for health conditions potentially associated with the use of AAS—despite some NSP clients considering physicians a less reliable source of information about AAS than NSP workers.[62] Despite the growing numbers of AAS users seeking the NSP, only a minority of primary NSP units offer specialised advice

Table 3 Univariable and multivariable predictors of the prevalence of AAS users seeking support from physicians (N=36)

| | | Univariable | | Multivariable | |
|---|---|---|---|---|---|
| Variable | N | Regression coefficient (95% CI) | SE | Regression coefficient (95% CI) | SE |
| Location | | | | | |
| USA | 8 | 1 | – | 1 | – |
| UK | 5 | −0.01 (−0.23 to 0.21) | 0.11 | −0.02 (−0.24 to 0.21) | 0.12 |
| Continental Europe | 6 | −0.05 (−0.26 to 0.16) | 0.11 | −0.02 (−0.24 to 0.19) | 0.11 |
| Australia | 4 | 0.35 (0.11 to 0.58)* | 0.12 | 0.33 (0.09 to 0.57)* | 0.12 |
| Brazil | 3 | 0.02 (−0.24 to 0.29) | 0.14 | 0.07 (−0.20 to 0.34) | 0.14 |
| Africa, Asia or Middle East | 5 | −0.12 (−0.34 to 0.11) | 0.12 | −0.07 (−0.30 to 0.17) | 0.12 |
| Transregional | 5 | 0.19 (−0.03 to 0.40) | 0.11 | 0.11 (−0.17 to 0.38) | 0.14 |
| Subpopulation | | | | | |
| Non-specific AAS users | 21 | 1 | – | | |
| Adolescents | 4 | −0.23 (−0.47 to 0.01) | 0.12 | | |
| Strength athletes | 9 | −0.12 (−0.29 to 0.05) | 0.09 | | |
| NSP clients | 2 | 0.13 (−0.18 to 0.43) | 0.15 | | |
| Sample size | | | | | |
| Small (<100) | 18 | 1 | – | | |
| Medium (>100, <1000) | 16 | 0.12 (−0.03 to 0.27) | 0.76 | | |
| Large (>1000) | 2 | 0.25 (−0.06 to 0.55) | 0.16 | | |
| Time of publication | | | | | |
| 2005–2021 | 26 | 1 | – | | |
| 1988–1999 | 10 | −0.13 (−0.29 to 0.03) | 0.08 | | |
| Study design | | | | | |
| Questionnaire | 33 | 1 | – | 1 | – |
| Interview | 3 | 0.24 (−0.04 to 0.52) | 0.14 | 0.14 (−0.14 to 0.42) | 0.14 |
| Online survey | 9 | 0.19 (0.04 to 0.34)† | 0.08 | 0.13 (−0.07 to 0.33) | 0.10 |
| Risk of bias | | | | | |
| Low (<2) | 24 | 1 | – | | |
| High (≥2) | 12 | −0.41 (−0.20 to 0.12) | 0.08 | | |

*P<0.01
†P<0.05.
AAS, androgenic-anabolic steroids; NSP, needle and syringe exchange programme.

about AAS.[63] Besides, the majority of people using injectable drugs access the NSP via retail pharmacies, where the services are frequently limited to the exchange of injectable material.[64]

The lower pooled prevalence of AAS users seeking support from physicians was seen among adolescents (17.27%). Although low rates of engagement with health services are seen among adolescents in general,[65] some factors could have influenced an even lower prevalence of adolescent AAS users seeking support from physicians. First, the prevalence of some health conditions potentially associated with the use of AAS—such as cardiovascular disease[66]—is lower among adolescents. Second, it is possible that the illegality of AAS use has deterred adolescents from seeking physicians more than other subpopulations of AAS users. As observed by Terney and McLain,[67] physicians were allowed to prescribe AAS for enhancement purposes in the US until 1988 and were frequently reported as a source of AAS to adolescents.[67–69] As near all of the selected studies with adolescents were located in the US, it is possible that the criminalisation of AAS use has driven adolescent AAS users further away from seeking the support of physicians.

Among strength athletes who use AAS, we estimated a prevalence of seeking support from physicians of 27.83%. Strength athletes who use AAS have been described as having a perception that the use of AAS can be safely managed, namely with the support of other AAS users who share their objectives, training routines and lifestyles.[20 22] The self-research and trial-and-error experiences with AAS, combined with aesthetical and performance goals frequently considered exaggerated by

people outside of the community of strength athletes[70] probably contribute to the perception that physicians are less knowledgeable about AAS than some members of this subpopulation. Furthermore, it is possible that some strength athletes are even more subject to stigma than other AAS users, due to their unusually muscular physiques or to a prejudice towards bodybuilding and other strength-related disciplines.[71]

Regarding the kind of support sought by AAS users from physicians among the 36 selected studies, 16 (44.44%) reported that AAS users sought physicians as a source of information about the use and adverse effects of AAS. The remaining studies described AAS users' contact with physicians in many different ways, such as having close contact with physicians,[56] seeking a doctor for interpretation of health checks,[18] and disclosing the use of AAS to a physician.[7 72] We considered that further exploration of the types of support sought by AAS users would lie beyond the scope of this study, as they have been recently investigated by other reviews.[17 73 74]

### Limitations of this study

The prevalence of AAS users seeking support from physicians varied widely across the selected studies, and this variation was only minimally explained by the meta-regression and the comparisons between subgroups of studies. Furthermore, the selected studies investigated and described the help-seeking behaviours of AAS users in many different ways that were synthesised as a single variable for the purpose of comparison. The pooled prevalence in different locations was based on a limited sample of highly heterogenic studies. For instance, the estimated prevalence of AAS users seeking support from physicians from Australia was based on only four studies—three with a non-specific population of AAS users and one with NSP clients—comprising 10.22% of the total nAAS users from selected studies. This review did not distinguish data from male and female AAS users, as the sex of participants or differences in help-seeking behaviour between male and female participants were not reported by the majority of studies. The review only included studies from a few countries and, among those, many contributed with a single study unable to represent the local population of AAS users. As discussed in this review, the engagement of AAS users with physicians can be influenced by several factors, including attitudes that can vary widely between locations and subpopulations of AAS users. These limitations can compromise the generalisation of our results, and further studies are necessary to better understand the help-seeking behaviours of AAS users, namely among understudied locations and subpopulations of AAS users.

### Implications for practice and policy

Available data suggest that factors such as the criminalisation of AAS use, the scarcity of physicians' knowledge about AAS and stigma against AAS users are barriers to the access of some AAS users to physicians. The results of this review can indicate locations and subpopulations of AAS users with higher engagement with physicians, so successful strategies can be replicated. Likewise, our results indicate the existence of under-studied and possibly undersupported populations of AAS users.

## CONCLUSION

This meta-analysis was the first to systematically investigate the prevalence of AAS users seeking support from physicians. Our findings suggest that the overall prevalence of AAS users seeking support from physicians is 37.12%, with considerable variation across locations and among subpopulations of AAS users. This study highlights the importance of understanding the help-seeking behaviours of AAS users and improving their access to physicians.

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**Prevalence of anabolic steroid users seeking support from physicians: a systematic review and meta-analysis**

Amaral JMX, Kimergård A, Deluca P

**SUPPLEMENTARY MATERIAL**

**eTable 1: Search algorithms**

| **PUBMED (results: 10,545)** |
|---|
| ((agents, anabolic[MeSH Terms]) OR (doping in sport[MeSH Terms]) OR (drugs, performance enhancing[MeSH Terms])) OR ((anabolic steroid*[Title/Abstract]) OR (anabolic androgenic[Title/Abstract]) OR (anabolic agent*[Title/Abstract]) OR (anabolic drug*[Title/Abstract]) OR (androgen* abuse[Title/Abstract]) OR (performance enhanc*[Title/Abstract]) OR (image enhanc*[Title/Abstract]) OR (synthetic androgen*[Title/Abstract]) OR (synthetic testosterone[Title/Abstract]) OR (testosterone ester*[Title/Abstract]) OR (designer steroid*[Title/Abstract]) OR (doping[Title/Abstract]) OR ("non prescript*" steroid*[Title/Abstract]) OR ("non medic*" steroid*[Title/Abstract]) OR ("non medic*" androgen*[Title/Abstract]) OR ("non prescript*" androgen*[Title/Abstract])) NOT ((review[Title/Abstract]) OR (animal*[Title/Abstract]) OR (bovine[Title/Abstract]) OR (in vitro[Title/Abstract]) OR (mice*[Title/Abstract]) OR (pig[Title/Abstract]) OR (pigs[Title/Abstract]) OR (rat[Title/Abstract]) OR (rats[Title/Abstract]) OR (mouse[Title/Abstract]) OR (spectrometry[Title/Abstract]) OR (nano*[Title/Abstract]) OR (conductor*[Title/Abstract]) OR (semiconductor[Title/Abstract]) OR (electro*[Title/Abstract]) OR (optic*[Title/Abstract]) OR (hydrogen[Title/Abstract]) OR (superconductor*[Title/Abstract]) OR (catalyst*[Title/Abstract]) OR (thermoelectric[Title/Abstract]) OR (ions[Title/Abstract])) AND (humans[Filter]) |
| **Web of Science (results: 1,261)** |
| ((TS=( "doping in sport" OR "performance enhancing drug*"OR "anabolic steroid*" OR "anabolic androgenic*" OR "anabolic agent*" OR "anabolic drug*")) NOT (TS=(review OR animal* OR bovine OR "in vitro" OR mice* OR pig OR pigs OR rat OR rats OR mouse OR spectrometry OR nano* OR conductor* OR semiconductor OR electro* OR optic* OR hydrogen OR superconductor* OR catalyst* OR thermoelectric OR ions))) Filters: Articles, Sport Sciences, Medicine (all), Psychology (all), Toxicology |
| **APA PsycNet (results: 816) A** |
| ((anabolic or doping or performance enhancing) not (review or animal or bovine or vitro or mice* or pig* or rat* or mouse or spectrometry or nano* or conductor* or semiconductor or electro* or optic* or hydrogen or superconductor* or catalyst* or thermoelectric or ions)).ti - limit to human |
| **Scielo (results: 153)** |
| (ti:((ti:((ti:(anabolic)) OR (ti:(doping)) OR (ti:( performance enhancing)))) AND NOT (ti:(review)))) AND NOT (ti:((ti:(animal)) AND NOT (ti:(bovine)) AND NOT (ti:(vitro)) AND NOT (ti:(mice*)) AND NOT (ti:(pig*)) AND NOT (ti:(rat*)) AND NOT (ti:(mouse)) AND NOT (ti:(spectrometry)) AND NOT (ti:(nano*)) AND NOT (ti:(conductor*)) AND NOT (ti:(semiconductor)) AND NOT (ti:(electro*)) AND NOT (ti:(optic*)) AND NOT (ti:(hydrogen)) AND NOT (ti:(superconductor*)) AND NOT (ti:(catalyst*)) AND NOT (ti:(thermoelectric)) AND NOT (ti:(ions)))) |

**eTable 2: Risk of bias**

| | Risk of bias: MMAT criteria* | | | | | |
|---|---|---|---|---|---|---|
| Authors, year | 1 | 2 | 3 | 4 | 5 | Observations |
| Yesalis et al., 1988 | Y | N | ? | Y | Y | Small sample of AAS users. Source of information described as 'Physician/pharmacist/medical literature'. |
| Johnson et al., 1989 | Y | Y | Y | Y | Y | n/a |
| Kisling et al., 1989 | Y | Y | ? | Y | Y | Nonresponse rate not informed. |
| Lindstrom et al., 1990 | Y | Y | Y | Y | N | The number of AAS users seeking a physician must be inferred from the text. |
| Terney et al., 1990 | Y | Y | N | Y | Y | The number of AAS users seeking support from physicians was extrapolated from the total number of participants. |
| Peters et al., 1993 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |
| Tanner et al., 1995 | Y | Y | N | Y | Y | The number of AAS users seeking support from physicians was extrapolated from the total number of participants. |
| Korkia et al., 1997 | Y | Y | Y | N | Y | Nonresponse rate = 41%. |
| Bolding et al., 1999 | Y | Y | ? | Y | Y | Support described as 'regular health checks to screen for steroid-related health problems'. |
| Auge et al., 1999 | Y | N | Y | ? | Y | Small sample of AAS users. Nonresponse rate not informed. |
| Perry et al., 2005 | Y | Y | N | Y | Y | The number of AAS users seeking a physician must be inferred from a graph and was extrapolated from the total number of participants. |
| Parkinson et al., 2005 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |
| Pope et al., 2004 | Y | N | Y | ? | Y | Small sample of AAS users. Nonresponse rate not informed. |
| Striegel et al., 2006 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |
| Cohen et al., 2007 | Y | Y | ? | ? | Y | Nonresponse rate not informed. Support described as 'willing to seek medical supervision'. |
| Al-Falasi et al., 2008 | Y | N | N | N | Y | Nonresponse rate = 56%. The number of AAS users seeking a physician was extrapolated from the total number of participants. |
| Larance et al., 2008 | Y | N | Y | ? | Y | Small sample of AAS users. Nonresponse rate not informed. |
| Posiadala et al., 2010 | Y | N | Y | N | ? | Small sample of AAS users. Nonresponse rate = 28.57%. |
| Gradidge et al., 2011 | Y | Y | N | Y | Y | Small sample of AAS users. The number of AAS users seeking a physician was extrapolated from the total number of participants. |
| Ip et al., 2011 | Y | Y | Y | Y | Y | n/a |
| Santos et al., 2011 | Y | N | N | ? | Y | Small sample of AAS users. Nonresponse rate not informed. The number of AAS users seeking a physician was extrapolated from the total number of participants. |
| Hope et al., 2013 | Y | Y | Y | Y | Y | n/a |
| Raschka et al., 2013 | Y | N | N | ? | Y | Small sample of AAS users. Nonresponse rate not informed. The number of AAS users seeking a physician was extrapolated from the total number of participants. |
| Mooney et al., 2016 | Y | N | N | ? | Y | Small sample of AAS users. Nonresponse rate not informed. The number of AAS users seeking a physician was extrapolated from the total number of participants. |
| Rowe et al., 2016 | Y | Y | Y | Y | Y | n/a |
| Westerman et al., 2016 | Y | Y | Y | Y | Y | n/a |
| Zahnow et al., 2017 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |
| Althobiti et al., 2018 | Y | Y | N | ? | Y | Nonresponse rate not informed. The number of AAS users seeking a physician was extrapolated from the total number of participants. |
| Hill et al., 2019 | Y | Y | Y | Y | Y | n/a |
| Jacka et al., 2019 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Macedo et al., 2019 | Y | N | Y | ? | Y | Small sample of AAS users. Nonresponse rate not informed. |
| Pany et al., 2019 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |
| Pereira et al., 2019 | Y | Y | Y | ? | Y | Nonresponse rate not informed. |
| Uddin et al., 2019 | Y | Y | N | Y | Y | The number of AAS users seeking a physician must be inferred from the text. |
| Bonnecaze et al., 2020 | Y | Y | Y | Y | Y | n/a |
| Jokipalo et al., 2021 | Y | Y | Y | Y | Y | n/a |

* MMAT's quality-assessment criteria:
1 - Is the sampling strategy relevant to address the research question?
2 - Is the sample representative of the target population?
3 - Are the measurements appropriate?
4 - Is the risk of nonresponse bias low?
5 - 'Is the statistical analysis appropriate to answer the research question?'
Y = yes. N = no. ? = not clear.

**R codes for the meta-analysis, forest plots and meta-regression**

The table below contains the dataset of the file 'metaAAS.csv'. The column 'ti' contains the number of androgenic-anabolic steroids (AAS) users in each study, and the column 'xi', the number of AAS users who sought support from physicians. The subsequent columns contain the coded variables utilised in the forest plots and meta-regression.

| study id | studies | ti | xi | locat | pop | size | time | bias | design |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Yesalis et al.,1988 | 15 | 8 | 0 | 1 | 0 | 0 | 0 | 0 |
| 2 | Johnson et al.,1989 | 95 | 28 | 0 | 0 | 0 | 0 | 1 | 0 |
| 3 | Kisling et al.,1989 | 85 | 21 | 2 | 3 | 0 | 0 | 1 | 0 |
| 4 | Lindstrom et al.,1990 | 138 | 12 | 2 | 1 | 1 | 0 | 1 | 0 |
| 5 | Tierney et al.,1990 | 94 | 5 | 0 | 0 | 0 | 0 | 1 | 0 |
| 6 | Peters et al.,1993 | 100 | 42 | 3 | 3 | 0 | 0 | 1 | 0 |
| 7 | Tanner et al.,1995 | 184 | 33 | 0 | 0 | 1 | 0 | 1 | 0 |
| 8 | Korkia et al.,1997 | 110 | 39 | 1 | 3 | 1 | 0 | 1 | 0 |
| 9 | Bolding et al.,1999 | 81 | 25 | 1 | 3 | 0 | 0 | 1 | 0 |
| 10 | Auge et al.,1999 | 17 | 8 | 0 | 1 | 0 | 0 | 0 | 1 |
| 11 | Perry et al.,2005 | 207 | 46 | 0 | 1 | 1 | 1 | 1 | 0 |
| 12 | Parkinson et al.,2005 | 500 | 185 | 6 | 3 | 1 | 1 | 1 | 2 |
| 13 | Pope et al.,2004 | 43 | 16 | 0 | 1 | 0 | 1 | 0 | 1 |
| 14 | Striegel et al.,2006 | 84 | 47 | 2 | 3 | 0 | 1 | 1 | 0 |
| 15 | Cohen et al.,2007 | 1955 | 1290 | 0 | 3 | 2 | 1 | 0 | 2 |
| 16 | Al-Falasi et al.,2008 | 34 | 4 | 5 | 3 | 0 | 1 | 0 | 0 |
| 17 | Larance et al.,2008 | 60 | 46 | 3 | 3 | 0 | 1 | 0 | 1 |
| 18 | Posiadala et al.,2010 | 18 | 2 | 2 | 3 | 0 | 1 | 0 | 0 |
| 19 | Gradidge et al.,2011 | 4 | 1 | 5 | 0 | 0 | 1 | 1 | 0 |
| 20 | Ip et al.,2011 | 506 | 387 | 6 | 3 | 1 | 1 | 1 | 2 |
| 21 | Santos et al.,2011 | 41 | 4 | 4 | 1 | 0 | 1 | 0 | 0 |
| 22 | Hope et al.,2013 | 395 | 178 | 1 | 2 | 1 | 1 | 1 | 0 |
| 23 | Raschka et al.,2013 | 79 | 30 | 2 | 3 | 0 | 1 | 0 | 0 |
| 24 | Mooney et al.,2016 | 26 | 1 | 1 | 3 | 0 | 1 | 0 | 2 |
| 25 | Rowe et al.,2016 | 605 | 382 | 3 | 2 | 1 | 1 | 1 | 0 |
| 26 | Westerman et al.,2016 | 231 | 153 | 6 | 3 | 1 | 1 | 1 | 2 |
| 27 | Zahnow et al.,2017 | 195 | 68 | 6 | 3 | 1 | 1 | 1 | 2 |
| 28 | Althobiti et al.,2018 | 476 | 181 | 5 | 3 | 1 | 1 | 0 | 0 |
| 29 | Hill et al.,2019 | 216 | 91 | 1 | 1 | 1 | 1 | 1 | 2 |
| 30 | Jacka et al.,2019 | 267 | 237 | 3 | 3 | 1 | 1 | 1 | 2 |
| 31 | Macedo et al.,2019 | 25 | 9 | 4 | 3 | 0 | 1 | 0 | 0 |
| 32 | Pany et al.,2019 | 74 | 24 | 5 | 1 | 0 | 1 | 1 | 0 |
| 33 | Pereira et al.,2019 | 194 | 117 | 4 | 3 | 1 | 1 | 1 | 0 |
| 34 | Uddin et al.,2019 | 512 | 9 | 5 | 3 | 1 | 1 | 1 | 0 |
| 35 | Bonnecaze et al.,2020 | 2385 | 1047 | 6 | 3 | 2 | 1 | 1 | 2 |
| 36 | Jokipalo et al.,2021 | 50 | 15 | 2 | 1 | 0 | 1 | 1 | 2 |

**R codes**

```
## Loading packages previously installed
library("robumeta")
library("metafor")
library("dplyr")
library("forestplot")
library("checkmate")
library("nloptr")
library("meta")
library("CompQuadForm")

## Meta-analysis of all studies
metaAAS <- read.csv("metaAAS.csv")
View(metaAAS)
metaAAS <- escalc(measure="IR", xi=xi, ti=ti, data=metaAAS, slab=paste (studies))
res <- rma(yi, vi, data=metaAAS)
res
confint(res)

## Baujat plot
b_res <- rma(xi, ti, data=metaAAS, slab=study.id)
baujat(b_res)
inf <- influence(res)
print(inf)
plot(inf)


### funnel plot
funnel(res,atransf=mytransf,xlab = "Estimated prevalence")
regtest(res)
ranktest(res)
warnings()


### Cross-tabulation of the number of studies – location vs subpopulation
addmargins(table(metaAAS$locat, metaAAS$pop))


### Setup functions for the forest plot
mlabfun <- function(text, res) {
 list(bquote(paste(.(text),
            " (Q = ", .(formatC(res$QE, digits=2, format="f")),
            ", df = ", .(res$k - res$p),
            ", p ", .(metafor:::.pval(res$QEp, digits=2, showeq=TRUE, sep=" ")), "; ",
            I^2, " = ", .(formatC(res$I2, digits=1, format="f")), "%, ",
            tau^2, " = ", .(formatC(res$tau2, digits=2, format="f")), ")")))}
mytransf<-function(x)
 (x)*100


## Forest plot of all studies
forest (res, transf=mytransf, cex=.7,header=c("Authors and Year", "Effect size [95%
CI]"),xlab="Prevalence rate",
     mlab=mlabfun("RE Model for All Studies", res), order="obs", refline=NA)
```

```
## Forest plot - subgroup LOCATION
forest (res, transf=mytransf, cex=.6, refline=NA,top=0,
      order=metaAAS$locat,
      rows=c(65:58,53:49,44:39,34:31,26:24,19:15,10:6),
      mlab=mlabfun("RE Model for All Studies", res),
      header=c("Authors and year", "Effect size [95% CI]"),
      xlab="Estimated prevalence")


### switch to bold italic font
par(font=4)

### add text for the subgroups
text(-130, c(54,45,35,27,20,11), pos=4,
    c("UK","Continental Europe","Australia","Brazil",
     "Africa,Asia and Middle East","Trans-regional"))

### fit random-effects model in the seven subgroups
res.0 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="0"), data=metaAAS)
res.1 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="1"), data=metaAAS)
res.2 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="2"), data=metaAAS)
res.3 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="3"), data=metaAAS)
res.4 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="4"), data=metaAAS)
res.5 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="5"), data=metaAAS)
res.6 <- rma(measure="IR", xi=xi, ti=ti, subset=(locat=="6"), data=metaAAS)

### add summary polygons for the seven subgroups
addpoly(cex=.5,res.0, row=56.5, mlab=mlabfun("RE Model for Subgroup", res.0),transf=mytransf)
addpoly(cex=.5,res.1, row=47.5, mlab=mlabfun("RE Model for Subgroup", res.1),transf=mytransf)
addpoly(cex=.5,res.2, row=37.5, mlab=mlabfun("RE Model for Subgroup", res.2),transf=mytransf)
addpoly(cex=.5,res.3, row=29.5, mlab=mlabfun("RE Model for Subgroup", res.3),transf=mytransf)
addpoly(cex=.5,res.4, row=22.5, mlab=mlabfun("RE Model for Subgroup", res.4),transf=mytransf)
addpoly(cex=.5,res.5, row=13.5, mlab=mlabfun("RE Model for Subgroup", res.5),transf=mytransf)
addpoly(cex=.5,res.6, row=4.5, mlab=mlabfun("RE Model for Subgroup", res.6),transf=mytransf)


### fit meta-regression model to test for subgroup differences
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ factor(locat), data=metaAAS)
resMeta
confint(resMeta)

### add text for the test of subgroup differences
text(-130, -3, pos=4, cex=0.6,
    bquote(paste("Test of moderator (location): ",Q[M], " = ",
           .(formatC(resMeta$QM, digits=2, format="f")),
           ", df = ", .(resMeta$p - 1),
                      ", p = ", .(formatC(resMeta$QMp, digits=2, format="f")))))
```

```
##Forest plot -subgroup SUBPOPULATION
forest (res, transf=mytransf, cex=.6, refline=NA,top=0,
     order=metaAAS$pop,
     rows=c(53:50,45:37,32:31,26:6),
     mlab=mlabfun("RE Model for All Studies", res),
     header=c("Authors and year", "Effect size [95% CI]"),
     xlab="Estimated prevalence")

### fit random-effects model in the four subgroups
res.0 <- rma(measure="IR", xi=xi, ti=ti, subset=(pop=="0"), data=metaAAS)
res.1 <- rma(measure="IR", xi=xi, ti=ti, subset=(pop=="1"), data=metaAAS)
res.2 <- rma(measure="IR", xi=xi, ti=ti, subset=(pop=="2"), data=metaAAS)
res.3 <- rma(measure="IR", xi=xi, ti=ti, subset=(pop=="3"), data=metaAAS)

### add summary polygons for the four subgroups
addpoly(cex=.5,res.0, row=48, mlab=mlabfun("RE Model for Subgroup", res.0),transf=mytransf)
addpoly(cex=.5,res.1, row=35, mlab=mlabfun("RE Model for Subgroup", res.1),transf=mytransf)
addpoly(cex=.5,res.2, row=29, mlab=mlabfun("RE Model for Subgroup", res.2),transf=mytransf)
addpoly(cex=.5,res.3, row=4, mlab=mlabfun("RE Model for Subgroup", res.3),transf=mytransf)


### fit meta-regression model to test for subgroup differences
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ factor(pop), data=metaAAS)
resMeta
confint(resMeta)

### add text for the test of subgroup differences
text(-130, -3, pos=4, cex=0.6,
   bquote(paste("Test of moderator (sub-population): ",Q[M], " = ",
            .(formatC(resMeta$QM, digits=2, format="f")),
            ", df = ", .(resMeta$p - 1),
            ", p = ", .(formatC(resMeta$QMp, digits=2, format="f")))))


### Univariate meta-regression model. Moderator: LOCATION
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ relevel(factor(locat), ref="0"),  data=metaAAS)
resMeta
confint(resMeta,transf=mytransf)


### Univariate meta-regression model. Moderator: SUBPOPULATION
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ relevel(factor(pop), ref="3"), data=metaAAS)
resMeta
confint(resMeta)

### Univariate meta-regression model. Moderator: SAMPLE SIZE
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ relevel(factor(size), ref="0"), data=metaAAS)
resMeta
confint(resMeta)

### Univariate meta-regression model. Moderator: TIME OF PUBLICATION
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ relevel(factor(time), ref="1"), data=metaAAS)
resMeta
confint(resMeta)
```

**### Univariate meta-regression model. Moderator: STUDY DESIGN**

```
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ relevel(factor(design), ref="1"),
data=metaAAS)
resMeta
confint(resMeta)
```

**### Univariate meta-regression model. Moderator: RISK OF BIAS**

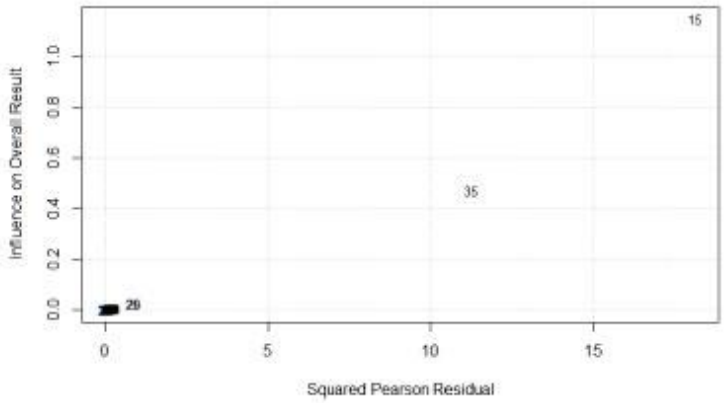
```
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ relevel(factor(bias), ref="1"), data=metaAAS)
resMeta
confint(resMeta)
```

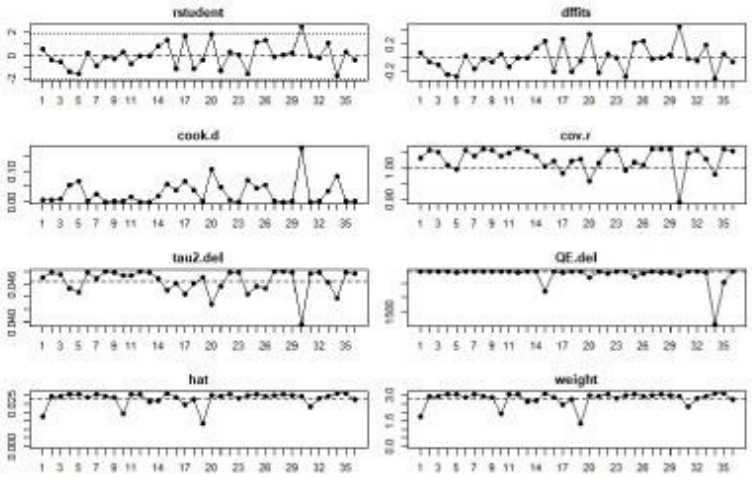
**### Multivariate meta-regression model. Moderators: LOCATION + STUDY DESIGN**

```
resMeta <- rma(measure="IR",xi=xi, ti=ti, mods = ~ factor(locat)+relevel(factor(design),
ref="0"), data=metaAAS)
resMeta
confint(resMeta)
```

**Results of the Baujat plot**

| | rstudent | dffits | cook.d | cov.r | tau2.del | qe.del | hat | weight | dfbs | inf |
|---|---|---|---|---|---|---|---|---|---|---|
| Yesalis et al.,1988 | 0.5691 | 0.0751 | 0.0057 | 1.0296 | 0.0470 | 2901.5926 | 0.0174 | 1.7416 | 0.0749 | |
| Johnson et al.,1989 | -0.3444 | -0.0615 | 0.0039 | 1.0362 | 0.0477 | 2901.1899 | 0.0288 | 2.8822 | -0.0615 | |
| Kisling et al.,1989 | -0.5615 | -0.0986 | 0.0099 | 1.0307 | 0.0475 | 2903.7126 | 0.0289 | 2.8917 | -0.0986 | |
| Lindstrom et al.,1990 | -1.3464 | -0.2365 | 0.0546 | 1.0080 | 0.0453 | 2888.7020 | 0.0303 | 3.0336 | -0.2363 | |
| Tierney et al.,1990 | -1.5188 | -0.2662 | 0.0681 | 0.9939 | 0.0446 | 2872.4020 | 0.0304 | 3.0377 | -0.2658 | |
| Peters et al.,1993 | 0.2168 | 0.0346 | 0.0012 | 1.0367 | 0.0478 | 2891.9587 | 0.0282 | 2.8196 | 0.0346 | |
| Tanner et al.,1995 | -0.8914 | -0.1576 | 0.0250 | 1.0380 | 0.0468 | 2904.9166 | 0.0301 | 3.0113 | -0.1576 | |
| Kurkia et al.,1997 | -0.0751 | -0.0154 | 0.0002 | 1.0393 | 0.0479 | 2896.1842 | 0.0288 | 2.8712 | -0.0154 | |
| Bolding et al.,1999 | -0.2797 | -0.0501 | 0.0026 | 1.0366 | 0.0478 | 2901.0530 | 0.0284 | 2.8416 | -0.0501 | |
| Auge et al.,1999 | 0.3864 | 0.0502 | 0.0025 | 1.0367 | 0.0473 | 2902.0604 | 0.0193 | 1.9265 | 0.0501 | |
| Perry et al.,2005 | -0.8882 | -0.1224 | 0.0152 | 1.0477 | 0.0473 | 2903.7785 | 0.0301 | 3.0053 | -0.1225 | |
| Parkinson et al.,2005 | -0.0059 | -0.0036 | 0.0000 | 1.0626 | 0.0480 | 2858.4148 | 0.0303 | 3.0265 | -0.0036 | |
| Pope et al.,2004 | 0.0035 | -0.0017 | 0.0000 | 1.0536 | 0.0478 | 2900.9937 | 0.0259 | 2.5919 | -0.0017 | |
| Striegel et al.,2006 | 0.8253 | 0.1366 | 0.0188 | 1.0157 | 0.0468 | 2884.0498 | 0.0269 | 2.6891 | 0.1365 | |
| Cohen et al.,2007 | 1.3765 | 0.2473 | 0.0594 | 1.0032 | 0.0451 | 2203.3151 | 0.0303 | 3.0526 | 0.2470 | |
| Al-Falasi et al.,2008 | -1.1563 | -0.1977 | 0.0388 | 1.0208 | 0.0460 | 2903.5873 | 0.0286 | 2.8616 | -0.1977 | |
| Larance et al.,2008 | 1.6754 | 0.2655 | 0.0680 | 0.9820 | 0.0444 | 2878.6129 | 0.0241 | 2.4114 | 0.2654 | |
| Postadala et al.,2010 | -1.1536 | -0.1919 | 0.0366 | 1.0200 | 0.0461 | 2904.0448 | 0.0271 | 2.7140 | -0.1920 | |
| Gradidge et al.,2011 | -0.3687 | -0.0438 | 0.0019 | 1.0253 | 0.0470 | 2904.9093 | 0.0131 | 1.3108 | -0.0438 | |
| Ip et al.,2011 | 1.9001 | 0.3414 | 0.1077 | 0.9160 | 0.0428 | 2681.1261 | 0.0298 | 2.9778 | 0.3407 | |
| Santos et al.,2011 | -1.2671 | -0.2186 | 0.0470 | 1.0136 | 0.0456 | 2901.6068 | 0.0292 | 2.9249 | -0.2186 | |
| Hope et al.,2013 | 0.3845 | 0.0618 | 0.0039 | 1.0575 | 0.0477 | 2842.9150 | 0.0300 | 3.0010 | 0.0619 | |
| Raschka et al.,2013 | 0.0375 | 0.0040 | 0.0000 | 1.0575 | 0.0479 | 2897.1920 | 0.0279 | 2.7884 | 0.0040 | |
| Mooney et al.,2016 | -1.5763 | -0.2731 | 0.0714 | 0.9891 | 0.0444 | 2889.9271 | 0.0298 | 2.9798 | -0.2728 | |
| Rowe et al.,2016 | 1.2229 | 0.2170 | 0.0483 | 1.0150 | 0.0457 | 2712.0790 | 0.0301 | 3.0072 | 0.2168 | |
| Westerman et al.,2016 | 1.3474 | 0.2350 | 0.0539 | 1.0053 | 0.0452 | 2825.5656 | 0.0290 | 2.8960 | 0.2349 | |
| Zahnow et al.,2017 | -0.1027 | -0.0204 | 0.0004 | 1.0610 | 0.0479 | 2890.1445 | 0.0296 | 2.9607 | -0.0204 | |
| Alhobtti et al.,2018 | 0.0413 | 0.0047 | 0.0000 | 1.0624 | 0.0480 | 2856.9754 | 0.0302 | 3.0228 | 0.0047 | |
| Hill et al.,2018 | 0.2275 | 0.0373 | 0.0014 | 1.0592 | 0.0479 | 2876.4907 | 0.0295 | 2.9508 | 0.0373 | |
| Jacka et al.,2019 | 2.5277 | 0.4496 | 0.1749 | 0.8926 | 0.0397 | 2756.3671 | 0.0287 | 2.8694 | 0.4492 | |
| Macedo et al.,2019 | -0.0457 | -0.0092 | 0.0001 | 1.0485 | 0.0476 | 2902.8855 | 0.0235 | 2.3471 | -0.0091 | |
| Many et al.,2019 | -0.2084 | -0.0378 | 0.0015 | 1.0570 | 0.0478 | 2900.6346 | 0.0281 | 2.8096 | -0.0378 | |
| Pereira et al.,2019 | 1.0596 | 0.1829 | 0.0333 | 1.0252 | 0.0462 | 2848.8713 | 0.0288 | 2.8819 | 0.1829 | |
| Uddin et al.,2019 | -1.7165 | -0.3019 | 0.0858 | 0.9758 | 0.0437 | 1099.7302 | 0.0307 | 3.0725 | -0.3012 | |
| Bonnecaze et al.,2020 | 0.3139 | 0.0533 | 0.0029 | 1.0598 | 0.0478 | 2520.6043 | 0.0306 | 3.0626 | 0.0534 | |
| Joktpalo et al.,2021 | -0.3118 | -0.0543 | 0.0030 | 1.0537 | 0.0477 | 2902.8279 | 0.0272 | 2.7230 | -0.0543 | |


Influence on Overall Result
Squared Pearson Residual
15
35
29


rstudent
dffits
cook.d
cov.r
tau2.del
QE.del
hat
weight

# 7. WP2 – Risk factors and strategies to prevent and treat adverse health conditions associated with the use of AAS

As discussed in Chapter 3, adverse health conditions associated with the use of AAS (AAS-HC) include problems as diverse as acne (Melnik et al., 2007), cardiovascular conditions (McCullough et al., 2021) and increased aggressiveness (Chegeni, Notelaers, et al., 2021), as summarised by Pope et al. (2014) and observed in recent ecological studies (Eu et al., 2023; Smit, Buijs, de Hon, et al., 2021). People using AAS might adopt different strategies to prevent and treat AAS-HC, (see Chapter 4), including preventive measures – e.g., having blood tests to monitor their health whilst using AAS, using sterile injectable equipment and discussing AAS use with a physician – and seeking treatment when an AAS-HC occurs. The sources of support sought to treat AAS-HC can be described as formal and informal sources. Formal sources of support include physicians, the NSP, Steroid/IPED clinics and Sexual Health Clinics. Informal sources of support are friends, online forums, coaches and suppliers of AAS suppliers (Amaral, Kimergård, et al., 2022; Havnes et al., 2019; Jacka et al., 2019; Kimergård & McVeigh, 2014; Tighe et al., 2017; Zahnow et al., 2017). The study described in chapter 6 (WP1) estimated that about one-third of people using AAS in the UK seek physicians for help with AAS-HC (Amaral, Kimergård, et al., 2022), and it is reasonable to assume that General Practitioners (GPs) represent the vast majority of these professionals (Vallejo-Torres & Morris, 2018). People using AAS in the UK may also seek assistance for AAS-HC at accident and emergency services (A&E), Sexual Health Clinics specialised in genitourinary medicine and sexually transmitted diseases (Begley et al., 2017), and Steroid/IPED clinics (Campbell, 2020; Kimergård & Mcveigh, 2014). Units of the NSP are another important

source of support for people using AAS in the UK, with many services reporting an increasing number of AAS users amongst their clients (Kimergård & Mcveigh, 2014; McVeigh & Begley, 2017).

The adoption of these strategies seem to vary across subpopulations of AAS users (van de Ven et al., 2018; Zahnow et al., 2017). For instance, females are more prone to seek physicians to handle AAS-HC (Copeland et al., 2000; Zahnow et al., 2017), whilst adolescent AAS users are less likely to engage with health services (Amaral, Kimergård, et al., 2022; Irving et al., 2002). As discussed in item 3.17, given the barriers experienced by the LGBTQIA+ population in their engagement with health services (Bancroft et al., 2005; Chakraborty et al., 2011; Roberts et al., 2013; Smalley et al., 2017), it is reasonable to expect a high prevalence of untreated AAS-HC amongst the that population of AAS users. Furthermore, the high prevalence of AAS use amongst gay men (Bolding et al., 2002; Griffiths et al., 2021; Ip et al., 2019) raises concerns about the prevalence of AAS-HC in this population.

The aim of study is to investigate the impact of health-related behaviours in regards to the likelihood of reporting AAS-HC in the last 12 months, identify and compare AAS-HC and health-related behaviours across subpopulations of AAS users living in the UK.

## 7.1 Objectives and hypothesis

### 7.1.1 Primary and secondary objectives

The primary objective of this study is to identify health-related behaviours associated with the likelihood of experiencing AAS-HC.

The secondary objectives are:

1 – To describe the demographic characteristics of participants and their patterns of AAS use (methods of administration and estimated time of AAS exposure) and the use of other IPEDs.

2 – Compare the prevalence of AAS-HC between subpopulations of AAS users.

3 – Compare the strategies adopted to prevent and treat of AAS-HC between subpopulations of AAS users.

### 7.1.2 Hypotheses

The null hypothesis ($H_0$) is that there is no association between the likelihood of experiencing an AAS-HC in the last 12 months and the following characteristics and behaviours:

$H_1$ – Having blood tests to monitor one's health whilst using AAS.

$H_2$ – Using the services of the NSP.

$H_3$ – Seeking a GP for information about AAS.

$H_4$ – Informed the use of AAS to a GP.

## 7.2 Methods

### 7.2.1 Study design

To fulfil the objectives and verify the hypotheses above, a cross-sectional online survey was developed. Online surveys are commonly used to reach a large population of AAS users (Bonnecaze et al., 2020; Cohen et al., 2007; Jacka et al., 2019; Parkin & Kimergård, 2022; Westerman et al., 2016; Zahnow et al., 2017). They are particularly useful when

targeting a geographically dispersed population (Wellman, 1997b) and people involved in illegal or stigmatised activities (Miller & Sønderlund, 2010). They eliminate the need of travel for both researchers and participants, allow the participation at any time that it is convenient to the participants, allow researchers to perform other activities whilst the data is collected, and the costs per response are inversely proportional to the sample size (Andrews et al., 2003a; Bachmann & Elfrink, 1996; Watt, 1999). In addition, the large number of online communities and social media profiles related to bodybuilding, fitness and the use of AAS (Andreasson & Johansson, 2016; Griffiths et al., 2018; Tighe et al., 2017), associated with the ubiquity of internet access in the UK (ONS, 2020) supported the decision of using an online survey in this study. Furthermore, this research was conducted during the social-distancing and travel-restriction measures taking place in the UK in response to the COVID-19 pandemic, making it unfeasible to physically reach its target population in a sensible timeframe. Despite its several benefits, online surveys have limitations in comparison to other methods of data collection (Wright, 2017). These include the risk of sampling bias, as participants might be restricted to those able to access the platforms where the survey was advertised (L. Thompson et al., 2003). There is also a risk of under-representation of people with limited computer literacy or access to the internet, those unable to understand the language(s) used in the survey and people suffering from debilitating health conditions – associated or not to the use of AAS (Miller & Sønderlund, 2010). Additionally, the use of online tools for data collection increases uncertainty reading the accuracy or veracity of participants' responses (Andrews et al., 2003b), as well as the risk of fraudulent participation through automated responses, also known as 'bots' (Storozuk et al., 2020). Finally, remote participation precludes an analysis of the substances actually used by

the participants, a limitation exacerbated by the high prevalence of counterfeits amongst illegally distributed AAS (Evans-Brown et al., 2009), might be different than the ones respondents believe they are using. Nevertheless, the ubiquity of internet use in the UK (ONS, 2020) and the popularity of online forums and social media platforms amongst people using AAS (Griffiths et al., 2018; Tighe et al., 2017; Underwood, 2017) makes an online survey a useful method of data collection from this population. Moreover, it offers a broad perspective of health-related strategies adopted by people using AAS and helps identify participants for an in-depth analysis of these behaviours – as described in chapter 8 (WP3).

### 7.2.2 Participants

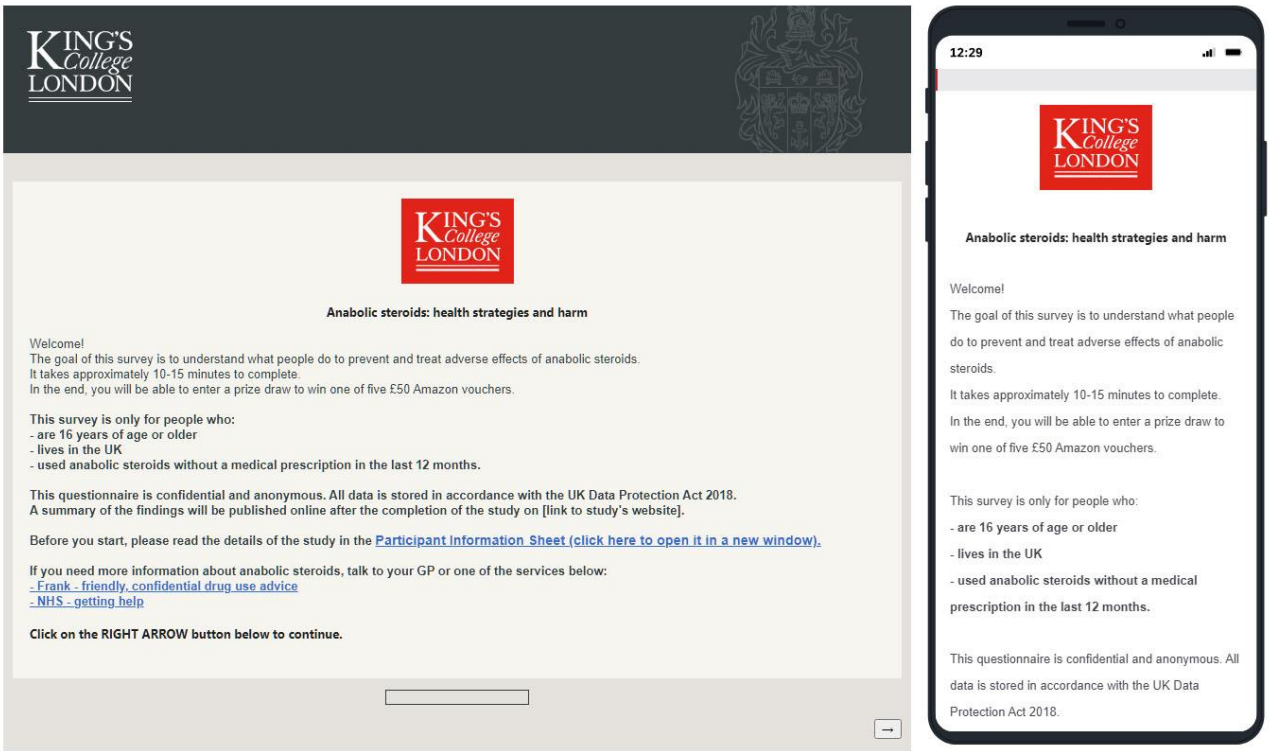
In order to take part in the survey, participants had to fulfil the criteria below.

Table 5: WP2 - Inclusion and exclusion criteria of participants

| **Inclusion criteria** | **Exclusion criteria** |
|---|---|
| People assigned male or female at birth, of any ethnicity, gender identity or sexual orientation | People unwilling to declare their sex assigned at birth |
| People aged 16 years old or more | People aged less than 16 years old |
| People located in the UK at the time of the survey, regardless of residency status | People located outside of the UK at the time of the survey |
| Having used any type AAS in the last 12 months | Not having used AAS or have used AAS for the last time more than 12 months before their participation in the survey |
| Having used AAS in the last 12 months without a medical prescription | Having used AAS in the last 12 months with a prescription for the treatment of medical conditions |
| Having access to a mobile or desktop device connected to the internet | Not having access to a device connected to the internet |
| Being able to understand written English | Not being able to understand written English |
| Not previously completed the survey | Having completed the survey previously |

Participants accessing the survey were directed to a page with the inclusion criteria, general information about the survey and a link to the participant information sheet (PIS; see Appendix 1), as shown in Figure 27.

Figure 27: WP2 - Initial page of the survey and summary of inclusion criteria

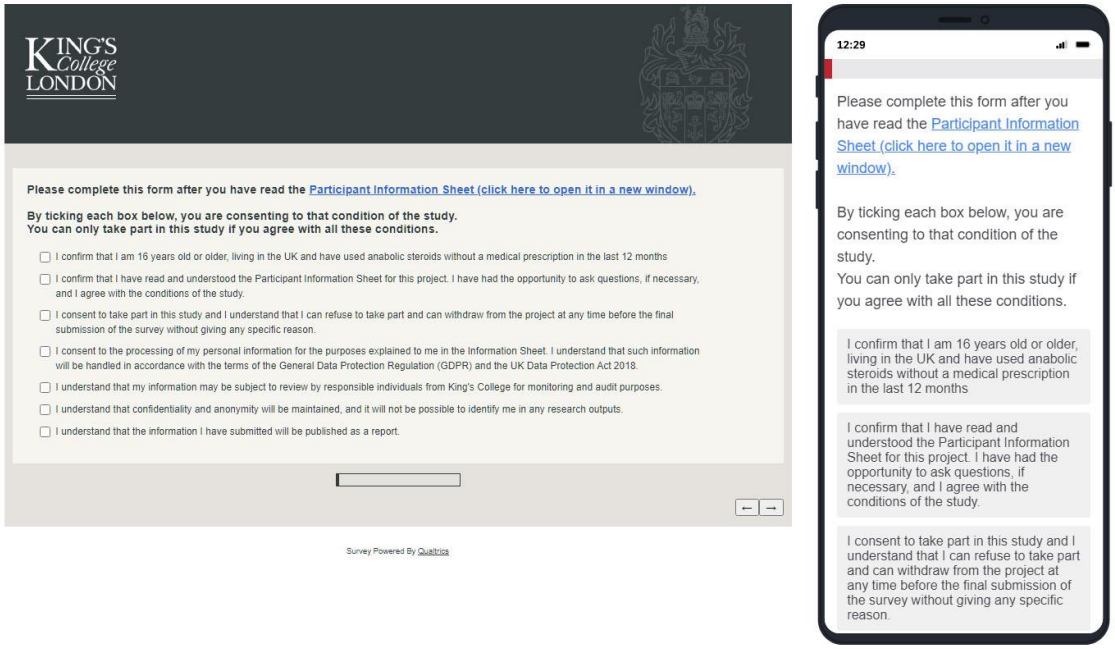



Those accessing the survey were informed that they should agree with the following terms to take part (see Figure 28).

- I confirm that I am 16 years old or older, living in the UK and have used anabolic steroids without a medical prescription in the last 12 months.
- I confirm that I have read and understood the Participant Information Sheet for this project. I have had the opportunity to ask questions, if necessary, and I agree with the conditions of the study.

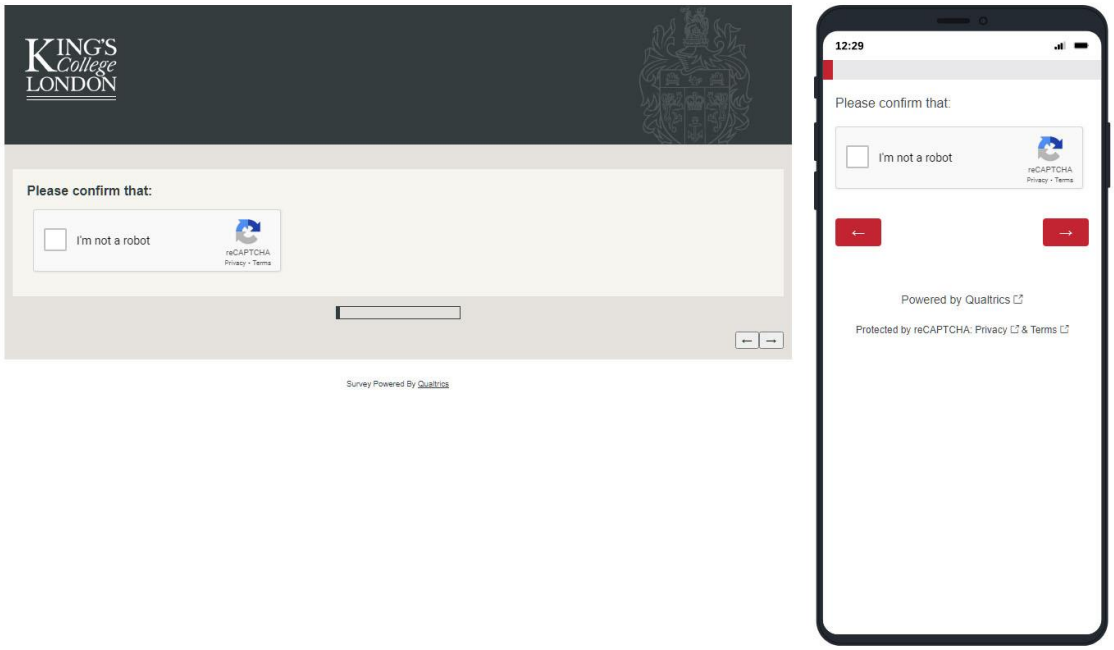
- I consent to take part in this study and I understand that I can refuse to take part and can withdraw from the project at any time before the final submission of the survey without giving any specific reason.
- I consent to the processing of my personal information for the purposes explained to me in the Information Sheet. I understand that such information will be handled in accordance with the terms of the General Data Protection Regulation (GDPR) and the UK Data Protection Act 2018.
- I understand that my information may be subject to review by responsible individuals from King's College for monitoring and audit purposes.
- I understand that confidentiality and anonymity will be maintained, and it will not be possible to identify me in any research outputs.
- I understand that the information I have submitted will be published as a report.

Figure 28: WP2 - Survey's consent form



Finally, participants were asked to click on a 'human-verification' button – also known as Completely Automated Public Turing test to tell Computers and Humans Apart (reCAPTCHA; see Figure 29). The reCAPTCHA feature is a widespread security measure used to prevent automated responses (Von Ahn et al., 2008).

Figure 29: WP2 - Survey's human verification feature (reCAPTCHA)

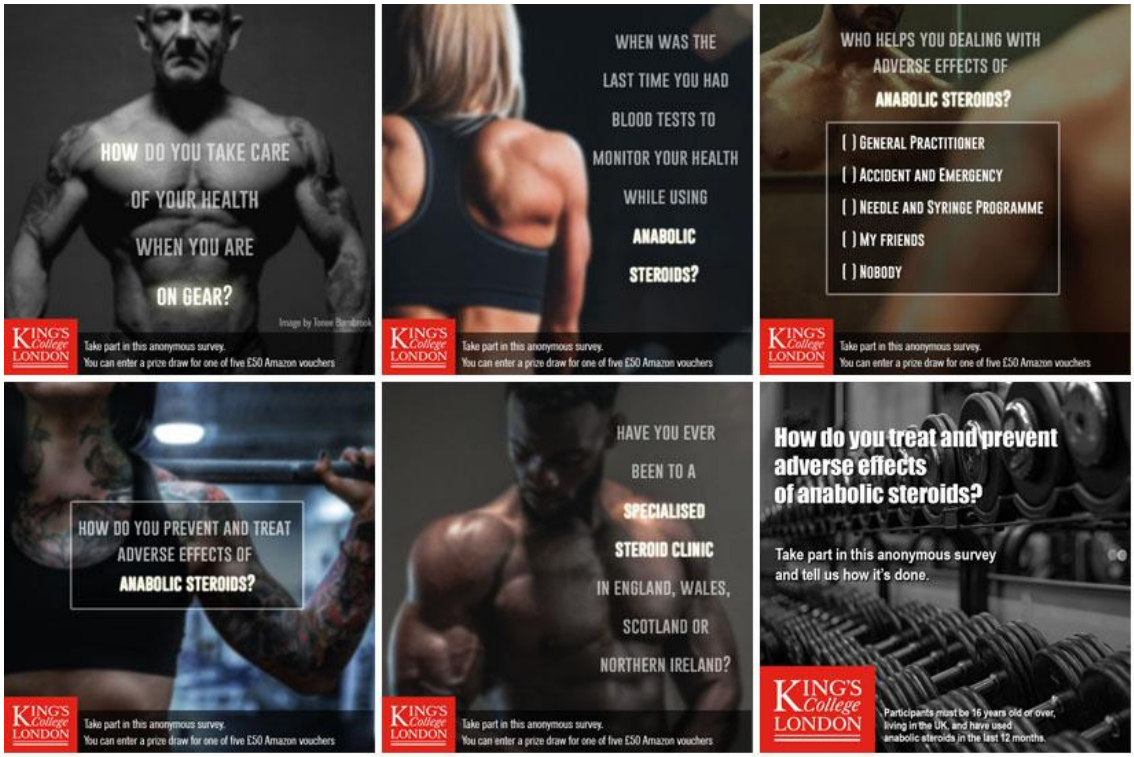



### 7.2.3 Recruitment of participants

As this study aims to understand health-related strategies of people using AAS amongst the general population, efforts were taken to recruit a large and diverse sample of people using AAS, ideally including participants from all the four countries of the UK and subpopulations of AAS users. Participants were recruited via links to the survey posted in online forums, social media platforms such as Twitter, Instagram, and Facebook. An Instagram profile (@dr_amaral21) was created to 'follow' UK-based gyms, bodybuilding federations and individuals commenting about AAS, including providers of these drugs,

which frequently followed our profile and therefore were likely to receive information about the survey in their 'feeds'. Additionally, moderators of online forums, staff members of harm-reduction services and gyms were approached via email (Appendix 2), as the collaboration with gatekeepers can be helpful when performing research with hard-to-reach and/or stigmatised populations (Rattani & Johns, 2017). The chance to win one of five £50 vouchers was offered to participants who completed the survey as an incentive to take part. In an attempt to reach more participants and have a better understanding of the practices of AAS use in the UK, the authour of this thesis reached out to a member of the UK bodybuilding community, Mr Tony Barnbrook, who offered insights and suggestions on how to approach people using AAS. The contact with an member of a community of practice can increase the researcher's ability to understand and approach other members of that group (Chavez-Reyes, 2008). There was no financial compensation to Mr Barnbrook, who also agreed with the royalty-free use of his pictures in the images created by the author of this thesis to advertise the survey (Figure 29).All the images used in this study can be found in Appendix 3.

Figure 30: WP2 - Examples of images used to advertise the survey in social media and posters




From the top left: Image by Tony Barnbrook. Images by Scott Webb, Dollar Gill, Nicole de Khors, Panther and Luis Reyes on Unsplash.

### 7.2.4 Materials and measures

The survey's questionnaire contained 43 questions, customised according to participants' sex at birth and AAS-HC. The questionnaire was composed of multiple-choice questions complemented by optional open-ended fields. Measures included demographic data, the use of AAS and other IPEDs, AAS-HC experienced in the last 12 months and health-related strategies, including sources of information about AAS. Most questions were compulsory, except for those asking participants to provide an email address if participants wanted to take part in the prize draw and be invited to future studies. The survey was delivered via the Qualtrics platform (Qualtrics, 2020), and the questionnaire can be found in Appendix 3.

#### 7.2.4.1 Demographics

To aid the characterisation of the study sample and to investigate associations with AAS-HC and health-related strategies, participants were asked to provide their age, sex assigned at birth (SaB), sexual orientation, gender identity, ethnicity, household's annual income and country of residence in the UK. Age groups for the comparison of AAS-HC and health-related strategies were based on a similar distribution of participants observed in the linear (non-grouped) distribution of participants' ages. Efforts were taken to produce groups of comparable sizes and expected prevalence of age-related health conditions (e.g., hypertension, low libido, etc.). For the purposes of this study, the terms male and female represent the sex assigned to participants at birth (MaB and FaB, respectively), regardless of gender identity. Transgender participants were grouped as LGBTQIA+ regardless of their sexual orientation because of the challenges faced by transgender people accessing health services (Safer et al., 2016). Heterosexual participants who identify with their sex assigned at birth are referred to as Cis-Hetero MaB or FaB.

#### 7.2.4.2 Use of AAS and other IPEDs

This domain included questions investigating their use of AAS and other IPEDs frequently used in combination with AAS (Grönbladh et al., 2016; McVeigh et al., 2021; Mullen et al., 2020; Sagoe et al., 2015). Given the cyclic and variable patterns of AAS use (Mullen et al., 2020), the estimated time of AAS exposure (AAS-years) was calculated subtracting the participants' age from the age when they first used AAS. Due to the large number of experienced users in our sample, AAS-years ≤ 4 were considered 'short-to-medium' and AAS ≥ 5 'long-term' use of AAS, as seen in similar investigations (Langli, 2015; Yu et al., 2014). The use of the following IPEDs was investigated: Human growth hormone (GH),

growth hormone releasers (GHr) such as CJC-1295 and CJC-1293), insulin, selective androgen receptor modulators (SARMs), anti-estrogens (such as tamoxifen and 5α-aromatase inhibitors), 2,4-Dinitrophenol (DNP), ephedrine and post-cycle therapy (PCT) drugs such as clomid and human chorionic gonadotropin (HCG). The participants were asked to inform their age when using AAS for the first time, methods of AAS administration (intramuscular injections, oral or both) and if they considered that using AAS improves their performance at work.

#### 7.2.4.3 AAS-HC experienced in the last 12 months

This section of the survey contains questions investigating the occurrence of AAS-HC in the last 12 months, which were grouped in five domains (details about these health conditions and their relationship with AAS can be found in Chapter 3):

- **Dermatologic:** Acne, hair loss, hirsutism, striae, and injection site injuries.
- **Orthopaedic:** Muscle or joint injuries, spine injuries, and chronic muscle or joint pain.
- **Endocrine:** Testes hypotrophy, clitoromegaly, gynecomastia, breast atrophy, erectile dysfunction, menstrual disorders, low sexual drive and infertility.
- **Neuropsychiatric:** Insomnia, anxiety, depression, and increased aggressiveness.
- **Other:** Hypertension, high haematocrit, dyslipidaemia, liver and kidney problems.

Questions about sex-specific AAS-HC such as testicular hypotrophy, clitoromegaly and menstrual cycle abnormalities were customised according to the participants' SaB. All the questions in this section were compulsory and displayed as dichotomous variables.

A positive answer prompted a question about which source of support (if any) was sought to help the participant treat each health condition.

#### 7.2.4.4 Preventive strategies

Participants were asked to inform if they adopted any of the following strategies, regardless of experiencing AAS-HC: Having regular consultations with a GP; informing a GP about AAS use; having blood tests to monitor their health; using the NSP or an; using the services of a Steroid/IPED Clinic; using the services of a Sexual Health Clinic; and contacted the FRANK drug support service.

#### 7.2.4.5 Sources of AAS-related information

As seen in Chapter 4, people might seek a variety of sources to obtain information about how to use AAS and how to prevent and treat adverse effects. These sources were grouped as follows:

- **Formal sources**: GPs, accident and emergency services (A&E), the NSP, Steroid/IPED clinics, Sexual Health Clinics, FRANK.
- **Informal sources:** Online forums, personal trainers or coaches, friends, self-conducted research in books, articles and the internet, and suppliers of AAS.

#### 7.2.4.6 Strategies to treat AAS-HC

Whenever a participant informed the occurrence of an adverse health condition, they are also asked who helped them treat that condition, choosing from the same options listed under 'Sources of information' in addition to the options 'other' and 'I did not treat this health condition'.

#### 7.2.4.7 Study variables

A list of the variables collected by the survey can be seen in Table 5. Variables from the groups 'Demographics' and 'Use of AAS and other IPEDs' are independent variables (IV),

and those from 'AAS-HC' are dependent variables (DV). The variables from the groups 'Preventive strategies' and 'Sources of information and treatment' were treated as either IV or DV, according to the analyses performed.

Table 6: WP2 - Study variables

*Demographics (IV)*
**1. Age**
**2. Sex at birth**
**3. Sexual orientation/Gender identity**
**4. Ethnicity**
**5. Annual household income**
**6. Country of residence in the UK**

*Use of AAS and other IPEDs (IV)*
**1. Estimated time of AAS exposure (AAS-years)**
**2. Methods of AAS use (injectable, oral or both)**
**3. Occupational use of AAS**
**4. Use of other PIEDs**

*Preventive strategies (IV/DV)*
**1. Blood tests**
**2. Using the services of the NSP**
**3. Seeking a GP for information about AAS**
**4. Disclosing the use of AAS to a GP**

*Sources of information and treatment (IV/DV)*
*Formal sources*
**1. GP**
**2. A&E**
**3. NSP**
**4. Steroid Clinic**
**5. Sexual Health Clinic**
*Informal sources*
**6. Online forums**
**7. Personal trainer or coach**
**8. Friends**
**9. Supplier of AAS**
**11. Other**
**12. None**

*AAS-HC (DV)*
*Dermatologic*
**1. Acne**
**2. Hair loss**
**3. Hirsutism**
**4. Striae**
**5. Injection site injuries**
*Orthopaedic*
**6. Muscle or joint injuries**
**7. Spine injuries or disc herniation**
**8. Chronic pain**
*Endocrine*
**9. Testes hypotrophy (males)**
**Clitoromegaly (females)**
**10. Gynecomastia (males)**
**Breast atrophy (females)**
**11. Erectile dysfunction (males)**
**Irregular or absent periods (fem.)**
**12. Low libido**
**13. Infertility**
*Neuropsychiatric*
**14. Insomnia**
**15. Anxiety**
**16. Depression**
**17. Increased aggressiveness**
*Other AAS-HC*
**18. Hypertension**
**19. High haematocrit**
**20. Dyslipidaemia**
**21. Liver problems**
**22. Kidney problems**
**23. Other**

### 7.2.5 Data collection and analysis

Data from the survey was collected between July and September 2021. Valid cases were selected based on a completion rate of at least 95% of the survey. Efforts were taken to

prevent automated responses by using a 'human-verification' feature (reCAPTCHA), the monitoring of duplicates, speed of survey completion and the quality of open-ended responses (Storozuk et al., 2020; Von Ahn et al., 2008). Features from the Qualtrics platform prevented multiple responses from the same IP address and flagged potential low-quality responses (Qualtrics, 2020).

#### 7.2.5.1 Sample size

A sample of 359 participants was considered necessary to conduct chi-square tests with a power of 95%, α error probability of 0.05% and 23 degrees of freedom (the higher possible number of adverse health conditions investigated in this study). Sample size calculations were made on G.Power version 3.1.9.7 (Faul et al., 2009). A similar value (n = 350) was given by the rule of thumb of 50+10i participants in a regression analysis - where 'i' is the number of proposed independent variables (i = 30). The survey had no maximum number of participants.

#### 7.2.5.2 Data analysis

The normal distribution of continuous variables was tested by visual inspection of the histograms of frequency distributions and steam-and-leaf plots, as well as tests of skewness, kurtosis, and the Kolmogorov-Smirnov test (Mishra et al., 2019). Non-normally distributed variables were analysed with Pearson's Chi-square, Spearman's Rho and Mann-Whitney U tests. Outliers, incongruent responses and responses such as 'prefer not to answer' were recorded as missing data and deleted listwise (Kang, 2013; Little et al., 2012). Missing data analysis showed a random distribution of excluded responses, representing under 5% of data (Tabachnick & Fidel, 2007). Descriptive data

was obtained for all variables. Pearson's Chi-square (α = 0.05%) was used to compare methods of AAS administration, age of first AAS use, AAS-years, occupational use of AAS and use of other IPEDs between cis-heterosexual and LGBTQIA+ participants, as well as those residing in different countries of the UK. The same demographic variables were used to compare the occurrence of AAS-HC and health-related strategies. For the purposes of this analysis, participants from England and Wales were collapsed in a single category due to the small number of responses from Wales (n = 23), in order to increase clarity and produce comparable cell sample sizes (Distefano et al., 2020). Although recent studies estimated a similar prevalence of AAS use in Wales and Scotland (Hope et al., 2022), England and Wales are commonly grouped together in statistical analysis due to similarities in demographics, health systems and legal frameworks (Office for National Statistics, 2019).

Univariate and multivariate binary logistic regressions were performed to investigate associations between the dichotomous dependent variable (DV) – presence of at least one AAS-HC in the last 12 months – and the dichotomous independent variables (IV): (i) having blood tests performed, (ii) using the services of the NSP, or (iii) seeking a General Practitioner (GP) for AAS-related information in the last 12 months; and (iv) having ever disclosed the use of AAS to a GP. Prior to the regression analyses, the IVs were tested for multicollinearity based on variance inflation factor (VIF), which assess the degree of interdependence amongst predictors (Thompson et al., 2017). To assess the VIF, dummy variables were created for each level of the dichotomous DVs and employed in a linear regression model to estimate the relationship between predictors (Field, 2018). The IVs with a VIF < 2.5 and showing a significant association ($p < 0.05$) with the DV in the univariate analyses were included in the multivariable analysis (Johnston et al., 2018).

Results were described as odd ratios to facilitate their interpretation – i.e., how much each IV impacts the likelihood of reporting one or more AAS-HC in the last 12 months (Stoltzfus, 2011). All statistical analyses were performed in SPSS Statistics version 29.0 (IBM Corp, 2021).

### 7.2.6 Ethical considerations

As the study collected sensitive information such as the use of controlled substances and recent experience of somatic and mental health conditions, we minimised the data required to ensure that individual or clinical services cannot be identified from the survey responses. As detailed in the participant information sheet (see Appendix 2), we recommended that participants should complete the survey in private and advised them that some questions might be sensitive and trigger strong emotions. Participants were encouraged to end the survey if they felt sad or anxious and advised to speak to their GP if this persisted. The storage of email addresses was required for the purpose of contacting participants willing to take part in an interview (WP3). The database held no other data and was used solely for selection of interviewees. All information collected during the course of the study was kept strictly confidential. All study staff and investigators have complied with the principles of the Data Protection Act 2018 and with all aspects of GDPR 2018 in protecting the rights of study participants with regards to the collection, storage, processing and disclosure of personal information. Information is securely electronically at King's College London. Each participant was assigned a unique study ID number which was used for all information entered into the electronic database. Data held electronically was encrypted as digital files within password-protected folders and storage media compliant with GDPR 2018 Regulations. No

participant identifiers were or will be included in any publications or dissemination activities arising from this work. This study was approved by the King's College London Psychiatry, Nursing and Midwifery Research Ethics Subcommittee (Reference HR-20/21-22034).

## 7.3 Results

### 7.3.1 Summary characteristics

After three months of data collection, 1,018 questionnaires were completed. Of these, 883 (86.7%) had a completion rate of at least 95%. All the 883 questionnaires were screened, considered unlikely to be automatic responses, and included in the study. As summarised in Table 7, the majority of participants were males (72.1%), of white ethnicities (69.2%) and residing in England (66.3%). The participants had an average age of 26 years (16 to 65 years), with those aged 21 to 30 representing 47.8% of the sample. The distribution of characteristics across sexes was similar except for ethnicity, with a significantly higher percentage of Asian males (19.8%) in comparison to Asian females (6.5%). A minority of participants declared an annual income of less than £20,000 (12.5%) or superior to £60,000 (13.0%). The percentages of LGBTQIA+ participants were similar between males (19.6 %) and females (16.7 %). About one-fifth (22.7%) of participants were under 21 years of age. Amongst participants from Northern Ireland, there was a higher prevalence of people under 21 years of age (32.9%), LBGTQIA+ (43.2%), and AAS users with an annual income of less than £20,000 or no income (22.3%).

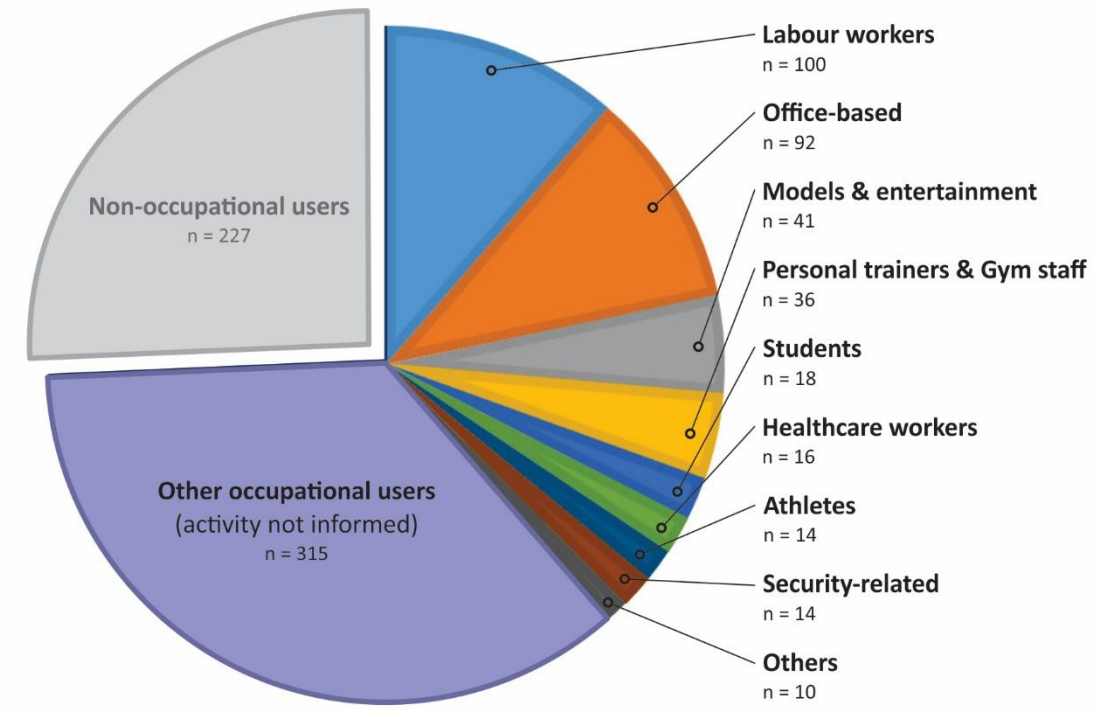
Table 7: WP2 - Summary characteristics

| | Total | Males | Females | Country of residence | | | |
|---|---|---|---|---|---|---|---|
| **Characteristics: n (%)[1]** | **n = 883** | **n = 637 (72.1%)** | **n = 246 (27.9%)** | **England** | **N. Ireland** | **Scotland** | **Wales** |
| **Age median = 26 (16 to 65)** | | | * | | | | * |
| 16 to 20 | 199 (22.7) | 144 (22.6) | 55 (22.8) | 128 (21.9) | 51 (32.9) | 16 (15.1) | 0 (0.0) |
| 21 to 30 | 422 (47.8) | 322 (50.6) | 100 (41.5) | 259 (44.3) | 73 (47.1) | 72 (67.9) | 14 (63.6) |
| 31 to 40 | 214 (24.4) | 139 (21.9) | 75 (31.1) | 163 (27.9) | 27 (17.4) | 16 (15.1) | 6 (27.3) |
| 41 to 50 | 30 (3.4) | 20 (3.1) | 10 (4.1) | 26 (4.5) | 2 (1.3) | 2 (1.9) | 0 (0.0) |
| 51 + | 12 (1.4) | 11 (1.7) | 1 (0.4) | 8 (1.4) | 2 (1.3) | 0 (0.0) | 2 (9.1) |
| **Sexual orientation and gender identity** | | | | | | | * |
| Heterosexual | 706 (80.0) | 502 (78.8) | 204 (82.9) | 505 (87.2) | 88 (56.8) | 91 (85.8) | 17 (73.9) |
| LGBTQIA+[2] | 166 (18.8) | 125 (19.6) | 41 (16.7) | 74 (12.8) | 67 (43.2) | 15 (14.2) | 6 (26.1) |
| **Ethnicity** | | | * | | | | * |
| Asian | 142 (16.1) | 126 (19.8) | 16 (6.5) | 89 (15.3) | 34 (21.9) | 11 (10.2) | 5 (21.7) |
| Black | 99 (11.2) | 71 (11.1) | 28 (11.4) | 46 (7.9) | 37 (23.9) | 9 (8.3) | 7 (30.4) |
| White | 611 (69.2) | 413 (64.8) | 198 (80.5) | 431 (74.2) | 79 (51.0) | 87 (80.6) | 10 (43.5) |
| Mixed race | 15 (1.7) | 12 (1.9) | 3 (1.2) | 7 (1.2) | 5 (3.2) | 1 (0.9) | 1 (4.3) |
| Other | 8 (0.9) | 8 (1.3) | 0 (0.0) | 8 (1.4) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| **Country of residence** | | | | | | | |
| England | 585 (66.3) | 431 (67.7) | 154 (62.6) | | | | |
| Northern Ireland | 157 (17.8) | 106 (16.6) | 51 (20.7) | | | | |
| Scotland | 108 (12.2) | 78 (12.2) | 30 (12.2) | | | | |
| Wales | 23 (2.6) | 13 (2.0) | 10 (4.1) | | | | |
| **Annual income** | | | * | | | | * |
| No income | 10 (1.1) | 2 (0.3) | 8 (3.3) | 5 (0.9) | 5 (3.2) | 0 (0.0) | 0 (0.0) |
| Less than £20,000 | 102 (11.6) | 76 (11.9) | 26 (10.6) | 67 (11.5) | 30 (19.1) | 3 (2.8) | 2 (8.7) |
| £20,000 - £39,999 | 333 (37.2) | 235 (36.9) | 98 (39.8) | 207 (35.4) | 62 (39.5) | 48 (44.4) | 13 (56.5) |
| £40,000 - £59,999 | 314 (35.1) | 241 (37.8) | 73 (29.7) | 197 (33.7) | 55 (35.0) | 51 (47.2) | 7 (30.4) |
| £60,000 or more | 116 (13.0) | 76 (11.9) | 40 (16.3) | 106 (18.1) | 4 (2.5) | 5 (4.6) | 1 (4.3) |

1: Percentages of valid responses. LGBTQIA+ = lesbians, gays, bisexuals, transgenders or others. * Chi-square test, $p < 0.05$

As shown in Figure 30, amongst the occupational users (OC) who provided the nature of their activities (n = 341), the larger group was formed by labour workers such as builders, carpenters and lorry drivers (n = 100), followed by office-based personell such as finance professionals and lawyers (n = 92), models and entertainment professionals (n =41), and personal trainers or gym staff members (n = 36). Smaller groups included students (n = 18), healthcare professionals (n = 16), athletes (n = 14), and security-related personell such as bouncers, security guards and police officers (n = 14).

Figure 31: WP2 - Occupational AAS users and informed activities




### 7.3.2 Use of AAS and other IPEDs

As seen in Table 8, the majority of participants (81.9%) used either only injectable (47.8%) or only oral AAS (34.1%). The majority of males (56.3%) used only injectable AAS, whilst most females (56.7%) only used oral compounds. The average age of participants' first use of AAS was 22 years, and the majority (63.1%) used AAS for the first time between the age of 16 and 25. The sample was composed by a majority of experienced AAS users, with 77.9% using AAS for 2 years or more. The majority of participants (74.3%) stated that the use of AAS helped them improve their performance at work. Aside from AAS, human growth hormone (GH) was the most common IPED used by the participants (37.4%), with a significantly higher prevalence amongst participants

from Scotland (45.4%). A higher percentage of participants from Northern Ireland (43.3%) and LGBTQIA+ females (58.5%) used GH releasers such as CJC-1295 and CJC-1293. These are synthetic peptides that stimulate the secretion of GH by the pituitary gland (Teichman et al., 2006). A significantly higher percentage of females (31.4%) and participants from England and Wales (24.2%) reported the use of insulin as an IPED in the last 12 months.

The majority of participants (75.3%) informed that the use of AAS helps them improve their performance at work. Amongst those who informed their occupations (52%) the largest group was formed of labour workers such as builders, carpenters and lorry drivers (15.2%), followed by office-based personel such as finance professionals and lawyers (14.0%), models and entertainment professionals (6.3%), and personal trainers or gym staff (5.5%). Other groups included students (2.7%), healthcare professionals (2.4%), athletes (2.1%), and security-related personel such as club and pub bouncers, security guards and police officers (2.1%).

Table 8: WP2 - AAS and IPED use by sexual orientation, gender identity and country of residence

| | | Assigned males at birth | | Assigned females at birth | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Total** | **Cis-Hetero** | **LGBTQIA+** | **Cis-Hetero** | **LGBTQIA+** | **England and Wales** | **Northern Ireland** | **Scotland** |
| Characteristic: n (%)[1] | 883 (100) | 502 (56.8) | 125 (17.2) | 204 (23.1) | 41 (4.6) | 608 (68.9) | 157 (17.8) | 108 (12.2) |
| **Methods of AAS use** | | | | | ** | | | |
| Injection only | 422 (47.8) | 269 (53.6) | 84 (67.2) | 53 (26.0) | 10 (24.4) | 297 (48.8) | 73 (46.5) | 45 (41.7) |
| Oral only | 301 (34.1) | 134 (26.7) | 26 (20.8) | 111 (54.4) | 28 (68.3) | 196 (32.2) | 56 (35.7) | 46 (42.6) |
| Injection and oral | 160 (18.1) | 99 (19.7) | 15 (12.0) | 40 (19.6) | 3 (7.3) | 115 (18.9) | 28 (17.8) | 17 (15.7) |
| **First use of AAS** (median = 22; 10 to 58) | | | | | ** | | | |
| 15 years or less | 75 (8.7) | 52 (10.6) | 5 (4.1) | 9 (4.6) | 9 (22.5) | 55 (9.3) | 11 (7.1) | 9 (8.7) |
| 16 to 25 years | 542 (63.1) | 307 (62.5) | 72 (58.5) | 139 (71.3) | 18 (45.0) | 386 (65.2) | 87 (56.5) | 63 (61.2) |
| 26 to 35 years | 221 (25.7) | 124 (25.3) | 39 (32.0) | 43 (22.1) | 11 (27.5) | 138 (23.3) | 50 (32.5) | 29 (28.2) |
| 36 years or more | 21 (2.4) | 8 (1.6) | 6 (4.9) | 4 (2.1) | 2 (5.0) | 13 (2.2) | 6 (3.9) | 3 (2.9) |
| **AAS-years** | | | | | ** | | | |
| 1 year or less | 187 (22.2) | 102 (21.0) | 25 (22.9) | 34 (17.2) | 21 (55.3) | 122 (21.0) | 43 (29.3) | 19 (18.1) |
| 2 to 5 years | 371 (44.1) | 232 (47.8) | 38 (34.9) | 83 (41.9) | 12 (31.6) | 254 (43.6) | 63 (42.9) | 50 (47.6) |
| 6 to 10 years | 190 (22.6) | 108 (22.3) | 21 (19.3) | 57 (28.8) | 4 (10.5) | 141 (24.2) | 27 (18.4) | 22 (21.0) |
| 11 years or more | 93 (11.1) | 43 (8.9) | 25 (22.9) | 24 (12.1) | 1 (2.6) | 65 (11.2) | 14 (9.5) | 14 (13.3) |
| **Occupational use of AAS** | 656 (74.3) | 379 (75.5) | 101 (80.8) | 145 (71.1) | 22 (53.7)* | 455 (74.8) | 108 (68.8) | 86 (79.6) |
| **Other IPED** | | | | | | | | |
| GH | 330 (37.4) | 212 (42.2) | 31 (24.8) | 66 (32.4) | 19 (46.3)** | 225 (37.0) | 50 (31.8) | 49 (45.4)* |
| GH releasers | 262 (29.7) | 135 (26.9) | 41 (32.8) | 59 (28.9) | 24 (58.5)** | 153 (25.2) | 68 (43.3) | 39 (36.1)* |
| Insulin | 190 (21.5) | 96 (19.1) | 17 (13.6) | 66 (32.4) | 11 (26.8)** | 147 (24.2) | 30 (19.1) | 12 (11.1)* |
| SARMs | 176 (19.9) | 110 (21.9) | 27 (21.6) | 37 (18.1) | 2 (4.9) | 120 (19.7) | 31 (19.7) | 23 (21.3) |
| Anti-estrogens | 144 (16.3) | 84 (16.7) | 21 (16.8) | 33 (16.2) | 5 (12.2) | 105 (17.3) | 24 (15.3) | 14 (13.0) |
| Clenbuterol | 130 (14.9) | 73 (14.5) | 32 (25.6) | 19 (9.3) | 6 (14.6) | 85 (14.0) | 24 (15.3) | 23 (21.3) |
| DNP | 65 (7.4) | 38 (7.6) | 8 (6.4) | 16 (7.8) | 2 (4.9) | 44 (7.2) | 16 (10.2) | 5 (4.6) |
| PCT | 63 (7.1) | 39 (7.8) | 8 (6.4) | 13 (6.4) | 2 (4.9) | 49 (8.1) | 8 (5.1) | 5 (4.6) |
| Ephedrine | 60 (6.8) | 38 (7.6) | 4 (3.2) | 18 (8.8) | 0 (0.0) | 44 (7.2) | 4 (2.5) | 12 (11.1)* |
| Other IPED | 6 (0.7) | 3 (0.6) | 1 (0.8) | 1 (0.5) | 1 (2.4) | 5 (0.8) | 0 (0.0) | 1 (0.9) |
| No other IPED | 48 (5.4) | 31 (6.2) | 3 (2.4) | 7 (3.4) | 1 (2.4) | 36 (5.9) | 6 (3.8) | 5 (4.6) |

1: Percentages of valid responses. AAS: androgenic anabolic steroids. AAS-years: estimated time of AAS use. IPED: Image and performance-enhancement drugs. SARMs: Selective androgen receptor modulator. DNP: 2,4-Dinitrophenol. PCT: Post-cycle therapy. Chi-square test: *p < 0.05; ** p < 0.001.

### 7.3.3 AAS-HC experienced in the last 12 months

As seen in Table 9, dermatological health conditions were the most prevalent amongst the overall participants (68.1%), followed by neuropsychiatric conditions (63.1%). The single most prevalent AAS-HC were insomnia, reported by about one-third of participants (33.3%) and muscle or joint injuries (28.5%). Amongst cardiovascular diseases, a considerable percentage of participants reported high haematocrit (21.2%), dyslipidaemia (19.3%) and hypertension (17.2%). About one-fifth (20.5%) of participants reported no AAS-HC in the last 12 months, whilst a larger group (45.9%) had five or more AAS-HC in the same period.

#### 7.3.3.1 Sexes and sexual orientations

Amongst cis-heterosexual males and females, insomnia was the most common AAS-HC (31.9% and 36.6%, respectively), followed by anxiety (28.7% and 32.4%) and muscle or joint injuries (25.9% and 29.4%). The prevalence of nearly all the AAS-HC investigated by this study was significantly higher amongst the LGBTQIA+ participants. The absolute majority of LGBTQIA+ males (81.6%) and females (92.7%) had five or more AAS-HC in the last 12 months. Erectile dysfunction was the most prevalent AAS-HC amongst LGBTQIA+ males (53.6%), followed by depression (50.4%) and hirsutism (44.8%). Amongst LGBTQIA+ females, muscle or joint injuries were the most common AAS-HC (75.6%), followed by insomnia (73.2%) and anxiety (73.2%). A large percentage of LGBTQIA+ females also reported spine injuries (70.7%) and clitoromegaly (70.7%).

#### 7.3.3.2 Countries of the UK

A significantly higher percentage of AAS users who did not experienced an AAS-HC in the last 12 months was seen amongst those from Scotland (31.5%), whilst a higher

percentage of participants from Northern Ireland reported five or more AAS-HC (65.6%). The prevalence of many AAS-HC was significantly higher amongst participants from Northern Ireland, namely neuropsychiatric conditions (78.3%) and cardiovascular, liver or kidney diseases (75.8%).

#### 7.3.3.3 Age groups

The percentages of those without any AAS-HC decreased towards the older age groups: 16 to 25 years (26.8%); 26 to 35 years (18.1%); and 36 years or more (8.2%). The prevalence of several AAS-HC significantly increased towards the older age group, such as insomnia (49.1%), low libido (37.3%), chronic pain (33.6%) and hypertension (24.5%).

#### 7.3.3.4 Occupational and non-occupational AAS users

The percentage of participants without AAS-HC was lower amongst occupational AAS users (17.4%) when compared with non-occupational users (29.5%). There was also a significantly higher percentage of participants with five or more AAS-HC amongst occupational users (51.4% versus 30%). Occupational users also reported a higher prevalence of anxiety (35.5% versus 22.5%), hirsutism (27.1% versus 9.7%), depression (27.3% versus 13.7%), chronic pain (23.5% versus 7.5%) and erectile dysfunction (22.3% versus 10.1%).

#### 7.3.3.5 Time of AAS exposure

Participants with AAS-years ≥ 5 reported a significantly higher prevalence of several AAS-HC when compared with more recent users, such as depression (28.3% vs 18.6%), dyslipidaemia (24.4% vs 14.3%), chronic pain (23.6% vs 14.7%) and low libido (20.7% vs 12.0%).

Table 9: WP2 - AAS-HC by participants'characteristics

| | Total | Assigned males at birth | | Assigned females at birth | | England and Wales | Northern Ireland | Scotland | Age: 16 to 25 y | Age: 26 to 35 y | Age: 36 y + | AAS-years: < 5 | AAS years: 5 + |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cis-Hetero | LGBTQIA+ | Cis-Hetero | LGBTQIA+ | | | | | | | | |
| **AAS-HC: n (%)[1]** | **883 (100)** | **502 (56.8)** | **125 (17.2)** | **204 (23.1)** | **41 (4.6)** | **608 (68.9)** | **157 (17.8)** | **108 (12.2)** | **380 (43.0)** | **387 (43.8)** | **110 (12.5)** | **322 (36.5)** | **341 (38.6)** |
| **Dermatological** | | | | | | | | | | | | | |
| Acne | 227 (25.7) | 125 (24.9) | 26 (20.8) | 49 (24.0) | 23 (56.1)** | 168 (27.6) | 37 (23.6) | 20 (18.5) | 119 (31.3) | 73 (18.9) | 34 (30.9)** | 122 (28.0) | 98 (24.1) |
| Hair loss | 228 (25.8) | 120 (23.9) | 25 (20.0) | 55 (27.0) | 26 (63.4)** | 134 (22.0) | 59 (37.6) | 35 (32.4)** | 100 (26.3) | 84 (21.7) | 40 (36.4)* | 109 (25.1) | 105 (25.9) |
| Hirsutism | 200 (22.7) | 105 (20.9) | 56 (44.8) | 28 (13.7) | 9 (22.0)** | 128 (21.1) | 46 (29.3) | 23 (21.3) | 85 (22.4) | 92 (23.8) | 22 (20.0) | 79 (18.2) | 109 (26.8)* |
| Striae | 132 (14.9) | 73 (14.5) | 22 (17.6) | 27 (13.2) | 8 (19.5) | 85 (14.0) | 26 (16.6) | 20 (18.5) | 46 (12.1) | 57 (14.7) | 27 (24.5)* | 51 (11.7) | 72 (17.7)* |
| Injection injuries | 115 (13.0) | 64 (12.7) | 21 (16.8) | 27 (13.2) | 2 (4.9) | 86 (14.1) | 15 (9.6) | 13 (12.0) | 23 (6.1) | 63 (16.3) | 28 (25.5)** | 39 (9.0) | 69 (17.0)** |
| **Any dermatological** | **601 (68.1)** | **322 (64.1)** | **118 (94.4)** | **117 (57.4)** | **38 (92.7)**** | **405 (66.6)** | **123 (78.3)** | **67 (62.0)*** | **253 (66.6)** | **265 (68.5)** | **77 (70.0)** | **269 (61.8)** | **297 (73.2)**** |
| **Orthopaedic** | | | | | | | | | | | | | |
| Muscle/joint injuries | 252 (28.5) | 130 (25.9) | 28 (22.4) | 60 (29.4) | 31 (75.6)** | 158 (26.0) | 59 (37.6) | 34 (31.5)* | 103 (27.1) | 106 (27.4) | 39 (35.5) | 114 (26.2) | 128 (31.5) |
| Spine injuries | 205 (23.2) | 110 (21.9) | 34 (27.2) | 29 (14.2) | 29 (70.7)** | 120 (19.7) | 62 (39.5) | 23 (21.3)** | 94 (24.7) | 78 (20.2) | 30 (27.3) | 88 (20.2) | 101 (24.9) |
| Chronic pain | 171 (19.4) | 82 (16.3) | 51 (40.8) | 30 (14.7) | 6 (14.6)** | 103 (16.9) | 37 (23.6) | 28 (25.9)* | 61 (16.1) | 73 (18.9) | 37 (33.6)** | 64 (14.7) | 96 (23.6)** |
| **Any orthopaedic** | **471 (53.3)** | **238 (47.4)** | **98 (78.4)** | **92 (45.1)** | **38 (92.7)**** | **295 (48.5)** | **115 (73.2)** | **57 (52.8)**** | **189 (49.7)** | **201 (51.9)** | **75 (68.2)*** | **199 (45.7)** | **241 (59.4)**** |
| **Endocrinological[2]** | | | | | | | | | | | | | |
| Testes hypotrophy | 101 (11.4) | 78 (15.5) | 20 (16.0) | | | 70 (11.5) | 17 (10.8) | 12 (11.1) | 45 (11.8) | 39 (10.1) | 17 (15.5) | 53 (12.2) | 46 (11.3) |
| Gynecomastia | 130 (14.7) | 95 (18.9) | 33 (26.4) | | | 76 (12.5) | 38 (24.2) | 25 (13.9)* | 59 (15.5) | 48 (12.4) | 23 (20.9) | 65 (14.9) | 56 (13.8) |
| Erectile dysfunction | 169 (19.1) | 99 (19.7) | 67 (53.6)** | | | 101 (16.6) | 43 (27.4) | 22 (20.4)* | 72 (18.9) | 76 (19.6) | 21 (19.1) | 74 (17.0) | 84 (20.7) |
| Clitoromegaly | 50 (5.7) | | | 21 (10.3) | 29 (70.7)** | 20 (3.3) | 24 (15.3) | 6 (5.6)** | 27 (7.1) | 17 (4.4) | 5 (4.5) | 27 (6.2) | 22 (5.4) |
| Breast atrophy | 50 (5.7) | | | 25 (12.3) | 25 (61.0)** | 26 (4.3) | 20 (12.7) | 4 (3.7)** | 27 (7.1) | 15 (3.9) | 7 (6.4) | 27 (6.2) | 22 (5.4) |
| Irregular periods | 62 (7.0) | | | 45 (22.1) | 17 (41.5)** | 41 (6.7) | 10 (6.4) | 11 (10.2) | 21 (5.5) | 25 (6.5) | 12 (10.9) | 25 (5.7) | 33 (8.1) |
| Low libido | 144 (16.3) | 81 (16.1) | 24 (19.2) | 32 (15.7) | 5 (12.2) | 102(16.8) | 20 (12.7) | 21 (19.4) | 38 (10.0) | 62 (16.0) | 41 (37.3)** | 52 (12.0) | 84 (20.7)** |
| Infertility | 16 (1.8) | 8 (1.6) | 2 (1.6) | 5 (2.5) | 1 (2.4) | 11 (1.8) | 1 (0.6) | 3 (2.8) | 1 (0.3) | 9 (2.3) | 6 (5.5)** | 5 (1.1) | 11 (2.7) |
| **Any endocrinological** | **457 (51.8)** | **225 (44.8)** | **113 (90.4)** | **74 (36.3)** | **39 (95.1)**** | **285 (46.9)** | **107 (68.2)** | **60 (55.6)**** | **191 (50.3)** | **191 (49.4)** | **69 (62.7)*** | **202 (46.4)** | **226 (55.7)*** |
| **Neuropsychiatric** | | | | | | | | | | | | | |
| **Insomnia** | 294 (33.3) | 160 (31.9) | 27 (21.6) | 74 (36.3) | 30 (73.2)** | 205 (33.7) | 59 (37.6) | 29 (26.9) | 114 (30.0) | 123 (31.8) | 54 (49.1)** | 149 (34.3) | 136 (33.5) |
| Anxiety | 284 (32.2) | 144 (28.7) | 42 (33.6) | 66 (32.4) | 30 (73.2)** | 175 (28.8) | 66 (42.0) | 43 (39.8)* | 115 (30.3) | 119 (30.7) | 45 (40.9) | 128 (29.4) | 142 (35.0) |
| Depression | 210 (23.8) | 96 (19.1) | 63 (50.4) | 35 (17.2) | 15 (36.6)** | 134 (22.0) | 50(31.8) | 23 (21.3)* | 81 (21.3) | 90 (23.3) | 38 (34.5)* | 81 (18.6) | 115 (28.3)** |
| Aggressiveness | 48 (5.4) | 33 (6.6) | 7 (5.6) | 6 (2.9) | 1 (2.4) | 34 (5.6) | 9 (5.7) | 5 (4.6) | 15 (3.9) | 15 (3.9) | 18 (16.4)** | 13 (3.0) | 33 (8.1)* |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Any neuropsychiatric** | **557 (63.1)** | **287 (57.2)** | **112 (89.6)** | **115 (56.4)** | **38 (92.7)**** | **366 (60.2)** | **123 (78.3)** | **64 (63.3)**** | **224 (58.9)** | **240 (62.0)** | **87 (79.1)**** | **251 (57.7)** | **274 (67.5)*** |
| **Other (cardiovascular, liver and kidney diseases)** | | | | | | | | | | | | | |
| Hypertension | 152 (17.2) | 77 (15.3) | 12 (9.6) | 39 (19.1) | 22 (53.7)** | 100 (16.4) | 35 (22.3) | 16 (14.8) | 71 (18.7) | 54 (14.0) | 27 (24.5)* | 73 (16.8) | 74 (18.2) |
| High haematocrit | 188 (21.3) | 100 (19.9) | 36 (28.8) | 23 (11.3) | 28 (68.3)** | 96 (15.8) | 66 (42.0) | 22 (20.4)* | 86 (22.6) | 69 (17.8) | 29 (26.4) | 87 (20.0) | 86 (21.2) |
| Dyslipidaemia | 170 (19.3) | 88 (17.5) | 31 (27.8) | 35 (17.2) | 14 (34.1)* | 101 (16.6) | 40 (25.5) | 28 (25.9)* | 62 (16.3) | 77 (19.9) | 27 (24.5) | 62 (14.3) | 99 (24.4)** |
| Liver diseases | 126 (14.3) | 71 (14.1) | 36 (28.8) | 15 (7.4) | 3 (7.3)** | 91 (15.0) | 21 (13.4) | 14 (13.0) | 44 (11.6) | 56 (14.5) | 25 (22.7)* | 49 (11.3) | 70 (17.2)* |
| Kidney diseases | 62 (7.0) | 27 (5.4) | 17 (13.6) | 16 (7.8) | 1 (2.4)* | 35 (5.8) | 17 (10.8) | 10 (9.3) | 16 (4.2) | 29 (7.5) | 16 (14.5)** | 23 (5.3) | 35 (8.6) |
| Other AAS-HC | 34 (3.9) | 13 (2.6) | 12 (9.6) | 8 (3.9) | 1 (2.4)* | 25 (4.1) | 4 (2.5) | 4 (3.7) | 13 (3.4) | 11 (2.8) | 9 (8.2)* | 8 (1.8) | 24 (5.9)* |
| **Any from this group** | **476 (53.9)** | **239 (47.6)** | **108 (86.4)** | **87 (42.6)** | **38 (92.7)**** | **296 (48.7)** | **119 (75.8)** | **56 (51.9)**** | **193 (50.8)** | **205 (53.0)** | **72 (65.5)*** | **201 (46.2)** | **246 (60.6)**** |
| **Number of AAS-HC in 12 months** | | | | | | | | ** | | | ** | | ** |
| None | 181 (20.5) | 115 (22.9) | 2 (1.6) | 58 (28.4) | 1 (2.4)** | 119 (19.6) | 25 (15.9) | 34 (31.5) | 102 (26.8) | 70 (18.1) | 9 (8.2) | 113 (26.0) | 65 (16.0) |
| 1 to 4 | 297 (33.6) | 192 (38.2) | 21 (16.8) | 81 (39.7) | 2 (4.9)** | 245 (40.3) | 29 (18.5) | 19 (17.6) | 102 (26.8) | 151 (39.0) | 44 (40.0) | 152 (34.9) | 132 (32.5) |
| 5 or more | 405 (45.9) | 195 (38.8) | 102 (81.6) | 65 (31.9) | 38 (92.7)** | 244 (40.1) | 103 (65.6) | 55 (50.9) | 176 (46.3) | 166 (42.9) | 57 (51.8) | 170 (39.1) | 209 (51.5) |

*Chi-square test, $p < 0.05$. 1: Percentages of valid responses. 2: Percentages of sex-specific endocrinological conditions are based on the number of male (M) and female (F) participants, separately.
AAS-HC: health conditions potentially associated with the use of AAS.

### 7.3.4 Sources of AAS-related information

As shown in Table 10, about half of the participants sought a GP for AAS-related information (49.2%) and to treat AAS-HC (55%). The other formal sources of support – Steroid Clinics, the NSP and Sexual Health Clinics – were most frequently sought for the treatment of AAS-HC than for information about AAS. A considerable percentage of users (42.7%) sought the A&E to treat AAS-HC, which was not included in the survey as a source of information. Online forums were the most common informal source of AAS-related information sought by the participants (18%), followed by self-conducted research on the internet – i.e., websites, video channels and scientific databases (17%). About one-third of participants (33.3%) sought online forums to help them treat AAS-HC, and a sizeable percentage of participants used their coaches/personal trainers (28.1%) and/or friends (25.5%) for similar reasons.

Table 10: WP2 - Sources of support for AAS-related information and treatment of AAS-HC

| **Sources of support: n (%)[1]** | **Information n = 883** | **Treatment n = 702[2]** |
|---|---|---|
| ***Formal sources*** | | |
| GP | 434 (49.2) | 386 (55.0) |
| Steroid Clinic | 205 (23.2) | 273 (38.9) |
| NSP | 198 (22.4) | 286 (40.7) |
| Sexual Health Clinic | 116 (13.1) | 279 (39.7) |
| A&E | - | 300 (42.7) |
| ***Informal sources*** | | |
| Online forums | 164 (18.6) | 234 (33.3) |
| The internet | 150 (17.0) | 146 (16.5) |
| Friends | 113 (12.8) | 179 (25.5) |
| Coach / Personal trainer | 101 (11.4) | 197 (28.1) |
| Supplier of AAS | 39 (4.4) | 48 (6.8) |

1: Percentages of valid responses. 2: Number of participants who reported one or more AAS-HC in the last 12 months. GP: General Practitioner. NSP: Needle and syringe exchange programme. A&E: Accident and emmergency.

### 7.3.5 Strategies to prevent and treat AAS-HC

As shown in Table 11, the majority of participants had blood tests to monitor their health in the last 12 months (86.4%) and used the services of the NSP (75.8%). Although the absolute majority of participants (88.8%) have disclosed the use of AAS to a GP, about half of them sought a GP for AAS-related information (49.5%) and/or to treat AAS-HC (55%) in the last 12 months.

#### 7.3.5.1 Sexes and sexual orientations

A higher percentage of female participants – regardless of sexual orientation or gender identity – adopted most of the strategies investigated by this study. A particularly higher percentage of LGBTQIA+ females sought a GP for AAS-related information (75.6%) and to treat AAS-HC (85.4%). Amongst the males, a significantly higher percentage of heterosexual participants sought a GP for AAS-information (49.4%) and to treat AAS-HC (59.4%) when compared with LGBTQIA+ participants (12.8% and 18.7%, respectively).

#### 7.3.5.2 Countries of the UK

The percentage of participants from Northern Ireland was significantly higher regarding having blood tests (93.2%), using the services of the NSP (89.8%) and disclosing AAS use to a GP (95.5%). However, seeking a GP to treat AAS-HC was less common amongst participants from Northern Ireland (44.7%) when compared with participants from the other countries of the UK.

#### 7.3.5.3 Age groups

The adoption rates of most health-related strategies was similar between participants from different age groups. However, the percentage of those aged between 16 and 26 years who used the services of the NSP (81.6%) and disclosed the use of AAS to a GP

(91.4%) was significantly higher when compared with participants aged 27 years or older (69.5% and 85.3%, respectively).

#### 7.3.5.4 Time of AAS exposure

Having blood tests was more common amongst those who used AAS for five years of more (88.4% versus 83.4%). The adoption rate of other health-related strategies was similar between those with different AAS-years.

Table 11: WP2 - Strategies to treat and prevent AAS-HC

| Strategies: n(%)[1] | Blood tests | NSP | sought a GP for AAS information | disclosed AAS use to a GP | sought a GP to treat AAS-HC[2] |
|---|---|---|---|---|---|
| Total = 883 (100) | 753 (86.4) | 661 (75.8) | 432 (49.5) | 774 (88.8) | 386 (55.0) |
| | * | | ** | | ** |
| Cis-Heterosexual MaB | 418 (83.3) | 372 (74.1) | 248 (49.4) | 441 (87.8) | 230 (59.4) |
| LGBTQIA+ MaB | 109 (87.2) | 94 (75.2) | 16 (12.8) | 106 (84.8) | 23 (18.7) |
| Cis-Heterosexual FaB | 187 (91.7) | 160 (78.4) | 137 (67.2) | 188 (92.2) | 97 (66.4) |
| LGBTQIA+ FaB | 39 (95.1) | 35 (85.4) | 31 (75.6) | 39 (95.1) | 35 (85.4) |
| | * | ** | | * | |
| England and Wales | 517 (85.0) | 453 (74.5) | 298 (49.0) | 530 (87.2) | 274 (56.0) |
| Northern Ireland | 146 (93.2) | 141 (89.8) | 71 (45.2) | 150 (95.5) | 59 (44.7) |
| Scotland | 89 (82.4) | 68 (63.0) | 62 (57.4) | 93 (86.1) | 50 (67.6) |
| | * | ** | | ** | |
| Age 16 to 25 | 336 (88..4) | 320 (84.2) | 192 (50.5) | 352 (92.6) | 141 (50.7) |
| Age 26 to 35 | 320 (82.7) | 270 (69.8) | 189 (48.8) | 335 (86.6) | 181 (57.1) |
| Age 36 + | 99 (90.0)* | 73 (66.4) | 47 (42.7) | 88 (80.0) | 58 (27.4) |
| | * | | | | |
| AAS-years < 5 | 363 (83.4) | 329 (75.6) | 217 (49.9) | 381 (87.6) | 178 (55.3) |
| AAS-years 5 + | 359 (88.4) | 306 (75.4) | 202 (49.8) | 361 (88.9) | 193 (56.6) |

1: Percentages of valid responses. 2: Amongst participants who reported one or more AAS-HC in the last 12 months (n = 702). Cis: Individuals who identify with the gender that was assigned to them at birth. MaB: Assigned male at birth. FaB: assigned female at birth. GP: General Practitioner. NSP: Needle and syringe exchange programme. AAS-years: estimated time of AAS exposure.

### 7.3.6 Logistic regressions: AAS-HC and health-related behaviours

All the IV showed a significant association ($p < 0.05$) with the DV in the univariate analyses and were included in the multivariable regression (Table V). The tests of multicollinearity indicated that all the IVs had an acceptable degree of multicollinearity (VIF ≤ 2.5) and could be used in the analyses. The multivariable model showed a significant improvement to the baseline model ($\chi^2 = 89.26$, $p < 0.001$), and able predict

15% of the variation in the outcome (Nagelkelrke $R^2 = 0.15$). Participants who had blood tests performed in the last 12 months (OR = 3.56, 95% CI 2.14 to 5.90, p < 0.001) or disclosed the use of AAS to a GP (OR = 3.74, 95% CI 2.12 to 6.62, p < 0.001) were about three times more likely to report at least one AAS-HC. Participants who sought a GP for AAS-related information were 74% less likely to report an AAS-HC in the last 12 months (OR = 0.26, 95% CI 0.18 to 0.40, p < 0.001).

Table 12: WP2 – Logistic regressions

| **Dependant variable**<br>1 or more AAS-HC in 12 months | **Univariable** | | **Multivariable**<br>$R^2 = 0.15$; $\chi^2 = 89.26$** | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **OR** | **SE** | **OR** | **SE** | **95% CI for OR** | **VIF** |
| **Having blood tests**[1] | 3.20** | 0.21 | 3.56** | 0.26 | 2.14 to 5.90 | 1.3 |
| **Using the NSP**[1] | 1.58* | 0.19 | 0.64 | 0.25 | 0.40 to 1.04 | 1.4 |
| **Seeking a GP for information about AAS**[1] | 0.40** | 0.18 | 0.26** | 0.29 | 0.18 to 0.40 | 1.2 |
| **Ever disclosed the use of AAS to a GP** | 2.93** | 0.22 | 3.74** | 0.29 | 2.12 to 6.62 | 1.4 |

*p < 0.05. **p < 0.001. 1: In the last 12 months. OR: Odds ratio. SE: standard error. AAS-HC: Health conditions associated with use of androgenic-anabolic steroids. VIF: Variance inflation factor. NSP: Needle and syringe programme. GP: General Practitioner.

## 7.4 Discussion

### 7.4.1 General considerations

We observed significant differences in the prevalence of AAS-HC and health-related behaviours between subpopulations of AAS users. Participants who sought a GP for information about AAS were far less likely to report an AAS-HC. Our findings underscore the need of interventions aiming to improve AAS users' access to health services and to train health professionals to recognise the most prevalent AAS-HC in different subpopulations.

### 7.4.2 Age and time of AAS use

The average age of participants (26 years) corroborates a high prevalence of AAS users between 21 and 30 years of age (Bonnecaze et al., 2020; Hope et al., 2016; McVeigh & Begley, 2017; Zahnow et al., 2017). The considerable number of younger participants in our sample raises concerns about the prevalence of AAS use amongst adolescents and young adults in the UK, and might be associated with the intensive advertisement of the survey in social media platforms. Online platforms, especially those relying heavily on visual content such as Instagram, Facebook and Snapchat are commonly employed by people using AAS and other IPEDs – namely young users – to display body-enhancement achievements (Underwood, 2017), share advice on strength-training and illegal trade of these drugs (Tighe et al., 2017; van de Ven & Koenraadt, 2017). As discussed in items 3.14 and 4.2.4, the intensive use of social media by the young population is associated with a high prevalence of body/muscle dissatisfaction and eating disorders (Griffiths et al., 2018). Although younger users might overlook the risks of long-term use of AAS, the high prevalence of problems such as low libido, depressive symptoms and dyslipidaemia amongst participants using AAS for more than five years underscores the risks of prolonged exposure to these drugs (Lindqvist Bagge et al., 2017; McCullough et al., 2021).

### 7.4.3 Occupational AAS users

Occupational AAS users are traditionally identified as professionals whose activities would benefit directly from the enhanced size, muscularity and strength provided by the use of AAS, such as security personnel and personal trainers (Antonopoulos & Hall, 2016; Hutson, 2013; Korkia et al., 1996; Larance et al., 2005; Monaghan, 1999). However, our

study shows that participants from a broad range of occupations consider that using AAS helps them improve their performance at work. This observation might suggest an expansion of work environments where the use of AAS and other IPEDs is becoming normalised or even encouraged (Hutson, 2013; Walsh & Van De Ven, 2022). Furthermore, if the desired effects of AAS are perceived as necessary to secure one's physical and/or economic safety, some users might neglect or refrain from disclosing and treating adverse effects (Hoberman, 2017). The high prevalence of occupational AAS users in our sample could also be explained by the approach adopted in this study, in which 'occupational use' was associated with the perceived benefits in the workplace of using AAS – instead of asking if the participants' main reason to use AAS was to improve their performance at work. Nevertheless, our findings highlight the importance to investigate the use of AAS in contemporary work environments.

### 7.4.4 Use of oral and injectable AAS

We observed a higher use of injectable AAS by males and of oral compounds by females, in keeping with other studies (Abrahin et al., 2017; Henning & Andreasson, 2021; Ip et al., 2010; Korkia et al., 1996). Women's preference for oral AAS – namely those not competing as strength athletes – has been attributed not only to concerns with the androgenic effects of injectable compounds (Kicman, 2008), but also to a perception that the use of injectables represents "crossing a line" towards self-identification as AAS users, associated with a use of higher doses and the stigma of using injectable drugs (Piatkowski et al., 2023). Besides, women displaying hyper-muscular physiques suffer even greater stigma than male AAS users (Ainsworth et al., 2022; Henning & Andreasson, 2021). For men, the normalisation of enhanced physiques, allied with established

networks of competition and peer support might enable a more 'serious' commitment with AAS use, represented by the use of injectables (Piatkowski et al., 2023). The high prevalence of exclusively oral use of AAS in our sample underscores the importance of improving the access of AAS users to health services beyond the NSP (van de Ven, Zahnow, et al., 2020).

### 7.4.5 Engagement with the health system

Overall, our sample reported a high level of level of engagement with health services such as GPs and the NSP. Some possible explanations include the questioning of treatment sources for unspecific health conditions (such as acne or insomnia) that would not require the participants to disclose the use of AAS, as well as the fact that the survey did not differentiate between primary NSP services and retail pharmacies providing syringe exchange. Female participants reported higher engagement with GPs for information and treatment of AAS-HC, as seen in previous studies (Augé & Augé, 1999; Havnes et al., 2021; Zahnow et al., 2017), and LGBTQIA+ males reported considerable lower levels of engagement with GPs when compared with cis-heterosexual males. Previous studies with gay men using AAS described a high prevalence of AAS-HC (Bolding et al., 2002; Ip et al., 2019), social pressures to have a muscular body, and a double stigma (being gay and using AAS) driving this population further away from health services (Griffiths et al., 2021). These findings are compatible with the high prevalence of mental health problems (Chakraborty et al., 2011) and other clinical conditions among the LGBTQIA+ population (Bancroft et al., 2005; Roberts et al., 2013; Smalley et al., 2017), and emphasize the need to increase the access of the LGBTQIA+ population to health services. These findings highlight that barriers for AAS users engaging with GPs

such as stigma and the lack of health professionals' knowledge about AAS (Dawson, 2001; Dunn et al., 2023; Hill & Waring, 2019; Pope et al., 2004; Zahnow et al., 2017) are experienced differently by subpopulations of AAS users. Therefore, populations whose engagement with the health system are already low, such as adolescents (Hargreaves et al., 2014), men and LGBTQIA+ (Thompson et al., 2016) seem to seek a GP even more rarely when using AAS (Amaral, Kimergård, et al., 2022). Recent interventions illustrate the benefits of training health professionals to support AAS users (Eu et al., 2023; van de Ven, Eu, et al., 2020), and further studies are necessary to assess their replicability.

### 7.4.6 Health-related behaviours and AAS-HC

We investigated the impact of health-related behaviours in the participants' likelihood of reporting AAS-HC. Participants who monitored their health with blood tests and disclosed the use of AAS to a GP were more likely to report an AAS-HC. As monitoring one's health with blood tests or disclosing their use of AAS to a GP are unlikely to increase the risk of AAS-HC, these results can be interpreted as follows: Either participants who previously experienced AAS-HC were more likely to have blood tests performed and/or disclose their use to a GP, or these behaviours increased their awareness about health conditions that would have otherwise remained unknown. Unfortunately, the order of these events was not investigated in this study. Participants who sought a GP for information about AAS were far less likely to report a recent AAS-HC, suggesting that the preventative interaction with health professionals has the potential to help prevent the occurrence of AAS-HC. The low goodness-to-fit of our model ($R^2$ = 0.15) highlights that many other factors can impact the likelihood of experiencing AAS-HC, warranting investigation by further studies.

### 7.4.7 Limitations

As a cross-sectional web-based survey, the main limitations of this study are sampling bias and the reliance on self-reported use of AAS and AAS-HC (Dillman, 2000). Most AAS-HC investigated in this study are not specifically related to AAS use and could have different causes. Other limitations include the prevalence of counterfeits and sub-standard AAS used by this population (Evans-Brown et al., 2009; Magnolini et al., 2022). In attempts to reduce the time required to complete the survey, several aspects of unprescribed AAS use that could influence our results were not included in the instrument, such as the diagnosis of BBV and the use of other psychoactive substances. A financial incentive to participate, as well as the public sharing of the survey link increased the risk of automated or multiple responses (Storozuk et al., 2020), although efforts were taken to prevent automated responses. Although we made no use of validated instruments for the assessment of health conditions, the survey's questions were based on similar investigations with AAS users (Begley et al., 2017; Jacka et al., 2019; Zahnow et al., 2017) and piloted with volunteers from different age groups, including users and former users of AAS, to improve clarity.

### 7.4.8 Implications for research and healthcare

Nearly half of AAS users in our sample experienced five or more AAS-HC in the last 12 months, and the majority of participants had blood tests to monitor their health and/or sought a GP to treat AAS-HC. LGBTQIA+ people using AAS showed an increased prevalence of several AAS-HC, and LGBTQIA+ males, lower levels of engagement with health services. Seeking a GP for information about AAS seemed to reduce the likelihood of experiencing AAS-HC, highlighting the need to improve the knowledge of health

professionals about AAS. These findings can be used to support research and interventions aiming to improve the access of AAS users to the health system, namely by identifying health conditions and health-related behaviours adopted by subpopulations of AAS users.

# 8. WP3 – Risk-management strategies adopted by people using AAS: A qualitative analysis

*Risk is the intentional interaction with uncertainty* (Cline, 2015)

Following the conclusion of WP2, in-depth interviews were performed to investigate the strategies adopted to prevent, treat and minimise harms associated with the use of AAS. The risks associated with the use of AAS were extensively discussed in chapter 3 of this thesis, and were grouped by Mullen et al. (2020) accordingly to the possibility of harms to users' physical, mental and social health – an approach rooted on the biopsychosocial model of disease (Engel, 1981). This distinction highlights that different aspects of peoples' lives can be affected by the use of AAS. Furthermore, these harms can be and ranked as mild, moderate and severe (Pope et al., 2014), as seen in Table 12.

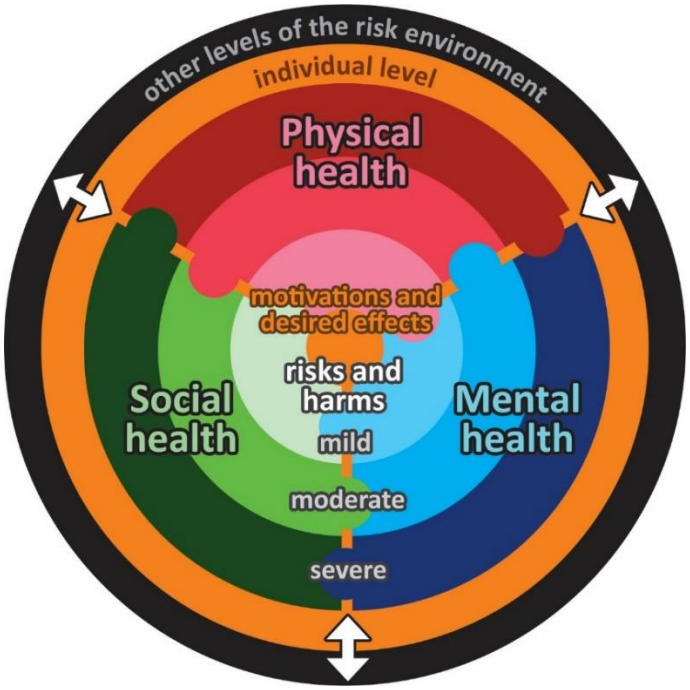
Table 13: WP3 - Examples and severity of AAS-related harm

| | Mild (common) | Moderate (uncommon) | Severe (rare) |
|---|---|---|---|
| **Physical health** | acne, dyslipidaemia | infertility, kidney failure | myocardial infarction, neoplasia |
| **Mental health** | insomnia, reduced empathy | anxiety, aggression | severe depression, suicide |
| **Social health** | excessive time spent in body-enhanced activities | anti-social behaviour, illegal activities (e.g. supplying AAS) | imprisonment, domestic violence |

The individual motivations, risks and harms experienced by each AAS user – as well as their strategies to prevent and treat AAS-HC – interact with the other layers of the socioecological risk environment of AAS use (Bates, Tod, et al., 2019; Rhodes, 2002). From a top-down level, factors such as the access to health services and the prevalence of AAS in a community might influence the prevalence of harm and the strategies adopted to handle adverse effects. From a bottom-up perspective, individual

experiences and strategies are disseminated and incorporated by other AAS users, whilst a demand for support can stimulate the provision of services such as NSP units and steroid coaches (see Figure 31). The actions involved in this dynamic process of identifying, monitoring and controlling risk are known as risk-management strategies (RMS; Wolke, 2017).

Figure 32: WP3 - Dimensions of AAS-related risks and harms




The development of RMS are an intrinsic part of drug use (Manning, 2007; Strang, 1992), and are seen amongst users of different substances – from methods to treat alcohol 'hangovers' to the prevention of dehydration and overheating associated with the use of 'club drugs' (Greenspan et al., 2011; Keeling et al., 2013; Soussan & Kjellgren, 2014). As discussed in chapter 4, many of the strategies adopted by people using AAS are based on self-experimentation, with scarce evidence of their ability to prevent negative outcomes of AAS use (Andreasson & Johansson, 2016; Cohen et al., 2007; Tighe et al., 2017). As such, these strategies are frequently dismissed as *broscience* or empirical attempts to legitimise drug use (Bilgrei, 2018; Monaghan, 1999; Santos & Coomber,

2017). Some authors, however, perceive the users' experiences as opportunities to support the implementation of harm-reduction practices for people using AAS (Harvey et al., 2019; Underwood, 2021). This approach is aligned with the recommendations of the Black report (C. Black, 2021), underscoring the importance of understanding the behaviour of people using drugs to inform evidence-based policies, including peer-led interventions.

The adoption of RMS reflects a tension between two approaches to AAS use. On the one hand, the prohibitionist framework adopted by medical guidelines and anti-doping organisations such as WADA perceives the use of AAS for enhancement purposes as essentially pathological and harmful not only for the users but to society as a whole (Backhouse et al., 2018). The goal of those advocating the prohibition of AAS is to prevent the use of AAS for enhancement purposes and support the abstinence of these substances. Following this approach, the only reasonable RMS would be to encourage cessation of AAS use and promote drug abstinence, whilst punishing the illegal use of AAS in professional and recreational sport (Backhouse et al., 2007). On the other hand, whilst acknowledging the risks of AAS use, a harm-reductionist approach aims to prevent the occurrence of severe negative outcomes whilst drug abstinence cannot be achieved (Ball, 2007; Karoll, 2010; Levengood et al., 2021; McCambridge & Strang, 2004; Stockings et al., 2016). For instance, the provision of intramuscular injection equipment by the NSP is likely to reduce the prevalence of infection from blood-borne viruses and injection-site injuries amongst people using AAS (Kimergård & Mcveigh, 2014). Likewise, the prescription of medication by a GP to an AAS user diagnosed with dyslipidaemia and high blood pressure is likely to reduce the likelihood of harm – such as myocardial infarction – even if the user is not prepared or willing to stop using AAS. As discussed in

chapter 4, however, the strategies adopted by AAS users are not limited to harm-reduction practices, and can include adjusting doses of AAS, having blood tests to monitor their health and following the advice of a 'steroid coach'. This approach is based on the fact that, from a user's perspective, the primary goal of using AAS is not to reduce harm, but to obtain the benefits of AAS for the purposes the drugs are being used. Secondarily, with different degrees of commitment and efficacy (Christiansen et al., 2017), is the intention to manage risks and harms associated with AAS use. The perception of risk as an intentional interaction with uncertainty (Cline, 2015) also allow us to approach AAS users as consumers of potentially harmful but also rewarding substances. As such, people using AAS or other substances are unlikely to change their consuming habits if the perceived benefits of the drugs outweigh the harms. Like other recreational drug users, however, people using AAS are more likely to change their habits according to their RMS after experiencing harm or changes in life circumstances (Christian et al., 2023; Eu et al., 2023; Havnes et al., 2019). We hypothesised that these episodes of increased flexibility in behaviour (S. Thompson et al., 2011) can be used in association with AAS-related RMS to identify opportunities to reduce harm and improve the health of people using AAS.

## 8.1 Objectives

The primary goal of this study is to describe and discuss the RMS adopted by a cohort of people using AAS. The secondary objectives are to investigate the participants' experiences with health services and other sources of support, as well as identify opportunities for health interventions based on behavioural changes described by the participants.

## 8.2 Methods

### 8.2.1 Study design

To fulfil the objectives above, a qualitative study was designed based on semi-structured interviews. Data from an online survey (WP2), was used to identify and select AAS users willing to take part in the interviews, as well as to indicate risk factors associated with AAS and RMS that should be addressed in the interviews. This complementary role of qualitative and quantitative studies is a useful way to investigate complex behaviours (Neale et al., 2005; C. Pope & Mays, 1995), allowing us to investigate the participants' experiences with the RMS quantitatively measured in WP2.

### 8.2.2 Ethical considerations

Given the sensitive nature of the topics discussed in this study, such as the use AAS and health conditions, we recommended the participants to complete the interviews in private, preferably wearing headphones, and advised them that some questions might trigger strong emotions. As detailed in the participants information sheet (Appendix 4), interviewees were made aware that if they presented concerns with their mental health, signs of emotional distress, current or future intent to harm themselves or others, the researcher would stop the interview and offer details of sources of support such as the NHS emergency numbers (111 and 999) and Samaritans. All of the information provided by the interviewees was anonymised and stored in accordance with the UK Data Protection Act 2018. The participants were made aware that data confidentiality could be broken if the researchers had reason to believe there was a risk of self-harm or harm

to others. Ethical approval was obtained from King's College London Psychiatry, Nursing and Midwifery Research Ethics Subcommittee (Reference HR-20/21-22034).

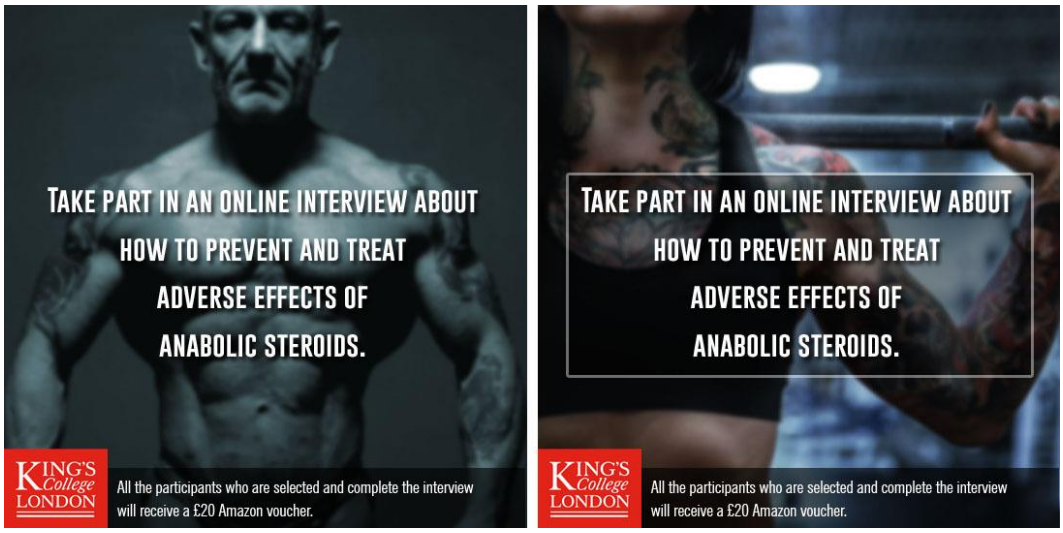
### 8.2.3 Recruitment of participants

We aimed to recruit a sample with maximum variation and a range of different backgrounds – such as sex at birth, age groups, region of residence and time using AAS (AAS-years) – in an attempt to observe a range of perspectives regarding the research questions (Gilburt et al., 2015). Based on similar studies (Kimergård et al., 2020; Lynch et al., 2019; Neale et al., 2017; Parkin et al., 2021; E. Roberts et al., 2020) and the number of health strategies and demographic variables investigated by this study, an estimated number of 20 to 30 participants would be required to achieve this goal. The inclusion criteria were similar to those required to take part in WP2 – being 16 years old or more, living in the UK at the time of the study and having used AAS in the last 12 months without a medical prescription.

The recruitment of participants was performed in two stages. In the first stage, potential interviewees were selected amongst the respondents of the online survey who agreed to be invited for an interview. Following the exclusion of invalid e-mail addresses, the selection sample was divided in eight groups, based on the respondents' sex assigned at birth and location of residence, i.e., males and females from England, Northern Ireland, Scotland and Wales. Next, each group was ranked by the number of different RMS adopted in the last 12 months and by the number of years since their first use of AAS (AAS-years). The four higher-ranked individuals of each group were invited via e-mail to take part in the interview. Each invitation was repeated after a week and then the next high ranked members of each group were invited. Next, a non-ranked invitation was

sent to all the remaining members of the selection sample. By the end of this process, the number of participants was considered insufficient and a second stage of recruitment was performed. In that stage, participants were recruitment via invitations published in online forums and social media platforms (see Figure 32), following the same inclusion criteria described above. People willing to take part were directed to an online form and invited to inform their age, sex assigned at birth, country of residence in the UK, AAS-years, and to provide an e-mail address. Those selected to participate were asked to invite their acquaintances by sharing the link to the study. The recruitment of participants continued until the number of participants was considered sufficient to exemplify the adoption of the RMS investigated by the study.

Figure 33: WP3 - Images used to advertise the study in social media




### 8.2.4 Data collection

The semi-structured interviews were composed of five domains. The first domain covered the participants' first use of AAS, including their history of strength-training prior to AAS use, their first sources of information about the drugs and their knowledge about AAS-HC. The subsequent domains addressed how the participants identify and

prevent harm associated with the use of AAS, followed by questions about their engagement with the health system and other sources of support such as online forums, coaches and suppliers of AAS. The fourth domain explores the impact of the consequences of the COVID-19 pandemic – such as the lockdown measures and the closure of gyms – in the participants' use of AAS and RMS. Finally, the participants offered suggestions on how to improve the support provided by people using AAS in the UK. The participants' information sheet can be found in Appendix 5, and the topic guide in Appendix 6. Before each interview, the participants were reminded of the purpose of study, data security measures, their right to refuse to answer any question and to interrupt the interview at any point. Verbal informed consent and permission to record the interview were obtained from all participants. All the interviews were performed online via Microsoft Teams and were conducted by the authour of this thesis.

### 8.2.5 Data analysis

Transcriptions of the interviews were automatically generated on Microsoft Teams, revised by the authour of this thesis and verified by the supervisors using the videos recorded during the interviews. The information provided by the interviewees was analysed following the principles of framework (Ritchie & Spencer, 1994) and iterative categorisation (Neale, 2016, 2021). Following familiarisation with the data, a thematic framework was developed based on deductive themes derived from the interview's domains and inductive themes that emerged from the data. Indexation of the labels (codes) assigned to each theme was performed on NVivo 1.7. Recurring themes, patterns and emerging themes were recategorised and refined into the final structure of themes used to describe the data (see Appendix X). During descriptive analysis, a

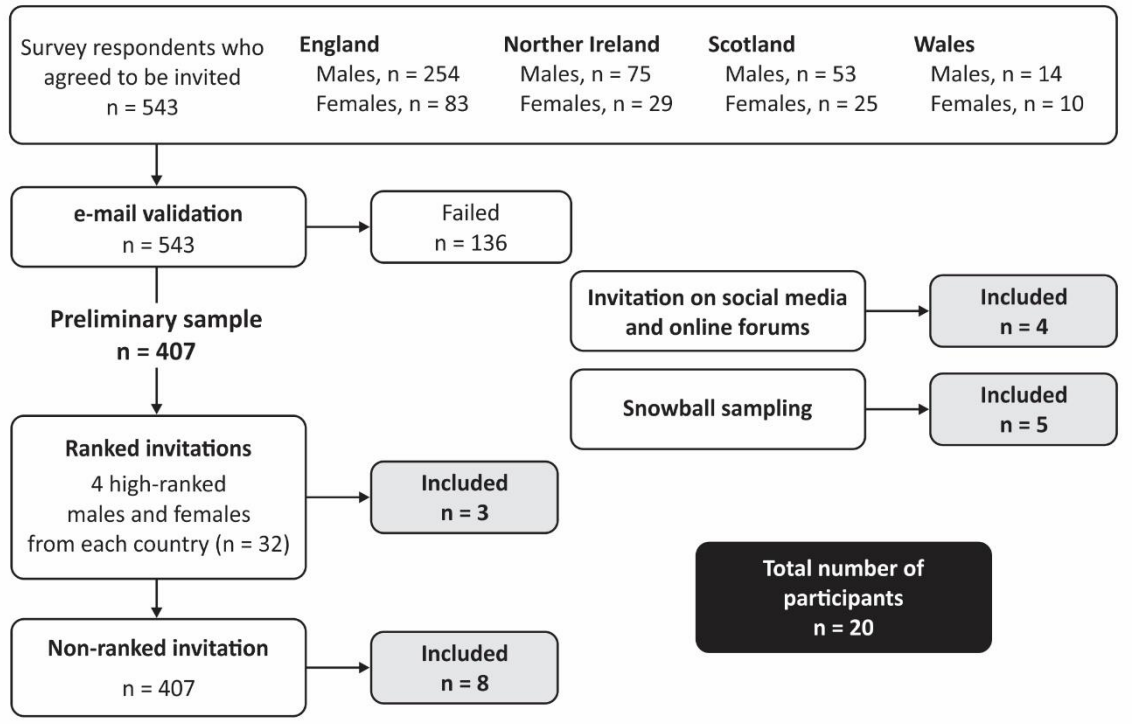
summary of each code as bullet points was created in a Microsoft Excel spreadsheet to facilitate associations between participants' data. Next, we sorted the participants' RMS in three groups – (i) Risks of early exposure to AAS; (ii) Lower doses and safer routines of AAS use; (iii) Seeking help from formal and informal sources – to analyse them in the light of available evidence.

## 8.3 Results

### 8.3.1 Summary characteristics

Amongst the respondents of the online survey (n = 883), 543 participants (61.5%) agreed to be invited and were contacted in order to verify the validity of their e-mail addresses. Following the exclusion of 136 (25.0%) invalid e-mail addresses, the remaining potential participants (n = 407) were divided in groups, ranked and invited accordingly to the procedures described in item 8.2.3. Eleven participants of the online survey agreed to take part in the interviews, four interviewees were selected via invitations on social media and online forums, and five selected via snowball sampling. A summary of the recruitment process can be seen in Figure 33. Twenty interviews were performed between November 2021 and March 2022, with an average duration of 49 minutes (37 to 114 minutes).

Figure 34: WP3 - Recruitment process




The sample was composed of 19 males and one female, the majority of them residing in England (see Table 13). The average age of participants as 39 years (26 to 58 years old). The one female and 13 males were heterosexuals, six males were either homosexuals or bisexuals and one preferred not inform his sexual orientation. All the participants were from white ethnicities apart from two British-Asian males. On average, the participants started using AAS when they were about 25 years old (18 to 39 years) and have been using AAS for about 8.5 years – from a minimum of less than one year and maximum of 36 years. All the males were using either injectable AAS or a combination of oral and injectable compounds, and the only female participant [P03] had used only oral AAS. The participants had different types of involvement with strength sports, such as recreational strength training, bodybuilding and powerlifting. Five of them (P05, P09, P15, P18 and P19) were competitive athletes in their modalities.

Table 14: WP3 - Summary characteristics of participants

| ID | Sex | Age | AAS-years | Country of residence | Occupation | Strenght-sport participation |
|---|---|---|---|---|---|---|
| P01 | male | 35 | 10 | England | Teaching assistant | Strongman |
| P02 | male | 54 | 36 | Wales | Senior manager | Bodybuilding |
| P03 | female | 27 | 1 | England | Researcher | Powerbuiling |
| P04 | male | 28 | 5 | England | Maintenance engineer | Strenght training |
| P05 | male | 30 | 5 | Scotland | Gym staff | Para-Powerlifting (C) |
| P06 | male | 32 | 8 | England | Funeral director | Strenght training |
| P07 | male | 57 | 30 | England | Train diver | Powerlifting |
| P08 | male | 41 | 20 | England | Technology director in healthcare | Strenght training |
| P09 | male | 26 | 1 | England | Sales manager (ex-Police Officer) | Bodybuilding (C) |
| P10 | male | 53 | 28 | England | Administrator | Bodybuilding |
| P11 | male | 58 | 26 | England | Marketing director | Bodybuilding |
| P12 | male | 46 | 8 | England | Medical Doctor | Strenght training |
| P13 | male | 36 | 1 | England | Construction manager | Bodybuilding |
| P14 | male | 28 | 10 | England | Preferred not to say | Bodybuilding |
| P15 | male | 31 | 3 | Scotland | Personal trainer | Powerlifting (C) |
| P16 | male | 32 | 6 | Scotland | Project manager - oil & gas | Strenght training |
| P17 | male | 52 | 28 | England | Personal trainer | Strenght training |
| P18 | male | 29 | 19 | England | Personal trainer | Bodybuilding (C) |
| P19 | male | 52 | 23 | England | Sports physiologist | Powerlifting (C) |
| P20 | male | 40 | 14 | Scotland | Healthcare assistant | Bodybuilding |

AAS-years: estimated time of AAS use. C: Competitive athlete.

### 8.3.2 Strength-training background

The sample was composed of six competitive strength athletes in bodybuilding, strong men or powerlifting, and fourteen recreational gym goers. Most of those involved in strength-sports competitions and some of the recreational athletes trained in gyms providing specialised equipment for their disciplines. Some participants highlighted their preference for training in the company of other strength-athletes:

> You feel more comfortable because you're in an environment where a lot of the other people have the same objectives (…) So you don't feel like the exception, as you do in commercial gyms where people are more focused on keeping fit, as opposed to specifically bodybuilding [P11].

### 8.3.3 The first use of AAS and early health strategies

The average age of participants' first experience with AAS was 25 years (minimum = 18, maximum = 36). Their use was motivated by a variety of reasons and with different degrees of preparation and concern about AAS-HC. We could not observe a clear association between motivations to use AAS and general trends of RMS. For instance, there were reports of minimal preparation and as little as one year of natural strength training, regardless of deciding to use AAS to improve body image or to take part in bodybuilding competitions,. A participant who started using AAS when he was 18 years old after three years of natural training, said that:

> I just wanted to get bigger, to be fair. And everyone around me was sort of doing it [using AAS] and at the time it seemed right, you know? I just thought I'd try it, yeah? (…) No one offered me any proper advice, no. Only basic information, from friends or friends of friends, things like that. Little bits and bobs, like gyno [gynecomastia ] and stuff like that. Just basic stuff. [P14].

Likewise, a bodybuilding competitor who started AAS use at 20 years of age, used the drugs after a single year of natural training and now works as an online coach recalls:

> I fell in love with [bodybuilding] very, very quickly (…) If I could go back, I would explore a few more years of natural training, definitely (…) I actually messaged the lad [the steroid supplier] and I ask him for some steroids. He gave me a bottle of test enanthate and a bottle of Equipoise. I didn't have a clue what to ask [the supplier] for, I just asked him for "a cycle". So he gave me that. [P18].

On the other hand, some participants trained natural for up to 24 years [P19] before taking AAS to improve their performance in powerlifting competitions, or trained drug-free for 18 years [P20] before considering they needed AAS as the *next step* to improve their gains in muscle development. One participant informed how, during the COVID-19 lockdown, he decided to use AAS after 15 years 'on-and-off' the gym:

> I got really out of shape. I just felt rubbish, so I wanted to turn my health and fitness around (…) being a bit older [35 years], I knew that I wouldn't be able to shift weight and my body wouldn't be as adaptive as it used to be, so I used steroids to assist me. [The COVID-19 lockdown] definitely gave me time away from work to research and look at things online and make my decision [P13]

A few participants identified body-image issues as indirectly influencing their decision to use AAS – such as lacking confidence, being over/underweight or the pressure from friends – namely amongst LGBTQIA+ males. One participant associated their decision to use AAS with some sort of body dysmorphia.

> I understand that I do it [use AAS] because of body dysmorphia (…) During a cycle I would really become very muscular. My weight would increase by about 15 kilos in four or five months and I was really big. I was muscular, very well defined. But when I would see myself in the mirror and I wouldn't see a very muscular body. I would always see myself small. [P06].

Only three participants reported an absence of AAS-HC after their first cycle, which they attributed to having a good amount of information about AAS and the use of what they considered very low doses of the drugs. Despite experiencing some mild AAS-HC during

their first cycle, several participants said they were happy with the advice received or found through self-conducted research – such as P10, who used AAS for the last 28 years.

> In those times the Internet was still not a household item. So my research was done predominantly with the man who supplied it, who advise me how to take the course, how much to take, and the duration, and that was coupled with a few readings from the books from the library. I was quite happy with it, because this gentleman was a bodybuilder himself, and he had a lot of knowledge of how to take steroids and what to take. Being a first time user, you're quite inquisitive as to what it does, the adverse effects and what to take. So it was almost like being advised by a doctor in some way. I was quite happy with it and quite confident after having a lengthy conversation with him about it. [P10]

One of the participants was interviewed during his first experience with AAS.

> I'm really new to this. I started [using AAS] last year, on [about 14 months ago]. I've been on what they call Blast and Cruise. Maybe out of the last 14 months, I spent I would say… 12 weeks at higher dose and the rest of the time I've been on a low-dose testosterone, like a TRT dose. [P13]

This man reported a positive experience with the advice received from his coach, although some adjustments were required after the onset of adverse effects. Below, he also describes how he managed the AAS-HC.

> I used an online coach. He gave me advice [on how to prevent adverse effects]. He mentioned drugs like metformin, telmisartan and things like

> regular blood checks, monitor blood pressure, monitor my blood glucose weekly, that sort of thing (…). A few months ago, I used a low dose of Trenbolone for about six weeks, and I suffered from some mental side effects. Anxiety, paranoia, night sweats. I was in like a cutting cycle. I was using testosterone, trenbolone, T3 and clenbuterol. (…) Once I notice the side effects I stopped using their T3, the Clen and the Tren and lowered my dose of testosterone back to cruise, like 150 mg [per week] and just sort of recovered on my own. It took about five weeks [to recover]. [P13]

Others had a negative evaluation of the advice they received on how to prevent AAS-HC. P02, who start using the drugs in the 1980s, described the challenges he faced in his first cycle:

> My friend gave me a handwritten note and a carrier bag with the steroids in them. There was more advice about what to eat than what the steroids were going to do, or what the side effects would be (…) so I started a pyramid cycle with oral Dianabol (…). I would be off every six weeks and I would probably lose about 75% of the gains that I had made, and feel like shit for about 3 weeks. I look back at it now and I just think… how silly this was. There was no PCT involved at all. After that, there was the [Daniel Duchaine's] Underground Steroids Handbook. It was good because there was nothing else available, but it was almost kind of broscience that you would listen to somebody who done it. But as far as milligrams or [duration] of your course, nobody knew what they were doing. [P02].

A similar account was given by P07, who had his first cycle 30 years ago:

> I first took [AAS] at the age of 27. There was no Internet, no nothing (…), so things like PCT, anything… that was not known about. I had nothing to read and I think that using [AAS] was a hush-hush thing… I never told anyone about it. I mean, now you can go online and buy them. Then it was an underground thing. You looked for the biggest person in the gym and thought… "He must know someone". And that's how we did it. So I never knew nothing about the backside of [using steroids]. You know, the protection, or precautions... I was fortunate that I got no adverse side effects at that first time, apart from a few spots. [P07]

Despite the ubiquitous access to online resources, recent AAS users also mentioned a lack of reliable advice. This was the case of P18, who had his first experience with AAS in 2012:

> The advice I had [about how to prevent adverse effects] was very, very basic. Just take three [tablets of] milk thistle. That's all anybody gave a shit about. Now people know that's actually just putting up a band aid on an open fracture. But that's all I was advised. Take milk thistle, it's good for your liver. You'll be good to go. [P18]

Overall, the participants described different degrees of preparation and self-conducted research about AAS and harm-reduction strategies before using the drugs for the first time. Following an equally diverse range of AAS-HC after that experience – including no adverse effects as all – almost all of them kept using the drugs and regarded any negative experiences as a normal aspect of AAS use, characterised by trial and error.

### 8.3.4 Identifying and managing risks

The participants mentioned several factors associated with AAS use that can have an impact on their health. These include their routines of AAS use, their access to substances, practices of harm-minimisation and social risk environments such as bodybuilding and untested sports competitions.

#### 8.3.4.1 The benefits of a late start

Many participants highlighted the risks of an early exposure to AAS. That was the case of P08, who started using AAS after two years of strength training.

> I definitely didn't have enough training experience before my first cycle. One of the regrets I have is that I wish I waited a lot longer. If I was going to use those substances again, I would want to really maximize all of the other training variables and lifestyle variables before doing that. [P08]

Amongst the training and lifestyle variables mentioned by P08, other participants corroborated the importance of incorporating the habit of strength training in one's routine and the establishment of practices to reduce harm and maximise the effects of AAS. This was the advice received by P02, a 54 years old male who used AAS for the last 26 years:

> Stay off them [AAS] for as long as you can. Train properly, eat properly and then make a decision to see whether you want to start. I felt like… "Blood hell" (…) As time goes on it, it's proved that that the longer you can hold off and train naturally the better the effects, and the more longevity you get, you don't down regulate, and you don't reach that kind of training plateau. [P02]

Although a prolonged period of drug-free strength training was unanimously referred as beneficial, the participants considered hard to ascertain a certain age or time of natural training as a threshold for a safer debut in AAS use.

> I'm not sure. I would never say it's completely safe [to use AAS]. There's always a risk, so I can't say there's a safe time. What I would say is explore your own strength. If you have confidence in your training program, when you are smart with how you train, you will know when you have reached your potential. [P15]

> I'm not trying to be evasive, but I think it's more about attaining knowledge and understanding rather than an amount of time. I think an average person… If they get their diet, their training and their recovery right… and an understanding of their body and their own biology... I think 5 years of hard training regularly, with a lot of commitment. [P08]

One of the participants, a 52 years old sports physiologist and competitive powerlifter who started using AAS at 39 years of age, suggested an indirect assessment of one's commitment with training, based on their ability to perform specific exercises.

> If someone says to me… "Hey man, I want to take a cycle. What should I do?" The first thing I'd ask is "How much do you bench, how much you squat, how would you deadlift? If you're not benching your body weight, squatting and deadlifting twice your body weight, go back in the gym, eat well, train hard. You don't need anything". [P19]

#### 8.3.4.2 Small doses

Several participants mentioned the benefits of using the smaller possible amount of AAS to achieve their desired results. There were frequent reports of how reduced doses of AAS could produce similar amounts of muscle growth with less adverse effects.

> I've done some more working with myself and realized that I was just taking too much [AAS], and actually you're wasting time. 'Cause it doesn't increase your strength… If I took 1 mL or took 3 mL it doesn't mean I was extra stronger. (…) You're just being like a sponge. It was based on the online forums that I upped my dosage. And I got spots, even in the back of my head. (…) Also the more I took, [the more] my sexual drive went down. [P07]

> I follow this 'safe use model' made famous by [name]. It's basically just the approach of using the minimum effective dose and using the safest possible compounds. Choosing your drug specifically based on the safety profile of the results it gets. (…) It's basically about spreading your risk and reducing the total exposure as much as possible. Then you might say "Yes, maybe I could get 10% better results by doubling that dose, but that's a pretty terrible risk reward ratio". [P09]

This advice was particularly common amongst the older participants and those who were using the drugs for more than 20 years.

> I think I didn't have many [AAS-HC] because of the controlled amount that I have used. I always set myself a limit, because I know that if I go used to excessive amounts that will cause me adverse effects. It would obviously

> cause liver failure, heart failure and a whole array of adverse effects with my body, so I always managed to keep to a strict control measure of steroids. A strict regime, strict numbers. [P10]

One of them observed that this approach required a different mind-set towards his relationship with body-image and the outcomes of strength training.

> I found out the hard way that you don't need as much [AAS] as people think you need. And the only way I found that is by not being attached to the outcomes anymore. When you're a youngster and when you're really keen, you've got this "all or nothing" approach. You say "If I am doing it, I might as well do a high dose". If you keep thinking… "I've gotta be bigger, I've gotta get stronger", Then you'll be taking more and more. (…) No, I thought… You know what? I'm gonna experiment with a low dose. And if it doesn't work, then what have I got to lose? I really didn't care about my appearance as I used to. I just love training. And I actually realized I didn't lose anything. I started experimenting with really low doses and then finding out that the low dosage can get as much if not better results than the high dosage. [P09]

#### 8.3.4.3 Cycling, Blast & Cruise and TRT

There was a clear polarisation between participants regarding the main routines of AAS administration. Nearly half of them (n = 11) adhered to cycles of AAS use followed by with an off period associated with PCT, whilst the rest (n = 9) followed the BaC regime. The BaC regime was seen by those supporting cycling as an important risk factor for AAS-HC and for the need of permanent use of AAS.

> The [BaC] is gonna keep your testosterone shut down for a long time, which means that your chances of having a permanent shutdown is quite inevitable. If you go for blast and cruise, you will go on long term TRT. [P10]

> No, I don’t like it [BaC]. It's a complete farce. People do it for because they're scared to come off (…) I mean, what's that? I know people who are cruising on the same amount that I would take when I'm on [cycle], and they think that they're cruising. [P17]

On the other hand, some participants considered the BaC regime to be more beneficial to their health and overall performance.

> Coming off [AAS] doesn't make sense to me. (…) I feel completely normal on a TRT level. (…) If you want to conceive a child, or if you are completely done with bodybuilding altogether, yeah, go for it. Restart your natural production [of testosterone]. You often hear the stories now that people are more than happy to accept that they will be on testosterone for the rest of their lives. That small injection you have to do, maybe twice a week it's going to give you such a better quality [of life]. Why you would choose to not do that? When you have on-and-off cycles you're gonna force your body into a state of where it doesn't know what it's doing. The hormones are all over the place while you try and rebuild them. [P18]

> I don't even come off of testosterone anymore. I have three courses a year, where I go above a TRT dose. (…) I'm 54 [years old]. I've got children. I'm not really obviously bothered about fathering another child. So, as far as I'm concerned, for me it's more beneficial to stay on [AAS] and to have regular checks on my blood than it is to come off. I'd much rather stay on a small doses of testosterone throughout my life until I die, then come off and watch myself slowly turn into a creeping massive old man. [P02]

#### 8.3.4.4 Counterfeits

A few users described their experiences with counterfeits or low-quality substances, including AAS and PCT drugs. To minimise the risks of using these types of substances, some participants utilised testing kits – which can be easily bought online – but most of them relied on a relationship of trust with their providers. One participant reported subcutaneous lumps after using HCG, which '*took weeks to dissipate*' [P10]. Routine use of testing kit was rare amongst the sample, namely due to the cost of the kits and the limited information they provide, as *'these tests don't tell you the dose or the strength of [AAS], only if a compound is there or not'* [P20]. Overall, the risk of using a substance with unknown composition was accepted as inherent to unprescribed AAS use. If they could perceive the expected results – included patterns of adverse effects associated with specific substances – most people would assume that the AAS were legitimate.

> I haven't had any experience with it myself, but I know people that have bought things and there's been no change in their bodies in eight weeks. They doubled the dose of what they should be doing and they're still not

> getting it (…) It's one of those type of things that you've got to have a reasonable relationship with the person you get your stuff from. But I think the younger people, they get drawn into it with the magic of it. And you know, even though it's placebo they'd probably be feeling they're getting stronger. Because they're probably eating better, they're trying to train harder. So they will almost be imagining that they're getting this superhuman ability. But they are chewing down chalk. [P02]

> One of my really good friends, he ordered a testing kit. And one of the tests the compound that he tested for was actually a completely different compound they said it was. They had completely mislabelled it… I don't know whether intentionally or unintentionally. [P01]

#### 8.3.4.5 Trenbolone

Although the use of specific substances was not inquired during the interviews, several participants spontaneously mentioned the risks associated with the use of trenbolone. This drug's esters such as trenbolone acetate and trenbolone enanthate are used in livestock to increase muscle growth (National Center for Biotechnology Information, 2023). This drug is considered an AAS with very high anabolic properties and has been associated with frequent reports of severe adverse effects, namely insomnia, vivid nightmares and behavioural changes (Gilmore et al., 2021; Smit, Buijs, de Hon, et al., 2021).

> Tren [trenbolone] will rip you off. It will make you look amazing. It's an amazing drug. You could eat burgers all day, you could eat cakes all day, and

you will still look amazing on tren. That's the problem. Because it fucking works. If tren didn't work, we wouldn't use it. £40 a vial. It's very cheap. [P19]

The biggest thing adverse effect I've noticed from steroids would be with trenbolone. The first time I took it, it turned me into a very different person. My empathy levels did not exist. I didn't care how anybody else. I felt I would proceed in my own way and I don't think that's a good thing as a human. So I don't take that drug anymore. I thought the classic roid rage was utter nonsense until I experimented with Trenbolone. That is real. [P15]

The biggest regret I have is that I used that particular substance, trenbolone, so heavily and for so long. Because of my emotional state. I mean, I'm a perfectly normal person. I have a loving family, I got two children… but I do sometimes have difficulty with emotional attachment. And I don't think I ever really had that prior to using trenbolone. [P08]

#### 8.3.4.6 Safe injection practices

Safe injection practices was mentioned by the participants as part of their health strategies to prevent harm, but also as something that is frequently learnt from personal experience or from more experienced AAS users. None of the participants reported looking for or receiving injection advice from a health professional.

I never had any proper [injection] training. It's just lots of research, there's lots of information out there. I just rotate sites regularly, clean sites, make sure I have a shower first, use an alcohol swab. [P04]

> Safe needle practice. If you've run out [of needles] and you've got one left and you've already used it, don't use it. Just wait till tomorrow. Don't re-use your needles. You're asking for problems. [P18]

#### 8.3.4.7 Blood tests and other exams

Almost all the participants highlighted the importance of having blood tests to monitor their health whilst using AAS. The only exception was P14, a 28 years old male who has been using AAS for the last 10 years.

> No, I never had blood tests [to monitor my health]. I just don't like going to the doctor, to be fair. I never had a private [blood] test either. I don't know if I should do it, really. I just go by how I feel, you know? [P14]

A closer look into the participants' history of health behaviours, however, shown that many of those who recommended regular blood tests only started doing so after many years of AAS use, or when an AAS-HC was perceived.

> I probably used [AAS] for some good thirteen, fourteen years without having any kind of real tests. It sounds moronic now, but I would gauge my health just by kind of "how I felt". (…) So I started doing blood tests. They were annual for the first couple of years, and then I was having them every three months. I think I was starting to take things more seriously. [P08]

Having access to blood tests to monitor their health through the NHS was usually described as challenging process, as some GPs do seemed to be concerned that prescribing the exams would be seen as an endorsement to their use of AAS. A few of them requested AAS-related blood tests when monitoring other health conditions –

namely LGBTQIA+ males who visited Sexual Health Clinics for HIV checks and pre-exposure prophylaxis (PREP).

> I used to go to 56th Dean St in London, and they would do my blood for me. I would go for sexual health screenings, but I would combine that with steroid tests. (…) I know that you can pay online to have blood tests done, but they are too expensive. I don't have the money to spend on that. [P01]

The majority of participants who had regular blood tests sought online private companies to monitor their health. These tests were performed every three to six months – or even monthly, depending on the participants' periodicity of cycles, their participation in strength-sports competitions, and their ability to afford the tests. The main reasons to seek private blood tests included *"not wanting to burden the NHS with my recreational drug use"* [P09], *"avoiding have steroid use in my medical records"* [P08], and obtaining comprehensive drug tests *"with all the parameters required to properly monitor my health"* [P06]. In face of the general attitude of the NHS towards monitoring their health, many participants considered that people using AAS should expect to be paying for their own blood tests and other exams.

> In my view, frankly… If I'm taking an underground drug, then I should be responsible for my own costs. This is my perspective. I'm old enough or silly enough to take an underground drug, then of course, I believe I should be responsible myself for paying the costs for monitoring my health. [P19]

> Get your blood work done. If you can't afford blood work, you can't afford gear. On the other way around, if you can afford to buy gear, you can afford

> to get your blood work done. If you don't, you're being stupid. (…) By the time you do get a problem, it will be too late to do anything about it. [P18]

Apart from blood tests, some participants had or intended to have other exams to monitor their health.

> I haven't done an echocardiogram or cardiac MRI [magnetic resonance imaging] yet, but given the recent deaths in the sport of bodybuilding, it's come to the forefront of attention that these things are essential checks. So I'll be looking to do these at least once a year in the future. [P09]

#### 8.3.4.8 The costs of RMS

As many of the exams considered important by the participants to monitor their health were unlikely to be obtained through the NHS, an awareness about the costs of monitoring one's health were mentioned as something to be taken into consideration by those using or planning to use AAS. As observed by P19, these costs might represent a challenge to low-income users.

> An MRI for the prostate costs about £400. An echo[cardiogram] will take £350 to £500. A consultation with a cardiologist, £300 to £400. Plus an urologist… You are looking at £1500 before you've even done the cycle. That's the sort of normal UK rate. Then, £200 for a prescription of testosterone. One injection is about £50 pounds each. For a year, you may be looking at £6000. So doctors, dentists, lawyers, the entire City of London… they can afford that. They look great, they are healthy, nothing will happen to them. But the average 20-year old, living in a council state, he's not paying

> that, is he? He pays £30 for a vial of steroids, take one shot per week, he won't even have a blood test. [P19]

#### 8.3.4.9 Diet, alcohol and recreational drugs

Some participants mentioned the importance of establishing a healthy lifestyle before considering the use of AAS.

> What does the rest of your life looks like? Are you getting enough sleep? Are you eating your vegetables or are you deficient in anything? Are you looking after yourself? Are you healthy before starting steroids? Because there's a good chance they're going to negatively impact your health. So if you're already starting from a compromised place, things could get worse quickly. [P03]

Their notion of a healthy diet, however, was frequently vague and intertwined with the need to consume large amounts of protein to support muscle hypertrophy.

> When I was using steroids, I didn't drink heavily. I never did recreational drugs. I never eat a poor diet. I was sort of looking after myself, but I was also using really massive quantities of [IPEDs]. I've had some guidance after the heart attack. The cardiac team showed me how to eat a more heart-friendly diet and to reduce my protein intake. I used to eat a ridiculous amount of protein, which I think was a mistake. [P08]

> After my episode of kidney failure, I made some changes in my diet. I was on a very high protein diet before. All the science that I could read so far was very consistent [in saying that] with a healthy kidney, there was nothing to

> worry about protein. But my kidneys were not healthy anymore, so I drastically reduced the amount of protein in my diet. [P20]

All the participants advised against the consumption of large amounts of alcohol and the use of recreational drugs whilst using AAS. Two of them, however, described a history of substance use disorder and its association with AAS use.

> I do suffer from alcohol addiction. I haven't drank for 12 years, and I haven't used any other drugs in the last three years. I go to Narcotics Anonymous, but I was at various points taking steroids and taking recreational drugs at the same time. With alcohol, I would start drinking and I would not stop until I ran out of money. Actually, steroids was the one type of drug that I never had an addictive relationship with**.** [P01]

> I haven't always been a healthy person (…) I was very fond of alcohol and drugs. I went completely sober four years ago. My addictions moved from drugs and alcohol to drugs and exercise, but in a different way. I basically started working with a coach, looking to losing body fat. And it got to a point where I wanted to dabble in [AAS] because the body fat was coming off, but I wanted muscle mass to grow. [P15].

#### 8.3.4.10 Bodybuilding and untested sports

The participants involved in bodybuilding and other strength-sports competitions mentioned additional challenges posed by their disciplines and the demands of enhanced sports federations. These included the need to use AAS in order to compete in an environment where the use of AAS is normalised. In the view of some participants,

the use of AAS was unjustified unless someone is planning to compete in untested sports.

> I say if you're going to compete in a tested sport, then do not take steroids. That's cheating. There's a reason why we have untested sports. [P16]

> I'm actually anti-steroids. Ideally, there should be no competition with steroids, if you ask my opinion. But when I started competing [in powerlifting] at a high level, then of course everybody use steroids and I decided I would use them as well. [P19]

The pressure to schedule your cycles or abandon the off-periods altogether depending on the competitions' calendar was also mentioned, as well as other demands of bodybuilding that go beyond the use of the drugs – but whose consequences can be hard to distinguish from AAS-HC.

> But the problem we get in is that… I was at the end of a twelve weeks cycle when I had a competition. But I've won and it's gonna put me in [a higher level powerlifting competition] in 2 months time, which is not enough time to come off. So I ended up staying on. I was on for like 25, 26 weeks at a time. Because the courses are leading onto one competition, another competition. And then you realize… when you're on for that long, there's such a down when you come off that you end up cruising. [P07]

> There's a point during contest prep [preparation time before a bodybuilding competition] where you just know that your life is going to be hell for the next few weeks. I ended up cutting the prep in the end, after about a week's time of not sleeping well, having a lot of issues with food. (…) The contest prep is just like normal routine, except for you're really hungry all the time. By the point where you get to the single digit body fat, your natural bodily functions rely on things which you can no longer provide, so stuff like sleep, your mood… They just completely change, like… irrational things get you very annoyed, or you're not sociable, or whatever. (…) The [AAS] dosing protocols were fairly minimal during contest prep. The rest of the physical changes caused the issues. I wasn't using anything over the top. [P09]

In the view of some participants, however, strength-sports athletes tend to be more careful with their health in comparison with those who use AAS exclusively to improve their body image. These recreational AAS users were described by Christiansen et al. (2017) as the YOLO type – an acronym for you-only-live-once – and are frequently looked down by those who perceive themselves as more serious or responsible AAS users.

> I certainly think that serious bodybuilders, although they probably take more [steroids], they are more considered in their approach to it. I find that a lot of my gay friends that have taken steroids don't tend to alter their lifestyle particularly. Their diets are not particularly healthy, they will continue to drink and smoke, and various other things. Alcohol, cigarettes and steroids… those can be pretty nasty combinations. So, to a certain extent, I think that casual users are a little bit less concerned about the health impacts than

> more serious users [of steroids] to be honest. Most of the bodybuilders that I know don't drink at all, they certainly don't smoke and their diets are reasonably healthy. They focus quite a lot on their cardiovascular health as well as resistance training. Bodybuilders are more serious about [steroid use]. They take more into account the potential side effects of steroids, and tend to modify their behaviours accordingly. [P11]

Nevertheless, the apparent protective factor of a more serious approach to AAS must be balanced against the pressures of untested sport competitions.

> You have to understand the psyche of competition. Arnold [Schwarzenegger] said himself. If someone told him to hold a burning coal to win Mr Olympia, he would have done it. [Names of three famous bodybuilders], they died on stage. They all knew they were ill, but to win, they will do anything. Lots of bodies are sitting on Mount Everest. It's in fact the same psyche. The warrior aspect… certain people will do what it takes, regardless. [P19]

That same participant recalled situations when he advised his clients to stop using AAS, despite the pressures of the enhanced competitive environment.

> I said: "Listen, mate. Your HDL is too low. Your kidney function is dropping. You got a heart condition. Go off the gear. You have to stop the gear". He goes back to his coach, and the coach said: "Don't ever go to see him again". (…) I won't be able to go to the [bodybuilding event] because of some of the things I said about the coaches. So why would anybody ever talk about safety? If they ban you, you'll lose 50% of your income. [P19]

#### 8.3.4.11 LGBTQIA+ people using AAS

A few participants described characteristics of AAS use amongst LGBTQIA+ men that could indicate distinct patterns of risk exposure and RMS. As highlighted by Hibbert et al. (2021), although the social pressure for having a lean an muscular body is ubiquitous, the LGBTQIA+ population seem to experience higher body image demands associated with increased levels of objectification, weight stigma, competition for sexual status (Filice et al., 2019; Griffiths et al., 2021; Pachankis et al., 2020).

> I know a lot of gay people who feel very pressured to use them [AAS]. And that's just like the attitude is like: “Ohh well, everybody else is doing it, so I should be doing it as well”. Particularly. There's a lot of gay personal trainers who will push their clients onto steroids. [P01]

> Nowadays it affects all people, but I think in the gay community, the pressure is even stronger to look better. Otherwise you think you're gonna fail… You're not with the group, you're not gonna be popular and you're not gonna be sexually popular. Because, you know, people naturally gonna pick the best looking ones. [P02]

Some studies observed a higher prevalence of use of recreational drugs – namely *club drugs* such as ecstasy and methamphetamine – amongst gay AAS users when compared with heterosexual AAS users (Ip et al., 2017, 2019), a tendency corroborated by the participants of this study. As observed by Marinelli et al. (2019), the popularisation of *chemsex* – where either heterosexual or gay men have sex under the influence of psychotropic and non-psychotropic sex-enhancing drugs – represents an additional risk and motivator for the use of AAS.

> Again, this is such a diverse world. You have gay men that are settle down, married with children. But I'm talking about the gay scene, the type of gay men that would take steroids and go out on a Saturday night. These are the guys that take their tops off, the guys that need to have their "pecs in order". There's a huge amount of pressure to look good in these places, or they could be left on the shelf at the end of the night. And then obviously with that electronic music culture comes recreational drugs. Then the value of their health it's really out of the window. Some guys take recreational drugs, and they are on bodybuilding just to look good. [P17]

> Chemsex and stuff like that has become quite popular (…) So I think that what they [gay AAS users] are doing on top of the steroids might impact their system, you know? Because the steroids… they don't know whether you're gay, straight or a giraffe. [P02]

There were conflicting perceptions about the RMS of LGBTQIA+ AAS users and their engagement with the health system. Whilst most participants recognised that a double stigma – i.e. being homosexual and using AAS – could prevent them from seeking the support of health care professionals, some considered that gay men were more likely to admit the presence of AAS-HC and seek help if necessary.

> Before our interview I wasn't aware that you could even go to your GP and have check-ups related to being on steroids, you know… You said you could go and get blood tests and things like… I wasn't even aware of that. And I've used them [AAS] for years and I don't know anyone else who is like… I've

> literally never heard of that. And I think yeah, because of a lot of gay men's experience with doctors, which is often negative, they will not go. They will not engage with the health services.[P01]

> I think probably straight men in general are far less likely to admit weakness. I think they're far less likely to admit when something's wrong. (…) Gay man in general are far more likely to go to the gym, to spend money on various aspects of looking after themselves. [P01]

#### 8.3.4.12 Bloodletting and blood donation

Some participants described doing bloodletting – the practice of drawn venous blood, also known as self-phlebotomy – and blood donation as strategies to manage high haematocrit or high blood pressure (Brennan et al., 2018b).

> My haematocrit will usually go up, whenever I start doing higher doses. So I'll usually donate blood or do bloodletting whenever I'm on cycle to try and keep that down. (…) I had bloodletting done from an NHS nurse. She does blood work on the side, and also advice on blood tests for people that take performer enhancements. (…) The bloodletting is about £40, I think. [P05]

Even knowing that people using AAS are not eligible for blood donation (NHS, 2023) due to the risks of coagulation disorders in the recipient (Ansell et al., 1993; Chang et al., 2018), some participants reported omitting their use of AAS in order to donate blood.

> On the NHS sheet [for blood donation] there's all the tick boxes and they will ask that [AAS use], but I'd obviously tick the other one. [P05]

> I had high haematocrit during my second cycle. (…) So I went to donate blood. Obviously, I'm aware that the guidelines or they say that you should not donate blood if you're injecting steroids. So the day after I called them and I said that I felt very sick, that I probably have an infection and so they discarded my blood. [P06]

#### 8.3.4.13 PCT and interruptions in the use of AAS

The participants described both planned and unplanned interruptions in their use of AAS. Naturally, those cycling between on-and-off periods had planned interruptions – frequently associated with some sort of PCT. Several participants, however, halted the use of AAS due to involuntary circumstances such as muscle or joint lesions, surgeries or the closure of gyms during the COVID-19 pandemic. One of the participants described how he managed his decision to interrupt an AAS cycle in order to conceive a child.

> I was in what I would consider my heavier and most effective cycle at the time. My wife and I were already thinking about having a baby and my wife decided that was the perfect time. At the beginning I thought “let me finish this cycle and then we can try”. But then I realized that that was a very “drug addict way” of putting the thing. So I decided. “You know what? I don't like the idea that I need to finish this, so let me just stop it”. So I stopped it. I did a pretty extensive PCT. I remember stopping the cycle, and two months later my wife was pregnant. So the PCT worked. [P20]

Even without PCT, some of them reported an absence of severe symptoms of hypogonadism or AAS withdrawal. That was the case of P13, who decided to stop using

AAS three months before the interview due to adverse mental health effects of Trenbolone.

> I didn't really feel anything. I was braced for all the things that I've been told about low mood, low libido, everything else. But I haven't really noticed anything. My libido is clearly lower, but it was super high [when I was on AAS]. So I think this is just physiological now. [P13]

Other participants described the onset of depressive symptoms, lethargy and quick loss of muscle mass following an unplanned interruption of AAS without PCT: *"It was quite difficult to initially coming off. It feels a bit like a car crash, mentally and physically" [P16].* Participant P08 described a severe withdrawal syndrome following the abrupt cessation of AAS.

> I basically stopped cold turkey. (…) I sank into an absolutely horrific phase of depression, anxiety, and many suicidal thoughts and ideations. I was convinced I was going to get fired from my job. It was just absolutely horrible. And it was my own fault, because I didn't take any kind of precautions whilst I was using, and I just stopped literally overnight. [P08]

His decision to stop using AAS took place after an episode of acute myocardial ischemia 10 months before the interview, when he was 40 years old. Three months before the heart attack, after using AAS for 21 years, changes in his life circumstances led him to reconsider his strength training routine and the use of AAS.

> It comes to a point in life where you realize that you're never going to pay your mortgage or feed and clothe your family through lifting weights. It's a very draining hobby to take it to that level. I mean, at times in my 20s I was

> training twice a day, seven days a week. Morning and evening, and I was tired and sore all of the time. I spent an absolute fortune on food. And I think you reach a point where you grow up. You start a family or you maybe start a serious relationship or you start to take on more commitments at work. And so you interest drops off (…) So I dropped my dosage and I dropped some of the stronger compounds. I probably did that for about two or three months, and then I had my heart attack [P08]

Another participant who had decided to stop using AAS was P03, a 27 years old female. She told us that her brief experience with the drugs – a six week cycle with Anavar© – was disappointing: *"My strength increased a little bit, but not like… "Oh, I'm on steroids" kind of strength increase"* [P03], and interrupted after a blood test revealed abnormalities in her liver enzymes.

> I just don't think it's worth it. (…) Everyone has different risk tolerance. I had one like minor scare with a blood test and I was like… "that's it for me". But some people let it go on for a lot longer, and they're willing to deal with, like potentially shortening their lives. It's kind of concerning. [P03]

An account of quitting and returning to the use of AAS was provided by P17, a 52 years old Personal Trainer who was diagnosed with prostate cancer during an off period.

> The doctors decided to put me in a complete ablation of androgens alongside my radiotherapy. (…) I've made the decision to go to radiotherapy only, (…) because this is my life. I love bodybuilding. And I decided to start using a lower, a reasonable dose of steroids again. Only testosterone. This

was [about 7 months ago]. Last week I had my PSA checked and the cancer is still successfully in remission. [P17]

### 8.3.5 Experiences with the health system

People using AAS might seek support from different health services, such as GP clinics, the A&E, and units of the NSP, as well as private physicians and services providing blood tests and other exams (Christian et al., 2023; Hope et al., 2020). Their willingness to engage with health system can be influenced by previous experiences and the availability of specialised services such as Steroid Clinics.

#### 8.3.5.1 GPs and other physicians

GP clinics are the most common sources of primary care in the UK (Vallejo-Torres & Morris, 2018). As shown in WP1 of this thesis (see chapter 6), about one-third of AAS users in the UK seem to seek a physician for support with their health (Amaral, Kimergård, et al., 2022). The experiences of participants of this study with GPs were similar to those described in previous reports (Hill & Waring, 2019; Pope et al., 2004; Zahnow et al., 2017), and included problems such stigma and the unwillingness to disclose the use of AAS, and the refusal to provide treatment or prescribe exams unless the participants abandoned the use of AAS.

> My GP said: “Taking steroids is a personal choice, and I don't really think that we should be supporting you, because you shouldn't really be taken them”. And I said: “So if I was drinking all day and I had a problem with my liver, would you suggest that I wouldn't be allowed to have a test on my liver?” And the GP said: “That's different”. I said: “Well, drinking is a personal choice, don’t you think? (…) I can't believe that you're not going to give me

> a test". And he said: "What you gonna to do?" I said, "I just have to pay for the tests". And that's what I've done ever since. [P02]

None of the participants reduced or stopped the use of AAS after being denied exams or medication by a GP. Most often, this behaviour led them to seek private doctors and laboratories, coaches or more experienced AAS users to help them interpret their blood tests and to buy ancillary drugs in illegal markets – frequently from the same providers who supply AAS.

> It happened to somebody I know. He was running 180 / 110 regularly and the doctor said: "You stop what you're doing. I'm not prescribing [blood pressure] medication". So what did this guy do? He went to buy blood pressure medication in the black market. [P20]

One of the reasons given by some participants to refrain from seeking a GP or, if they do, to deny the use of AAs was the fear of having the use of these drugs added to their medical records. This fear was generally associated with concerns about their need to seek private health insurance in the face of a general perception of crisis faced by the NHS.

> The main reason I've not went to a GP is just in case the NHS gets privatized in the UK. The steroids might be on my medical records and increase the rates you have to pay for private medical care and that kind of thing. [P06]

Similar concerns were expressed by P12, a 46 years old Medical Doctor who had been using AAS for the last 8 years and preferred to seek advice from his partner – who is also a doctor and a more experienced AAS user. Some participants refused to disclose the use of AAS even in face of emergency surgeries.

> I was always very concerned about invalidating things like life insurance, so I have never discussed it [AAS use] with GPS at all. Even to the extent that, when I was taken to hospital with a strangulated bowel [hernia] and was told I'd be having emergency surgery (…) I was told “We're going to cut you open, we're going to operate on you. We really need to know whether you have anything affecting your blood volume, or your ability to coagulate your blood”, I still denied it. [P08]

Some participants, however, informed having a good relationship with their GPs. According to them, some GPs were willing to monitor their health and treat eventual AAS-HC even if the doctors were against the use AAS. These GPs were described as being tolerant and interested in learning more about IPEDs, sometimes liaising with private doctors sought by the participants.

> I never felt judged. I had high blood pressure and my GP still followed through with giving me medication, keeping me checked up to make sure my blood pressure got in line. So I don't think I've been victimized or anything because I'm taking a substance. [P07]

> My private doctor wrote my GP a letter making him aware of our TRT therapy. They've got a good line of communication with one another. I wouldn't say my GP is knowledgeable [about AAS], but I would say he is tolerant. (…) He openly admits that I'd be better off speaking to an endocrinologist for certain things, and if there's ever any issue, he would refer me to an endocrinologist. I’m grateful for his level of support. [P15]

Most participants agreed that doctors should learn more about AAS and other IPEDs, but recognised the challenges in keeping up-to-date with information about these drugs.

> It's not the GPs' fault they don't know about this stuff. You have 177 SARMs currently, which I know of. Probably 114 injectable types anabolic steroids, maybe 60 types of oral steroids. And every day a new peptide is coming out. We can't keep abreast of this, let alone the GP. [P19]

#### 8.3.5.2 The NSP and other sources of injectable equipment

Most participants of this study did not use the services of the NSP, despite having used it in the past. Their perceptions echoed the accounts from previous reports (), where people using AAS might avoid the NSP for fear of being confounded with heroin users, who most participants defined with derogatory terms such as “junkies” or “addicts”.

> I've heard about it [the NSP], but I never used it. I always felt that there was a stigma attached to injectable substances. And I always felt that an average person on the street would not differentiate between a heroin user and a steroid user. I'm otherwise a respectable member of society. I have a job, I have a family. I don't drink. I don't do any other kind of recreational drugs and I didn't want any association with that. I don't look down on people that have drug problems, but I didn't want to be associated with that. [P08]

> The first time I went [to the NSP] I had a really bad experience. I went to this little pharmacy, just to get the needles. I went up to the counter and said: “Oh hi, I just wanted to get some needles for taking steroids”. The woman call the pharmacist, and he looked absolutely disgusted at me. (…) I felt so

> humiliated by that experience. (…) I think there is a real fear of judgment, and I think that's what prevents people from seeking help. [P01]

One participant who started using AAS before the popularisation of the internet described how he stopped using the services of the NSP as injectable equipment became increasingly accessible online.

> For the fir st 20 years I went to the needle exchange 'cause there was nowhere else to buy needles from. (…) When I first went to a needle exchange it was probably one of the most embarrassing things I've ever done. (…) I used to see that they treat the smackheads [heroin users] better than they used to treat us [AAS users]. I would roll in in a nice car, with a shirt and tie on, ring the bell and say: “Hi, would it be possible to get some needles, please? I've got my old sharps box, and can I give you that to you know to get rid of these, please?” And they buzz me in, and say [makes unfriendly face and hasty voice] “Right, no problem, what do you want?” And you get some guy who was there, wasted all the time… He probably couldn't get up to the doorbell and they treated him with more respect than they treated me, which was mad, it was crazy (…) It got gradually worse, and worse… Until it was more embarrassing to go and get them [at the NSP] then it was to pay for them. So as soon as I saw somebody selling them online, I said that's it. Now I'm done. [P02]

As both AAS and injectable equipment were seen as products available online, the habit of buying their own needles was seen not only as something that distinguished AAS users from drug addicts, but also as part of their RMS.

> If you can buy the steroids, you can buy the needles. I think the [NSP] is for someone who's on serious drugs with hardly any money. They might be robbing to buy they drugs or something like that. But someone who's on steroids is not robbing, you are buying them yourself. So you got the money to buy the needles. [P06]

> I would never go [to the NSP]. I would feel embarrassed to go there. I might be a drug user of anabolic steroids, but I don't consider myself to be a junkie to go there. (…) The only steroid users who are going to the NSP are the ones who don't have any money. Everybody else is going online and buying packs. For £10 you get one of these. You got 20 needles, swabs, cotton balls. Why would you want to go to an NSP and seat with a bunch of junkies and queue to get free needles? [P19]

A few participants, however, used the services of the NSP regularly. Their satisfaction with the service seemed to be associated not only with a welcoming attitude of the staff, but with their willingness to provide the quantity of needles requested by each user. The wide range of different injectable AAS routines – from weekly administrations to daily injections of different compounds, each requiring a fresh needle – might represent a challenge for some NSP services and their ability to accommodate their provisions to the users' demands. Additionally, participants who remained engaged with the service mentioned the advantages of primary NSP units, where they could receive advice on injection practices – in contrast with pharmacies where the service was limited to the exchange of injectable equipment.

> Yeah [I use the NSP] regularly. (…) It's like a health clinic, but it's more sort of aimed at the other type of injectable drug users, shall we say. (…) The great thing about that service is that you can request what you want. I'm a daily injectable type of guy (…), so I go through my stock pretty quickly. And they are happy to give me a box. They give me a box of 100 [needles] and see me in a month. That's great about them, and they will answer any questions that you want. [P18]

A participant who stopped using AAS a few months before the interview due to a heart attack reflected on his desire to have sought the NSP for injection advice, namely on his early years of AAS use.

> In reflection, I kind of wish I did [used the NSP], especially earlier on, because I could have many questions. I hate to think how many injections I've done on myself over the years. I think early on my technique was probably not very good, and I could have probably done with some help and guidance there. I'm surprised I have not injured myself quite badly doing that. [P08]

#### 8.3.5.3 Steroid clinics – public and private

From a public-health perspective, Steroid Clinics are NSP units offering specialised services for people using AAS, such as advice on intramuscular injection techniques, dietary and strength training recommendations (Kimergård & Mcveigh, 2014). It is hard, however, to estimate the current availability of such services in the UK. Some Steroid Clinics, such as DISCUS in Durham and the Pump Clinic in Manchester, are no longer active, and an internet search for NHS-funded Steroid Clinics at the time of this research returned only two results, both in Scotland: The Glasgow IPEDs Clinic (Scottish Drug

Services, n.d.) and the Edinburgh Steroid Clinic (NHS Lothian, 2020). The majority of participants was not aware of the existence of Steroid Clinics, but some of them described positive experiences with these services.

> There is a health clinic explicitly for steroid users in [location]. It would be the only place where I've spoke about steroids. I think they are focused on HIV prevention, sharing needles and that kind of thing. There's a gentleman that talks to you about which steroids you're going to take, how much… He tries and give you some better advice on what to do, and obviously all the dangers and risk factors and that kind of stuff. They also do the blood work for you, but because it's funded by the NHS, the blood work was minimal. They had kind of guidelines on different compounds, and like things… "You maybe shouldn't go above this amount"… and they would kind of try and talk you through the process of how everything works and maybe what side effects might happen. That kind of thing. [P05]

> There's a steroid clinic in [location]. I go there. I think it's great what they do. There's obviously an interest to learn about the drugs, and you know… They're dealing with this sort of patients on a regular basis, so they are comfortable and they know what they're looking for. That's where I got my bloods done the last time. 'Cause I only really heard about it recently. They do your bloods for free. [P15]

In contrast with the scarcity of specialised NHS services for people using AAS, an internet search retrieved a large number of private services across the UK. As discussed in

chapter 4 (item 4.1.3), private steroid clinics operate by prescribing AAS as TRT and/or by offering harm reduction services for people using AAS without a medical prescription. One of the participants described his experience with a TRT clinic.

> It was very good in one way, because they would prescribe whatever I would ask. But from another point of view, the doctor was not really very knowledgeable. Obviously, they don't call it steroids. They call it TRT. (…) I went there for advice. It was after my second cycle and I wasn't feeling great, maybe one month after the end of the PCT. I did a blood test and there was nothing clearly wrong to me. So I went to this specialist to try and find a solution, but he was not interested in helping me feeling better, or helping to understand what was wrong. He just wanted to sell me TRT. [P06]

#### 8.3.5.4 Sexual Health Clinics

As discussed in item 4.14, Sexual Health Clinics – previously known as genitourinary medicine (GUM) clinics are frequently sought for the provision of contraceptive methods, pregnancy testing, testing and treatment of sexually transmitted infections, hepatitis B vaccination, abortion advice, and pre-exposure and post-exposure prophylaxis (PREP and PEP, respectively) for HIV (NHS, 2021). Several participants had used the services of Sexual Health Clinics in the past, mostly to test for STI. Although the use of AAS has been associated with risky sexual behaviour and multiple sexual partners (Hope et al., 2016, 2020; Korkia & Stimson, 1993; Midgley et al., 2000), it fell beyond our scope to discuss the participants' sexual history. Nevertheless, one of the participants shared his view of dangerous sexual behaviour associated with the use of AAS.

> Steroid use can lead to deviant sexual behaviour. Too much training, too much androgens, too much sex, too many sexual partners. Trenbolone, you know, makes you loopy. Every woman looks good. Some bodybuilders are highly promiscuous. Male and female. [P19]

None of the participants reported going to a Sexual Health Clinic due to AAS-HC, and only once, during a HIV screening, the clinic staff asked about the use of AAS. Generally, the service of these clinics was described by the participants as efficient and non-judgmental. Participant P01, a 35 years old homosexual male, described his experience at a Sexual Health Clinic specialised in the support for the LGBTQIA+ population.

> The only time I have had a good response from NHS staff regarding steroid use was when I attended [name of clinic], which is a GUM and Sexual Health Clinic. They are excellent and they are totally nonjudgmental. They are there to help people. They are like… "OK you do steroids? Fine. Do you need needles, syringes? [P01]89.3.6.6 Talk to FRANK

None of the participants ever used the services of the FRANK website for information about AAS. There was a consensual perception that FRANK was a service for people looking for help to stop using a substance, i.e., experiencing addiction, a condition refuted by all participants.

> Yeah, I heard about FRANK but I never used it. I never felt like a drug taker. I know it is, but I've never felt that way. I always assumed that steroids… it could be stopped anytime, which was. You know, when I competed I just went longer, but normally I would have just two courses a year… 10 weeks

> each, so 20 weeks. And 30 weeks not using nothing. So I don't feel I was in that sort of situation where you normally talk to Frank. [P07]

When explaining their reasons not to seek FRANK, all the participants shared their perception that their use of AAS is under control, can be interrupted any time they wanted and is not comparable with the use of other substances – as described by some participants who had experienced addiction to alcohol or drugs (see item 8.3.4.9).

#### 8.3.5.5 Stigma

Numerous reports described the stigma associated with AAS use as one the barriers faced by people using these substances when interacting with health care professionals (). Likewise, nearly all the participants have had an experience where they felt judged or had treatments and exams denied due to their use of AAS.

> I detached the long head of my bicep when I was curling, (…) so I went to see my GP.(…) He said "Well, I'll make an appointment for you to go to hospital", (…) So I went and this doctor (…) looked at the size of it and she said "I'll assume you take steroids. (…) You've overexerted your muscle and that's created an issue with the tendon (..) because you spend a long time in the mirror, looking at yourself, it's probably a big deal to you, but you've still got quite a lot of power in your arm and you will also have quite a lot of power in your hand, so I'd just be very careful". So I said: "Hold on, what about reattaching it?" "No, no. Not for you to be taking gear. It's been self-inflicted. If you're not happy, go back to your doctor, but the only way you're going to get it done is if we go private". [P02]

Some participants informed they had never a negative experience with help professionals simply because they never revealed their use of AAS or because they avoided seeking their GPs in fear of being judged and have to explain their reasons to use AAS. Some participants considered understandable that health care professionals would advise against the unprescribed use of AAS. In their opinion, however, this approach should take into consideration the context of individual AAS users and their ability to make an informed decision about the use of non-illegal drugs.

> What else are they supposed to say? If someone is taking steroids and they are not aware that they are bad for their health, then they should be made more fully informed. [P11]

> I think if you're 17, you go to a GP, and you say you've been using a boatload of steroids, I think they actually have an active right to judge your decision. Because you've clearly just seen something on the Internet, bought some vials with your dad's credit card and that's it. [P18]

There were also attempts to differentiate use and misuse of AAS, based on the severity of AAS-HC and people's control over their use of these drugs. Frequently, the attitude of health care professionals towards people with SUD related to alcohol and other substances was compared with their approach to AAS users.

> My impression is that there's a huge proportion of people who will use [AAS] and probably will have no significant negative health outcomes because of it. Just like people who use alcohol versus those who are addicted to it or have significant issues associated with its use. (…) I think the trouble is that doctors tend to judge all the users (…) in accordance with the problems that

> they might see in the very high strata, in the sort of person that is having addiction problems. [P12]

The participants also made a distinction between advising against the unprescribed use of AAS and withholding treatments or demeaning people using AAS. Participant P12, a 46 year-old Medical Doctor, shared his perception about health care professionals' justification of stigma.

> When people ask if reducing stigma to steroids is feasible, for me it's a bit like saying that it's not possible for people to ditch their stigma about HIV. Of course it is. There's no excuse for stigma in this day and age. (…) Lack of knowledge is not an excuse to be a bad doctor. I'm not expecting a GP to know everything about steroid use, that's why I think that referral clinics are useful. A bad attitude when it comes to use and a judgy attitude that comes to steroid use is inexcusable, regardless of how busy GPs are P12]9.3.7 Informal sources of support and RMS

As discussed in item 4.2, people using AAS frequently seek support and information about these drugs and AAS-HC from informal sources, such as online forums, coaches and suppliers of AAS (Cohen et al., 2007; Kimergard, 2015; Kimergård & Mcveigh, 2014).

#### 8.3.5.6 Online forums

Only a few participants refrained from seeking information in online forums and regarded the contents of these platforms as *"broscience bullshit"* [P12]. Most participants, however, considered the anonymity of online forums' members and the quality of the information found there simultaneously beneficial and problematic.

> I think the problem is… everyone has an opinion, and all you need is an avatar and a log in, and you can provide advice for people. And these people… you don't know their experience. They may have copied and pasted it. They may have never taken steroids in their life, but they've done a bit of research and they think they're some type experts. [P02]

> It can be quite a mixed batch, because there's different levels of experience there. The people who are training at a very high level to compete, obviously, they're running very, very large cycles… very intense cycles. Then you have people who are just starting… a lot more mild cycles. People who train just for aesthetics. I think it would be easy to follow the wrong advice because you could read something that's maybe far too advanced to yourself and think: "Oh, OK. I need to do this". [P04]

Some of the more experienced users shared their perceptions on how the characteristics forum members and the quality of their advice changed throughout the years. In these participants' perception, most online forums nowadays advocate the use of larger doses of AAS and are composed of an increasingly younger population of users.

> Over the past seven or eight years, the forums became very pro-drug use. People are using eye-watering doses, and it's all normalized. "Don't worry, it can't hurt you, you're invincible. Just using more and more and more… Combine more compounds. Use more substances". (…) People in forums went from being older users telling about their experiences to young people advising other young people on what to do to look like an Instagram models.

> They just read a ton of stuff on the Internet and they're regurgitating it. It tends to involve ridiculous amounts of drugs at a very young age, or at a very young part of their training lifecycle. [P08]

> Nowadays, because of the Internet, people are coming on their second week of ever been in a gym and they're jacking up. It's like… Yeah, there's information out there, but it's making everyone jump on it right away. [P07]

Most participants considered very hard to assess the quality of the information found in the online forums, especially by those less experienced or contemplating the use of AAS. Some advised verifying how the rest of the community endorsed or refused an opinion and complement what was being said in the forums with self-conducted research in scientific databases. Other subjective criteria included prioritising the advice or forum members displaying more muscular physiques and those who advocate a more careful approach to AAS use.

> Probably the first point is how does the person [who is giving advice] looks like. If they've never put their physique out there, you know it could be some chronically underweight teenager who just read something online and it's repeating it. (…) You can use the forums as a reference point. Then you look at the scientific and compare to the anecdotal and come to a middle ground conclusion. [P09]

> You generally get the sense [of the quality of information] from the contributors of online forums from their attitude to steroid use. (…) If someone says: “Hang on a second, you've been training for 18 months you don't have a proper diet, you’re inexperienced, maybe you should think about getting a few of the other requirements in place before you start a cycle”. (…) When you’ve studied a little bit more about [steroids], you tend to place a little bit more weight on what these users say. [P11]

As the only female in our study, P03 described her preference for online forums composed exclusively of female AAS users. These virtual communities seemed to provide her with useful insight on other women’s experiences with AAS and the opportunity to discuss female-specific AAS-HC, such as disturbances in menstrual cycles.

> I think the quality of information is quite good and that's pretty much a result of the administrators being really honest with disinformation and potentially harmful information. They're some coaches in there as well, and they’re sharing their own experience from years of coaching women through some of this stuff. (…) I used [the online forum] more as a source of information about real people sharing their real experiences, but I still learned way more on any papers that I could get, like the actual use steroids in a clinical trial, the reporting of side effects. (…) I don't weigh the forums as high quality sources of information compared to the literature. [P02]

#### 8.3.5.7 Steroid coaches and online medical advise

Coaches were considered an important source of information about AAS to many participants, frequently participating in their decision to start using AAS.

Understandably, these participants had chosen professionals who did not oppose to their use of AAS and who shared similar approaches to their use of the drugs.

> I used an online coach. (…) You send them a photo of your body composition, they will build you a training program, a nutritional program and an anabolic steroid program. (…) They give advice about adverse effects. They mentioned drugs like metformin, telmisartan and things like regular blood checks, monitor blood pressure, monitor my blood glucose weekly, that sort of thing. (…) They can sell you the steroids, but I had my own [supplier] and I was happy with that. [P13]

> My coach prescribes my cycles, (…) so we discuss what I am and what I'm not willing to do compound-wise. Because there's a spectrum of safety. He's fairly conservative and he follows the safer-use model (…) I picked my coach based on his approach to anabolics. (…) I don't need something like Trenbolone coming in and ruining my mind, and then I'll wake up from it [and say] "Oh my God. What have I done?" But a lot of coaches who prescribe anabolics do not care as much about people's health (…) a lot of them still push [AAS] doses to ridiculous levels. [P08]

Medical doctors, frequently based outside the UK, also provide remote supervision for people using AAS, including individual consultations and members-only access to online platforms.

> I get my cycles now from a guy in [name of European country] who is a doctor. He kind of specializes in training people and advise, writing programs

> and steroid cycles for people. (…) It's not his professional practice per say. He's an Epidemiologist, but he trains and advisors like a lot of people, he's extremely knowledgeable and I trust him. [P01]

> There is a doctor on YouTube… He is a steroid doctor. He used to be a competitive bodybuilder. Now is a medical professional in this field and specializing in this field. There are several doctors from America that talk about regular steroid use. They have podcasts, forums about the use of steroids, how to use steroids safely. I do listen to those doctors more than any other commentators or any other professional bodybuilders. [P10]

Some participants who provided advice to people using AAS described their own work ethics and criticised the relationship between some clients and their coaches.

> Coaches can only advise. I know people who will come to a coach and say “I want to do this, I'm quite happy to take these anabolics for quite a bit”. And some people, they'll just go and take more than you recommended. (…) These are sort of people that come back and go “Well, when I left him [the coach] my blood work was all wacked up”. [P18]

> A lot of the coaches are selling steroids, so it's in their interest to give you a higher dose. (…) Everybody who I work with, they have to do the complete tests or I don't work with them. (…) Why will send your blood test to a coach? He’s not a doctor. Your HCL is low, your creatinine is high, your ALT is high,

> your AST is high, all your lipid profile is high, the albumin might be high, ferritin may be high, you may have polycythaemia. The coach says, “That’s all steroid-related. Nothing to worry about”. So really, what is the point of having a blood test? I have a sarcastic approach to it: “If you're not going to listen to my advice, save your money and go buy more steroids”. [P19]

#### 8.3.5.8 Suppliers of AAS

Suppliers of AAS were frequently mentioned as sources of information about the drugs and on how to prevent and treat AAS-HC. When compared with participants who only bought AAS online, those involved in strength training before using AAS seemed more likely to ask for advice from their suppliers, who were frequently training in the same gym.

> I did that a lot when I first started this. Because I've got steroids from a semi-pro bodybuilder. He advised what I should take, health issues, protection and all that. [P07]

> [My AAS supplier] used encrypted messaging service and he was paid in cryptocurrency, so I never met him. I only dealt with him electronically, so it just didn't seem appropriate [to ask for his advice]. [P11]

Whilst some of the participants seemed to trust their AAS providers enough to ask them for advice, the majority of them considered it a dangerous practice. Most frequently, the supplier was described as having a stake in selling large quantities of AAS and trying to “push” compounds to inexperienced users.

> The first the first time I bought them, I relied on the dealer to tell me what to take, which was a really bad idea, in retrospect. [P01]

> No. I can't think of anything worse. They'd just sell you the most expensive stuff and a lot of it. A lot of [suppliers] are just "your friendly neighbourhood drug dealer". You don't really want to take advice from somebody like that. They're not health conscious. [P09]

> Do not take advice from the guy you buy steroids from. All he's gonna do is take your money and you're gonna see him more frequently than you would like. And he might seem very friendly. And it might seem like a nice dude, but what he cares about is money. So don't ask them. [P18]

Another reason why some participants avoided asking advice to a seller of AAS was the perception that many suppliers are prone to use and recommend AAS doses unsuitable for beginners and people with different goals.

> The majority the people that supply [AAS] would be bodybuilders, and potentially strong men, which are sports that has very different needs. Bodybuilders have reduced calories, and they also have different training methods. Their anabolic use is a lot higher, and they rely a lot more on drugs when they're competing. [P16]

#### 8.3.5.9 Friends and partners

Friends and partners might represent important sources of support for people using AAS. The participants frequently described the use of AAS as a small – yet determinant – part of a broader lifestyle that unites people with similar interests. As described by Macho et al. (2021), the degree of commitment to enhanced strength training – ranging from the casual use of AAS for aesthetical purposes to professional bodybuilders competing on international level – seems to be associated with the participation in an

increasingly specialised social circle. Some participants described their friends as their first line of advice, as well as how their lifestyle precludes the discussion of AAS-related issues with friends unfamiliar with these substances.

> I'll just ask for advice from more advanced friends rather than going the route of paying somebody. (…) When you get into this lifestyle, there will be people you work with, or people you interact with. You know, it becomes your social circle. (…) But I probably wouldn't discuss it with friends that are not involved in this lifestyle. Because it's [about] needles, injections… this is very extreme behaviour to some people. [P04]

Even some participants who regarded the knowledge of gym-buddies as mere broscience and secondarily placed in their informal hierarchy of AAS folk-pharmacology (Monaghan, 1999; Tighe et al., 2017) were willing to provide support to less experienced AAS users.

> Even today in the gym, there was a guy and he was saying he was having problems digesting a lot of food. And I'm saying, well, there are easy ways of trying to get around it. I take probiotics, kefir, yogurt and apple cider vinegar to kind of help with the digestive process. I still enjoy trying to help people, and I always have. Because I, you know, I'd rather spend 5 minutes with somebody and try and get them to avoid some of the mistakes I may have done when I first started. [P02]

Although the impact of the participants' use of AAS in intimate relationships was not addressed in the interviews, some of them described the role played by their partners in their use of AAS.

> I got a bit of advice from my other half… as sensible as possible, ways to do would harm minimisation. (…) My boyfriend is also a doctor, who specializes in IPED use and runs a clinic for IPED users abroad. [P12]

> I got the blessings from my wife, told her that it [AAS use] was important for me, because obviously, I wasn't going to hide the thing. She's obviously not happy with that but she's understanding, which is as much as I can ask. [P20]

### 8.3.6 Using AAS during the COVID-19 lockdown

The main RMS adopted by the participants during the COVID-19 lockdown measures was the reduction of AAS doses to "TRT levels" or postponing planned cycles. Although two participants of this study started using AAS during the COVID-19 pandemic lockdown – as *"the pandemic gave me time away from work (…) and make my decision that I wanted to pursue that gym life"* [P13] – most of them reduced or halted their use of AAS in that period.

> When the lockdown came, I was planning to do a cycle. But I realized straightaway that was a bad idea. Instead, I stayed on actual TRT for not just the whole lockdown, but the whole 2020 and the whole 2021. For the simple reason that it was impossible for me to be sure [that] I could rely on the gym and everything that goes with that in order to get the gains that a cycle helps you to get. I trained just as much as I could at home. I had a little bit of equipment with me and sometimes I used my daughter and my wife as extra body weight. [P20]

> When lockdown started, I gave some advice for everyone to cut their cycle down. Either going to a cruise [on a reduced dose of AAS] or drop your cycle, do a PCT. This was the best time to give your body a rest. (…) A lot of people listened to this. They run off the gear for a year. They gave their bodies a rest. Some people never went back to competition. They realised… you know, "I don't need this. I should have done this years ago". [P19]

None of the participants informed suffering from severe symptoms of AAS withdrawal due to these unplanned changes in their AAS routines. Generally, the closure of gyms and other lockdown measures were described more as a nuisance than as something that forced them into an abrupt cessation of AAS. None of them reported major changes in their access to AAS, apart from a slight increase in the price of the drugs.

> Some of the underground labs… the people were I get my stuff from said that there were quite a few places that shut down, and they were shutting down until the gyms were back open. Because basically no one was buying. So it wasn't huge, but there was a definite mark up on top of what you would normally pay and all that. [P02]

The general perception was that the supply chain of AAS in the UK was only mildly affected by the lockdown measures, as AAS and the raw products used in their production are mostly bought online.

> There was no disruption at all. The raws that are used for creating steroids primarily come from China. Only problems there would have caused a disruption in these supplies. [P16]

> During lockdown, there were rumours that could have been a disruption [in the supply of AAS] in the community, but that actually never happened. There was a bigger disruption, although just briefly, but definitely noticeable when China decided to stop the export of anabolic steroids to private foreign entities. What happened now in China and other countries is that anabolic stories are perfectly legal, so what they do is they produce a great amount of raw powders and they are allowed to sell this powder, not just to a pharmaceutical company from a different country, but also to private providers. These private providers are nothing more than people who run the underground labs. They buy them, they produce them, and they sell them. There was a moment when the Chinese government decided to stop this and they even start to enforce this rule. It didn't last for long, but for those few months there was a slight but noticeable reduction of products coming in in the country. It didn't last for long, but that had a much bigger impact [in the supply of AAS] than any lockdown could have. [P20]

Most participants seemed confident that they had enough AAS to manage their cycles in the case of an eventual shortage in the supply of the drugs. Their access to the drugs and ability to make adjustments in their AAS routines suggests a controlled use of these substances by the members of our sample, but also indicates a selection bias where AAS users less able to stock up or manage a reduction in use might have been under-represented in this study.

> I always make sure that I have at least a six months stock available, so in terms of my personal and impact, I haven't had any. I have seen people who

> aren't financially able to have everything ready and they did have issues getting steroids for themselves. [P16]

### 8.3.7 How to improve the support for people using AAS

The suggestions made by the participants of this study on how to improve the support provided for people using AAS in the UK were mainly focused on: (i) Training health care professionals to identify and manage AAS-HC; (ii) medically prescribed and supervised use of AAS; (iii) improve the service provided by the NSP and Steroid Clinics; and (iv) reduce the stigma against people using AAS.

> GPs should know a little bit more and be more knowledgeable about how people use different compounds, and what the different compounds are used for within their bodybuilding community. Remember, people will take steroids regardless, and they will not really know how to inject and they would do it in a way. So if you can teach someone how to be safe and inject in a safe way, hygienically, which location to inject, how to inject, wow to draw up… That would obviously cut down on abscesses and things like that, so it [would] lessen the burden on the NHS. [P13]

The medically supervised use of AAS for cosmetic and performance-enhancement purposes is a controversial issue, opposed by many physicians (Dawson, 2001; Hotze et al., 2011) and medical associations (Pope et al., 2014). However, some participants saw the proliferation of TRT clinics in the UK as an endorsement for the prescription of AAS – as some of these clinics seem to prescribe testosterone for men with normal testosterone levels (Barbonetti et al., 2020; Bhasin et al., 2018a; Nieschlag et al., 2004).

Other arguments supporting the medical prescription of AAS included not buying drugs from illicit markets, comparisons with aesthetical procedures and hormone replacement therapy (HRT) for women.

> Perhaps make certain steroids available through your doctor. So at least you would know that, regardless of whatever you were gonna use them for, you would have a genuine source of gear. (…) I think that perhaps this could be linked to women's HRT [hormone replacement therapy]. 'Cause I do think that men over a certain age should be provided with a set amount [of testosterone] anyway, because I think it would make their lives better. They wouldn't lose the sexual appetite, hair, skin would be better… Mentally, they'd probably be in a better place. [P02]

> I think doctors should be allowed to prescribe testosterone replacement therapy. But not NHS doctors. It must be private. I mean, why not? People go for plastic surgery, so why shouldn't people go privately for steroids if they wanted? They wanted enhancement. That's another form of enhancement. [P17]

> Let's put those little bit of anabolic steroids, now used as TRT, and legally prescribing [them]. At the end of the day, the majority of the time we rely on something that has been literally made in a bathtub. And we need to use more of them because the majority of the time labs used less raw powder than pharmaceutical grade steroids. (…) Nobody is asking for any exotic

> compound, but there are some anabolics in use for medical reasons, and those are the anabolics that could be made available to people who asked their doctors. [P20]

Many of the participants' suggestions to improve the services of the NSP and Steroid Clinics were similar to the ones described by Kimergård & Mcveigh (2014) and Harvey et al. (2020), such as advise on intramuscular injection techniques, PCT, blood tests and management of AAS-HC. Some of their other ideas included procedures that, in their opinion, would make AAS users more likely to engage with the NSP.

> It would be nice if I could hand them [at the NSP] a card saying "I'm here to collect this and that", they'd just give me a bag and I walk out. It needs to be more discreet, I believe. I felt like I'd been judged by everyone. [P07]

> Do you know something small that would make such a difference [in the NSP]? When you get your stuff (…) it would not harm just to put there just a gentle reminder about getting your blood work done. We're bodybuilders, we like routine. I have four noticeboards upstairs in my bed.(…) We are meticulous, we like structure. We like routine. If somebody reminds us to keep our blood tests in check, we'd love that. [P18]

As discussed in item 4.1.5, there is a scarcity of guidelines supporting the service provided to people using AAS and other IPEDs, although the challenges faced by that population are mentioned in several public health reports in UK (ACMD, 2010; Department of Health, 2017; Manchester Health & Care Comission, 2021; Public Health England, 2014, 2018). In the absence of these guidelines, the few existing Steroid Clinics seem to develop ad-hoc guidelines of harm reduction, including the prescription of

blood tests, dietary and physical training advice (Campbell, 2020). One of the participants, who ran a private clinic offering support for people using AAS, had a critical perspective about NHS-funded Steroid Clinics.

> I think most people using steroids don't want any support. (…) Maybe that's the approach we should be taking: "If you wanna help, we gonna help you. We're here to guide you. As long as you follow these guidelines. If you don't follow these guidelines, we won't help you". Maybe this is what we should be doing, instead of this mother-like approach we've got, where the NHS must be responsible for the user. "Harm reduction services"… it's a very nice word, isn't it? But maybe the user doesn't want any help from us. Maybe they don't give a fuck. [P19]

That same participant, however, suggested that the efforts of the NHS should be focused on those abusing – as opposed to safely using – AAS.

> A lot of people like me don't have serious adverse effects. So the first thing is to take away this condescending approached that says to all steroid users: "This is what is going to happen", and then we could concentrate more on abuse. If you are 21 or 22 [years old], you want to get big because I want to look good on holiday… they want to take high doses, and after three months they look great. But when they go off cycle, they go back down. This is the user that harm reduction needs to target. Because he's a stupid one. He wants to look like that all year, so he will blast and cruise throughout the year to look like that. [P19]

The participants opinion on how to address the stigma against AAS users was generally focused on an increased awareness about AAS use by the general population, namely in the fitness industry and amongst content providers in social media. In their perception, addressing the use of AAS more openly would indirectly reduce the negative attitudes of health care professionals, therefore increasing the likelihood of users engaging with the health system.

> There's this culture of pseudo-illegality [of AAS use], shame, and lack of knowledge by health staff, lack of knowledge by GPs… For example, in gyms, there's nothing like. “Are you using steroids? Do you need clean needles and stuff? Do you need advice? Go to this place”. (…) The fitness industry does not want to talk about it (…) because they think they might be seen as encouraging people to use steroids. But there's no advice about testing or anything like that (…) and there's just people who don't know where to go for help. I personally find it very difficult. I don't know where to go for help. I don't know if I can go to my GP. I think the health system needs to acknowledge [AAS use] and not shame people about it. [P01]

> It would be good if there was a way to force advertisers, and particularly some social media stars to divulge their habits. I think it's unbelievably unhealthy to have young men and young women looking at pictures of people that are in incredible shape and they will never, ever reach that shape without using a lot of very harsh chemicals. [P08]

Some participants highlighted that a greater awareness about AAS should include the risks of the drugs and the testimony of experienced AAS users.

> I think if people understood, actually [steroids] are not the magic drug we always say they are. (…) I think a lot of people don't realize the amount of work you have to put in for it to actually work properly. (…) And the mental side of steroids… How much they affect people's mental health. I think that's massively misunderstood even within the steroid community. I've got a friend that every time he takes a certain compound he will get suicidal. (…) I think this awareness should come from top elite athletes, bodybuilders or something. People talking openly about their experiences and all the downsides of it. They're the ones that get glorified, so they should come out and say: "This isn't quite what it seems. There's all this other crap that's came along with it, so be prepared if you're going down this road". [P05]

## 8.4 Discussion

This investigation described RMS associated with use of AAS adopted by a diverse group of people from across the UK and their experiences with formal and informal sources of support. Our findings illustrate a diversity of methods used to prevent and treat AAS-HC whose safety and efficacy are based on anecdotal reports and empirical experimentation, and should not be seen as instructions for the use of AAS without medical supervision. The efficacy of many RMS described here are not supported by clinical evidence and their usefulness is debateable even amongst the participants of this study, who represent a small sample of AAS users. Furthermore, the ecological use of AAS for enhancement purposes is not based on clinical guidelines, where the risks of

a controlled exposure to testosterone are justified by the treatment of conditions such as primary and secondary hypogonadism (Bhasin et al., 2018b). Nevertheless, the participants' experiences can be analysed in the light of available evidence and provide greater insight onto the use of AAS by the general population.

### 8.4.1 Risks of early exposure to AAS

Several participants of this study reported – and regretted – early use of AAS, although their average age of first use (25 years) was slightly higher than the median observed in WP2 (22 years). None of them reported the most commonly mentioned risks of AAS by adolescents and young adults – such as dysfunctional growth (Goldman et al., 2019; Karpakka et al., 1992; Larance et al., 2005) and risky behaviour – although some mentioned problems of substance use disorder. Their regret for early AAS exposure seemed to be due to with a general feeling of not having the patience to explore their natural limits and improve other training variables that would give them extra benefits if the decision to use AAS had been postponed for a few years. Furthermore, the participants considered early exposure an unnecessary exposure to risk whose consequences only begin to appear by their late 30s and early 40s. By that time, some problems more commonly seen in elderly populations – such as dyslipidaemia and erectile dysfunction – might be already part of the lives of people who started using AAS in their early 20s or less.

As the use of AAS inevitably leads to transient hypogonadism, an early exposition to these drugs increases the chances of irreversible sexual and reproduction disorders. Some AAS users presented with persistent erectile dysfunction and permanently compromised fertility even after their return to physiological levels of endogenous

testosterone production – with or without PCT (Smit, Buijs, De Hon, et al., 2021). Besides, the higher prevalence of body dissatisfaction and eating disorders in the young population, associated with a greater exposure and vulnerability to dysfunctional body ideals, namely on social media (Griffiths et al., 2018), can increase the risks of body dysmorphia associated with AAS use in that population. An increased prevalence of impulsivity and risky behaviour during adolescence has been attributed to a natural gap of maturation between different brain areas. These include the early development of frontostriatal circuits involved in reward mechanisms and the pursue of new experiences and of amygdala-related structures associated with aversive responses, fear and negative affect; and the later maturation of prefrontal cortex structures regulating impulse control and decision-making, only considered to be completed around 25 years of age (Ernst, 2014). Even those who criticise a strictly neurodevelopmental explanation for the increased risky behaviour in adolescence recognise that the drive for experimentation tends to occur before the person have acquired enough experience to evaluate and manage the risks associated with these impulses (Steinberg, 2008). These characteristics of the young brain, added to social stressors such as body-shame, physical and psychological abuse – to which a quickly-acquired muscular body seems to be an ideal solution – can contribute to an early motivation to use AAS, the impulsive use of high doses and the pathological fear of losing or not having enough muscle mass observed amongst some adolescents who use these substances (Irving et al., 2002). Naturally, these arguments do not amount to say that is safe to use AAS at a given age, or that people would be increasingly safer to experiment with AAS as they grow older and older. The natural risk of age-related cardiovascular problems and dementia can be exacerbated by the use of AAS (Hearne et al., 2022; Kaufman et al., 2015), and even

more so if this use is initiated at an early age. Another argument against the early use of AAS highlighted the importance of acquiring enough experience in strength training before considering the use of AAS. As detailed in item 3.5 (Effects of AAS on skeletal muscle growth), the anabolic properties of AAS in the skeletal muscle are potentialized by exercise, as they influence the repair of micro trauma in skeletal muscle tissue caused by mechanical tension following resistance training. The level of AAS-induced enhancement in muscle hypertrophy is also associated with the type of the exercise, as observed when comparing the physiques of athletes from different modalities – such as cycling and bodybuilding – who made use of AAS. Although there is great degree of variation between training routines and outcomes for the many modalities of strength sports such as bodybuilding, weightlifting, powerlifting and strong men (Panayotov, 2020), most people using AAS seek to maximise muscle hypertrophy in their strength training programs. As discussed in chapter 3, AAS might induced muscle hypertrophy at faster and greater rates than the adaptation capacity of adjacent muscle structures, therefore increasing the risks of injury in poorly trained tendons, joints and ligaments suddenly submitted to supraphysiologic demands. In addition to the physiological stress created by AAS on the musculoskeletal system, many participants highlighted the importance of acquiring enough experience in strength training to minimise the risks of musculoskeletal injuries and maximise muscle hypertrophy. Some of them associated this level of expertise with being able to perform the three basic powerlifting exercises – bench press, squat and deadlift – with heavy weights, safely and without the aid of AAS. It can be argued that this informal measurement reflects not only the time required to develop tendons prepared to withstand the additional stress of AAS-enhanced muscles, but also to incorporate strength training routines, resting intervals, sleep

hygiene and dietary adjustments in someone's budget and life's routine (Stark et al., 2012). Overall, someone ignoring the additional risks of a premature exposure to AAS can be compared to a fast-growing tree with shallow, week roots and illustrates the YOLO (you only live once) type of user described by Christiansen et al. (2017), in which impulsiveness and lack of discipline lead to a high-risk exposure to AAS.

### 8.4.2 Lower doses and safer routines of AAS use

Most participants of this study reported a reduction in AAS dosages as one of their main strategies to prevent harm, whilst their most prominent AAS-HC – namely psychiatric affects such as aggressiveness and anxiety – were associated with the use of higher dosages. Four studies can be used to exemplify conflicting observations of a dose-dependent association between AAS and the severity of AAS-HC. The first of these studies was a randomised controlled trial in which 50 men were exposed to up to 600 mg of testosterone cypionate per week, for six weeks (Pope, Kouri, et al., 2000). In that study, 6 (12.0%) participants displayed mild symptoms of hypomania and 2 (4.0%) had severe symptoms of hypomania when exposed to more than 500mg/w of AAS, therefore suggesting a dose-dependent association between AAS and psychiatric symptoms in a small number of highly responsive men. Another positive association was described in a study where 160 AAS users following their own ecological doses and cycles were stratified as light, medium or heavy AAS abusers (based on type, doses and cycle durations of AAS used) and compared with a cohort of non-AAS users (n = 80) and placebo users (n = 80), all of them athletes following comparable dietary and training routines for 13 months (Pagonis et al., 2006). The study described a significant increase in psychiatric symptoms, namely hostility and aggression, proportional to the levels of

AAS exposure. Opposite conclusions were found by the HAARLEM study, in which 100 ecological AAS users were followed for 12 months and neither dose or cycle duration could be associated with the type or severity of AAS-HC experienced by the participants (Smit, Buijs, de Hon, et al., 2021). Similar observations were made by the authour of this thesis in a cross-sectional study comparing the weekly AAS exposure of 103 Brazilian bodybuilders (Amaral, Deslandes, et al., 2022). This apparent contradiction can be explained by the fact that the absence of a dose-dependent association occurred when comparing regular AAS exposure between subjects, which is fails to describe how individual users would respond to crescent doses of AAS. As made clear by almost every study in this field, individual vulnerabilities and a plethora of other factors – types, doses and cycles of AAS, use of ancillary drugs, counterfeits, substandard drugs, etc. – can compromise the accuracy of ecological observation of AAS use. For this reason, it is reasonable to assume that two people exposed to the exact same amount of AAS might have completely different reactions to these drugs – both desirable and undesirable – and vice-versa, leading some authours to describe an absence of a dose-related association. However, reports such this study and the logic that the body cannot be indifferent to the drugs suggest that the likelihood and severity of AAS-HC tends to increase proportionally to the intensity of AAS exposure, despite different thresholds between individuals. In fact, a growing body of folk-pharmacological advice supports the benefits of using a minimum effective dose of AAS – apparently requiring a great deal of self-experimentation to be defined (V. Black, 2023; Doucette, 2022a; Irons, 2023; O'Connor, 2021a). Regarding time of AAS exposure, the HAARLEM study also observed that the users' testosterone concentrations returned to baseline levels after three months of AAS cessation, and the recovery of spermatogenesis after about one year

(Smit, Buijs, De Hon, et al., 2021). However, those with abnormal gonadal function at baseline and high past exposure to AAS had testosterone concentrations below normal and low total sperm count, regardless of the use of PCT – suggesting a greater risk of permanent gonadal dysfunction after prolonged exposure to AAS. Interestingly, participants of our study considered the BaC as a RMS in itself. In these interviewees' perception, the continuous use of AAS protects them from experiencing hormonal fluctuations and withdrawal symptoms whilst maintaining the physical and psychological benefits of AAS. There is a scarcity of analysis describing the consequences of continuous AAS use in healthy individuals, but studies with men with congenital hypogonadism described both positive (Naharci et al., 2007; Reddy & Yadav, 2021) and negative (Sonmez et al., 2011) impacts of TRT on insulin resistance, lipid profile, blood pressure and risk of metabolic syndrome. Despite the risks of long-term or permanent reproductive and sexual dysfunction, a growing number of AAS users seem willing to accept the prospect of being on TRT for the rest of their lives, as seen in this study. This decision can lead to different level of risk exposure, as some people might consider any anything below their blasting dose to be TRT – usually between 50 mg to 500 mg per week (Doucette, 2022b; Irons, 2021; O'Connor, 2021b). Considering the available evidence on time-and-dose-dependent effects of AAS, the continuous use of these drugs is certainly not a decision not be taken lightly.

### 8.4.3 Counterfeits, testing kits and Trenbolone

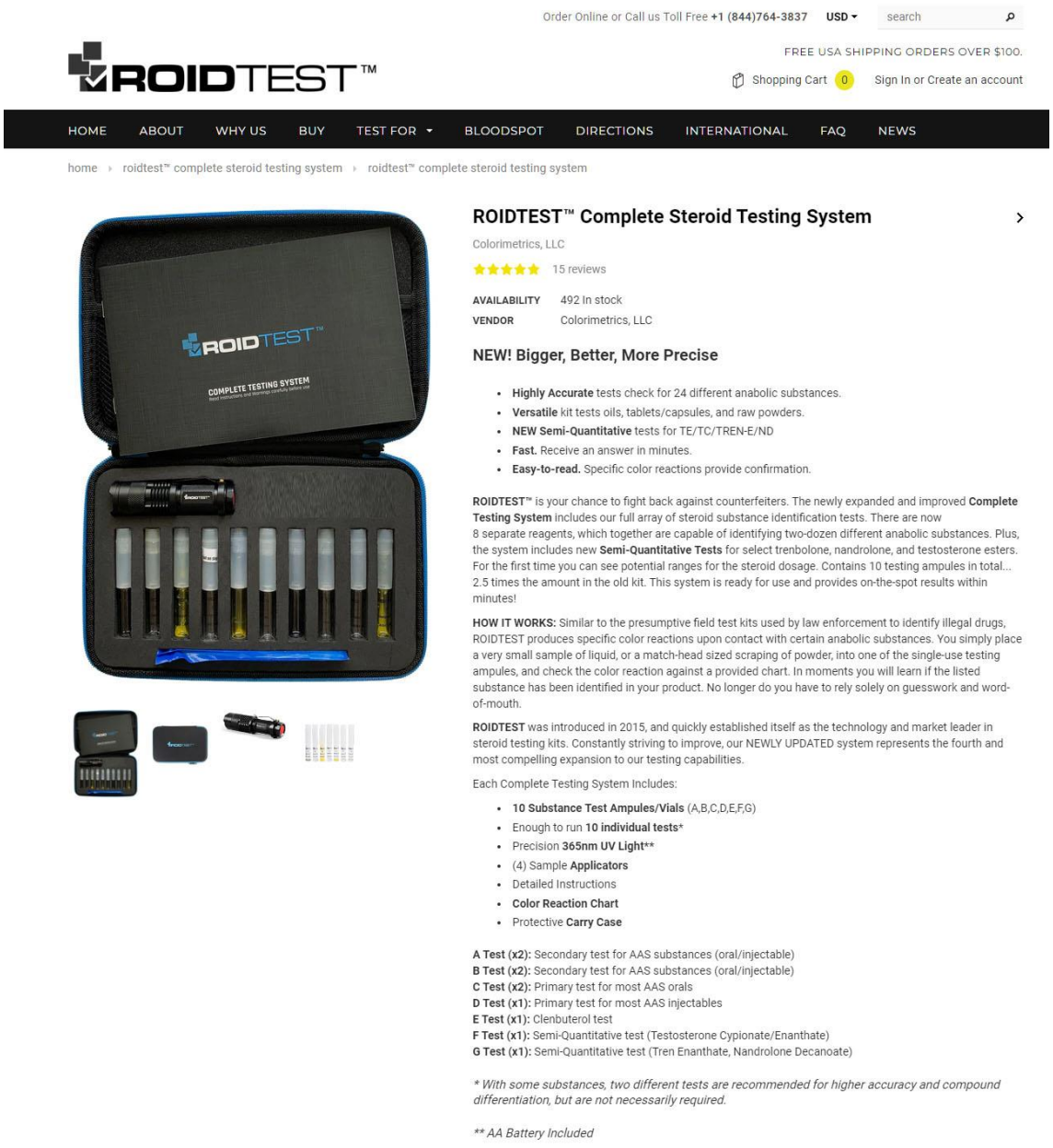
Most participants who had experiences with substandard or counterfeit AAS seemed to minimise their problems, regarding the uncertainty about the compounds' composition, dosage and general quality an inherent risk of using unprescribed AAS. As discussed in

item 4.2.3, the majority of AAS obtained without a prescription comes from illegal markets, increasing the risk of exposure to counterfeits, substandard and contaminated substances (Coopman & Cordonnier, 2012; Neves & Caldas, 2017). A normalisation of the risks associated with the AAS market was previously described amongst people using these drugs (Coomber et al., 2014; Santos & Coomber, 2017; van de Ven & Mulrooney, 2017). In order to manage this risk, little more was done by the participants apart from trying to establish some level of trust with their suppliers of AAS. The spectrum of social networks established around the trade of AAS range from local gym buddies and staff to contacts in social media and international websites with a diversity of features to improve customers' services (Coomber et al., 2014; van de Ven & Koenraadt, 2017). These new dynamics of trust were seen with suspiciousness by older participants of this study, who seemed to favour face-to-face interactions with a friendly dealer (frequently also an AAS user or bodybuilder) whose credibility and merchandise were ascertained by the community of AAS users. However, as exemplified by the resilience of participants' supply chains during the COVID-19 lockdown, the online trade of AAS and raw materials seems to have become the norm in the acquisition of these drugs, sometimes involving untraceable transactions in cryptocurrencies (Barratt et al., 2014; Martin, 2014). It is possible that these virtual and anonymous environments represent additional risks to AAS users – namely younger ones – whose body-image ideals are increasingly influenced by social media and other forms of online interaction (Griffiths et al., 2018; Richardson et al., 2019).

An additional RMS adopted by some participants was the use of testing kits to assess the quality of their AAS. Most tests available online are limited to inform if a given AAS is present in a tablet, oil or raw powder, although some tests seem to be able to detect

dosage ranges – but not the presence of other substances contaminating the sample (see Figure 34). No studies so far have investigated the impact of AAS testing kits in users' behaviour or their ability to prevent harm associated with the use of counterfeits or substandard substances. A review discussing the use and provision of drug checking services for psychoactive substances – namely MDMA, opioids and cannabinoids – described that users of these services were more likely to change their drug-using behaviour when an unexpected substance were detected in the sample and highlighted how drug checking services can be used to monitor illegal drug markets (Maghsoudi et al., 2022). In the case of AAS, the employment of drug check technologies in harm-reduction settings could contribute to mitigate the uncertainties in the composition of the drugs consumed by people using AAS (Evans-Brown et al., 2009).

Figure 35: WP3 - A testing kit for AAS analysis




Adapted from http://www.roidtest.com

Amongst the AAS used by the participants, Trenbolone was frequently mentioned as a substance associated with higher risks of adverse effects, namely insomnia and behavioural changes such as increased aggressiveness. Commercialised as Trenbolone acetate (Finaplix©, Finajet©), Trenbolone enanthate or Trenbolone cyclohexylmethyl-carbonate (Parabolan©, Hexabolan©), this drug was synthesised in 1963 as a veterinary AAS to increase muscle mass in livestock (ACS, 2013). As an AAS from the nandrolone

group, Trenbolone cannot be aromatised into estrogen but apparently exacerbating the risk of joint, mood and libido dysfunction, especially if used as the single AAS in a cycle (Roberts, n.d.). Trenbolone is considered an extremely potent AAS with high risk of androgenic effects (Llewellyn, 2017) and anecdotal reports in online communities commonly advise against its use unless someone is willing to endanger their health for the chance of winning professional-level strength-sports competitions (Doucette, 2022c; O'Connor, 2018; Palumbo & Crosland, 2017). A case report described an episode of extreme violence perpetrated by a man using Trenbolone and Dianabol (Aknouche et al., 2021), and in a study with 521 patients in treatment for substance use disorder in Norway, the use of Trenbolone was associated with severe symptoms of AAS dependence (Scarth et al., 2022).

### 8.4.4 Using AAS during the COVID-19 pandemic

Our sample's experiences of AAS use during the COVID-19 pandemic corroborated observations from similar reports, such as the reduction in dosages, continuous TRT and interruption of cycles (Carter et al., 2021; Gibbs, 2021). Many participants managed to adapt their physical training routines either by exercising at home or having access to gyms (an illicit practice according to the UK's lockdown regulations). As described by Dores et al.(2021) in a multi-national study, some participants started using AAS during lockdown, illustrating how the changes in peoples' circumstances can influence both a reduction or an increase in AAS-related risk exposure. Debuting on AAS during lockdown might reflect a consequence of Fitspiration and the pursue of an improved and 'healthy-looking' physique when social interactions were limited (Cataldo et al., 2021; Shibata et al., 2021). Furthermore, in the UK, the 'furlough' and job retention schemes allowed

millions of people to keep part of their incomes whilst staying at home (Green et al., 2022), providing people with the time and resources to experiment new activities and habits, including the use of AAS (McKinlay et al., 2021). Another consequence of the COVID-19 pandemic in the UK was the increase in online shopping (Chronopoulos et al., 2020), widely recognised as an important source of AAS trade (Cordaro et al., 2011; Fink et al., 2019; Van Hout & Bingham, 2013). Our results suggest marginal disruptions (if any) in the supply chain of AAS during the COVID-19 pandemic, highlighting the resilience of this particular drug market and corroborating previous findings (Carter et al., 2021; Gibbs, 2021). Aligned with reports from the UK (Carter et al., 2021), Australia (Dunn & Piatkowski, 2021) and trans-regional studies (Dores et al., 2021; Shibata et al., 2021), a minority of participants reported physical and mental health problems associated with the abrupt interruption of AAS use during lockdown, although most were mild and transient.

### 8.4.5 Seeking help from formal and informal sources

The participants mentioned the judgmental attitude of health care professionals and the lack of access to specialised services as the main barriers to their engagement with the health system, as described in previous analyses (Havnes et al., 2019; Hill & Waring, 2019; Zahnow et al., 2017). The only female participant of this study described her preference for online communities composed exclusively by women using AAS, corroborating previous reports describing the development of a 'sister-science' environment where females feel more comfortable to seek support and discuss their use of AAS and other IPEDs (Andreasson & Henning, 2022; Fomiatti et al., 2023; Henning & Andreasson, 2021). Interestingly, several participants described how a refusal by

health professionals to prescribe exams and provide treatment led to an increased use of private health services. According to these participants, for instance, some GPs might refuse to treat AAS-HC – sometimes described as self-inflicted conditions – in attempts to dissuade their patients from using AAS, as well as from fear of endorsing their patients' drug use and unhealthy lifestyles. From an ethical point of view, these practices would go against the UK's General Medical Council's guidance, in which medical doctors are exhorted to advise against unhealthy lifestyles without denying treatment for health conditions associated with these behaviours (GMC, 2013).

> The investigations or treatment you provide or arrange must be based on the assessment you and your patient make of their needs and priorities, and on your clinical judgement about the likely effectiveness of the treatment options. You must not refuse or delay treatment because you believe that a patient's actions or lifestyle have contributed to their condition. [Good Medical Practice, item 57]

Likewise, the British Medical Association advises against the practice of refusing treatment for health associated with the patients' lifestyles.

> It is not appropriate for doctors to refuse to treat patients whose illnesses are thought to arise from their personal choices, for example, smoking, alcohol, and drugs. (BMA, 2022)

Unsurprisingly, many participants sought private companies to have regular blood tests, as well as consultations with private physicians and steroid coaches to interpret exams and treat AAS-HC, sometimes buying ancillary drugs from their AAS providers. As discussed in item 4.2, this dynamic fosters a thriving and poorly regulated market,

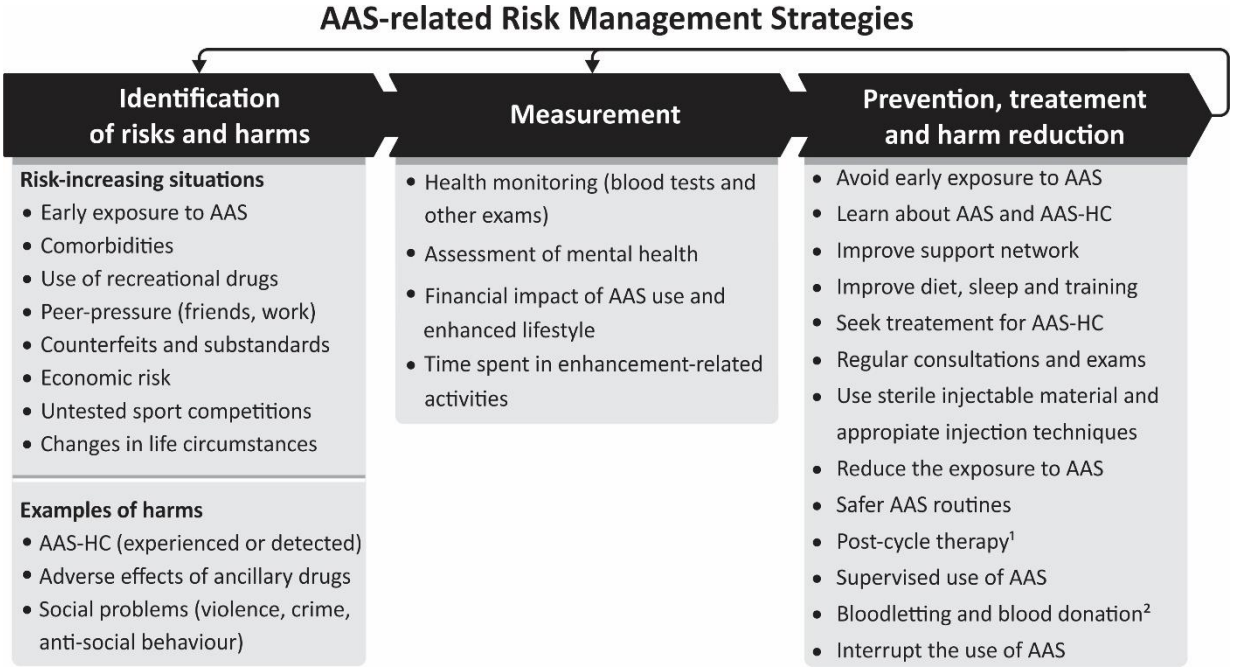
populated by formal and informal agents. Unsurprisingly, some participants advocating private tests were also providing payed advice to AAS users. The informal sources of support sought by participants of this study were similar to those described in previous studies (Henning & Andreasson, 2021; Tighe et al., 2017) and highlight the risks of unsound advice provided by members online forums and AAS suppliers. As observed by van de Ven & Mulrooney (2017), part of the process of becoming an experienced AAS user involves learning how find reliable information amidst a virtually endless amount of opinions and interpretations of data. The ever-growing number of AAS and drug regimens, training routines, diets, ancillary drugs and combinations with other IPEDs frequently involved in the use of AAS increase the risks of misuse and misinformation, especially for new users. As much as the experience from seasoned AAS users might be useful to identify risks and prevent previous mistakes, it is unreasonable to expect a risk-free trajectory when using these drugs.

### 8.4.6 The process of managing risks related to AAS

Our findings illustrate several behaviours adopted by people using AAS to prevent and treat AAS-HC. These RMS include harm-reduction practices as well as actions to identify harm, negotiate the hazards of illegal markets, select sources of support and information, and decisions to reduce or stop the consumption of AAS. The development and adoption of AAS-related RMS can be described as a continuous process of risk-management (Wolke, 2017), as seen in Figure 33. This model highlights the changes in drug-using routine spontaneously made by some users to adapt to contingences. The peak of the COVID-19 pandemic offered an unparalleled opportunity to observe changes in human behaviour, namely in locations such as the UK where the entire population

was subject to measures of social distance and travel restriction commonly known as the lockdown. Our findings corroborated the observations of previous studies describing how the consequences of the COVID-19 pandemic – such as the closure of gyms, social distancing and travel restrictions – impacted the use of AAS (Carter et al., 2021; Dores et al., 2021; Gibbs, 2021).

Figure 36: AAS-related risk management strategies




AAS: Androgenic anabolic steroids. AAS-HC: adverse health conditions potentially associated with the use of AAS. 1: There is limited evidence regarding the efficacy and safety of different PCT protocols. 2: People must inform their history of AAS use before donating blood. Providing false or misleading health information is a crime in the UK (Department of Health, 2014).

Using the COVID-19 lockdown to illustrate the model, we observed how major changes in life circumstances led some users to measure their ability to cope with the closure of gyms and limited opportunities of social interaction. Some users – namely those with unlawful access to gyms or how owned appropriate training facilities – reported little or no change in their AAS use, which also shows the resilience of AAS supply chains, based on online sources whose efficiency only grew during the pandemic. After assessing their access to gyms and stocks of AAS, some users decided to reduce their doses or to halt

AAS use altogether, returning to their previous routines after what some of them considered a welcomed break. The RMS model underscores the resiliency and agency of individual AAS users and their community of practice, and might help explain why is so rare that people using these drugs will seek health services to help them reduce or stop their use (Pope et al., 2004). Naturally, not every AAS users' decisions are based on effective and conscious processes of risk-management. As described by Christiansen et al. (2017) in their typology of AAS users (see item 1.2), the main difference between the types lies in their balance between risk exposure and pursue of higher levels of AAS-induced body and image enhancement. Amongst haphazard decisions and experimentations, it can be argued that the process of becoming an 'Expert' type is intrinsically associated with the development of more efficient RMS. However, as observed in the interviews, the effectiveness of AAS-related RMS should not be measure by the presence of a given strategy, but their ability to reduce harm. For instance, having regular blood tests will not reduce harm unless the problems identified in the exams are addressed by treating AAS-HC, reducing or changing drug exposure or interrupting the use of AAS. As discussed below, recognising and understanding AAS-related RMS also provides opportunities for health interventions.

### 8.4.7 RMS and opportunities for intervention

The RMS described in this study are based on an holistic approach to AAS use, in which similar theoretical attention is given to the substances and how they are used, users' protective factors and vulnerabilities, as well as how the socioecological context can influence the likelihood of individuals experiencing AAS-HC. Holistic frameworks such as the biopsychosocial model of disease have been criticised for being too inclusive and

eclectic in their description of factors involved in the production of risk and for failing to prioritise which aspect(s) of risk should be addressed by public policies or in the support to a particular individual (Ghaemi, 2010). However, as highlighted by Rhodes (2009) when describing the applications of the risk environment framework for harm reduction, although this model does not delineate causal pathways, it can be used to identify opportunities for intervention. Likewise, recognising how RMS adopted by AAS users address physical, mental and social problems in their risk environment can help those seeking to improve the health of that population. As exemplified in this study, behavioural changes regarding AAS use are more likely to happen when a health condition is identified, or the users experience major changes in life circumstances – such as the social distancing measures following the COVID-19 pandemic in the UK. Even so, most participants of this study kept using AAS after experiencing minor, moderate and severe AAS-HC, and many either kept their regular cycles during lockdown or resumed their use as soon as they had access to a training facility. Only three participants of this study stopped using AAS immediately after experiencing or identifying an AAS-HC. One after a myocardial infarct, another after mild alterations in her liver enzymes, and the third following the diagnosis of prostate cancer – although he resumed the use of AAS after remission of the cancer. In addition to these few examples of relative AAS abstinence, the participants described several behavioural changes adopted in consequence of their RMS. Although the correctness of some of these decisions are debatable from a medical perspective – such as doing bloodletting or opting for a BaC regimen to prevent symptoms of AAS withdrawal – they can include voluntary reductions in AAS exposure, showing a flexibility that might be overlooked if drug abstinence is expected as the only desirable outcome of health interventions. Long-

running initiatives and recent experiments where specialised services were offered to people using AAS showed promising results in harm reduction by aligning their actions with RMS adopted by people using AAS instead of conditioning their support to the cessation of AAS use. Examples of these programmes are given by the Glasgow IPED clinic (Campbell, 2020), the Norwegian information service Steroidelab (Havnes et al., 2019) and the PUSH! Audit from Australia (Eu et al., 2023).

Established in 2010, the Glasgow IPED clinic provides needle exchange and injection advice, identification and support for AAS-HC, discussion and alternatives to IPEDs. The service is anonymous and one of its central features are the blood tests used to monitor the health of people using AAS. Blood tests are considered by the clinic's founder and manager John Campbell powerful tools to influence users' behaviour (Henning & Andreasson, 2022) and were recently incorporated in the IPED NEO 360 Module, a database of blood tests results and IPDEs in use (Campbell, 2020). The Steroidlab was created in partnership with the Oslo University Hospital to provide free and anonymous information sessions about AAS and AAS-HC – via telephone or personal meetings – to the general public, AAS users and their next to kin. Over four years, 232 AAS users contacted the service, amongst which 77.2% sought treatment to help them with AAS cessation. Although the vast majority of AAS users (97.4%) seeking the Steroidlab were already motivated to stop using AAS, this intervention was able to identify mental health problems as the main motivation for cessation and the profile of AAS users most likely to seek treatment, i.e. older, long-using and with a higher number of AAS-HC (Havnes et al., 2019). Finally, the PUSH! Audit provided training to GPs from five different cities in Australia to help them identify and manage AAS-HC. From the 141 users included in the analysis, 81.5% reported behavioural changes that led them to improve their health

monitoring, treat AAS-HC or modified their AAS use to improve safety. Nearly ten percent of these patients reported ceasing AAS use following the consultations with the trained GPs (Eu et al., 2023). The PUSH! audit illustrates the effort of Australian researchers in improving the quality of the service provided by GPs to AAS users, echoed by the online guide of harm minimisation for patients using AAS and other IPEDs (van de Ven, Eu, et al., 2020). These approaches adhere to the evidence that people using AAS are more like to seek support from non-judgmental sources who are aware of the many aspects of AAS use, such as their impact on mental health and the factors increasing or reducing the risks of AAS experienced by different users (Harvey et al., 2020; Zahnow et al., 2017). Furthermore, these interventions benefit from potential 'moments of change' (S. Thompson et al., 2011) in AAS users' RMS, as a behaviour is more likely to be changed following the diagnosis of an AAS-HC or the identification of a risk. As highlighted by Havnes et al. (2019), the goals of such interventions must be developed *with* the users – and not *for* them – in order to reduce the health consequences of AAS use, which might, at some point, include support for cessation (Dawson, 2001). In that sense, health professionals supporting AAS users might find themselves helping the users develop more efficient RMS – a role currently played by an uneven and growing field of steroid coaches and gurus (Gibbs et al., 2022). We believe that the analysis of AAS-related RMS can help identify these opportunities and improve the health of people using AAS.

# 9. Conclusion

This research aimed to investigate the strategies adopted by people to prevent and treat adverse health conditions associated with the use of AAS, as well as their experiences with physicians and other sources of support. We presented an extensive review on AAS' mechanisms of action, formal and informal sources of information and support. The research estimated an overall prevalence of AAS users seeking support from physicians of 37.1% (95% CI 29.7 to 44.5), with wide variations between locations and subpopulations of AAS users. The online survey (WP1) described the use of AAS amongst a relatively large and diverse sample of UK residents. That study highlighted the use of AAS by adolescents, young adults and other vulnerable groups such as male and female members of the LGBTQIA+ population across the UK. It also described dermatological (68.1%) and neuropsychiatric conditions (63.1%) as the most prevalent AAS-HC in the sample, with nearly half of AAS users (45.9%) experiencing five or more AAS-HC in the last 12 months. The majority of participants of the survey had blood tests to monitor their health (86.4%) and sought a GP to treat AAS-HC (55.0%). These and other strategies to manage the risks associated with the use of AAS were explored through in-depth interviews (WP2). The interviews highlighted barriers and facilitators for accessing health support that might contribute to explain the results observed in the previous WPs – such as the stigma of health professionals towards AAS users and the use of private services to obtain blood tests and specialised advice. The combination of data from the three WPs led to a better understanding of the multidimensional aspects of risks and harms associated with AAS use and the process of risk-management adopted by some

AAS users. This research's contributions to its theoretical framework, methodology and implications for practice and research are outlined below.

## 9.1 Contributions to the theoretical framework

In this thesis we observed how trans-regional fluxes of information and support can affect various levels of different risk environments, therefore expanding the framework outlined by Rhodes (2002) and used by Bates et al. (2019) to understand the use of AAS. In its original form, the risk environment is described as closed system of macro social factors influencing micro scales towards an individual level portrayed as a passive receptor of influences beyond their control. Our results illustrate and how trans-regional (i.e., online) sources of supply and information contribute to form a broader, open and complex system (Von Bertalanfy, 1968) in which countless risk environments dynamically interact with each other. This research also exemplified how the initiatives of AAS' users, suppliers and support networks co-create the risk environment, potentially impacting 'higher' levels of the socioecological framework. This 'bottom-up' effect can be observed in the influence of enhanced bodybuilding over popular culture since the 1950's, contemporary social media platforms and informal sources of support provided remotely via the internet (see item 4.2). It is reasonable to assume that the growing normalisation of AAS in recreational sport and different work environments has contributed to the provision of health services and private initiatives such as the Enhanced Games, which by their turn might reinforce a perception of safety and enable the use of AAS and other IPEDs.

## 9.2 Contributions to research methodology

This research exemplified a successful employment of the mixed methods approach, in which the WPs worked synergistically to produce knowledge bigger than the sum of its parts. The sequence of a systematic review followed by quantitative and qualitative studies not only provided a database of surveys, lists of AAS-HC and potential participants, but also offered complementary perspectives of AAS use in the UK – from the historical/global throughout the individual/contemporary experience of AAS users. This plurality of perspectives led to a proto-type description of risk-management strategies by the end of WP3 unlikely to be accomplished by a stand-alone study.

### 9.2.1 WP1: Systematic review and meta-analysis

The heterogeneity of data describing the engagement of AAS users with physicians represents a challenge for research, as the prevalence of AAS use and health-related behaviours vary widely across locations and subpopulations of AAS users. Furthermore, the scarcity of studies from several countries and hard-to-reach subpopulations such as females, LGBTQIA+ and adolescents compromises the generalisation of data in this field. In an attempt to minimise these limitations, WP1 adopted a broad selection strategy, aiming to include the largest possible number of studies investigating health-related behaviours of AAS users. Different approaches for engagement with physicians – such as seeking information, treatment and interpretation of exams – were considered valid forms of support, as they represent an opportunity for harm-reduction and professional health advice. Comparison groups were created to improve data analysis, reflecting variations in prevalence and indicating opportunities for future studies. Furthermore,

the publication of the R codes utilised in the meta-analysis allowed a cost-free reproduction of results and further analysis with similar purposes.

### 9.2.2 WP2: Online survey

The main contribution of this WP for research methodology was its recruitment process, which succeeded in gather more than 800 AAS users from different regions of the UK. Driven by necessity in face of the social-distancing measures imposed soon after the beginning of this research, the recruitment of participants was almost entirely based on cost-free advertising on social media – namely Instagram©, a particularly popular platform amongst people using body-image enhancing drugs (Griffiths et al., 2018). The creation of a professional account on Instagram and the process of following commercial and personal profiles associated with bodybuilding, gyms, fitness or openly advocating the use of AAS contributed to the success of this method. Furthermore, the use of attractive pictures using royalty-free images and the support of a bodybuilder willing to promote the study also helped making the survey known amongst AAS users.

### 9.2.3 WP3: In-depth interviews

The selection of participants amongst respondents of the online survey proved advantageous for two reasons. Firstly, it allowed us to identify potential participants with demographic characteristics, histories of AAS use and health-related strategies compatible with the aims of the study. Whilst we aimed for a diverse sample, similar methods would allow researchers to select a sample composed uniquely by participants from specific locations, age ranges, sexualities, etc. Secondly, it provided an insight on topics to be discussed in depth such as previous health conditions, use of health services,

occupational use and time of AAS use. Although questions investigating these issues were asked to all participants, having this information beforehand helped us building rapport with the interviewees and make sure that relevant events were not overlooked. Although the sample had to be completed with additional advertising and snowball invitations – whose personal information was unknown to the researchers until the interview – having a clear method for the selection of participants contributed to the reproducibility of the study. Regarding qualitative data analysis, this study exemplified a successful application of Iterative Categorisation (Neale, 2016). The flexible methodology of Iterative Categorisation helped us organise, compare and analyse a large amount of qualitative and quantitative data, unveiling the patterns described in this study as risk-management strategies.

## 9.3 Contributions to clinical practice

Findings from this research (WP1) suggest that about one-third of people using AAS see support from physicians, meaning that the majority of them do not. The levels of disengagement seem to be even higher amongst adolescents. This should raise concern on clinicians and promote attempts to improve the engagement of people using AAS with the health system. The prevalence of AAS-HC observed in the survey's (WP2) can be used to support further investigations and raise awareness on the most common complaints presented by people using AAS. As discussed in WP3, conditioning exams and treatments to AAS abstinence is unethical and most likely inefficient in reducing the use of AAS. Future studies should evaluate the impact of training physicians to improve the support provided to AAS users. The findings of this research highlight the importance of guidelines for health professionals working with people using AAS, namely harm-

reduction strategies for those unwilling to stop their use (such as the types and frequency of blood tests and other exams to monitor their health, the provision of injection equipment for intramuscular injections, PCT, etc.).

## 9.4 Contributions to policy

This research highlights the need to improve the access of people using AAS to health services whose professionals are trained to recognise and manage AAS-HC. As the prevalence of AAS use apparently increases, the number of NHS-funded Steroid Clinics paradoxically dwindles, leaving users – namely adolescents and young adults – at the mercy of informal sources of support and private health services. Beyond the provision of specialised services, policy-makers should consider adaptations of successful programs such as the previously discussed PUSH! initiative from Australia (Eu et al., 2023). Our findings also suggest that AAS users who actively minimise the risks of these drugs – via health monitoring, prevention and treatment of harms – are less likely to experience AAS-HC. However, this research also indicates that some AAS users will only adopt RMS after the occurrence of harm. Instead of educational campaigns purely focused on prevention of AAS use, our findings suggest that improving the RMS of AAS users might enable them to prevent harm and make informed choices regarding the use of these drugs. Overall, promoting awareness about the use of AAS and about RMS might contribute to reduce the stigma towards people using these drugs and increase their engagement with the health system. People using AAS users are a sentinel population for new IPEDs (McVeigh et al., 2021), fragilities in the health system and social pressures for enhanced levels of body-image and performance. Integrated efforts in policy and research are required to address these public health challenges.

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# Appendix 1: Online Survey (WP2) Participant Information Sheet

**Health Strategies and Harm related to the use of Anabolic Steroids**

**Online Survey**

*You can print a copy of this information sheet for your records*

I would like to invite you to take part in a study as part of my PhD research. Before you decide to participate, I would like to explain why the research is being done and what it involves. Please take time to read the following information and take time to decide if you want to take part or not.

**What is the purpose of the study?**

The purpose of the study is to understand strategies to prevent and treat adverse effects of anabolic steroids.

This survey will ask you about anabolic steroids and other substances you might have used. It will also ask about your health condition and problems that you might have experienced in the last 12 months. The survey has been approved by King's College London (REMAS No. 22034).

**Who can participate?**

I ask that only people that are 16 years old or older, lives in the UK and used anabolic steroids in the last 12 months without having a medical prescription take part in this survey.

The survey will be available between 1st July and 30th September 2021.

If you are eligible, choose to participate and complete the survey, I would like to thank you for your time. At the end of the survey, you can choose to enter into a prize draw for one of five £50 Amazon gift vouchers.

**What are androgenic anabolic steroids?**

They are substances derived from the hormone testosterone. Some examples of anabolic steroids include Axiron, Androgel, Fortesta, Testopel, Striant, Delatestryl, Testim, Androderm, Androstenedione, Stanozolol (Winstrol), Nandrolone (Deca-Durabolin) and Methandrosteolone (Dianabol).

**What are health strategies?**

Any actions or methods used to obtain health-related information or receive treatment for health conditions. These include consultations with your General Practitioner (GP), medical exams to monitor your health, visiting the A&E, Needle and Syringe Programmes, Steroid Clinics, and also contact with friends, coaches, social media and online forums.

**Do I have to take part?**

Taking part in the research by completing the questionnaire is entirely up to you. There are no consequences if you decide not to take part in this research.

**What will happen to me if I take part?**

If you decide to take part, I will ask that you fill a survey which may take 10 to 15 minutes to complete. Questions about drugs and lifestyle choices are sensitive and therefore we recommend completing this survey in private. Should you become distressed by any of the questions exit the survey immediately and seek help from your GP if necessary.

The survey will also contains questions about the following categories of personal data: Age, email address (optional), gender, occupation (optional), ethnic origin, health data and sexual orientation.

If you do not want to answer any question in the survey, simply choose the option "I prefer not to answer this question".

**Will my participation be kept confidential?**

This questionnaire is confidential and anonymous. I will not ask your name, address or date of birth. Cookie files are not used in this survey. All of the information you give us will be stored in accordance with the UK Data Protection Act 2018. Only the researchers for this study will have access to it. The survey data you provide is completely anonymous. This means you cannot be identified and the answers you provide cannot be linked to you. If you provide an email address to participate in the prize draw, it will be stored in a separate database from the survey data. There will be no way to link this to your survey answers.

All the information collected about you during the course of the research will be kept strictly confidential subject to legal limitations. Any information that is stored will have your name and address removed so that you cannot be recognised. If, however, you discuss anything that gives the researchers reason to believe that there is a risk that you might harm yourself or others, or if you disclose details of abuse, neglect or any other serious crime, such as one involving children, I will have to report this to the appropriate authorities, such as the police. This is standard practice for all research.

**Data Protection Statement**

If you would like more information about how your data will be processed under the terms of UK data protection laws please visit the link below:
**https://www.kcl.ac.uk/research/support/research-ethics/kings-college-london-statement-on-use-of-personal-data-in-research**

**What if I change my mind about taking part?**

You can exit the questionnaire at any time without giving a reason. Data from incomplete questionnaires will be deleted and will not be used by this study.

You can withdraw your participation after submiting the questionnaire if you provide an email address at the end of the survey (otherwise, it will not be possible for us to identify your questionnaire).

If you want to withdraw your participation after submiting the questionnaire, please send me an email ( **julio.amaral@kcl.ac.uk** ) until [two weeks after the end of data collection]. You do not have to give a reason to withdraw your participation. After [two weeks after the end of data collection] it will not be possible to withdraw your participation from the research.

**How is the project being funded?**

The research has been developed and is funded by King's College London.

**What will happen to the results of the study?**

The results of the study will be published in the form of reports, articles and conference presentations. If you would like to receive a copy of the results, send me an email (see below).

**Invitation to an interview**

At the end of the survey, you will be invited to participate in an interview, taking place between November and December 2021.

If you want to take part in the interview, I will ask you to inform a valid email address in the end of the survey, so I can get in touch with you. If you choose to do so, please note that data from your survey will be associated to your email address. However, your personal data and email address remains confidential and will not be published anywhere.

I will contact some of the participants of the survey that agreed to take part in an interview. If you are selected, I will contact you via email and ask if you still want to participate in the interview, in a date convenient to you. The interview will last about 1 hour, and you can choose how it will be conducted: via telephone or online (via Microsoft Teams). Interviews will be recorded, but all personal data will be anonymised (your name and personal details will not be published). Furthermore, if you choose to be interviewed online, you can choose to switch off your device's camera/video. All the participants who complete the interview will receive a £20 Amazon gift voucher. Further details about the online interviews will be provided for those selected to participate.

**Who should I contact for further information?**

If you would like to receive more information about this study, please contact me using the email below:

**Dr Julio Amaral - PhD student**
**julio.amaral@kcl.ac.uk**
King's College London - Addictions Department
4 Windsor Walk
SE5 8BB

**What if I have further questions, or if something goes wrong?**

If this project has harmed you in any way or if you wish to make a complaint about the conduct of the project you can contact King's College London using the details below for further advice and information:

**Dr Paolo Deluca - Research Supervisor**
**paolo.deluca@kcl.ac.uk**
King's College London - Addictions Department
4 Windsor Walk
SE5 8BB

**If you feel distressed or need help, this a list of resources that are available to you:**

**- NHS (111):** Non-emergency medical support and health advice.
**- NHS (999):** Medical emergencies, fire or crime taking place.
**- Samaritans (08457 90 90 90 / jo@samaritans.org):** Telephone and email support if anyone is worried, upset or suicidal.
**- Papyrus HOPEline UK (0800 068 41 41):** Support and advice to young people worried about themselves.
**- Get Connected (0808 808 4994):** Help for people under 25 who self-harm.

Thank you for reading this information sheet and for considering taking part in this research.

## Appendix 2: Online Survey (WP2) Message to gatekeepers

Dear Sir or Madam,

I hope this message finds you well.

As part of a PhD research at King's College London, an online survey was developed to help understand the strategies adopted by people who use anabolic steroids to treat and prevent adverse health conditions.

Results of this study will add to the knowledge on the prevention of harm related to the use of anabolic steroids by the general population.

I would like to ask your collaboration by inviting members of [name of service, gym or online forum] to take part in the survey using the attached [link, image or poster].

The survey will be active from the 1st of July to the 30th of September 2021. The survey is confidential and anonymous. All data is stored in accordance with the UK Data Protection Act 2018.

This study is registered at King's College London Research Ethics Committee, REMAS 22034 (rec@kcl.ac.uk).

Please reply to this message informing if you agree with the advertising of the survey and to clarify any questions you might have about this study.

Kind regards,
**Dr Julio Amaral**
PhD Student
King's College London

# Appendix 3: Online Survey (WP2) Questionnaire

**Anabolic steroids: health strategies and harm**

Welcome!

The goal of this survey is to understand what people do to prevent and treat adverse effects of anabolic steroids.

It takes approximately 10-15 minutes to complete.

In the end, you will be able to enter a prize draw to win one of five £50 Amazon vouchers.

This survey is only for people who:

- are 16 years of age or older

- lives in the UK

- used anabolic steroids without a medical prescription in the last 12 months.

This questionnaire is confidential and anonymous. All data is stored in accordance with the UK Data Protection Act 2018.

A summary of the findings will be published online after the completion of the study on [link to study's website].

Before you start, please read the details of the study in the Participant Information Sheet (opens new window).

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If you need more information about anabolic steroids, talk to your GP or one of the services below:

- Frank - friendly, confidential drug use advice

- NHS - getting help

Click on the ARROW button on the right to continue.

---

Please complete this form after you have read the Participant Information Sheet.

By ticking each box below, you are consenting to that condition of the study.

You can only take part in this study if you agree with all of these conditions.

- I confirm that I have read and understood the Participant Information Sheet for this project. I have had the opportunity to ask questions, if necessary, and I agree with the conditions of the study.
- I consent to take part in this study and I understand that I can refuse to take part and can withdraw from the project at any time before the final submission of the survey without giving any specific reason.
- I consent to the processing of my personal information for the purposes explained to me in the Information Sheet. I understand that such information will be handled in accordance with the terms of the General Data Protection Regulation (GDPR) and the UK Data Protection Act 2018.
- I understand that my information may be subject to review by responsible individuals from King's College for monitoring and audit purposes.
- I understand that confidentiality and anonymity will be maintained, and it will not be possible to identify me in any research outputs.
- I understand that the information I have submitted will be published as a report.

---

**Please confirm that:**

- I am 16 years old or older
- I am currently living in the UK
- I have used anabolic steroids in the last 12 months

## Section 1 - Demographics

Please answer the following questions about yourself.

**1. How old are you?**

- Please type your answer in years:_____

**2. What sex were you assigned at birth?**

- Male
- Female

**3. What is your ethnicity?**

Choose one option that best describes your ethnic group or background.

- **Asian**
  Includes Asian British, Bangladeshi, Chinese, Indian, Pakistani and other Asian backgrounds
- **Black**
  Includes Black British, African, Caribbean and other Black backgrounds
- **White**
  Include White British, Irish, Scottish, Welsh, and other White backgrounds
- **Mixed** or multiple ethnic groups
- **Other** ethnic background:
- I prefer not to answer this question

**4. Where in the UK do you live?**

- England
- Northern Ireland
- Scotland
- Wales

**5. Can you tell us your household annual income?**

- No income
- less than £20,000
- £20,000 - £39,999
- £40,000 - £59,000
- £60,000 or more

- I prefer not to answer that question

## Section 2 - Use of AAS and other substances

Now, we would like to ask you about the use of anabolic steroids and other body-enhancement substances.

**6. How old were you when you used anabolic steroids for the first time in your life?**

Please type your answer in years: _____

**7. How did you use anabolic steroids in the last 12 months?**

Choose all that apply:

- intramuscular (IM) injection
- oral (tablets, pills, powder)
- other:

**8. Have you used any of the substances below in the last 12 months without having a medical prescription?**

Choose all that apply:

- Human Growth hormone (GH, HGH, somatropin, hygetropin, etc.)
- Growth hormone releasers (GHRH)
- Growth Hormone releasers (GHRH, CJC-1295, CJC-1293, etc.)
- Insulin
- Selective androgen receptor modulators (SARMs)
- Clenbuterol (Spiropent, Ventolase)
- Ephedrine
- DNP (2,4-Dinitriphenol)
- Anti-estrogen medication (tamoxifen, arimidex, letrozol, etc.)
- Post-cycle therapy (PCT) medication (clomid, tamoxifen, HCG, etc.)
- Other body enhancement substances:
- None of the substances above

**9. Would you say that steroids help you improve your performance at work?**

That would include increasing your performance in an occupation that is (or you plan to be) a source of income to you, such as sports competitions, security-related jobs, personal training, modelling, entertainment, etc.

- Yes. Can you tell us what your occupation is? (optional)
- No. Can you tell us what your occupation is? (optional)

## Section 3 - Preventive strategies

Now, we would like to ask you about your strategies to prevent health problems related to the use of anabolic steroids.

**10. Do you have regular consultations with your GP to help monitor your health?**

- Yes
- No

**11. Have you ever discussed the use anabolic steroids with your GP?**

- Yes
- No. Can you tell us why not? (optional):

**12. Did you have a blood test in the last 12 months to monitor your health?**

This includes tests to monitor your general health, hormones or screening for blood borne viruses (HIV, hepatitis, etc.).

- Yes
- No

**13. Did you use the services of a Needle and Syringe Programme (NSP) in the last 12 months?**

- Yes
- No

**14. Did you use an outreach syringe exchange service in the last 12 months?**

This service provides sterile injection material outside pharmacies or NSP facilities, such as in gyms.

- Yes
- No

**15. Did you use the services of a Steroid Clinic in the last 12 months?**

These specialist clinics provide harm reduction services for people who choose to use anabolic steroids. They can also be called **IPED Clinics** (image and performance-enhancing drugs).

- Yes
- No

**16. Did you use the services of a Sexual Health Clinic in the last 12 months?**

- Yes
- No

**17. Did you use the FRANK (talktofrank.com) drug support service in the last 12 months?**

- Yes
- No

**18. Where do you look for information about how to prevent health problems related to the use of anabolic steroids?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- The internet
- My provider of anabolic steroids
- Other:
- I don't look for this kind of information

**19. Do you have any other strategy to prevent health problems related to the use of anabolic steroids?**

- Yes. Please, specify:
- No

## Section 4 - Harm and treatment strategies

We would like to ask you about health conditions that you might have had in the last 12 months, and how did you choose to treat (or dealing with) them.

**20. Did you have any of the following health conditions in the last 12 months?**

Choose all that apply:

- Acne
- Hair loss
- Hirsutism (abnormal growth of hair)
- Striae (stretch marks)
- Injection site injuries (abscess, infection, swelling)
- I didn't have any of these conditions in the last 12 months

*The following questions will be available for each condition marked on question 21.*

**21 to 25. Who helped you treating (or dealing with) the acne / hair loss / Hirsutism / Striae / Injection site injuries?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this health condition

**26. Did you have any of the following health conditions in the last 12 months?**

Choose all that apply:

- Muscle or joint injuries (elbow, knees, etc.)
- Spine injuries or disc herniation
- Chronic pain (muscle or joint pain lasting more than 6 months)
- I didn’t have any of the conditions above in the last 12 months.

*The following questions will be available for each condition marked on question 27.*

**27 to 29. Who helped you treating (or dealing with) the Muscle or join injuries / Spine injuries / Chronic pain?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this health condition

*The following question will be available if the option ‘Male’ is marked on question 2 (Gender at birth).*

**30. Did you have any of the following health conditions in the last 12 months?**

Choose all that apply:

- Testes hypotrophy (reduction in the size of your testes)
- Gynecomastia (growing of breasts in men)
- Erectile dysfunction (trouble getting or maintaining an erection)
- Low sexual drive (lower libido)
- Infertility
- I didn't have any of these conditions in the last 12 months

*The following questions will be available for each condition marked on question 31.*

**31 to 35. Who helped you treating (or dealing with) the Testes hypotrophy / Gynecomastia / Erectile dysfunction / Low Sexual Drive / Infertility?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this health condition

*The following question will be available if the option 'Female' is marked on question 2 (Gender at birth).*

**36. Did you have any of the following health conditions in the last 12 months?**

Choose all that apply:

- Clitoromegaly (enlargement of your clitoris)
- Breast atrophy (reduction of your breasts)
- Irregular or absent periods
- Low sexual drive (lower libido)
- Infertility
- I didn't have any of these conditions in the last 12 months

*The following questions will be available for each condition marked on question 37.*

**37 to 41. Who helped you treating (or dealing with) the Clitoromegaly / Breast atrophy / Irregular or absent periods / Low sexual drive / Infertility?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic

- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this health condition

**42. Have you had any of the following conditions in the last 12 months?**

Choose all that apply:

- Insomnia (having trouble falling asleep or sleeping)
- Anxiety (intense feelings of worry or fear)
- Depression (intense feelings of sadness or hopelessness)
- Increased aggressiveness
- I didn't have any of these conditions in the last 12 months

*The following questions will be available for each condition marked on question 43.*

**43 to 46. Who helped you treating (or dealing with) the Insomnia / Anxiety / Depression / Increased aggressiveness?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this health condition

**47. As far as you know, did you have any of the following health conditions in the last 12 months?**

Choose all that apply:

- Hypertension (high blood pressure)
- High haematocrit (elevated number of blood red cells)
- Dyslipidaemia (high levels of LDL cholesterol)
- Liver problems (fatty liver disease, liver damage, etc.)
- Kidney problems (elevated creatinine, kidney stones, etc.)
- As far as I know, I didn't have any of the health conditions above in the last 12 months.

*The following questions will be available for each condition marked on question 48.*

**48 to 52. Who helped you treating (or dealing with) the Hypertension / High haematocrit / Dyslipidaemia / Liver problems / Kidney problems?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this health condition

**53. Did you have any other health condition(s) that could be related to the use of anabolic steroids?**

- No
- Yes - please specify:

*The following question will be available if 'Yes' is marked on question 54.*

**54. Who helped you treating (or dealing with) the health condition(s) that you mentioned in the previous question?**

Choose all that apply:

- General Practitioner (GP)
- Accident and Emergency Department (A&E)
- Needle and Syringe Program (NSP)
- Steroid Clinic
- Sexual Health Clinic
- FRANK (talktofrank.com)
- Online forums
- Personal trainer or coach
- Friends
- Books and articles
- My provider of anabolic steroids
- Other:
- I did not treat this(these) health condition(s)

**Section 5 - Final section**

---

**55. How would you describe your gender indentity?**

- Male
- Female
- Transgender
- Other:
- I prefer not to answer this question

**56. How would you describe your sexual orientation?**

- Heterosexual (straight)
- Homosexual (gay, lesbian)
- Bisexual
- Other:
- I prefer not to answer this question

We will select some participants of this survey to take part in an interview to talk more about anabolic steroids.

Participation in the interview is optional, and each participant will receive a £20 Amazon voucher.

If you want to be invited to an interview, please type your email below.

---

Please note that your email will be associated with data from your survey. However, your information remains confidential and will not be shared with anyone outside the research team.

---

**57. Would you like to participate in the online interview?**

- No
- Yes. Please, type your email:

**End of survey**

---

**Thank you for completing this survey.**

If you want to participate in a prize draw to win a £50 Amazon voucher, click on the link below.

You will be directed to a separate website, where you will be asked to inform an email to enter the prize draw.

There will be no link between your answers to this survey and the email you provide for the prize draw.

**Click here to enter a prize draw for a £50 Amazon voucher.**

If you need more information about anabolic steroids please talk to your GP or one of the services below:

- Frank - friendly, confidential drug use advice

*(link to www.talktofrank.com/)*

- NHS - getting help

(link to www.nhs.uk/live-well/healthy-body/drug-addiction-getting-help/)

# Appendix 4: Online Survey (WP2) Adverts and posters

## Social media adverts

**- Instagram and Facebook**

Share your strategies on how to handle adverse effects of anabolic steroids and help improve the support offered to people who choose to use these substances.

If you choose to complete the survey, you can enter a prize draw for one of five £50 Amazon vouchers.

You can only take part in this survey if you are 16 years of age and over, have used anabolic steroids in the last 12 months and live in the UK.

This is an anonymous survey from King's College London. All data is stored in accordance with the UK Data Protection Act 2018.

Click on the link to access the survey and read our Participant Information Sheet before you decide whether you want to take part.

[url to the survey's website and participant information sheet]

**- Twitter** (limited to 280 characters)

How do you handle the adverse effects of anabolic steroids?

A survey from King's College London to help improve the support to people who use anabolic steroids.

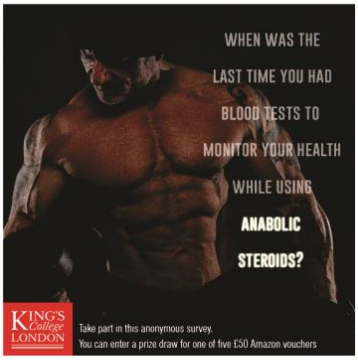
Participants must be 16 years old and over, living in the UK and have used anabolic steroids in the last 12 months.

## Images for social media

Messages on social media were accompanied by royalty-free images and credits to the photographers were informed, as seen below.

The images were posted on Instagram, Facebook and Twitter every day for the duration of data collection.

Images by Tony Barnbrook.





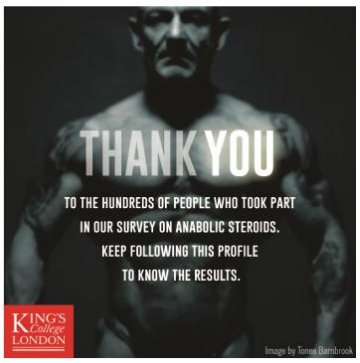



Image by Simone Pellegrin on Unsplash.

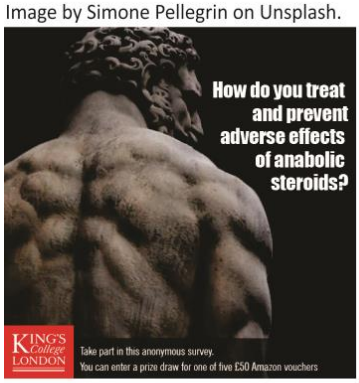



Image by Pawel Nekoranec on Unsplash.


Image by Nicole De Kohrs on Burst.


Image by Panther on Pexels.



Image by Damir Spanic on Unsplash.



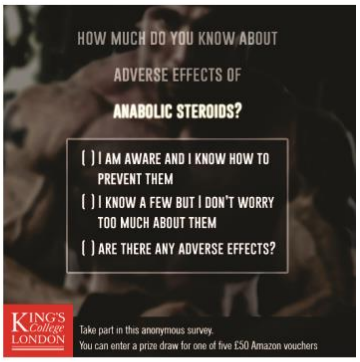




Image by Luis Reyes on Unsplash.


Image by Edgard Chaparro on Unsplash.

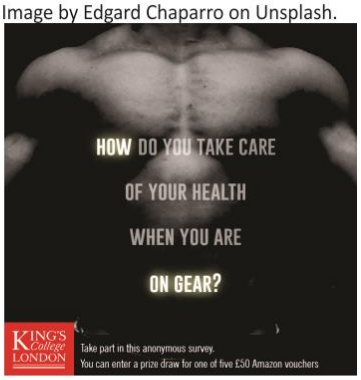
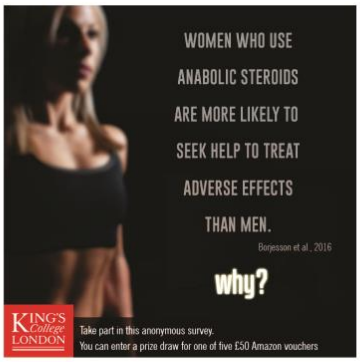



Image by Scott Webb on Unsplash.



Images by Alora Griffiths on Unsplash.

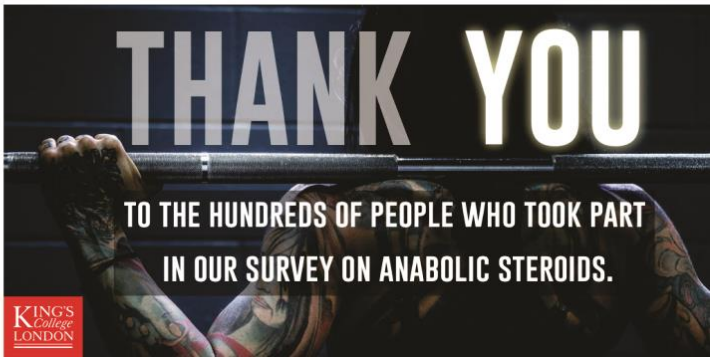



Image for printed poster

# Appendix 5: Interviews (WP3) Participant Information Sheet

**Health Strategies and Harm related to the use of Anabolic Steroids**

**Interview**

*You can print a copy of this information sheet for your records*

I would like to invite you to take part in a study as part of my PhD research. Before you decide to participate, I would like to explain why the research is being done and what it involves. Please take time to read the following information and take time to decide if you want to take part or not.

**What is the purpose of the study?**

The purpose of the study is to understand people's strategies to prevent and treat adverse effects of anabolic steroids. I also want to investigate the impact of the consequences of COVID-19 pandemic on the lives of people using anabolic steroids in the UK, such as the closing of gyms, social distancing measures and difficulties accessing health care. The survey has been approved by King's College London (REMAS No. 22034).

**Why am I being invited to participate?**

When you took part in the online survey "Health Strategies and Harm related to the use of Anabolic Steroids", you manifested an interest in participate in an interview.

**Do I have to take part?**

Taking part in the interview is entirely up to you. There are no consequences if you decide not to take part in the interview.

**What will happen to me if I take part?**

If you decide to take part, I will ask you about your health, the use of anabolic steroids, your experience in preventing and treating adverse effects and the impact of the COVID-19 pandemic on your life.

The interview will last about 1 hour, and you can choose how it will be conducted: via telephone or online (via Microsoft Teams). Interviews will be recorded for research purposes, but all personal data will be anonymised (your name and personal details will not be published). Furthermore, if you choose to be interviewed online, you can choose to switch off your device's camera/video. You will be able to choose a data for the interview between November 1st and December 19th 2021.

Please note that questions about drugs and lifestyle choices are sensitive and therefore I would recommend participating in the interview in private.
The interview will also contains questions about the following categories of personal data: Your name, age, email address, gender, occupation, ethnic origin, health data and sexual orientation. You can refuse to answer any question without giving a reason.

At the end of the interview you will receive a £20 Amazon gift voucher to thank you for your time.

**Will my participation be kept confidential?**
All data from the interview is confidential. I will not publish your name or any personal data that allows your identification. All of the information you provide will be stored in accordance with the UK Data Protection Act 2018. Only the researchers for this study will have access to it.
All the information collected about you during the course of the research will be kept strictly confidential subject to legal limitations. Any information that is stored will have your name and address removed so that you cannot be recognised. If, however, you discuss anything that gives the researchers reason to believe that there is a risk that you might harm yourself or others, or if you disclose details of abuse, neglect or any other serious crime, such as one involving children, I will have to report this to the appropriate authorities, such as the police. This is standard practice for all research.

**Data Protection Statement**
If you would like more information about how your data will be processed under the terms of UK data protection laws please visit the link below:
**https://www.kcl.ac.uk/research/support/research-ethics/kings-college-london-statement-on-use-of-personal-data-in-research**

**What if I change my mind about taking part?**
You can exit the interview at any time without giving a reason.
If you decide to withdraw your participation during the interview, I will ask you if data obtained so far can be retained or not (including data from the online survey). In the case of a negative, all data collected from you will be deleted.
If the interview is interrupted due to technical reasons such as poor internet/telephone connection, I will contact you again and ask if you would like to resume the interview. If you do not express your wish to withdraw, incomplete interviews will be used as valid data.
After the interview is concluded, you will be able to withdraw your participation by emailing me (**julio.amaral@kcl.ac.uk**) up to to two weeks after the day of your

interview. After that period, it will not be possible to withdraw your participation from the research.

**How is the project being funded?**
The research has been developed and is funded by King's College London.

**What will happen to the results of the study?**
The results of the study will be published in the form of reports, articles and conference presentations. If you would like to receive a copy of the results in the future, see contact information.

**Who should I contact for further information?**
If you would like to receive more information about this study, please contact me using the email below:
**Dr Julio Amaral - PhD student**
**julio.amaral@kcl.ac.uk**
King's College London - Addictions Department
4 Windsor Walk
SE5 8BB

**What if I have further questions, or if something goes wrong?**
If this project has harmed you in any way or if you wish to make a complaint about the conduct of the project you can contact King's College London using the details below for further advice and information:
**Dr Paolo Deluca - Research Supervisor**
**paolo.deluca@kcl.ac.uk**
King's College London - Addictions Department
4 Windsor Walk
SE5 8BB

**If you feel distressed or need help, this a list of resources that are available to you:**
**- NHS (111):** Non-emergency medical support and health advice.
**- NHS (999):** Medical emergencies, fire or crime taking place.
**- Samaritans (08457 90 90 90 / jo@samaritans.org):** Telephone and email support if anyone is worried, upset or suicidal.
**- Papyrus HOPEline UK (0800 068 41 41):** Support and advice to young people worried about themselves.
**- Get Connected (0808 808 4994):** Help for people under 25 who self-harm.

Thank you for reading this information sheet and for considering taking part in this research.

# Appendix 6: Interviews (WP3) Participant Information Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Participant's ID | | Date: | | Start: | | End: | |
| email: | | ☐ | M.Teams | ☐ | Phone: | | |

| | | | | | |
|---|---|---|---|---|---|
| Age: | | Sex at birth: | | Gender ID: | | Sexual orientation: | |
| Ethnicity: | | Residence: | | | | Income: | |
| Method(s) AAS: | | Occupational use? | | Occupation: | | | |
| Age of 1st use of AAS: | | AAS years: | | | | | |

**Informed consent**

Hello, ____. How are you today? Thank you for attending this interview.

Before we start, I would like to remind you that we will be talking about health conditions and the choices you make to take care of your health. I will not make any enquire about illegal activities, but these can be sensitive topics, so it is recommended that you are alone and using headphones to protect your privacy, ok? You can choose to turn off your camera if you want. If you feel uncomfortable during the interview or if you do not want to answer any question, please let me know. This interview will take from 30 minutes to 1 hour. Do you have any questions? Did you read the Participant Information Sheet?

**From now on, our conversation will be recorded. Is that ok?**

**Preliminary questions**

Have you read and understood the Participant Information Sheet?

Do you have any questions about your participation in this study?

Having been provided with this information, can you confirm that you would like to take part in an interview about health strategies and harm related to the use of anabolic steroids?

Do you consent to the recording of this interview?

**Rapport**

Ok, ____. How are you feeling today?

Can you tell me a little bit about your physical training routine? Do you go to any gym or workout at home?

**History of AAS use**

In the survey, you mentioned that you used steroids for the first time ____ years ago, when you were ____ (years old), is that right?

Did someone helped you on your first cycle? Can you tell me a little bit more about that?

Did you do anything to prevent adverse effects on your first cycle? What did you do? Did it work?

Did you have any adverse effects after you first cycle? Can you tell me a little bit more about that?

| Health conditions | Source(s) of support |
|---|---|

Let's talk about some health strategies that you mentioned in the survey.

**General Practitioner (GP)**

*GP – regular consultations? ( ) yes ( ) no*
*GP – discuss AAS use? ( ) yes ( ) no*
*Why not?*

*GP as source of AAS information? ( ) yes ( ) no*
*GP as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/don't have] regular consultations with a GP, and that you [have/have not] discussed the use of anabolic steroids with your GP. Can you tell me more about that?

Do you think your GP can help you <u>prevent</u> adverse effects of anabolic steroids?
Which effects? How can your GP help you with that? Why not?

In the survey, you mentioned that you [do/don't] seek your GP as a source of information about anabolic steroids. Can you tell me more about that?

Do you think your GP can help you <u>treat</u> adverse effects of anabolic steroids?
**[if the GP helped treating]** In the survey, you mentioned that you sought your GP to help you treat
_____ _____ _____ _____
Can you tell me more about that? Were you happy with the support provided by you GP for these problems?

**[if the GP DID NOT help treating]** In the survey, you mentioned that you had some health conditions in the last 12 months, such as
_____ _____ _____ _____
But you did not seek your GP to help you that.
Can you tell me more about that? Is that a reason why you choose not to seek your GP for these problems?

**Needle and syringe programme (NSP)**

*NSP in the last 12 months ( ) yes ( ) no*
*NSP as source of AAS information? ( ) yes ( ) no*
*NSP as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/don't have] used the needle and syringe programme in the last 12 months.

**[if YES]** Can you tell me more about your experience with the needle and syringe programme?
Which services from the NSP do you use?
What do you think about the service provided by the NSP for people using anabolic steroids?

**[if NOT]** Did you ever use this service? Is there a reason why you never used this service?

**[if the NSP helped treating]** In the survey, you mentioned that you sought the NSP to help you treat
_____ _____ _____ _____
Can you tell me more about that? Were you happy with the support provided by the NSP for these problems?

**Outreach syringe exchange service**

*Used the outreach service in the last 12 months ( ) yes ( ) no*

In the survey, you mentioned that you [have/don't have] used the outreach syringe exchange service in the last 12 months.

**[if YES]** Can you tell me more about your experience with the outreach syringe exchange service?

**[if NOT]** Did you ever use this service? Is there a reason why you never used this service?

**Accident & Emergency (A&E)**

*A&E as source of information ( ) yes ( ) no*
*A&E as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/don't have] used the outreach syringe exchange service in the last 12 months.

**[if YES]** Can you tell me more about your experience with the A&E?

**[if NOT]** Have you ever sought the A&E for a health problem related to the use of anabolic steroids? Is there a reason why you never used this service?

**Steroid Clinic**

*Steroid Clinic as a source of information ( ) yes ( ) no*
*Steroid Clinic as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] used the services of a Steroid Clinic in the last 12 months.

**[if YES]** Can you tell me more about your experience with the Steroid Clinic?

**[if NOT]** Have you ever used the services of a Steroid Clinic? **[if NOT]** Is there a reason why you never used this service?

**Sexual Health Clinic**

*Sexual Health Clinic as a source of information ( ) yes ( ) no*
*Sexual Health Clinic as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] used the services of a Sexual Health Clinic in the last 12 months.

**[if YES]** Can you tell me more about your experience with the Sexual Health Clinic?

**[if NOT]** Have you ever used the services of a Sexual Health Clinic? **[if NOT]** Is there a reason why you never used this service?

**FRANK**

*FRANK as a source of information ( ) yes ( ) no*
*FRANK as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] used the services of a FRANK in the last 12 months.

**[if YES]** Can you tell me more about your experience with FRANK?

**[if NOT]** Have you ever used the services of FRANK for information related to anabolic steroids? **[if NOT]** Is there a reason why you never used this service?

**Online forums**

*Online forums as a source of information ( ) yes ( ) no*
*Online forums as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] sought Online Forums for information related to anabolic steroids and/or support for health conditions see in the last 12 months.

**[if YES]** Can you tell me more about how the Online Forums helped you with this kind of information / support?

**[if NOT]** Have you ever sought Online Forums for information related to anabolic steroids and/or support for health conditions?
**[if NOT]** Is there a reason why you never sought this kind of information or support in Online Forums?

**Personal Trainer or Coach**

*PT / Coach as a source of information ( ) yes ( ) no*
*PT / Coach as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] sought a Personal Trainer or Coach for information related to anabolic steroids and/or support for health conditions see in the last 12 months.

**[if YES]** Can you tell me more about how your Personal Trainer/Coach helped you with this kind of information / support?

**[if NOT]** Have you ever sought Online Forums for information related to anabolic steroids and/or support for health conditions?
**[if NOT]** Is there a reason why you never sought Online Forums for this kind of information or support?

**Friends**

*Friends as a source of information ( ) yes ( ) no*
*Friends as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] sought your friends for information related to anabolic steroids and/or support for health conditions see in the last 12 months.

**[if YES]** Can you tell me more about how your friends helped you with this kind of information / support?

**[if NOT]** Have you ever sought your friends for information related to anabolic steroids and/or support for health conditions?
**[if NOT]** Is there a reason why you never sought your friends for this kind of information or support?

**The Internet**

*The internet as a source of information ( ) yes ( ) no*
*The internet as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] sought the internet for information related to anabolic steroids and/or support for health conditions see in the last 12 months.

**[if YES]** Can you tell me more about how the internet helped you with this kind of information / support?

**[if NOT]** Have you ever sought the internet for information related to anabolic steroids and/or support for health conditions?
**[if NOT]** Is there a reason why you never sought the internet for this kind of information or support?

**Provider of AAS**

*Provider of AAS as a source of information ( ) yes ( ) no*
*Provider of AAS as support for health conditions? ( ) yes ( ) no*
*Health conditions:*

In the survey, you mentioned that you [have/haven't] sought your provider of anabolic steroids for information related to anabolic steroids and/or support for health conditions see in the last 12 months.

**[if YES]** Can you tell me more about how your provider of anabolic steroids helped you with this kind information / support?

**[if NOT]** Have you ever sought the internet for information related to anabolic steroids and/or support for health conditions?
**[if NOT]** Is there a reason why you never sought the internet for this kind of information or support?

**If NO health conditions in the last 12 months were informed in the survey:**

1. In the survey you mentioned that you had not experienced any of those health problems in the last 12 months. Is that right?
2. Have you ever experienced any health problem that could be related with the use of anabolic steroids?

**[if YES]** How did you handle this/these problem(s)? Did you seek any kind of support?
**[if NOT]** Would you say that the fact that you never experienced health conditions related to the use of anabolic steroids has anything to do with your strategies to prevent adverse effects?

| **Occupational use of AAS**<br>*( ) yes* ☐ *( ) no* ☐ |
|---|
| You mentioned in the survey that anabolic steroids [help you improve] / [has no relation to] your performance at work. Do you think this has any impact on the way you prevent and treat adverse effects? |
| |

**Changes in health strategies**

Would you say that your strategies to prevent adverse effects have changed since you started using steroids? Why?
What about your strategies to treat health problems when they appear, did they change? Why?
Do you have any plans to change your health strategies in the future? Why?
What do you think it could be done to improve the support provided to people who choose to use anabolic steroids?

**Impact of COVID-19 and Brexit on AAS use and health strategies**

Did the pandemic have an impact on the way you use steroids? Why? Did you change your steroid routine? Did they became more expensive? Did they became harder to buy?
Did the pandemic have an impact on your health strategies (was it harder to get a consultation, go to A&E, have blood tests, NSP, etc.)? Why do you say that?
Do you think that after the UK left the European Union steroids became harder to buy, or more expensive? Did you change your provider of steroids?

**Conclusion**

What do you think that could be done to improve the support provided to people who choose to use anabolic steroids?

2. Is there anything else you would like to add or tell me about anabolic steroids, or the best ways to treat and prevent harm?

3. Would you like to receive a copy of this study via email when the research is published?

4. Do you have any questions for me?

[ ] **, according to our ethical procedures, you have two weeks to decide if I am allowed to use your interview in this study.**

**Therefore, if until** [ ] **you do not ask me to delete your interview, it will be used in the study and I will send a £20 voucher to your email, to thank you for your time.**
**Did you understand?**

**Thank you again for taking part in this study. Bye!**

*Stop recording. Leave the meeting. Inform the time the interview ended, on page 1.*