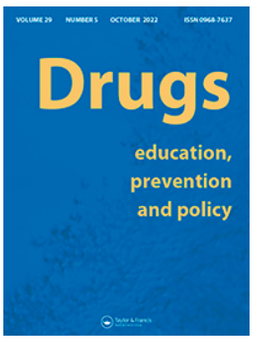

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'Sustaining masculinity': a scoping review of anabolic androgenic steroid use by older males

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ABSTRACT

In the past, research, policy and media have reported the use of anabolic androgenic steroids (AAS) primarily among younger males. However, recent studies have indicated the presence of an older cohort of men who use AAS in comparison to previous years. We carried out a scoping review of the extant literature to map and describe what is known about the use of AAS by older men (>40 years). A systematic search collected and analysed empirical research and grey literature relevant to the research question. Following application of inclusion and exclusion criteria, 44 studies were included which were subsequently charted and thematically analysed. The records included originated from the UK, USA, Canada, Australia, Slovenia, Norway, Spain, Turkey, Switzerland, Japan, and five global studies and were published between 1996 and 2021. Age ranged overall from 14 to 78 years old, however our review only discussed findings pertaining to those older than 40. Three main themes with subthemes were generated as follows: 1) Characteristics of AAS Use; Self-reported Adverse Effects from AAS Use; and Harms Diagnosed by Medical Professional. The review highlights the significant risks to hypothalamic-pituitary testicular function, cardiovascular health, and other organ systems as a result of the ageing man who is motivated to sustain masculine characteristics such as muscularity, youthfulness, sexual function, and perceived desirability and attractiveness. Future research is required to further understand the motivations of older men who use AAS. Furthermore, there is a need for age-specific research and recommendations to inform future policy and practice pertaining so that age-appropriate healthcare and policy decisions can be made in the future.

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Anabolic steroids; ageing; wellbeing; masculinity; cardiovascular health; healthcare

Background

The use of substances to modify physical appearance or athletic performance is not a new phenomenon. Image and performance enhancing drugs (IPEDs) are commonly used by individuals who want to improve physical strength and muscularity as well as having a healthy and attractive body (Brennan et al., 2017). IPEDs are pharmacologic agents with a variety of different functions on a person's body. They include a range of substances whose function is primarily for the promotion of muscle growth, in particular anabolic androgenic steroids (AAS) which have received the most empirical attention for their non-medical use (Korkia & Stimson, 1993; McVeigh & Begley, 2017; Pope et al., 2014; Sagoe et al., 2014).

AAS are synthetic derivatives of testosterone, the primary male hormone which is accountable for masculinising (androgenic) and tissue building (anabolic) effects in males (Kanayama & Pope, 2018; Yesalis & Bahrke, 1995). The current study focuses on non-prescribed AAS use only. AAS are not typically consumed for intoxication or immediate psychoactive gratification (Bates et al., 2019). They are primarily taken to increase muscle size, definition and strength (Evans-Brown et al., 2012; McVeigh et al., 2012; van de Ven et al., 2019; Zahnow et al., 2018), however, they can produce rewarding secondary effects such as euphoria, increased libido, and increased self-confidence (Kanayama et al., 2009). More recently, research has reported the use of AAS for what is considered self-medicated testosterone replacement therapy (TRT) (Underwood et al., 2021). Those men were self-medicating with AAS as they either had not met the threshold for low testosterone diagnosis, had met the criteria but refused treatment by a physician, did not trust physicians so would not attend with low testosterone symptoms, or felt that black market testosterone is less expensive and easily accessible.

In the past global lifetime AAS prevalence rates were estimated at 3.3% with use higher amongst males (6.4%) than females (1.6%) (Sagoe et al., 2014). In the UK data from needle and syringe programmes (NSPs) in the UK observed a threefold increase over a ten year period in the number of clients who use AAS accessing services which accounts for

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54.9% of clients (McVeigh & Begley, 2017). Prevalence estimations in the UK have been largely based on a household population-based survey; the Crime Survey for England and Wales (CSEW), has indicated that 31,000 people between aged 16–59 years are reportedly using AAS (Office for National Statistics, 2020). However, new and emerging research has reported that this is an under-estimation and it is likely ten-times higher than this (Hope et al., 2022) which is similar to estimates in the US (Pope et al., 2014) and wider regions globally (Sagoe et al., 2014).

Age of initiation to AAS use is reportedly also increasing compared to previous years (Bates & McVeigh, 2016; Begley et al., 2017). A systematic review of the trajectory of AAS use in 2014 reported most men who use AAS initiating use before 30 years of age (Sagoe et al., 2014). However, NSP data in the UK has observed an increased median age of AAS using clients from age 25 years in 1995 compared to 30 years in 2015 (Begley et al., 2017; McVeigh & Begley, 2017).

AAS use has been investigated in different settings such as gyms (Begley et al., 2017; Monaghan, 2001; Salinas et al., 2019), NSPs/drug and healthcare services (Bates & McVeigh, 2016), online communities/fora (Bonnecaze et al., 2020; Chandler & McVeigh, 2014; Perry et al., 2005; Underwood, 2017; Underwood et al., 2021); Underwood & Olson, 2019and among different user groups. Identified groups are generally non-competitive weightlifters, bodybuilders, recreational gym users (Begley et al., 2017), those who use for occupational benefits such as police (Hoberman, 2017) and security personnel/doormen (Monaghan, 2003), and those who use for TRT purposes (Underwood et al., 2021).

Research documents a number of motivating and influencing factors for AAS use such as to increase muscle mass and strength (Christiansen et al., 2016; Zahnow et al., 2018), to improve self-esteem and athletic performance (Petersson et al., 2010), to decrease muscle dysmorphia symptoms and body dissatisfaction (Greenway & Price, 2018), and for occupational reasons (Monaghan, 2003). However, motivations for AAS use are often complex and multi-faceted, and dependent on a variety of factors related to the individual themselves, their wider social network, and community, institutional, and societal influences which often change over time (Bates et al., 2019). Socio-cultural pressures drive an image and body conscious society defined by consumerism (Ricciardelli & Williams, 2012), particularly media saturation of idealised bodies which over time becomes normalised in society (Boothroyd et al., 2016; Thornborrow et al., 2020). For example, a v-shaped muscular body with particularly enhanced upper body, a flat stomach and low body fat percentage (Leit et al., 2001) known as a 'mesomorph' body (Grogan, 1999). Having a muscular body displayed as well-developed muscle mass is significant for masculine identity as it denotes strength and sexuality (Griffiths et al., 2015). A man's failure to reach these media ideals of masculinity and muscularity can cause anxiety or stress, regarding gender role for the man, who will in then try to reach this goal by any means possible (Walker & Joubert, 2011). Brennan et al. (2013) found that whilst risky drug taking practices such as injecting untested AAS products and with minimal medical support in place, the goal of body, image enhancement and perceived perfection justifies the behaviours and risks taken by the users.

The physical and psychological harms associated with the use of AAS are well documented (Pope et al., 2014) particularly those related to major organs and systems (Hartgens & Kuipers, 2004). Furthermore, the harms resulting from injecting AAS sourced from illicit unregulated markets which are potentially adulterated are a concern (Brennan et al., 2018; Coomber et al., 2014; Hope et al., 2015; Kimergard et al., 2014; van de Ven, 2016) such as localised injection site infections (Hope et al., 2015) and the transmission of blood borne viruses (BBVs) (Hope et al., 2013, 2021). The risk of BBV transmission however is lower among people who inject AAS and other IPEDs than those who inject psychoactive drugs (Hope et al., 2013). This may be due to the difference in injecting practices such as being on an off-cycle period (ACMD, 2010), injecting less frequently during an on-cycle period (Hope et al., 2015), and lower rates of needle-sharing among this cohort (Day et al., 2008; Hanley Santos & Coomber, 2017; Rowe et al., 2017).

Of concern is the long-term morbidity and mortality resulting from damage to cardiovascular health (Baggish et al., 2017; Darke et al., 2014; Frati et al., 2015; McCullough et al., 2021), the liver (Creagh et al., 1988; Schumacher et al., 1999), and cognitive effects from long-term high-dose AAS use (Bjørnebekk et al., 2019; Kanayama et al., 2013). Long-term high doses of AAS can be the result in changing patterns of use over time, from cycling i.e. an on-cycle period followed by an off-cycle period; to continuous cycles that include a high-dose period and a lower dose period known as 'blast and cruise' (Chandler & McVeigh, 2014; McVeigh & Begley, 2017). This results in the individual continuously using AAS, which is a concern for their health and the possibility of recovery from AAS related health issues. People who use AAS are often aware of risks to health however they continue to use them as they believe the benefits outweigh the harms (Maycock & Howat, 2005). This can be for a number of reasons such as fear of loss of muscle mass and social status, or withdrawal-like symptoms such as low mood, low libido, and depression (Griffiths et al., 2017; Kanayama et al., 2015; Pope & Kanayama, 2022).

Prolonged use of AAS is a concern as it can result in anabolic steroid induced hypogonadism (ASIH), also known as secondary hypogonadism. This occurs as hypothalamic-pituitary testicular (HPT) function is suppressed (Kanayama et al., 2008, 2015) and natural testosterone function cannot recover, which may result in ASIH even long after cessation of AAS use (Kanayama et al., 2015; Tan & Scally, 2009). Symptoms of ASIH have been reported to include erectile dysfunction, infertility, decreased sex drive, and depression (Kanayama et al., 2015; Pope & Kanayama, 2022). This is a concern for older males who experience lowered testosterone levels and decreased HPT function as part of the natural ageing process (Bhasin et al., 2006) and may be an indicator as to why some initiate, continue, or restart the use of AAS, particularly when the body is ageing.

We do know that many people who use AAS in the general population who began using in their youth in the 1980s and have a lifetime history of AAS use, are now in their 50 s

or older and may present to health services with AAS related health issues such as cardiomyopathy and atherosclerotic disease (Kanayama et al., 2008; Kanayama & Pope, 2018). In 2017, media reports emerged, of men using testosterone purchased on the illicit market for self-prescribed TRT to increase libido, mood and the desire to look younger (Kemp, 2017; Marsh, 2017; Moody, 2017). Whilst media reports are anecdotal, this may be supported by the increased age of initiation to AAS use and ageing cohort effect. Considering the reported rise in age of initiation to AAS use, and the harms of long-term AAS use, specifically the effect on HPT function, we conducted a scoping review of extant literature to describe and map what is known about the use of AAS among older men (>40).

Methodology

Scoping reviews

Scoping reviews are increasingly used to address broader research questions than systematic reviews can answer (Arksey & O'Malley, 2005; Khalil et al., 2016; Levac et al., 2010; Peters et al., 2015). Tricco et al. (2018, p. 1) define a scoping review approach as *'a type of knowledge synthesis, following a systematic approach to map evidence on a topic and identifying main concepts, theories, sources, and knowledge gaps'*. This approach is generally adopted to identify knowledge gaps, examine the nature/characteristics, size, and the range/variety) of a specific subject (in the case of this research, men who use AAS), summarise the findings of a large diverse body of knowledge, and propose health agendas for future policy, interventions and research (Arksey & O'Malley, 2005; Brandt et al., 2014; Daudt et al., 2013; Levac et al., 2010; Tricco et al., 2016).

Search strategy

The review approach was underpinned by the research question: '*What is known about the use of anabolic steroids by older men?*' We defined an older man as older than 40 years of age for two reasons. First, there is only one quantitative study in the USA, with specific focus on the older male who uses AAS (Ip et al., 2015). This study considered those aged >40 as 'older' and based this choice on emerging evidence of a subset of individuals older than 40 using AAS (Cohen et al., 2007; Hakansson et al., 2012; Ip et al., 2011; Perry et al., 2005). Whilst some UK studies (see (Begley et al., 2017; Chandler & McVeigh, 2014; Korkia, 1994; Lenehan et al., 1996; McVeigh et al., 2015), report older males (>40) in their demographic findings, none have specifically focused on older men who use AAS (OMAAS). Secondly, the UK national IPED survey in 2017 reported a similar proportion of men under 25 (17%) using AAS and those over 40 years of age (20%) (Begley et al., 2017) indicating a possible emerging cohort of men older than 40 using AAS.

Arksey and O'Malley's (2005) five-stage iterative process scoping review methodology was closely adhered to. The five stages are: (1) identifying the essential research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collecting, summarising, and reporting the results. A search was undertaken in April 2022, in Liverpool John Moores University Library catalogues using the following databases: Scopus, MEDLINE, CINAHL, PsychINFO, SPORTDiscus, Cochrane, PubMED, Web of Science and Wiley. There was no restriction on publication dates when carrying out searches. Search terms used were broad to ensure records pertaining to AAS use were included (see Table 1). Inclusion criteria focused on the use of AAS among men older than 40 years of age (see Table 2). We reviewed relevant and available published empirical and grey literature in the English language.

Study selection

The initial search identified 10,355 records based on the search terms outlined in Table 1, which were then imported into Endnote® citation manager where they were managed and categorised. Following initial examination by author one (EH), 9,755 records were removed (e.g. duplicates, animal

Table 1. Search Strategy/Terms.

S1	**TI** "anabolic–androgenic steroid*" OR "anabolic steroid*" OR "anabolic androgenic steroid*" **OR AB** "anabolic–androgenic steroid*" OR "anabolic steroid*" OR "anabolic androgenic steroid*"
S2	**TI** "image and performance enhanc* drug*" OR "performance and image enhanc* drug*" OR "performance enhance* drug*" OR "performance enhance* substance*" **OR AB** "image and performance enhanc* drug*" OR "performance and image enhanc* drug*" OR "performance enhance* drug*" OR "performance enhance* substance*"
S3	**TI** "anabolic–androgenic steroid*" OR "anabolic steroid*" OR "anabolic androgenic steroid*" OR AB "anabolic–androgenic steroid*" OR "anabolic steroid*" OR "anabolic androgenic steroid*" **AND TX** "Boldenone" OR "Masteron" OR "Mesterolone" OR "Metandione" OR "Methandrostenolone" OR "Methenolone" OR "Nandrolone*" OR "Oxandrolone" OR "Oxymetholone" OR "Stanozolol" OR "Sustanon" OR "Testosterone*" OR "Trenbolone*"
S4	**TI** "image and performance enhanc* drug*" OR "performance and image enhanc* drug*" OR "performance enhance* drug*" OR "performance enhance* substance*" **AND TX** "Boldenone" OR "Masteron" OR "Mesterolone" OR "Metandione" OR "Methandrostenolone" OR "Methenolone" OR "Nandrolone*" OR "Oxandrolone" OR "Oxymetholone" OR "Stanozolol" OR "Sustanon" OR "Testosterone*" OR "Trenbolone*"
S5	S1 **OR** S2 **OR** S3 **OR** S4
S6	**Limit to:** English language, Human Studies

Table 2. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
English articles.	Articles in any language other than English.
Articles that referred to male anabolic steroid use.	Animal studies.
Evidence of AAS use among males older than 40.	In-vitro studies.
Non-prescribed AAS Use	Prescribed AAS use.

studies, female only studies) *(see flow chart for detailed breakdown)*. This was followed by title and abstract screening of the remaining 600 records. Studies included were empirical studies in peer-reviewed journals, clinical case reports, and grey literature such as national policy reports and documents and needs assessments. At this stage, 600 records were identified for charting and full text screening whereby a further 512 were removed leaving a final number of 88. Manual hand-searching of the reference lists of these eighty-nine records was carried out as an additional step to capture any further empirical studies and in particular grey literature, resulting in a final number of 165 records for charting and analysis. A final search for grey literature was carried out on google and on websites of relevant public health and community organisations. This phase was supported by a key expert consultation exercise with a multi-stake holder expert group representing key identified academics working in the field, professionals and former people who use AAS, in order to identify any gaps in what was retrieved. From this analysis, a further 121 records were removed from the final dataset as, whilst their demographics had age-ranges higher than 40, the findings did not distinguish the age-ranges and so were not included in the review (see Supplementary Table). At this stage author two reviewed and agreed on the included records, which was carried out to avoid possible bias and subjective interpretation of author one. The final dataset consisted of 44 records for inclusion in the review.

Charting

Using Microsoft Excel, a spreadsheet was created to chart relevant data with the headings: author, year of publication, country of publication, study type, sample type, sample size, age range, age of first AAS use, mean/median age, and key findings pertaining to men older than 40 years. The extracted data were then thematically analysed to identify commonalities, emergent issues, themes, and gaps in the literature using Microsoft Excel spreadsheet. The spreadsheet data extraction table was broad, to ensure all records included were thoroughly analysed. Keywords and themes emerging were charted in parallel to the data extraction. Author one re-read the textual dataset numerous times so as to familiarise with the data and coded emergent themes. Themes were then reviewed and cross checked by all members of the research team who have specialist expert knowledge in scoping review methods and IPED use, which guided the final reporting of the results. Disagreements were addressed through discussion among all authors (Table 3).

Results

Profile of studies included

The final 44 records comprised of qualitative studies (n = 3), surveys (n = 8), mixed method studies (n = 2), retrospective data analysis (n = 2), clinical case reports (n = 23), forensic case reports (n = 2), observational studies (n = 1), prospective studies (n = 1), biomedical analysis (n = 1) and reviews (n = 1). The records originated from a variety of different countries including the UK (Bates & McVeigh, 2016; Begley et al., 2017; Boregowda et al., 2011; Graham et al., 2006; Hanley Santos & Coomber, 2017; Kimergard, 2015; Kimergard & McVeigh, 2014; Lenehan et al., 1996; McVeigh & Begley, 2017; Patil et al., 2007; Ravindran et al., 2020; Zahnow et al., 2018), the USA (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Baggish et al., 2017; Cabb et al., 2016; Cohen et al., 2007; Colburn et al., 2017; Farzam, 2021; Flo et al., 2018; Gangadharamurthy et al., 2018; Ip et al., 2015; Kovac et al., 2015; Long et al., 2019; Pope et al., 2021; Rashid, 2000; Rothman et al., 2011; Shiber, 2013; Shinya et al., 2013), Slovenia (Alibegović, 2018), Canada (Rosenfeld et al., 2011; Weinreb et al., 2010), Australia (Ding et al., 2013; Lovelock et al., 2021), Norway (Havnes et al., 2019), Spain (Llamas-Velasco et al., 2021), Japan Tashiro et al. (2021), Switzerland (Fisler et al., 2018), Turkey (Ilhan et al., 2010) and five global studies (Bonnecaze et al., 2020; Chandler & McVeigh, 2014; Christiansen et al., 2016; Harvey et al., 2021; Zahnow et al., 2017). Studies included ranged from 1996 to 2021. Participants in the included studies were described as gym users, bodybuilders, athletes, IPED users, prisoners, needle and syringe program (NSP)/Harm reduction service clients, men who have sex with men (MSM), online bodybuilding, fitness and health forum members, and patients from clinical settings. It must be noted that these terms are interchangeable and not mutually exclusive within studies. Oldest age reported in studies included was 78 years. Following final charting and analysis of the data as outlined above, three themes with subthemes emerged: 1) Characteristics of AAS Use (age of initiation, motivations for use, sustained harmful patterns of use); 2) Self-Reported Adverse Effects from AAS Use (effects on sexual function and fertility, other self-reported adverse effects); and 3) Health Harms Diagnosed by a Medical Professional (cardiovascular harms, hepatotoxicity, other diagnosed health issues, experiences of healthcare) (see Table 4 for themes).

Theme 1: characteristics of AAS use

Age of initiation. First use of AAS at aged 40 years or older was reported in eight studies. These were in the UK (Bates & McVeigh, 2016; Begley et al., 2017; Lenehan et al., 1996), USA (Ip et al., 2015; Rothman et al., 2011), Norway (Havnes et al., 2019) and two global studies (Bonnecaze et al., 2020; Harvey et al., 2021). The global study by Bonnecaze et al. (2020) included respondents from the USA, Canada, Europe, Australia, New Zealand, Asia, and Africa, with 7% (175/2385) of the total participants having initiated AAS use when older than 40 (Bonnecaze et al., 2020). Harvey et al. (2021) reported oldest age of initiation to use at 57 years in their global study which included fifteen different countries. The oldest reported age of initiation among all studies was 69 years (Ip et al., 2015). Another US study reported older age of initiation by a male who began at 68 years old (Cohen et al., 2007). Recruitment for both US studies was primarily using online methods aimed at those using AAS and engaging in regular strength training.

In the UK, national annual IPED surveys reported age of initiation for both oral and injectable AAS (Bates & McVeigh, 2016; Begley et al., 2017; Chandler & McVeigh, 2014). In 2013 the age of initiation to oral AAS was mostly among the 18- to 24-year-old age-group. In the 40 to 54 year age-group 6%

Table 3. Charting of records.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Ahlgrim and Guglin (2009). Anabolics and cardiomyopathy in a bodybuilder: case report and literature review. **Clinical case report.** *Sample n* = 1 *Age* = 41	USA	41-year-old bodybuilder with severe systolic dysfunction and Class IV heart failure despite maximal medical therapy two weeks prior. 23 years resistance training. Disclosed AAS use on first admission in 2007.	***Patterns:*** Last used AAS (250mg test enanthate injected every 5th day for 6-week cycle) in 2008 (4years prior to presenting). Also used furosemide, spironolactone, and hydrochlorothiazide before competitions to lose weight. ***Motivations:*** For competitive BB: previously semi-professional, national class bodybuilder.	Severe systolic dysfunction and Class IV heart failure. Diagnosed with cardiomyopathy in 2006 which resolved in 2007. Presented in 2007 with breathlessness, fatigue, and dyspnoea, affecting his ability to carry out resistance training.	The patient's cardiac failure was associated with the use of AAS and other IPEDs and continuing to carry out heavy resistance training after being diagnosed. This resulted in the patient being evaluated for a heart transplant.
Ahmed et al. (2019). Bodybuilding Gone Wrong: Anabolic Steroid Induced Cardiomyopathy. **Clinical case report.** *Sample n* = 1 *Age* = 48	USA	48-year-old male presented with shortness of breath, nausea, and abdominal bloating. He showed for high testosterone level 2607 ng/dl (normal 241–827). AAS induced cardiomyopathy was diagnosed. Disclosed AAS use on admission.	***Patterns:*** Prescription testosterone supplementation for 5 years reported by patient; however, this was not closely monitored, and use was reportedly abused. Patient had concerns regarding cessation of AAS for fear of losing muscle mass. ***Motivations:*** To increase muscle mass.	Severe dilated cardiomyopathy, liver dysfunction and mood was affected.	He received psychosocial treatment to aid with his fear of losing muscle mass whilst not using AAS. He made a full recovery in one month.
Alibegović (2018). Testicular morphology in hypogonadotropic hypogonadism after the abuse of anabolic steroids. **Forensic case report.** *Sample n* = 1 deceased male. *Age* = 57	Slovenia	A case report of a man who committed suicide after a history of aggressive behaviour and reported physical abuse of his wife.	***Patterns:*** Injected with AAS for an unspecified long period of time. He also consumed Cialis pills (tadalafil) for erectile dysfunction. ***Motivations:*** NR	The autopsy revealed secondary hypogonadism as a result of anabolic steroid abuse.	A more accurate analysis confirmed an overdose of AAS.
Baggish et al. (2017). Cardiovascular Toxicity of Illicit Anabolic-Androgenic Steroid Use. **Journal Article.** Quantitative. Observational study using a cross-sectional cohort design. *Sample n* = 86 weightlifters recruited at gyms. *Age range* = 39–47; *Median age* = 42; *Age of first use* = 19–30	USA	Age range 39–47 so including this paper in the older male AAS user category. This is the first controlled study to demonstrate that long-term AAS use is associated with systolic and diastolic myocardial dysfunction, and coronary atherosclerosis. Systolic function was found to recover on cessation of AAS but diastolic dysfunction was less reversible. Atherosclerotic disease strongly linked to lifetime use of AAS.	***Patterns:*** Cumulative lifetime total duration of AAS use median 7.4 years. Cumulative lifetime dose of AAS, 166–608g (n = 366). ***Motivations:*** NR	Long-term use of AAS associated with myocardial dysfunction and accelerated coronary atherosclerosis.	Premature coronary artery disease and LV dysfunction associated with AAS use. Findings inform public health initiatives to control exposure to AAS and provide healthcare providers improve patient care.
Bates and McVeigh (2016). Image and Performance Enhancing Drugs 2015 Survey Results. **Report** Quantitative. Survey of IPED users recruited predominantly gyms and sports settings. Also, drug and health services, NSPs[b] and on online forums. *Sample n* = 636; *Age-range* = 16–68; Mean = 30; Median = 29; Age of first use = 19–41+	UK	Study focused on all IPEDs. 65% reported both oral and injectable IPEDs. Most commonly used AAS reported was Deca Durabolin (38%), followed by testosterone enanthate & Sustanon. Polypharmacy of AAS and other IPEDs for oestrogen control, PCT, and fat loss reported. Motivations primarily for muscle enhancement, improve strength & fat loss. A minority of participants engaged with healthcare pertaining to adverse effects of AAS use.	***Patterns:*** n = 18 initiated injecting AAS use over age 41. n = 8 initiated oral AAS use over age 41 years. ***Motivations:*** NR	NR NR	The findings highlight the importance of the need for IPED users to better engage with health services for the treatment of adverse health of IPED use. Effective identification and approaches to increase testing for blood borne viruses is warranted.

(*continued*)

Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Begley et al. (2017). Image and Performance Enhancing Drugs: 2016 National Survey Results. **Report**. Quantitative. Survey of IPED users recruited at NSPs, harm reduction outreach, gyms and sports settings. *Sample n* = 643; *Age-range* = 17–74; Mean = 32; Median = 30; Age of first use = 14–53	Wales & England	AAS most commonly reported IPED used. 89% ever used oral IPEDs, 85% ever injected. Dianabol most commonly reported oral AAS, testosterone most reported injected AAS. Changing body image/ aesthetics primary motivations for use. Adverse effects reported: testicular atrophy, sleep problems, libido changes, aggression, and acne. More than half would not seek medical advice.	***Patterns:*** $n = 26$ initiated injecting AAS use over age 41;$n = 20$ initiated oral AAS use over age 41 years ***Motivations:*** NR		They average person using IPEDs in the UK is likely to be a white British male, in their 30s using both orals and injectables (intramuscular) combined. Aesthetics primary motive for use.
Bonnecaze et al. (2020). Characteristics and Attitudes of Men Using Anabolic Androgenic Steroids (AAS): A Survey of 2385 Men. **Journal Article.** Quantitative; Survey of AAS users on online fora. *Sample* = 2385; *Age-range* = 18–51+; *Mean* = 31.69 + 10.09; Age of first use = 22–30.	Global	Testosterone enanthate, testosterone cypionate, metandione, trenbolone, oxandrolone, and nandrolone decanoate most reported AAS used. Motivations: To improve appearance and strength. Continued use due to fear of decreased quality of life, muscle loss, and decreased strength/athletic performance. Primary sourcing route was the internet. 56% had never disclosed their AAS use to healthcare provider (HCP) due to judgement, lack of confidence in physician knowledge, and legal repercussions. Adverse effects reported include testicular atrophy, acne, hypersexuality, hypertension, mood changes, erectile dysfunction, dyslipidaemia, and gynecomastia. Older males less likely to use illicit substances however Marijuana, alcohol, MDMA, amphetamines, psychedelics and cocaine were reported.	***Patterns:*** 471 (20%) participants older than 40. 7% ($n = 175$) reported age of initiation older than 41 years of age. ***Motivations:*** [men older than 35]: to improve appearance/muscle (80%), improve strength (40%), self-esteem (20%), BB competitions (13%), athletics (8%), peer pressure (1%) and history of sexual abuse (<1%). Reason for not stopping/continued use [older than 35] fear of: decreased quality of life (60%), loss of muscle mass/appearance (40%), strength/ athletic performance (35%), and lack of medical support (14%), withdrawal syndrome (11%) and addiction (5%). Males over 35 years old less likely to consider stopping AAS use than those younger.	Testicular atrophy, acne, hypersexuality, hypertension, mood changes, erectile dysfunction, dyslipidaemia, and gynecomastia reported. Older males were more likely than younger counterparts to report hair loss, tendon rupture, left ventricular hypertrophy, infertility, injection site abscess, and polycythaemia. Older males more likely than younger males to have diagnostic tests such as: prostate specific antigen (PSA) testing, coronary artery calcium scan, transthoracic echocardiogram and electrocardiogram.	Further research required to address the treatment of AAS use disorder. Healthcare professionals should be informed, non-judgemental and adopt a harm reduction approach to those who use AAS.
Boregowda et al. (2011). Persistent primary hypogonadism associated with anabolic steroid abuse. **Clinical Case Report.** *Sample n* = 1 *Age* = 40	Wales	40-year-old man with secondary gonadal failure resulting from anabolic steroid use with subsequent primary gonadal failure and infertility. Patient referred by his primary care physician to the local endocrine clinic with erectile dysfunction and infertility over the preceding 6 years. He and his partner had undergone infertility investigations.	***Patterns: O***ver 10 years he administered nandrolone, T, and growth hormone He reported he had stopped taking anabolic steroids 2 years before seeking medical help ***Motivations:*** To promote muscle growth for bodybuilding.	He complained of low libido and erectile dysfunction since stopping anabolic steroid use and testicular atrophy. Thirty months after discontinuing anabolic steroids he had evidence of primary gonadal failure.	His erectile function improved with a phosphodiesterase-5 inhibitor. This case adds to the current literature and illustrates that the side effects of anabolic steroids can be prolonged and irreversible.

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Cabb et al. (2016). The Diagnosis and Manifestations of Liver Injury Secondary to Off-Label Androgenic Anabolic Steroid Use. **Clinical Case Report.** *Sample n* = 1 *Age* = 45	USA	45-year-old male with progressive pruritus, jaundice, and scleral icterus for the past 2 weeks. Patient disclosed AAS use on admission.	***Patterns:*** Man was taking AAS for the past 3 months (Anavar 50 mg daily and testosterone injections once weekly). He discontinued after the onset of symptoms. ***Motivations:*** NR	Pruritus, jaundice, and scleral icterus. Associated signs included pale stools and dark urine.	Suspected drug-induced liver injury. Two follow-up visits where a metabolic panel was repeated. The first visit, 4 days after hospital discharge, showed worsening laboratory values, although the patient's overall history and physical examination expressed clinical improvement. On last contact with the patient, he reported complete resolution of signs and symptoms, and his liver function tests continued to improve.
Chandler and McVeigh (2014). Steroids and Image Enhancing Drugs; 2013 Survey Results. **Report.** Quantitative. Survey of IPED users recruited at NSPs. *Sample n* = 79; *Age-range* = 16–56; Mean = 32.5; Age of first use = .18–29	UK and Ireland	78.7% reported ever injecting AAS and 85% oral use. 85.1% reported ever used AAS. Other IPED use was reported and included growth hormone and insulin and DNP. 27 participants reported blast and cruise regime. Participants generally self-managed adverse effects themselves ad would not seek medical treatment.	***Patterns:*** 6 initiated injecting AAS use over age 41 and 5 initiated oral AAS use over age 41 years. ***Motivations:*** NR	NR	Older experienced users (gender not specified) reported concerns for younger users IPED use regimes.
Christiansen et al. (2016). Outline of a typology of men's use of anabolic androgenic steroids in fitness and strength training environments. **Journal Article.** Qualitative. Semi-structured interviews conducted for three different research projects, specific recruitment details not reported. *Sample n* = 37; *Age-range* = 21–42.	Global	The authors suggested an ideal typology as a new approach to studying the use of AAS in fitness and strength training environments. The typology consists of four types: the Expert type, the Well-being type, the YOLO type and the Athlete type. These represent four ideal-typical approaches to AAS use that emerge out of an analysis of users' attitudes to risk and effectiveness.	***Patterns:*** The well-being type typically uses lower dosages than the Athlete type and the Expert type. He possibly had his point of departure for AAS use in one of the other types before he was the. The well-being type is typically older than users in the other types. The well-being type considers the risks involved in using AAS and takes precautions by using PCTs to counter side effects. ***Motivations:*** For the well-being type: muscle mass and strength. Physical, mental and social well-being experienced from training and bodybuilding to achieve an appealing, fit-looking body was important and makes him feel younger and more self-assured.	NR	The Well-being type is generally the older male. The Well-being type bears resemblance to the typical AAS user described by Cohen et al. (2007).
Cohen et al. (2007). A league of their own: demographics, motivations and patterns of use of 1,955 male adult non-medical anabolic steroid users in the United States. **Journal Article.** Quantitative. Survey of AAS users recruited on Online fora, Email and Postal.	USA	Increased muscle mass, increased strength and physical appearance primary motivations. Continued use was due to fear of losing muscle mass. Most commonly reported AAS used were single ester testosterones, methandrostenolone, and nandrolone decanoate. Injectable AAS preferred over orals.	***Patterns:*** One participant-initiated use at 68 years old. ***Motivations:*** Older males motivated by fat loss.	NR	The study highlighted that most AAS users do so responsibly, by adopting safer routes of administration and hygienic injection practices, consuming a healthy diet, employing methods to reduce side effects, obtaining regular blood work,

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Sample n = 1955; *Age-range* = 18–76; *Mean* = 31; *Median* 29; *Age of first use* = 18+		Most (66%) were willing to seek medical advice for AAS related issues and 61% obtained blood work at least once a year to assess the effects of AAS use on health.			and periodically cycling on and off AAS.
Colburn et al. (2017). The cost of seeking an edge: Recurrent renal infarction in setting of recreational use of anabolic steroids. **Clinical Case Report.** Sample *n* = 1; Age = 43.	USA	43-yer-old Man with a past medical history of obsessive-compulsive disorder (OCD) and prior appendectomy. Presented with 2 days of left flank pain described as severe, sudden onset, sharp, constant, and without radiation. Reported medication was escitalopram 20mg. Pt was discharged same day with opioid analgesics. Patient returned the next day as pain had not ceased. Did not inform medical professionals of his AAS use on first hospital admission. Admitted AAS use on second admission.	***Patterns:*** Patient revealed on the second visit to hospital that he had been using both testosterone and trenbolone acetate, intermittently over a period of 5 years, with last use 2 weeks prior to initial admission. ***Motivations:*** NR	Diagnosed with left renal parenchymal infarct and acute kidney injury (AKI). He was admitted and started on a continuous heparin drip for anticoagulation.	The patient experienced gradual improvement in pain and renal function. On hospital day 3, enoxaparin was started as a bridge to therapeutic INR on warfarin. He was discharged on hospital day 4, following stabilization of creatinine and acceptable pain control. Extensive counselling was provided regarding the risk of thromboembolic events with continued use of anabolic steroids.
Ding et al. (2013). Androgenic-anabolic steroid drug-induced liver injury. **Clinical Case Report.** Sample *n* = 1; Age = 46	Australia	A 46-year-old man present with jaundice and weight loss. Following liver biopsy, intrahepatic cholestasis and occasional necroinflammatory foci was reported. These are consistent with stanozolol use. Disclosed AAS use on admission.	***Patterns:*** He had ingested stanozolol (40 mg) and methandrostenolone (40 mg) daily for 2 months and reported stopping usage 5 months prior to his initial symptoms. ***Motivations:*** NR	Nausea, pruritus, and anorexia	Patient was required to cease use of AAS for 5 months.
Farzam (2021). Anabolic-Androgenic Steroids and Cardiometabolic Derangements. **Clinical Case Report.** Sample *n* = 1; Age = 56.	USA	56-year-old male presented to the family medicine clinic for a general check-up for health maintenance. The patient had a blood pressure of 136/80. Disclosed AAS use on admission	***Patterns:*** He first began using anabolic steroids over thirty years ago and cycled up until the day of admission. AAS used included trenbolone, nandrolone decanoate, methenolone, stanozolol (Winstrol), boldenone undecylenate (Equipoise), oxymetholone (Anadrol), metandienone (Dianabol), and fluoxymesterone (Halotesin). Use on admission was testosterone cypionate at 125 mg per week along with supplements including garlic tablets, tauroursodeoxycholic acid (TUDCA) at 500 mg daily, resveratrol, alpha-lipoic acid (ALA) at 600 mg daily, turmeric, vitamin C, fish oil at 3 grams daily, vitamin D at 5000 IU daily, coenzyme Q10, and n-acetyl cysteine (NAC) 1200 mg daily. ***Motivations:*** NR	Diagnosed with Type 2 Diabetes Mellitus diagnosis, hyperlipidaemia, borderline elevated blood pressure, and moderately elevated hs-CRP. Echocardiogram revealed mild left ventricular hypertrophy and mildly decreased right ventricular function.	The patient was placed on aspirin 81 mg daily. He was not willing to begin statin therapy and opted for major lifestyle modification and niacin therapy for his dyslipidaemia. He was also started on an angiotensin-converting enzyme (ACE) inhibitor at a low dose to aid in his left ventricular remodelling and better optimize his hypertension. This case highlights the potential need for extensive metabolic and cardiac evaluation in long term AAS users.
Fisler et al. (2018). Bile Cast Nephropathy: The Unknown Dangers of Online Shopping.	Switzerland	A 56-year-old man presented in the emergency department due to painless icterus and severe pruritus.	***Patterns:*** Intramuscular use of propionate, testosterone acetate, dromostanolone propionate, and methyltrienolone.	Reduced urine volume and discoloration of the urine was reported on admission.	Patient required 4 weeks of dialysis to recover kidney function.

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Clinical Case Report. Sample $n = 1$; Age = 56.		The clinical examination revealed hypertension bp 173/90; acute kidney injury and hyperbilirubinemia attributed to suspected drug use, finally revealed to be AAS. Did not disclose AAS use initially and was significantly ill with hepatotoxicity and jaundice by the time he did disclose AAS use history.	***Motivations:*** to increase muscular mass for bodybuilding training.	Clinical examination revealed hypertension bp 173/90; acute kidney injury and hyperbilirubinemia attributed to 'suspected drug use'. Anuric acute kidney failure developed while patient at hospital followed by further severe pruritus.	Hyperbilirubinemia normalized over those weeks also.
Flo et al. (2018). Anabolic androgenic steroid-induced acute myocardial infarction with multiorgan failure. **Clinical Case Report.** Sample $n = 1$; Age = 41.	USA	A 41-year-old male fitness trainer presented with sudden onset chest pain at rest 3 hours prior to presentation. At presentation, the electrocardiograph was consistent with inferior ST segment myocardial infarction with a heart rate of 54 beats/min. Angiogram showed a totally occluded right coronary artery. Cardiac echocardiography demonstrated a severely dilated right atrium, right ventricle, and left atrium; a normal-sized left ventricle with moderate concentric left ventricular hypertrophy; and a severely reduced left ventricular ejection fraction of <20%. By hospital day 2, he developed worsening acute kidney injury, an abnormal coagulation profile, hyperbilirubinemia, and acute liver injury. Disclosed AAS use on admission.	***Patterns:*** Use of AAS for >20 years in significant amounts. ***Motivations:*** NR	Based on assessments by a gastroenterologist and nephrologist, the patient had acute ischemic injury to both kidney and liver secondary to decreased cardiac output. The acute prothrombotic event which caused right coronary artery infarct, left ventricular dysfunction secondary to chronic dilated cardiomyopathy was attributed to abuse of AAS.	Thrombectomy and percutaneous coronary intervention with insertion of a drug-eluting stent were performed. He was given low-infusion-rate intravenous dextrose for the acute liver injury. Eight days after admission the patient showed improvement and was discharged in stable condition. Follow-up with cardiology, nephrology, and gastroenterology was arranged.
Gangadharamurthy et al. (2018). Anabolic Androgenic Steroid Abuse and Reversible Cardiomyopathy: An Emerging and Under-Recognized Cardiovascular Public Health Problem among Fitness Enthusiasts. **Clinical Case Report.** Sample $n = 1$; Age = 53	USA	A 53-year-old well-built muscular man and fitness trainer presented with left facial droop, left arm weakness and NYHA II symptoms (mild shortness of breath and/or angina, limitation during ordinary daily activity). Disclosed AAS use on admission.	***Patterns:*** Using AAS for 20 years ***Motivations:*** NR	Cardiomyopathy was an incidental finding. Cardiac MR showed mid-myocardial enhancement consistent with nonischaemic cardiomyopathy. Erythrocytosis was reportedly due to AAS use.	Symptoms resolved with therapeutic phlebotomy, treatment of stroke and heart failure. The patient achieved near reversal of cardiomyopathy with continued therapy of heart failure and abstinence from AAS.
Graham et al. (2006). Homocysteine induced cardiovascular events: a consequence of long term anabolic-androgenic steroid (AAS) abuse. **Journal Article.** Cross-sectional quantitative study, collecting biomedical data with a control group. Recruited from a database of subjects who had been involved in previous	UK	Biomedical data collection: Plasma concentrations of HCY, plasma folate, testosterone, sex hormone binding globulin (SHBG), free androgen index (FAI), urea, creatinine, haematocrit (HCT), and vitamin B12 (B12) were measured.	***Patterns:*** NR ***Motivations:*** Competitive BB	Three individual subjects died suddenly during the study. They had elevated homocysteine levels greater than the SU group as a whole Their mean age ($n = 3$) was 43 years.	The findings suggest that the long-term use of supraphysiological doses of AAS are significant for hyperhomocysteinaemia and dramatically elevated HCT concentrations.

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
studies, and from notices placed on bodybuilding web sites. Sample n = 40; Mean = 42.4 + 3.8.					
Hanley Santos and Coomber (2017). The risk environment of anabolic–androgenic steroid users in the UK: Examining motivations, practices and accounts of use. **Journal Article.** Qualitative. Semi-structured Interviews with IPED users, gym owners, and suppliers. Recruited from local safer injecting service through purposive and snowball sampling. Sample n = 22; Age-range = 20–44; Mean = 31; Age of first use = 16–38.	England.	Themes found: Motivations for use. Different pathways into steroid use. Patterns of use: managing risk (or not). Accounts of use: downplaying risk. Ambivalence and stopping steroid use. Patterns of steroid use by participants varied according to motivation for use, experience and knowledge gained. Participants differentiated themselves from other groups of steroid users—for example, older users. Participants older than 40 ($n = 5$)	***Patterns:*** NR ***Motivations:*** To look good, nice physique in their 40s.	NR	Older users expressed concern over patterns of use of inexperienced younger AAS users as they believed they were engaging in riskier behaviours than themselves. Older participants also believed younger males are now using for aesthetics rather than serious bodybuilding which they felt was due to lack of knowledge on safe use of AAS. Conversely one older participant was engaging in continual steroid use without cycling.
Harvey et al. (2021). Libido as a motivator for starting and restarting non-prescribed anabolic androgenic steroid use among men: a mixed-methods study. **Journal Article.** Mixed methods. Questionnaires and semi-structured interviews with AAS users. Sample n = 133; Age-range = 18–65; Mean = 35.7; Age of first use = 14–57.	Global	74% reported improved quality as a result of uptake of AAS use. Motivations included muscle enhancement, appearance, enhance confidence, fitness, sex drive, and stamina. 90% reported re-starting AAS for the positive feelings associated with increased libido. Experiences of healthcare were positive for USA participants but negative for UK participants who felt physicians had a poor understanding and knowledge of the psychological effects of AAS use. Increased libido was reported by many as both a positive and negative effect of AAS use.	***Patterns:*** One older male particiapant could access TRT (Testosterone Replacment Therapy) from his doctor. However, when he wanted to compete, he would top up with non-prescribed AAS. ***Motivations:*** Increased libido as a motivation for initiation and also re-starting AAS use. A desire to combat the effects of the natural aging process. Motivated to use to manage the negative effects such as moving away from using in cycles to instead using a 'blast and cruise' regime.	NR	One older male form the USA older male participant illustrated the benefits of healthcare access at private online clinic. The effects of aging, particularly the side effects of lowered testosterone, can impact men's self-esteem regarding their sense of self and masculine identity and this could lead them to choose to self-medicate with AAS.
Havnes et al. (2019). Anabolic-androgenic steroid users receiving health-related information; health problems, motivations to quit and treatment desires. **Journal Article.** Quantitative; Cross-sectional prospective study. Users of AAS and next of kin who voluntarily contacted the Steroid Project for health-related information session from April 2015 to March 2019. Sample n = 232; Age-range = 16–67; Mean = 31.4; Age of first use = 19, 12–51.	Norway	77.2% desired treatment for AAS health related issues and cessation. 47.8% reported mental health problems as the primary motivation for AAS cessation.	***Patterns:*** NR ***Motivations:*** NR	NR	Those who wanted to attend for treatment were significantly older.

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Ilhan et al. (2010). Acute myocardial infarction and renal infarction in a bodybuilder using anabolic steroids. **Clinical Case Report.** Sample $n = 1$; Age = 41	Turkey	A 41-year-old male bodybuilder was admitted to the emergency service with chest pain of four-hour onset. Disclosed AAS use.	***Patterns:*** Use of oxymetholone and methenolone for 15 years ***Motivations:*** For performance enhancement.	Chest pain. Primary percutaneous coronary intervention (PCI) was performed for a total occlusion localized proximal to the right coronary artery with a door-balloon time of 25 minutes.The patient was discharged on the 10th day on treatment with dual antiplatelet therapy and anti-ischemic drugs.	Medical history should be taken carefully with individuals who engage in bodybuilding or other performance sports with respect to possible AAS use to aid the prevention and early diagnosis of cardiovascular problems.
Ip et al. (2015). Characteristics and Behaviors of Older Male Anabolic Steroid Users. **Journal Article.** Quantitative; Cross-sectional survey of AAS users. Online bodybuilding, fitness, & AAS forum members. Sample n = 67; Age-range = 40–73; Mean = 47.3 ± 6.7; Age of first use = 17–69.	USA	Most Caucasian, heterosexual, recreational gym goers. Exercise patterns in the over 40-year-old were similar to those of AAS users in the general population. OMAAS more likely than nonusers to binge drink and partake in heavy alcohol use which is greater in comparison to current drinkers in the general older adult population.	***Patterns:*** Used multiple PIEDs including agents to compensate for adverse effects. Used supraphysiologic doses of AAS. Weekly AAS dose, mg 1103.6 + 1165.6. Plan to use AAS in future ($n = 57$) ***Motivations:*** AAS users rated increase muscle mass, increase strength, and improve physical appearance as important/very important reasons for using AAS. They also ranked "slow the aging process" as somewhat important/important.	AAS users were more likely to report an anxiety disorder. DSM-IV-TR Psychiatric Diagnoses in OMAAS: Any psychiatric illnessd ($n = 11$) Anxiety disordere ($n = 8$) Major depressive disorder ($n = 6$) ADHD ($n = 3$)	The findings in this study can help clinicians and researchers better understand the older AAS-using population, which may lead to improved identification and potential interventions in the older male population.
Kimergard (2015). A qualitative study of anabolic steroid use amongst gym users in the United Kingdom: motives, beliefs and experiences. **Journal Article.** Qualitative; Semi-structured Interviews with AAS users. Recruited from fixed-site needle and syringe programmes; outreach service; steroid clinics; a gym; and a prison. Sample n = 24; Age-range = 21–61; Mean = 34; Age of first use = 16–25.	UK	Motivations for AAS use centred on improved physique, increased muscle strength and definition, anti-ageing. Other IPEDs used included Growth hormone and weight loss drugs. Many believed that AAS and IPEDs can be used safely and are part of a healthy lifestyle. Older than 40 ($n = 5$).	***Motivations:*** To maintain appearance when getting older and combatting ageing	NR	The study of AAS users demonstrates the inconsistencies in the perception of the harms of AAS between users and health authorities, the media and policymakers which has implications for the promotion of public health.
Kimergard et al. (2014). Environments, risk and health harms: a qualitative investigation into the illicit use of anabolic steroids among people using harm reduction services in the UK. **Journal Article.** Qualitative; Semi-structured Interviews with AAS users. Recruited from fixed-site needle and syringe programmes; outreach service; steroid clinics; a gym; and a prison. Sample n = 24; Age-range = 21–61; Mean = 34; Age of first use = 16–25.	UK	Motivations for AAS use centred on body image enhancement.	***Patterns:*** Older experienced user reported concerns for younger users IPED use regimes and acted as mediators and recommended advice regarding cycles, dosages and also recommended that young users not use until they are older. ***Motivations:*** NR	NR	Consideration of situational and environmental factors for the potential harms from AAS use are significant for public health strategies and the promotion and protection of health.

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Kovac et al. (2015). **Men regret anabolic steroid use due to a lack of comprehension regarding the consequences on future fertility.** **Journal Article.** Quantitative; Survey of Hypogonadal men being treated with TRT recruited at a Urology clinic. Sample n = 79; Mean = 40 + 0.9.	USA	84.8% (n = 67) stated that they had no regret (NR) about their AAS use. 15.2% (n = 12) expressed regret (R) about their AAS use. The majority of the men were heterosexual and married. Men who regretted use were more likely to have no children (58.3%) while men who were not regretful of their prior AAS use were more likely to have 1–2 children (58.2%).	***Patterns:*** NR ***Motivations:*** NR	40.5% (n = 32/79) of men with prior AAS use indicated having erectile dysfunction. A similar number of people in those men with R (50%, n = 6/12) and those with NR (38.8%, n = 26/67) experienced erectile dysfunction (P = 0.537, Figure 1(c)). Mood was similarly affected (R = 41.7%, n = 5/12; NR = 32.8%, n = 22/67). The men with regret, 25% (n = 3/12) did not understand the possible future impact of AAS use on their serum testosterone levels.	The findings in the current study are important when dealing with hypogonadal patients with ASIH seeking TST. It is valuable for men with ASIH to understand the impact that exogenous AAS may have had on their fertility.
Lenehan et al. (1996). A study of anabolic steroid use in the North-West of England. **Journal Article.** Mixed methods. Prevalence Survey & Interviews with gym users. Survey Sample n = 258; Age-range = 14–73. Interviews *n* = 379; Age-range = 17–56; Age of first use = 15–49.	England	AAS prevalence was higher in what were considered 'hardcore' gyms than 'mixed' gyms, with bodybuilders the largest user group. 58% were competitive bodybuilders. Increased muscle mass, strength, performance, recovery from injury, sex-drive and confidence most reported positive effects. Adverse effects reported included kidney problems, acne, water retention, infections and decreased sex drive. On cessation of AAS use over 1/3 of participants reported depression and suicidal ideation. Most commonly reported AAS used deca durabolin, testosterone, Dianabol, and Pronabol. 21.7% attended GP for AAS related issue. 2.1% were refused treatment by a GP because of their AAS use.	***Patterns:*** NR ***Motivations:*** NR	NR	More AAS users in the 40–44-year age category than the 15–19 years. 35 were in the 40–74 age group.
Llamas-Velasco et al. (2021). Bilateral Nipple Enlargement as a Secondary Effect of Anabolic Drugs: A Histopathological Mimicker of Smooth Muscle Hamartoma. **Clinical Case report.** Sample *n* = 1; Age = 40	Spain	A 40-year-old male presented with progressive bilateral enlargement of both nipples excised due to cosmetic concerns. Disclosed AAS use.	***Patterns:*** History of AAS use but details not specified. ***Motivations:*** To improve his physical performance	Bilateral enlargement of both nipples. symmetrical, cylindrical, well-defined and slightly indurated nipples of 10 mm diameter and 11 mm height attributed to AAS use.	Enlarged nipples excised with the clinical diagnosis of bilateral leiomyomas. Dermatopathologists and physicians should consider the side-effects of AAS use particularly lesions that present due to cosmetic concerns.
Long et al. (2019). Gerstmann syndrome complicating polycythemia secondary to anabolic steroid use. **Clinical Case Report.** Sample *n* = 1; Age = 49. Age of first use = in his teens.	USA	A 49-year-old man with presented with aphasia, ataxia, and right-sided weakness. Previous medical history was significant for a reported stroke in his 20s, panic attacks and rhabdomyolysis. Disclosed AAS use.	***Patterns:*** A history of AAS use since his teens Still using AAS intermittently. He works as a personal trainer and trains 5–6 days/week (2–3 hours/day). ***Motivations:*** Competitive Bodybuilding.	Diagnosed with an AAS induced stroke.	The patient's stroke symptoms improved after 2 days but he developed dysgraphia, dyscalculia, finger agnosia and left–right disorientation consistent with Gerstmann syndrome. Dysgraphia and left–right disorientation resolved

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Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
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					but dyscalculia and finger agnosia remained on discharge.
Lovelock et al. (2021). A Case of Brachial Artery Infected Aneurysm Secondary to Infective Endocarditis from Intramuscular Steroid Use. **Clinical Case Report.** Sample $n = 1$; Age = 52.	Australia	52-year-old male presented with a 24-hour history of lethargy, blurred vision, and ataxia. This followed undiagnosed fevers and headaches with neck pain for 4 weeks. He had also developed left arm swelling and pain 2 days prior.	***Patterns:*** AAS Use for the past 5 years ***Motivations:*** NR	A diagnosis of infective endocarditis of the mitral valve was made, secondary to C. hominis, likely due to intramuscular anabolic steroid use	The patient underwent excision and debridement of the infected aneurysm. Histopathology was consistent with infected thromboembolism with aneurysmal degeneration of the artery. The patient underwent mitral valve replacement 10 days later.
McVeigh and Begley (2017). Anabolic steroids in the UK: an increasing issue for public health. **Review.** Review using the two time points between 1995 (prior to legislation changes in the United Kingdom) and 2015, a review of the evidence related to health harms was conducted, in conjunction with needle and syringe programme (NSP) data in Cheshire & Merseyside (UK) relating to anabolic steroid users.	UK	Dramatic increase in the number of AAS users accessing NSPs, from 553 in 1995 to 2446 in 2015. Increased mean age of steroid using clients from 26 years old (median age of 25) in 1995 compared to 31 years old (median age of 30) in 2015. The percentage of steroid users has risen from 17.1% to 54.9% over the last 20 years.	***Patterns:*** NR ***Motivations:*** NR	NR	Increased mean age of steroid using clients from 26 years old (median age of 25) in 1995 compared to 31 years old (median age of 30) in 2015. There is a need for widespread interventions in the context of increasing numbers of those injecting AAS. Greater engagement is required at gyms and other areas where AAS use is prevalent. Future research to estimate the prevalence of AAS use, drivers for AAS use, risk behaviours, and harm reduction initiatives require further research. The impact of the illicit market, the internet, and the demand for AAS also requires further research.
Patil et al. (2007). Near-fatal spontaneous hepatic rupture associated with anabolic androgenic steroid use: a case report. **Clinical Case Report.** Sample $n = 1$; Age = 43.	Wales	A 43-year-old man was brought to the accident and emergency department after he collapsed at home. He had epigastric pain for 2 days before the collapse. There was no history of trauma. Disclosed AAS use.	***Patterns:*** He had stopped taking steroids 4 years previously. He had been taking AAS for 25 years, which included nandrolone decanoate, stanozolol, primabolin and most forms of testosterone. By comparison with the doses taken in the bodybuilding fraternity, his consumption was at the low end of the range of steroid usage. ***Motivations:*** NR	Spontaneous hepatic rupture which was attributed to history of AAS use.	Clinicians need to be aware of such a possibility for AAS use and related effects in a fit and healthy young person.
Pope et al. (2021). Anabolic-Androgenic Steroids, Violence, and Crime: Two Cases and Literature Review. **Forensic Case Report.** Forensic evaluations men who committed serious crimes while using AAS. Sample $n = 2$; Age = 58 and 50.	USA	Forensic case report account of 2 men who committed serious crimes while using AAS (only one used AAS older than 40 so will report on him only). The report highlighted that high doses of AAS can cause a minority of individuals to develop substantial personality and mood changes, and to display aggressiveness, violence, or criminal behaviour that appears	***Patterns:*** NR ***Motivations:*** For performance enhancement initially. Then to maintain a physique to succeed in the club scene. Then at age 56 he used to bulk up for his job as a doorman.	NR	Significant need for criminologist in forensic or clinical settings to establish if the person who committed violent crimes was using AAS exactly at the time of the incident.

(*continued*)

Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
		entirely different from their usual personalities.			
Rashid (2000). Testosterone abuse and affective disorders. **Clinical Case Report.** Sample $n = 1$; Age = 40.	USA	Case report of a man who presented to his psychiatrist and was using AAS to negate symptoms of perceived low testosterone. The patient described felling low, decreased energy, and decreased libido two months following cessation of AAS however in conjunction with his psychiatrist, he remained abstinent from AAS. Disclosed AAS use.	***Patterns:*** Using AAS for the past 2 years. ***Motivations:*** To improve his self-image and help him develop muscualr physique, which made him happy, energetic, and outgoing.	NR	The report highlights the importance of specific treatment interventions for those wishing to cease AAS use
Ravindran et al. (2020). Myositis, rhabdomyolysis and severe hypercalcaemia in a body builder. **Clinical Case Report.** Sample $n = 1$; Age = 53.	Wales	A 53-year-old retired fire-fighter presented with severe constipation of many weeks' duration. Disclosed AAS use.	***Patterns:*** For bodybuilding ***Motivations:*** Use of growth hormone (GH) 2 IU/day and testosterone (T) 350 mg/day on a '6-weeks on and 4-weeks off' regime for over 20 years	Severe symptomatic hypercalcaemia complicating acute inflammatory myositis and rhabdomyolysis. He also had AKI (with chronic kidney disease) and significant proteinuria due to Focal Segmental Glomerulosclerosis. He continued taking growth hormone and testosterone despite counselling but died suddenly of a myocardial infarction.	Diagnosis of hypercalcaemia may require multidisciplinary expertise and multiple and invasive investigations. There may be several disparate causes for hypercalcaemia, although one usually predominates. Maintaining 'body image' even with the use of harmful drugs may be an overpowering emotion despite counselling about their dangers.
Rosenfeld et al. (2011). Cholestatic jaundice, acute kidney injury and acute pancreatitis secondary to the recreational use of methandrostenolone: A case report. **Clinical Case Report.** Sample $n = 1$; Age = 50.	Canada	A 50-year-old man of Indian descent who presented with a six-week history of diffuse abdominal pain, anorexia and weight loss following an eight-week cycle of methandrostenolone use. Disclosed AAS use.	***Patterns:*** NR ***Motivations:*** NR	Imaging was consistent with acute pancreatitis while a liver biopsy was consistent with intra-hepatic cholestasis and a kidney biopsy revealed evidence of acute tubular necrosis attributed to AAS use.	This was reported as the first known case of a patient developing pancreatitis as a result of anabolic androgenic steroid use.
Rothman et al. (2011). Anabolic androgenic steroid induced myocardial toxicity: An evolving problem in an ageing population. **Clinical Case Report.** Sample $n = 1$; Age = 62; Age of first use = 61	USA	62-year-old man presented with exertional dyspnoea culminating in marked exercise intolerance. Disclosed AAS use.	***Patterns: B***egan regularly exercising at the age of 50 years. His exercise duration and intensity gradually increased over a several year period ultimately reaching 5 day per week regimen (2h of dedicated weightlifting and 30min of cardiovascular training). He began injecting AAS 1 year prior to admission. Reported the use of nandrolone 400–800 mg/week and methandrostenolone 20–40 mg/week to increase muscle mass and strength. ***Motivations:*** To increase lean muscle mass and strength.	Diagnosis of LV systolic dysfunction was made. The presumed aetiology was myocardial toxicity secondary to AAS exposure.	Cessation of anabolic steroids coupled with heart failure pharmacotherapy led to complete normalisation of LV size and function and a simultaneous increase in exercise tolerance. Several years after stopping AAS use he continues to train at a high level without limitations.
Shiber (2013). Pyomyositis Due To Anabolic Steroid Injection. **Clinical Case Report.** Sample $n = 1$; Age = 45.	USA	45-year-old amateur bodybuilder with pain and swelling at injection site for 3 days.	***Patterns:*** NR ***Motivations:*** Bodybuilding	Pain and swelling at injection site for 3 days.	Treated with intravenous vancomycin and piperacillin-tazobactam. The wound was surgically debrided and he recovered and was discharged in 5 days.

(*continued*)

Table 3. Continued.

Citation and Study Details[a]	Country	General Findings of Journal Articles / Presentation of Clinical Case Reports	Findings of Older Men (>40years)		
			Patterns and Motivations for Use	Adverse Effects Reported/Diagnosed	Conclusions
Shinya et al. (2013). Caution for Anabolic Androgenic Steroid Use: A Case Report of Multiple Organ Dysfunction Syndrome. **Clinical Case Report.** Sample $n = 1$; Age = 42.	USA	42-year-old male amateur body builder developed multiple organ dysfunction syndrome and Acute respiratory distress syndrome. Disclosed AAS use.	***Patterns:*** Injecting AAS: testosterone acetate, testosterone cypionate, testosterone decanoate, testosterone propionate, testosterone phenylpropionate, testosterone enanthate, and testosterone isocaproate, for a few years. ***Motivations:*** For muscle building	Nausea, vomiting, diarrhoea, and 5 days of shortness of breath and productive cough. He was hypoxic and had episodes of supraventricular tachycardia and rapid atrial flutter (ventricular rate 160–200 beats/min).	The relationship between AAS use and multi-organ dysfunction is not completely clear in this patient, but authors attributed his long history of AAS use with the systemic inflammatory response and multiple-organ dysfunction.
Tashiro et al. (2021). Subacute Stent Thrombosis After Primary Percutaneous Coronary Intervention in a Middle-Aged Anabolic Steroid–Abusing Bodybuilder. **Clinical Case Report.** Sample $n = 1$; Age = 54	Japan	A 54-year-old male bodybuilder who was abusing anabolic steroids developed an acute ST-segment elevation myocardial infarction after strenuous strength training. Disclosed AAS use.	***Patterns:*** Oral oxandrolone (20 mg) and methandienone (40 mg) daily. He was training for a world-class bodybuilding competition and had been taking the AAS cyclically with 3 months "on" and 1 month "off" in addition to protein supplements for the last 3 years ***Motivations:*** Competitive bodybuilding.	Exercise-related acute MI followed by subacute thrombosis, potentially predisposed by abuse of AA.	The patient was referred to a comprehensive cardiac rehabilitation program in the rehabilitation hospital for secondary prevention and advised to discontinue use of AAS and vigorous exercise training.
Weinreb et al. (2010). Factitial soft tissue pseudotumor due to injection of anabolic steroids: a report of 3 cases in 2 patients. **Clinical Case Report.** Sample $n = 1$; Age = 49.	Canada	49-year-old man presented with a large left lateral thigh mass at injection site.	***Patterns:*** Injecting AAS. ***Motivations:*** NR	Large left lateral thigh mass at injection site.	A benign reactive proliferation was diagnosed, and no treatment was needed.
Zahnow et al. (2018). Identifying a typology of men who use Anabolic Androgenic Steroids (AAS). **Journal Article.** Quantitative. Retrospective Data Analysis of AAS users from the Global Drug Survey 2015. Sample $n = 611$; Age-range = 16–68; Mean = 30.5; Age of first use = 24.39 ± 6.54	UK	Study developed a quantitative typology of AAS users. Four types: YOLO, Wellbeing, Expert and Athlete types. YOLO type are young, inexperienced, with high levels of risk; Wellbeing frequent the gym, concerns with image and wellbeing, less risky; Athlete type were more likely to be older, use of AAS and other IPEDs; Expert type minimal AAS and IPED use, low alcohol consumption, low risk.	***Patterns:*** NR ***Motivations:*** Individuals in cluster 3 are motivated to use AAS to gain muscle and lose fat.	NR	Athlete types were more likely to be older. The Athlete type are noted for combining steroids with other enhancement drugs. While all clusters were motivated by muscle gain and fat loss to some degree, a far higher proportion of cluster three were motivated by these goals than other clusters which aligns with the goals of the competitive bodybuilder. individuals in cluster 3 tended to use a greater number of AAS and IPEDs.
Zahnow et al. (2017). **Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users.** **Journal Article.** Quantitative. Retrospective Data Analysis of AAS users from the Global Drug Survey 2015. Sample $n = 253$ men, 59 women; Age-range = 17–72; Mean = 29.8.	Global	35% reported seeking advice from GP due to AAS related adverse effects with the majority reluctant to do so. Sexual function issues were a driver for men to seek GP treatment. Those AAS user that did seek GP and medical advice were in the older cohort	***Patterns:*** NR ***Motivations:*** NR	NR	On average, AAS users who engaged with health services were significantly older than those who did not

[a]NR: Not reported. [b]NSP: Needle and Syringe Programs.

Table 4. Themes and categories emerging during thematic analysis.

Theme	Subtheme	Categories
Theme One		
Characteristics of AAS Use	Age of Initiation	1. First use of AAS at aged 40 years or older documented in 8 records. 2. Oldest age of initiation to use was aged 69 years. 3. Evidence of increased age of initiation to use within UK national IPED studies over the past decade.
	Motivations for AAS Use	4. Motivations by AAS use documented in 23 records. 5. Motivations by older males to initiate AAS use do not differ greatly from young males and included aesthetics, performance enhancement, and increasing musculature for bodybuilding. 6. Wellbeing was considered a primary motivating factor for continued use and restarting use following a period of cessation. 7. Wellbeing was associated with emotional happiness resulting from sexual function, feelings of youthfulness, male status, and the ability to perform sexually later in life.
	Sustained Harmful Patterns of Use	8. Dependence on AAS and attempts at cessation is documented in 5 records and may indicate the 'neuroendocrine pathway' for AAS dependence. 9. Changes in patterns of use over time observed specifically in relation to continued use/not cycling and blasting and cruising. 10. Prolonged cycles associated with psychological dependence and wellbeing. 11. Some OMAAS do not perceive themselves as dependent, and that their AAS use is part of a healthy regime and a valued lifestyle.
Theme Two		
Self-Reported Adverse Effects	Effect on Sexual Function and Fertility	12. Most reported adverse effects centred on erectile dysfunction, from AAS use testicular atrophy, and low libido. 13. Psychological effects such as low mood and depressive symptoms. 14. One study documented infertility and hypogonadal failure 30 months after cessation of AAS use.
	Other Self-Reported Adverse Effects	15. Other harms included hormonal imbalances, fatigue, breathlessness and dyspnoea, and injecting harms.
Theme Three		
Health Harms Diagnosed by Medical Professional	Cardiovascular Harms	16. Cardiovascular harms were reported in 14 studies. 17. Cardiovascular harms: left ventricular systolic dysfunction, left ventricular hypertrophy, right coronary artery infarct, decreased right ventricular function, dyslipidaemia, myocardial infarction, Class IV heart failure, myocardial dysfunction, coronary atherosclerosis, hypertension, elevated hs-CRP, hyperlipidaemia, increased haematocrit level, and refractory supraventricular tachycardia (see Table 5). 18. Atherosclerotic disease was significantly linked to lifetime use of AAS. 19. Cardiovascular harms (left ventricular hypertrophy, dyslipidaemia, coronary atherosclerosis, hypertension) diagnosed in OMAAS are those more often diagnosed in sedentary or obese populations.
	Hepatotoxicity	20. Liver injury from AAS use was reported in five clinical case reports. 21. Reversal of liver injury on cessation of AAS use.
	Other Diagnosed Health Issues	22. Other diagnosed health harms were acute kidney injury, renal infarction, acute respiratory distress syndrome, type 2 Diabetes Mellitus, cholesterol imbalance, hypercalcaemia, inflammatory myositis, rhabdomyolysis, and erythrocytosis.
	Experiences of Healthcare	23. Only 3 studies documented experiences of healthcare by OMAAS. 24. OMAAS were reluctant to engage with medical professionals. 25. OMAAS with a longer lifetime of use than their younger counterparts wished to seek treatment for cessation of use. 26. The treatment needs of an OMAAS will require a multi-disciplinary approach including physicians, endocrinologists, psychologists and psychiatrists, and addiction specialist practitioners.

Table 5. Cardiovascular harms terminology.

Cardiomyopathy	Chronic disease of the heart muscle.
Class IV Heart Failure	Unable to carry on any physical activity without discomfort. Symptoms of heart failure at rest. If any physical activity is undertaken, discomfort increases.
Coronary Atherosclerosis	Condition where arteries become clogged with fatty substances called plaques, or atheroma. These plaques cause the arteries to harden and narrow, restricting the blood flow and oxygen supply to vital organs, and increasing the risk of blood clots that could potentially block the flow of blood to the heart or brain.
Decreased Right Ventricular Function	Symptoms of right heart failure due to systemic venous congestion and/or low cardiac output. This includes exertional dyspnoea, fatigue, dizziness, ankle swelling, epigastric fullness and right upper abdominal discomfort or pain.
Dyslipidaemia	Dyslipidemia is the imbalance of lipids such as cholesterol, low-density lipoprotein cholesterol, (LDL-C), triglycerides, and high-density lipoprotein (HDL).
Elevated Hs-CRP	High-sensitivity C-reactive protein is produced by the body when blood-vessel walls are inflamed. The higher your levels of hs-CRP inked to an increased risk of heart attacks.
Erythrocytosis	A high concentration of red blood cells in the blood making the blood thicker and less able to travel through blood vessels and organs.
Hyperhomocysteinaemia	A trigger for many cardiovascular diseases, such as atherosclerosis and congestive heart failure.
Hypercalcaemia	When the calcium level in your blood is above normal. Too much calcium in your blood can weaken your bones, create kidney stones, and interfere with how your heart and brain work
Hyperlipidaemia	abnormally high levels of fats (lipids) in the blood, which include cholesterol and triglycerides.
Hypertension	High or raised blood pressure, a condition in which the blood vessels have persistently raised pressure.
Increased Haematocrit Levels	Hematocrit is the percentage of red blood cells in a person's blood. High red blood cell levels could signal polycythemia, which can increase a person's chance of developing a blood clot.
Inflammatory myositis	Inflammation of muscle
Infective Endocarditis	An infection caused by bacteria that enter the bloodstream and settle in the heart lining, a heart valve or a blood vessel.
Left Ventricular Hypertrophy	A thickening of the wall of the heart's main pumping chamber. Eventually, the heart may fail to pump with as much force as needed.
Left Ventricular Systolic Dysfunction	A complication of myocardial infarction (MI) that leads to greatly increased risks of sudden death and of heart failure
Myocardial Dysfunction	The development of low cardiac output or ventricular systolic or diastolic dysfunction after cardiac arrest.
Myocardial Infarction	A heart attack - which happens when one or more areas of the heart muscle don't get enough oxygen.
Rhabdomyolysis	The breakdown of muscle tissue that leads to the release of muscle fibre contents into the blood. These substances are harmful to the kidney and often cause kidney damage.
Refractory Supraventricular Tachycardia	An episode of SVT (irregularly fast heartbeat) that did not convert to sinus rhythm despite the administration of 2 doses of adenosine at or above the AHA-recommended doses.
Right Coronary Artery Infarct	A myocardial infarction (MI)

(5/80) and 8% (6/74) reported first use of oral and injectable AAS respectively (Chandler & McVeigh, 2014). The 2015 survey reported 3% (18/572) of participants' older than 41 initiating use of injectable IPEDs, and 1.6% (8/505) initiating oral IPED use older than 41 (Bates & McVeigh, 2016). This was slightly higher in 2017 with initiation to use over 40 years for injectable IPEDs 5% (25/537) and for oral, 3% (20/590) (Begley et al., 2017).

Motivations for AAS use. Motivations by for initiating, continuing, and restarting AAS use by men older than 40 years of age were documented in twenty-three records (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Bonnecaze et al., 2020; Boregowda et al., 2011; Christiansen et al., 2016; Cohen et al., 2007; Fisler et al., 2018; Graham et al., 2006; Hanley Santos & Coomber, 2017; Harvey et al., 2021; Ilhan et al., 2010; Ip et al., 2015; Kimergard, 2015; Llamas-Velasco et al., 2021; Long et al., 2019; Pope et al., 2021; Rashid, 2000; Ravindran et al., 2020; Rothman et al., 2011; Shiber, 2013; Shinya et al., 2013; Tashiro et al., 2021; Zahnow et al., 2018).

Motivations to use AAS were reported as for aesthetics which included increased muscle mass, improved physique and appearance (Ahmed et al., 2019; Bonnecaze et al., 2020; Christiansen et al., 2016; Hanley Santos & Coomber, 2017; Harvey et al., 2021; Ip et al., 2015; Kimergard, 2015; Zahnow et al., 2018), improved physical strength for bodybuilding, sport and athletic performance, and other unspecified 'performance enhancement' (Bonnecaze et al., 2020; Harvey et al., 2021; Ilhan et al., 2010; Ip et al., 2015; Llamas-Velasco et al., 2021; Pope et al., 2021; Rothman et al., 2011; Tashiro et al., 2021), increased libido and endurance or stamina (Harvey et al., 2021), improved confidence and self-esteem (Bonnecaze et al., 2020; Harvey et al., 2021; Pope et al., 2021; Rashid, 2000), perceived low testosterone (Rashid, 2000), fat/weight loss (Christiansen et al., 2016; Cohen et al., 2007; Harvey et al., 2021), combating the ageing process and achieving feelings of youthfulness (Christiansen et al., 2016; Hanley Santos & Coomber, 2017; Ip et al., 2015; Kimergard, 2015), increasing musculature for bodybuilding (competitive and non-competitive) (Ahlgrim & Guglin, 2009; Boregowda et al., 2011; Fisler et al., 2018; Graham et al., 2006; Long et al., 2019; Ravindran et al., 2020); and for occupational reasons (Pope et al., 2021).

A clinical case study of a 48 year old male reported fear of losing muscle mass as a motivating factor for continued use (Ahmed et al., 2019). However, in 6 of the 23 studies documenting motivations, the main reported motivation for *continued* use by older men centred on 'wellbeing' and overall quality of life (QoL) especially during the ageing process (Bonnecaze et al., 2020; Christiansen et al., 2016; Harvey et al., 2021; Ip et al., 2015; Kimergard, 2015; Rashid, 2000). Wellbeing was not explicitly defined but represented a

subjective measure in each of these studies. Feelings of mental, physical and social wellbeing were associated with training outcomes such as an attractive more youthful body (Christiansen et al., 2016) and enhanced overall QoL (Bonnecaze et al., 2020). Maintaining physical appearance and slowing the ageing process were also associated with feelings of wellbeing and youthfulness among older males (Harvey et al., 2021; Ip et al., 2015; Kimergard, 2015).

Image and increased size to promote authority in an occupational setting was reported as a motivation for *restarting* AAS use following a period of cessation in one case study (Pope et al., 2021). Secondary reinforcement motivating continued use was identified as arising from the positive effects of AAS use such as increased muscle tone, self-confidence, and social recognition (Pope et al., 2021). Motivations to recommence AAS use in one case was reported by Pope et al. (2021) to increase confidence to impress a female partner. Another case study reported recommencing AAS use for self-directed TRT as use in the past improved quality of life (QoL) through confidence, happiness, image, and outgoingness (Rashid, 2000). Harvey et al. (2021) noted that motivation to use AAS of an older male (43yrs) had changed over time, and the primary reason to continue or restart was linked to emotional wellbeing associated with increased libido. Literature reports that as the use of AAS causes suppression of the hypothalamic-pituitary-testicular axis, resulting in natural testosterone production shutting down (Tan & Scally, 2009) as individuals who cease use may quickly begin again to negate the dysphoric feelings associated with this such as decreased libido and low mood (Kanayama & Pope, 2018). Furthermore as older men experience lowered testosterone levels as part of the natural ageing process (Bhasin et al., 2006) they may be motivated to begin use later in life.

Sustained harmful patterns of use. AAS dependence (Havnes et al., 2019; Ip et al., 2015) and attempts at cessation (Bonnecaze et al., 2020; Fisler et al., 2018; Rashid, 2000) by older men were reported in five records. A study of 67 men who use AAS, specifically explored AAS dependence utilising the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; (American Psychiatric Association, 2000) as a measure (Ip et al., 2015). It found similarities with traditional illicit drug seeking behaviours, such as requiring higher dosages over longer periods of time, to reach desired effects. Moreover, 27.4% (17/67) of their sample met the criteria for DSM-IV-TR substance use disorder, however it did not report on whether those who met the criteria for dependence had presented for medical treatment or advice pertaining to this, or if they wished to seek advice but did not do so. Havnes et al. (2019) reported 26% (62/232) of their participants said they experience dependence on AAS. However, this was based on self-disclosure and not on any dependence measures. Difficulty in attempts at cessation and high-levels of recommencement of AAS use by participants (663/2,385) were reported in the global study by Bonnecaze et al. (2020). Rashid (2000) noted that their case study participant reported feeling low, had decreased energy and decreased libido two months following cessation. However, in conjunction with his psychiatrist, he remained abstinent from AAS. Both points here underscore the importance of specific treatment interventions for those wishing to cease AAS use (Bates et al., 2019).

Theme 2: self-reported adverse effects from AAS use

Adverse effects described by older men resulting from the use of AAS were reported in ten records (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Bonnecaze et al., 2020; Boregowda et al., 2011; Ip et al., 2015; Kovac et al., 2015; Llamas-Velasco et al., 2021; Shiber, 2013; Shinya et al., 2013; Weinreb et al., 2010).

Effects on sexual function and fertility. The most self-reported adverse effects of AAS use centred on erectile dysfunction (Bonnecaze et al., 2020; Boregowda et al., 2011; Kovac et al., 2015), testicular atrophy (Bonnecaze et al., 2020; Boregowda et al., 2011), low libido (Boregowda et al., 2011), hypersexuality (Bonnecaze et al., 2020). Psychological effects such as low mood and depressive symptoms were directly associated with symptoms of low testosterone specifically low libido and erectile dysfunction (Harvey et al., 2021; Kovac et al., 2015; Rashid, 2000) and decreased energy (Rashid, 2000). Of interest is one of the participants of Harvey et al. (2021) study was receiving therapeutic TRT from his physician but continued to use non-prescribed AAS if he planned to compete in a sporting event. A forensic case report of a deceased male who used AAS was diagnosed with secondary hypogonadism following autopsy (Alibegović, 2018). However, it is unknown if the deceased suffered hypogonadal symptoms prior to death. AAS suppress HPT function in males resulting in hypogonadal symptoms such as erectile dysfunction, loss of libido (Pope et al., 2014) and infertility (McBride & Coward, 2016). In the current review, Ip et al. (2015) reported participants consuming clomiphene citrate and human chorionic gonadotropin in a bid to reduce these negative effects on sexual function and fertility. Infertility was reported by one male who had undergone investigations for this with his partner, and following cessation of AAS use (30 months after) primary gonadal failure was diagnosed (Boregowda et al., 2011). Infertility is the failure to successfully achieve pregnancy following one year or more of unprotected intercourse (de Souza & Hallak, 2011). Infertility resulting from AAS use is sometimes reversible after AAS discontinuation but the length of time to recovery cannot be ascertained, and should be considered by clinicians who are treating patients for infertility (McBride & Coward, 2016). Endogenous testosterone production and fertility are more likely to be restored in males who have used AAS in non-excessive doses and for a shorter length of time (Bonnecaze et al., 2021).

Other Self-Reported adverse effects. Other self-reported harms from AAS use included early-stage gynaecomastia in a 41-year old male (Llamas-Velasco et al., 2021), hormonal imbalances (acne, gynaecomastia, hair loss) (Bonnecaze et al., 2020), and fatigue, breathlessness and dyspnoea affecting one's ability to carry out resistance training (Ahlgrim &

Guglin, 2009). Injecting harms were reported in three studies (Bonnecaze et al., 2020; Shiber, 2013; Weinreb et al., 2010). Shiber (2013) reported their case of a 45-year-old bodybuilder who presented with pain and swelling three days following injecting AAS. Here the patient had surgical debridement and following recovery was discharged after five days. Weinreb at al. (2010) reported a patient with swelling at the injecting site of a 49-year-old man however in this case no treatment was necessary. Bonnecaze et al. (2020) note that OMAAS were more likely than younger males to report injecting harms.

Theme 3: health harms diagnosed by medical professional

Health harms diagnosed by a medical professional were reported in twenty-two records (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Alibegović, 2018; Baggish et al., 2017; Boregowda et al., 2011; Cabb et al., 2016; Colburn et al., 2017; Ding et al., 2013; Farzam, 2021; Fisler et al., 2018; Flo et al., 2018; Gangadharamurthy et al., 2018; Ilhan et al., 2010; Long et al., 2019; Lovelock et al., 2021; Patil et al., 2007; Ravindran et al., 2020; Rosenfeld et al., 2011; Rothman et al., 2011; Shinya et al., 2013; Tashiro et al., 2021).

Cardiovascular harms. The most commonly reported diagnosed adverse health effects resulting from AAS use were cardiovascular harms, reported in fourteen studies. These included eleven clinical case reports (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Farzam, 2021; Flo et al., 2018; Graham et al., 2006; Ilhan et al., 2010; Lovelock et al., 2021; Ravindran et al., 2020; Rothman et al., 2011; Shinya et al., 2013; Tashiro et al., 2021), an observational study (Baggish et al., 2017), and two cross-sectional surveys (Bonnecaze et al., 2020; Ip et al., 2015). Cardiovascular health problems attributed to the use of AAS included (see Table 5 for definitions of cardiovascular harms terminology) cardiomyopathy (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Flo et al., 2018), left ventricular systolic dysfunction (Ahlgrim & Guglin, 2009; Flo et al., 2018; Ravindran et al., 2020), left ventricular hypertrophy (Farzam, 2021), right coronary artery infarct (Flo et al., 2018), decreased right ventricular function (Farzam, 2021) dyslipidaemia (Bonnecaze et al., 2020), myocardial infarction (Ilhan et al., 2010; Ravindran et al., 2020; Tashiro et al., 2021), Class IV heart failure (Ahlgrim & Guglin, 2009), myocardial dysfunction (Baggish et al., 2017), coronary atherosclerosis (Baggish et al., 2017), hypertension (Bonnecaze et al., 2020; Farzam, 2021), elevated hs-CRP (Farzam, 2021), hyperlipidaemia (Farzam, 2021), hyperhomocysteinaemia (Graham et al., 2006), increased haematocrit levels (Graham et al., 2006), infective endocarditis (Lovelock et al., 2021), refractory supraventricular tachycardia (Shinya et al., 2013). A U.S. cross-sectional cohort study found that long-term AAS use may have led to premature coronary artery disease in their eighty-six older male participants (34–54 years old) (Baggish et al., 2017). Of interest in this study is that systolic dysfunction was reversible on cessation of AAS use, however, diastolic dysfunction was less reversible. The study also found that atherosclerotic disease was significantly linked to lifetime use of AAS. In a clinical case report, a 41-year-old male was reported as having cardiac failure associated with the use of supraphysiological doses of AAS and other IPEDs and continuing to carry out heavy resistance training after the diagnosis. This resulted in the patient being evaluated for a heart transplant (Ahlgrim & Guglin, 2009). The patient unfortunately died as a result before his follow-up could be carried out.

Hepatotoxicity. Diagnosed liver injury from AAS use was reported in five clinical case reports (Ahmed et al., 2019; Cabb et al., 2016; Ding et al., 2013; Fisler et al., 2018; Patil et al., 2007). Liver injury in an older male who used AAS was reported in one clinical case report, whereby a 46-year-old man experienced nausea, anorexia, and pruritus. Even though he had not been using AAS for at least five months, liver injury was associated with his past history of AAS use (Ding et al., 2013). The patient had been ingesting the oral AAS stanozolol (40 mg) and methandrostenolone (40 mg) daily for two months prior to cessation. Cabb et al. (2016) reported their case, a 45-year-old male who had been consuming Anavar (50 mg orally daily) and injecting testosterone (once a week) for three months and was diagnosed with AAS-induced liver injury. He discontinued AAS after the onset of his symptoms. It is documented that AAS induced hepatotoxicity among older men is related to oral AAS use (Carrasco et al., 1985; Neri et al., 2011). As oral AAS resist immediate degradation in the hepatic system, it takes longer for the liver to clear them, increasing their hepatotoxic potential. Hepatotoxicity of the liver is evident in the form of acute cholestatic syndrome, elevated liver transaminases, hepatic tumours, vascular injury, and fatty liver disease. Most of these can be reversed on cessation of AAS use (Niedfeldt, 2018). People who use AAS orally are an under researched group of older male users who are at risk of non-injecting related harms, particularly liver hepatotoxicity (van de Ven et al., 2020). Attributing hepatotoxicity to AAS use is not always possible due those using AAS not divulging their use to them. Non-disclosure to healthcare professionals may make treatment decisions difficult (Pope et al., 2004; Zahnow et al., 2017).

Other diagnosed health issues. Other health problems diagnosed by medical professionals included acute kidney injury (Colburn et al., 2017; Fisler et al., 2018; Rosenfeld et al., 2011; Shinya et al., 2013), renal infarction (Ilhan et al., 2010) acute respiratory distress syndrome (ARDS) (Shinya et al., 2013), type 2 Diabetes Mellitus diagnosis (Farzam, 2021), cholesterol imbalance (Bonnecaze et al., 2020), acute pancreatitis (Rosenfeld et al., 2011), ischaemic stroke (Long et al., 2019), hypercalcaemia, inflammatory myositis, rhabdomyolysis (Ravindran et al., 2020) and erythrocytosis (Gangadharamurthy et al., 2018).

Experiences of healthcare. Only a small number of included records (n = 3) reported on experiences of healthcare by OMAAS (Harvey et al., 2021; Havnes et al., 2019; Lenehan et al., 1996). There are reports in these studies that those using AAS were reluctant to engage with medical professionals, but those who did seek medical advice were in the

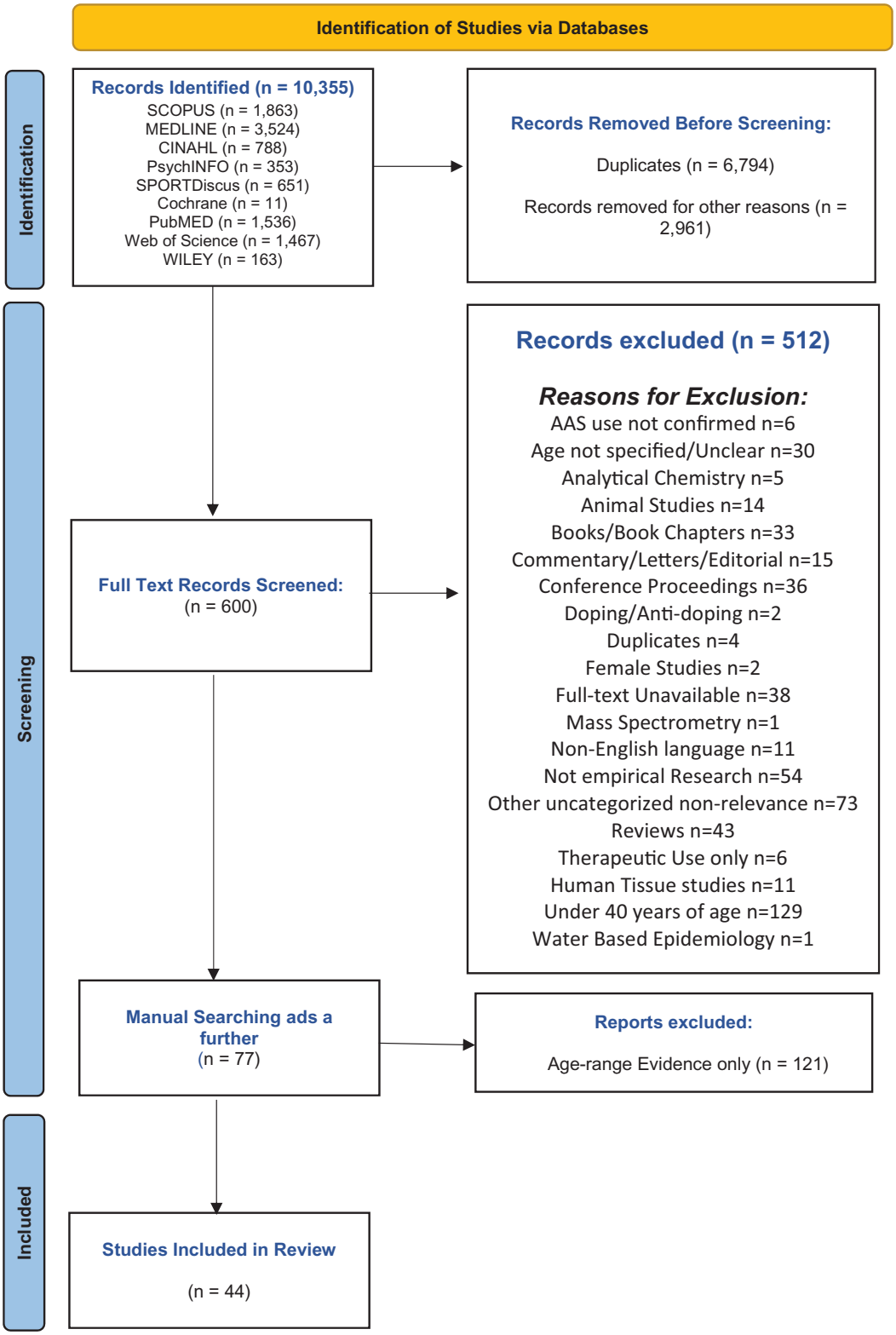

Figure 1. Flow chart of search strategy.

'older' cohort, although specific age was not reported (Zahnow et al., 2017). A Norwegian study reported that older people who use AAS with a longer lifetime of use than their younger counterparts wished to seek treatment for cessation of use Havnes et al. (2019). The reluctance of people who use AAS in general to seek medical professional advice and mistrust in GPs is documented in the literature (Hope et al., 2015; NICE, 2017; Pope et al., 2004). However, Zahnow et al. (2017) did report that concerns regarding sexual function increased the likelihood of those individual's engaging with healthcare. A US participant in the study by Harvey et al. (2021) described feeling dissatisfaction at the lack of empathy from medical professionals toward him, resulting in accessing

support from a private online clinic for AAS-related healthcare.

Discussion

This is the first known mapping exercise to scope the extant literature on the use of AAS by older men (>40). Whilst we closely adhered to the scoping review approach (Arksey & O'Malley, 2005), we wish to note the limitations of the study. First, as studies were restricted to those in the English language, our findings are only generalizable to those in English. Thus, our restriction to the English language may have limited the breadth of the review. Second, of the 165 articles that were initially found indicating the presence of OMAAS, 121 were removed as whilst they had respondents surpassing 40 years of age, they did not distinguish the age-ranges in the text and were therefore not included in our review. Participants in the older age-range within studies included have likely used AAS long-term and who may have begun using AAS in the 1980s, when the widespread use of illicit AAS and IPEDs emerged (McVeigh & Begley, 2017; Pope et al., 2014). Considering the long-term effects of AAS use on liver, cardiovascular, neuroendocrine, and cognitive health (Baggish et al., 2017; Bjørnebekk et al., 2019; Creagh et al., 1988; Kanayama et al., 2013, 2015; Schumacher et al., 1999; Tan & Scally, 2009), future researchers should acknowledge, distinguish, and separately analyse older males who use AAS as they may have specific long-term health effects from use compared to their younger counterparts. The studies included indicating men older than 40 using AAS were from the UK, USA, Canada, Australia, Slovenia, Norway, Spain, Switzerland, Japan, and five global studies. Historically, people who use AAS have been reported as young adults within the 20–29-year age group (Kanayama & Pope, 2018; Lenehan et al., 1996) with research, practice, and policy generally focused on this age-group (ACMD, 2010; NICE, 2017). However recent research has identified different populations of people who use AAS that are not consistent with the stereotypical young male who uses AAS (McVeigh et al., 2021). The global presence of OMAAS within studies in this scoping review highlight the need for age-specific research and recommendations to inform future policy and practice pertaining to this older cohort.

A comprehensive review of the global aetiology and trajectory of AAS use in 2014, reported that most men initiate use before 30 years of age. The authors found in their study age of initiation ranged from 14 to 54 years (Sagoe et al., 2014). However, the current scoping review found increasing numbers of men initiating AAS use later in life ranging as far as 69 years old (Bates & McVeigh, 2016; Begley et al., 2017; Bonnecaze et al., 2020; Cohen et al., 2007; Havnes et al., 2019; Ip et al., 2015; Lenehan et al., 1996).

Of significance in the UK national IPED studies is the increased age of initiation to use over the last decade (Bates & McVeigh, 2016; Begley et al., 2017; Chandler & McVeigh, 2014). It is important to note the different recruitment strategies in these studies which developed over time from those attending gymnasiums (Lenehan et al., 1996) to online forums and NSP clients (Chandler & McVeigh, 2014) and those in community drug/healthcare settings, NSPs, and harm reduction outreach (Bates & McVeigh, 2016; Begley et al., 2017), Thus, there is a possibility that under- or over-recruiting from these groups may have occurred. Whilst we know that there has been a significant increase in the numbers of people using AAS in the UK over the last quarter of a century (McVeigh & Begley, 2017), our scoping review has also indicated an increased age of initiation to use found within the included studies. Whilst the findings are not indicative of a definite trend of increased age of initiation, there are suggestions of a change over the decades.

There is limited research examining what motivates older men to initiate, continue, or restart AAS use following a period of cessation. People who use AAS and IPEDs are a heterogeneous population in terms of their lifestyle and motivations for the use of enhancement substances (Christiansen et al., 2016; Zahnow et al., 2018). However, a commonality among them exists in that improving body image, appearance, and/or performance are often the main drivers for initiating use (Brennan et al., 2017;; Cohen et al., 2007; Evans-Brown et al., 2012). Research illustrates primary motivations for younger males to use AAS to increase muscle size and weight (Antonopoulos & Hall, 2016; Cohen et al., 2007; Hanley Santos & Coomber, 2017; Underwood, 2017; Zahnow et al., 2017) which results in their perceived masculine identity (Cranswick et al., 2020) and feeling as though they have achieved 'male status' (Calogero & Thompson, 2010). Whilst motivations by older males to initiate AAS use in the current study do not differ greatly from young males, the motives for continued or restarting use are significant. The concept of AAS use for wellbeing was considered a primary motivating factor for *continued* use and *restarting* use following a period of cessation by OMAAS in 4 of the 23 studies documenting motivations (Bonnecaze et al., 2020; Harvey et al., 2021; Ip et al., 2015; Kimergard, 2015).

Wellbeing is associated with possessing and exercising specific human capabilities pertaining to human functioning and without these, an individual may feel they are not experiencing dignified and fulfilling lives (Nussbaum, 2011; Seligman, 2011; Sen, 1993). Enhanced wellbeing was associated with emotional happiness resulting from sexual function (Harvey et al., 2021) and feelings of youthfulness (Christiansen et al., 2016; Harvey et al., 2021; Ip et al., 2015; Kimergard, 2015; Rashid, 2000). In the case of the OMAAS here, continued use of AAS was likely a method to uphold their male status through their enhanced muscular physique (Calogero & Thompson, 2010) and ability to perform sexually later in life (Potts, 2000).

In contrast, participants of studies included in this review associated poor QoL with dysphoric feelings resulting from low testosterone such as low mood, decreased libido, and sexual dysfunction on cessation of AAS use (Harvey et al., 2021; Ip et al., 2015; Rashid, 2000). These were also the most self-reported adverse effect from AAS use (Boregowda et al., 2011; Harvey et al., 2021; Kovac et al., 2015). Western discourse on male sexuality indicates that the healthy functioning man must be capable of producing erections thus providing sexual satisfaction to his partner (Potts et al., 2004)

and loss of erectile function is often correlated with loss of masculinity or manhood (Potts, 2000). This is in part a response to the increase in biomedical enhancements and pharmaceuticals for erectile dysfunction over the last decade aimed at older or ageing men (Potts et al., 2006). Furthermore, inability to perform sexually, particularly as older men experience lowered testosterone levels is part of the natural ageing process (Bhasin et al., 2006) and may result in emotional, psychological, and social distress for a man (Potts et al., 2006), thus affecting his sense of wellbeing. Literature has underscored the likelihood that individuals who value traditional male gender roles and masculine values are likely to use AAS (Kanayama et al., 2006; Keane, 2005) allowing them to uphold a socially acceptable masculine status (Connell, 1995; Courtenay, 2000; Kimmel et al., 2005). Of interest is that the older male participants' perceived wellbeing could be considered as situated within traditional hegemonic masculine values concerned with desirability, libido and sexual function (Connell, 1995; Connell & Messerschmidt, 2005). Literature documents that men feel an internal need and intense pressure to have sex and to perform the stereotypical male sex-role (Kimmel et al., 2005). Not having the ability to perform this role can result in poor mental wellbeing and QoL (Courtenay, 2000). Our review indicates that motivations for initiating AAS use for aesthetics and performance enhancement differ in the older man who is using later in life for sexual function, desirability, and wellbeing (Christiansen et al., 2016; Harvey et al., 2021; Ip et al., 2015). This suggests that older men who continue to use AAS for this reason may be doing so to sustain their previously achieved 'male status,' embodied by their ability to continue to perform sexually. Our review has underscored the issue of older males who rarely seek medical or professional advice pertaining to their use of AAS. This is due to mistrust and lack of confidence in the knowledge of the primary care physician, feeling stigmatised because of their choice to use AAS (Bonnecaze et al., 2020; Zahnow et al., 2017) and their capability to self-manage their use (Harvey et al., 2021). Moreover, it is reported that men who hold or conform to strong masculine values are often reluctant to engage with healthcare (Courtenay, 2000). This has significance for healthcare practitioners who are urged to consider the wider spectrum of wellbeing to include PERMA (positive emotion, engagement, relationships, meaningful activities and accomplishment) (Seligman, 2011) in all areas of their lives, and how this impacts on male self-image, and the stereotypical masculine identity (Connell, 1995; Courtenay, 2000; Kimmel et al., 2005).

Research has identified an AAS dependence syndrome whereby they are used for prolonged periods of time despite negative effects on physical and psychological well-being (Kanayama et al., 2008, 2009; Pope et al., 2014). It is difficult to determine though if they are being used to restore an individual to a normal baseline gonadal state, or, to surpass the normal baseline and achieve specific outcomes (Anawalt, 2019). More recently, researchers have demonstrated structural brain differences between AAS dependent and non-dependent people, specifically a thinner prefrontal cortex in those who are dependent. The prefrontal cortex is associated with inhibitory control and emotional regulation, indicating why some people who use AAS become dependent (Hauger, Westlye, Fjell, Walhovd, & Bjørnebekk et al., 2019). The literature documents that AAS are used in supraphysiologic doses to enhance muscularity (Anawalt, 2019; Kaufman et al., 2019) as without doing this, muscle mass at the level they desire cannot be gained (Bhasin et al., 1996). It is approximated that up to 30% of those who use AAS in supraphysiological doses for extended periods of time may become dependent (Kanayama et al., 2009; Pope et al., 2014). A complication of this pattern of use often means that natural hormone function cannot recover and may result in anabolic steroid induced hypogonadism (ASIH) on cessation of use (Tan & Scally, 2009). In some cases, there is no possibility for recovery of HPT function and fertility in older males who employ this method (Pope et al., 2014) resulting in continued AAS use. Self-reported dependence was noted (Havnes et al., 2019; Ip et al., 2015) and unsuccessful attempts at cessation were documented in some studies in the current review (Bonnecaze et al., 2020; Fisler et al., 2018; Rashid, 2000). Continued use or unsuccessful attempts at cessation may be an indication of the 'neuroendocrine pathway' for AAS dependence (Kanayama et al., 2020). Whilst AAS are not used for psychoactive effects like traditional illicit substances (Bates et al., 2019), their continued use to negate the symptoms of low testosterone certainly mimic traditional illicit drug seeking behaviours. These negative feelings are symptoms of AAS withdrawal hypogonadism which potentiates the need to self-treat with AAS, thus resulting in dependence (Kanayama et al., 2020). Furthermore, the OMAAS' change in patterns of use from cycling to blast and cruise/prolonged use to improve overall wellbeing and QoL is indicative of psychological dependency, compounded by the fact than men are often unwilling to seek treatment for mental health issues such as depression (Courtenay, 2000). Other records which reported that participants simply did not perceive themselves as dependent, and that their AAS use is part of a healthy regime and a valued lifestyle (Cohen et al., 2007; Kimergard, 2015). The non-disclosure of AAS use to primary care physicians (Harvey et al., 2021; Pope et al., 2004; Zahnow et al., 2017), compounds this issue further and may result in inappropriate or lack of medical interventions and treatment. This results in the older man continuing to use AAS whilst also having undiagnosed and untreated AAS dependence syndrome.

Adverse health effects related to the use of AAS are well established in the literature, particularly the comprehensive review published in 2014 by the Endocrine Society (Pope et al., 2014). Physical harms outlined in their report include cardiovascular and liver harms, as well as psychological issues and dependence which have been identified in many of the studies included in our review. Cardiovascular harms diagnosed by medical professionals were more frequently reported in the current review than harms to other organ systems (Ahlgrim & Guglin, 2009; Ahmed et al., 2019; Baggish et al., 2017; Bonnecaze et al., 2020; Farzam, 2021; Flo et al., 2018; Graham et al., 2006; Ilhan et al., 2010; Ip et al., 2015; Lovelock et al., 2021; Ravindran et al., 2020; Rothman et al., 2011; Shinya et al., 2013; Tashiro et al., 2021).

Supraphysiological doses of AAS can adversely affect other organ systems such as endocrine, and neurological systems, requiring medical intervention (Kanayama et al., 2008). It is important to also consider that OMAAS may be entering the period of natural age-related increased risk for cardiovascular health problems, an aging myocardium, combined with a history or current AAS use may be at even higher risk for cardiovascular health issues (Kanayama et al., 2008; Thiblin et al., 2015). Of interest, is that cardiovascular harms reported such as left ventricular hypertrophy (Farzam, 2021), dyslipidaemia (Bonnecaze et al., 2020), coronary atherosclerosis (Baggish et al., 2017) and hypertension (Bonnecaze et al., 2020; Farzam, 2021) are mostly diagnosed in sedentary or obese populations (McCullough et al., 2021) and not among people who use AAS that consider their AAS use part of a health regime and a valued lifestyle (Cohen et al., 2007; Kimergard, 2015). As the long-term effects of AAS use cause damage not only to cardiovascular health (Baggish et al., 2017), but also to the liver (Creagh et al., 1988; Schumacher et al., 1999), neuroendocrine health (Kanayama et al., 2015; Tan & Scally, 2009) and cognitive decline (Bjørnebekk et al., 2019; Kanayama et al., 2013) as highlighted in our review, the intervention and treatment needs of an older man who is using AAS will require a multi-disciplinary approach including physicians, endocrinologists, psychologists and psychiatrists, and addiction specialist practitioners (Casavant & Griffith, 2017).

Conclusion

This unique scoping review has mapped and described for the first time what is known about the use of AAS among older men. Increased age of initiation and an ageing cohort of people who user AAS and who are motivated by feelings of wellbeing and youthfulness was observed. This is embodied by their ability to perform sexually and to have a good quality of life which they achieve by using AAS, despite the harms of use experienced. The use of AAS by older males coupled with the natural ageing decline in testosterone and the possibility for cardiovascular ill-health later in life, is a concern for healthcare and medical professionals. Future research, qualitatively exploring the motivations of older men to initiate, continue, and recommence AAS use following a period of cessation, will aid in the development of effective interventions, treatment, and harm reduction specific to their needs and can also inform AAS specific training for medical and healthcare professionals. Moreover, it is recommended that researchers acknowledge, distinguish, and separately analyse older males in future studies so as to age-appropriately inform healthcare, policy, and practice. By integrating gender perspectives into healthcare, may result in increased numbers of men seeking treatment for sexual dysfunction resulting from AAS use as well as other healthcare specific to their needs thus improving their wellbeing and QoL. Policymakers are urged to consider the findings of this review and consider the different needs this age-group have so that informed healthcare and policy decisions can be made in the future.

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