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

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ABSTRACT

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

Design Systematic review and meta-analysis.

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

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

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

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

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

PROSPERO registration number CRD42020177919.

STRENGTHS AND LIMITATIONS OF THIS STUDY

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

INTRODUCTION

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

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

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

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

METHODS

Overview

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

Search strategy and selection criteria

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

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

Risk of bias assessment

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

Table 1 Inclusion and exclusion criteria

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

AAS, androgenic-anabolic steroids.

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

Data synthesis

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

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

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

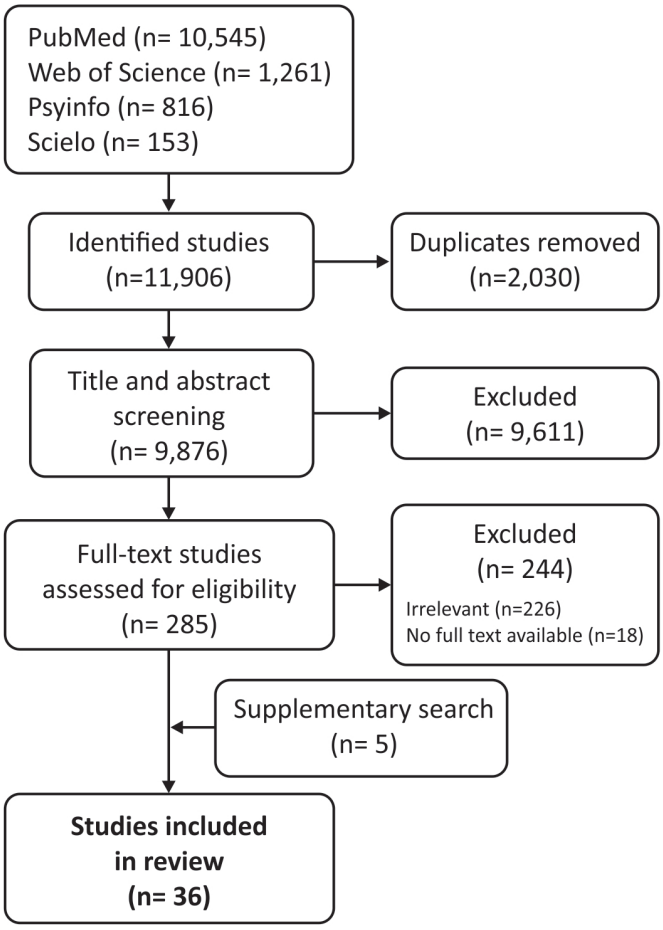

Figure 1 Flow chart of the inclusion of studies in the review.

Patient and public involvement

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

RESULTS

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

Table 2 Summary characteristics of selected studies

Authors, year	Location	Subpopulation	n	nAAS	nPhys n (%)
Yesalis *et al*[75] 1988	USA	Strength athletes	45	15 M	8 (53.33)
Johnson *et al*[76] 1989	USA	Adolescents	853	95 M	28 (29.47)
Kisling *et al*[77] 1989	Denmark	Non-specific	157	85 M	21 (24.71)
Lindström *et al*[78] 1990	Sweden	Strength athletes	138	138 M	12 (8.70)
Terney and McLain[67] 1990	USA	Adolescents	2113	94 (67 M/27 F)	5 (5.32)
Tanner *et al*[68] 1995	USA	Adolescents	6930	184 (139 M/45 F)	33 (17.93)
Korkia and Stimson[79] 1997	UK	Non-specific	1667	110 (97 M/13 F)	39 (35.45)
Bolding *et al*[80] 1999	UK	Non-specific	1004	81 M	25 (30.86)
Augé and Augé [43] 1999	USA	Strength athletes	17	17 (14 M/3 F)	8 (47.05)
Peters *et al*[81] 1999	Australia	Non-specific	100	100 (94 M/6 F)	42 (42.00)
Perry *et al*[82] 2005	USA	Strength athletes	207	207*	46 (22.22)
Parkinson and Evans[83] 2005	Trans-region	Non-specific	500	500 (494 M/6 F)	185 (37.00)
Pope *et al*[7] 2004	USA	Strength athletes	80	43 M	16 (37.21)
Striegel *et al*[56] 2006	Germany	Non-specific	621	84 (75 M/9 F)	47 (55.95)
Cohen *et al*[84] 2007	USA	Non-specific	1955	1955 M	1290 (65.98)
Al-Falasi *et al*[85] 2008	UAE	Non-specific	154	34 M	4 (11.76)
Larance *et al*[86] 2008	Australia	Non-specific	60	60 M	46 (76.66)
Posiadała *et al*[57] 2010	Poland	Non-specific	50	18 M	2 (11.11)
Gradidge *et al*[87] 2011	South Africa	Adolescents	100	4 M	1 (25.00)
Ip *et al*[88] 2011	Trans-region	Non-specific	1277	506 M	387 (76.48)
Santos *et al*[89] 2011	Brazil	Strength athletes	123	41 M	4 (9.76)
Hope *et al*[23] 2013	UK	NSP clients	395	395 M	178 (45.06)
Raschka *et al*[55] 2013	Germany	Non-specific	484	79 (62 M/ 17 F)	30 (37.97)
Rowe *et al*[62] 2016	Australia	NSP clients	605	605 M	382 (63.14)
Westerman *et al*[90] 2016	Transregion	Non-specific	231	231 M	153 (66.23)
Mooney *et al*[91] 2017	UK	Non-specific	377	26*	1 (3.85)
Zahnow *et al*[19] 2017	Transregion	Non-specific	195	195*	68 (34.87)
Althobiti *et al*[92] 2018	Saudi Arabia	Non-specific	4860	476 M	181 (38.00)
Hill and Waring[13] 2019	UK	Strength athletes	350	216*	91 (42.00)
Jacka *et al*[41] 2019	Australia	Non-specific	267	267 M	237 (88.76)
Macedo *et al*[93] 2019	Brazil	Non-specific	40	25 M	9 (36.00)
Pany *et al*[94] 2019	India	Strength athletes	74	74 M	24 (32.43)
Pereira *et al*[95] 2019	Brazil	Non-specific	719	194 (149 M/45 F)	117 (60.31)
Uddin *et al*[40] 2019	Pakistan	Non-specific	841	512 M	9 (1.76)
Bonnecaze *et al*[72] 2020	Transregion	Non-specific	2385	2385 M	1047 (43.90)
Jokipalo and Khudayarov[96] 2021	Finland	Strength athletes	50	50 (42 M/8 F)	15 (30.0)

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

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

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

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

Risk of bias

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

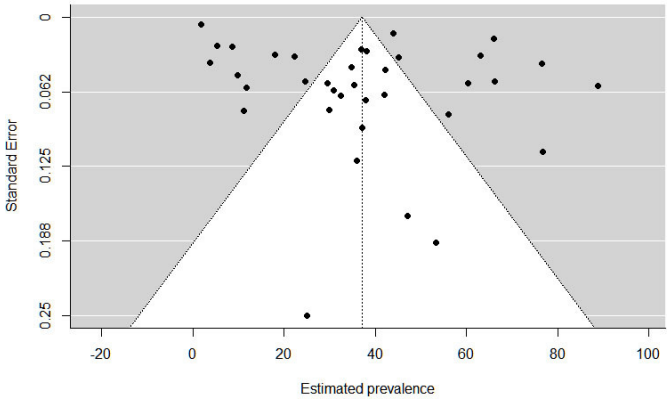

Figure 2 Funnel plot of studies included in the analysis with pseudo 95% CI.

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

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

Meta-analysis of prevalence rates of studies grouped by location

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

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

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

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

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

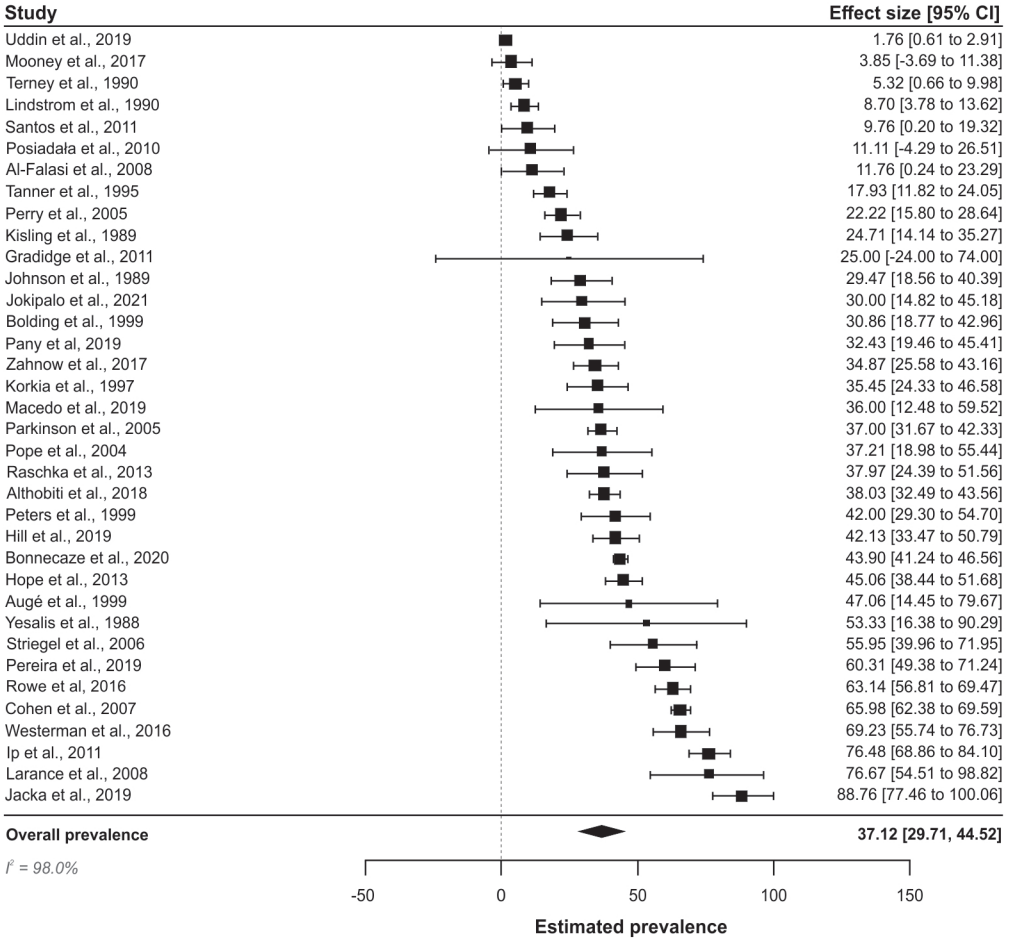

Figure 3 Forest plot of the pooled prevalence of AAS users seeking support from physicians. AAS, androgenic-anabolic steroids.

DISCUSSION

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

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

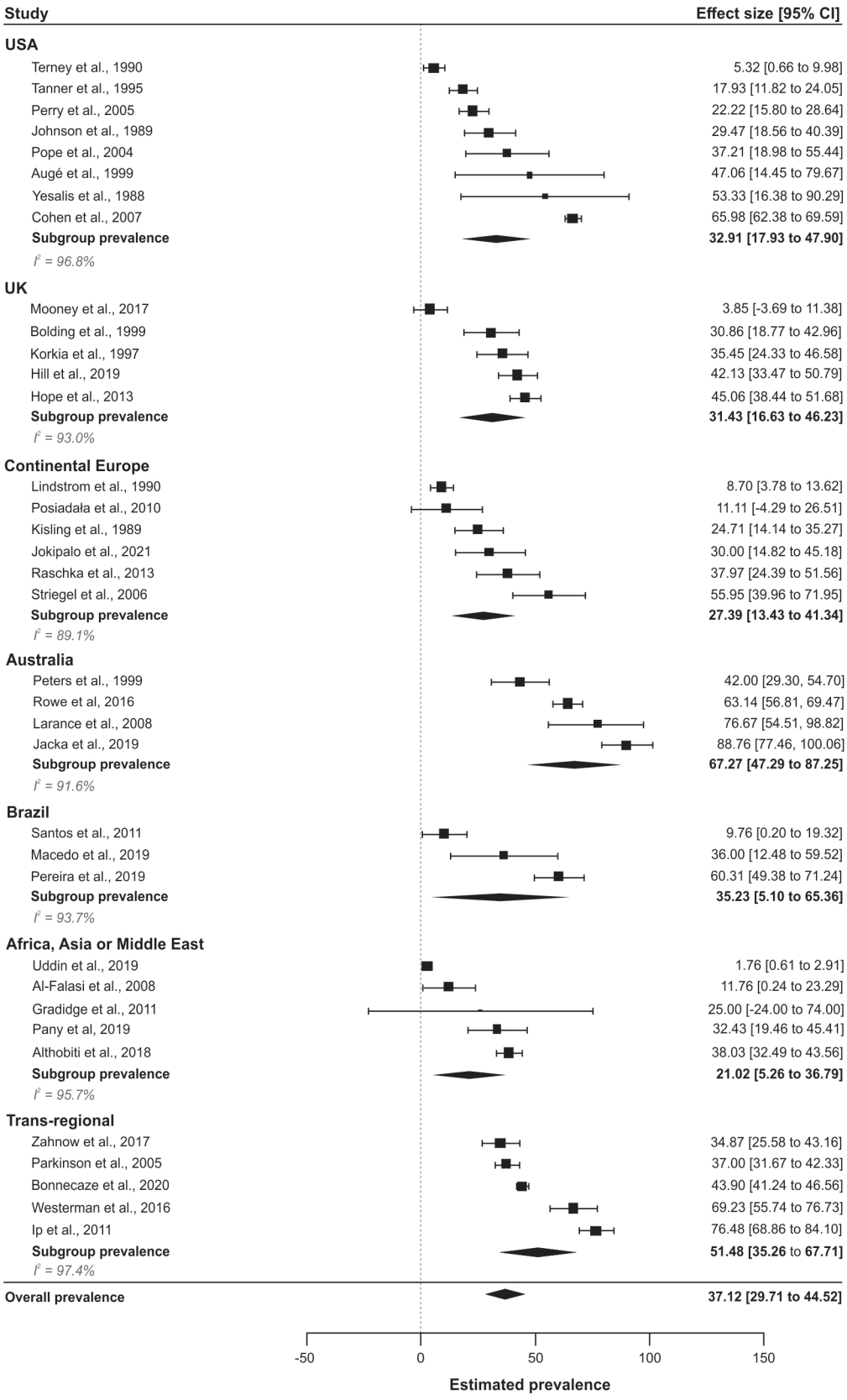

Figure 4 Forest plot of prevalence rates of studies, grouped by location.

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

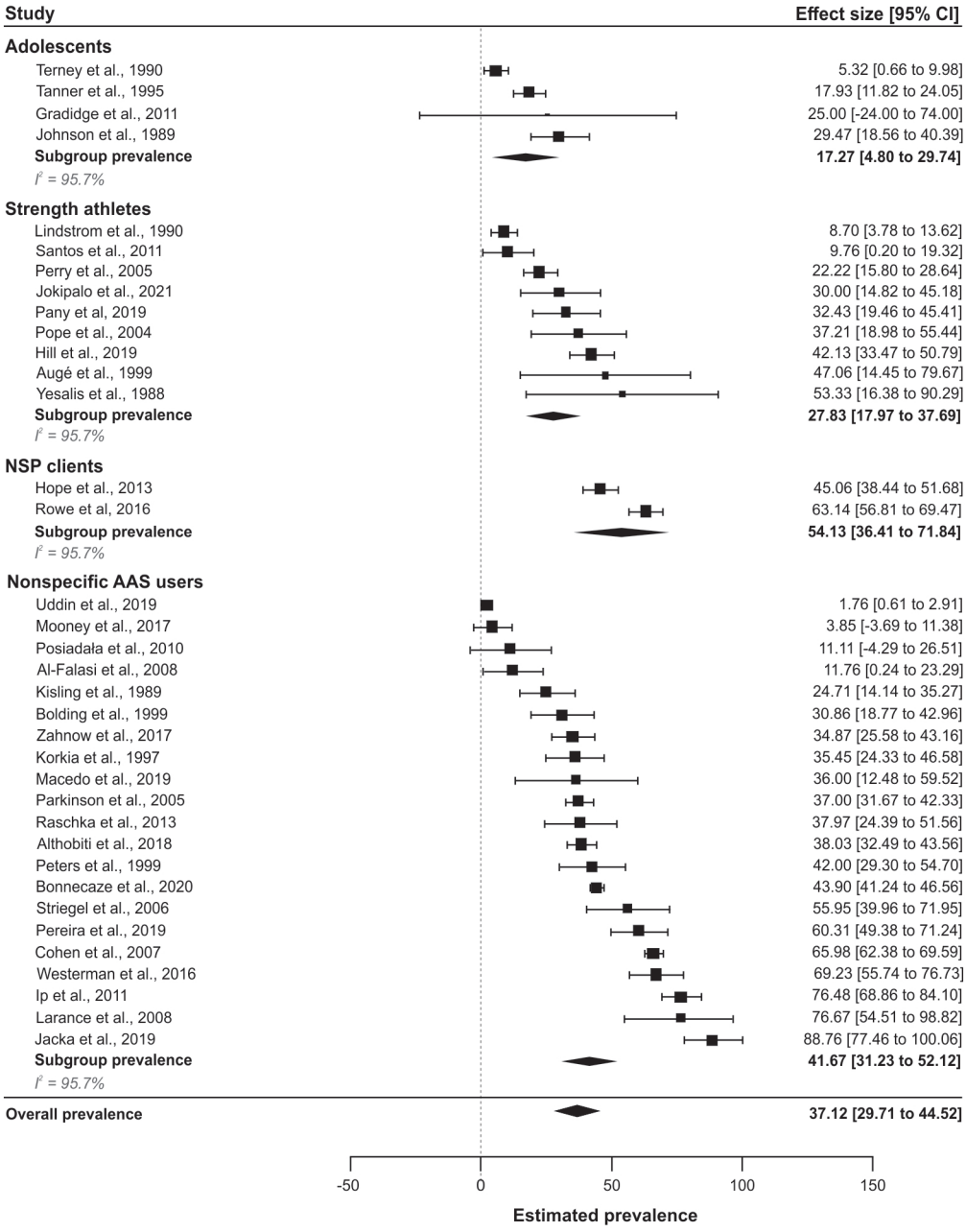

Figure 5 Forest plot of prevalence rates of studies, grouped by subpopulation of AAS users. AAS, androgenic-anabolic steroids; NSP, needle and syringe exchange programme

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

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

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

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

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

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

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

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

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

Regarding the kind of support sought by AAS users from physicians among the 36 selected studies, 16 (44.44%) reported that AAS users sought physicians as a source of information about the use and adverse effects of AAS. The remaining studies described AAS users' contact with physicians in many different ways, such as having close contact with physicians,[56] seeking a doctor for interpretation of health checks,[13] and disclosing the use of AAS to a physician.[7 72] We considered that further exploration of the types of support sought by AAS users would lie beyond the scope of this study, as they have been recently investigated by other reviews.[17 73 74]

Limitations of this study

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

Implications for practice and policy

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

CONCLUSION

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

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