Title: An evidence-based socioecological framework to understand men's use of anabolic androgenic steroids and inform interventions in this area.

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Abbreviated title: A sociological framework to understand men's use of anabolic steroids

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Abstract

Research into men's use of anabolic androgenic steroids (AAS) over the past three decades has identified many factors that contribute to decision making in this area. However there are limited theoretical frameworks to synthesize this research and guide practice, such as interventions to prevent use or reduce health risks. To address this gap a socioecological framework is presented based upon the international literature examining AAS use. Socioecological models recognize that individuals and behaviors exist within complex physical and social systems and are useful tools for guiding interventions to ensure consideration is given to multiple influential factors. This framework proposes that use of AAS is the result of the interaction of a range of factors at the individual, social network, institutional, community and societal levels that are likely to change over time and with experience. Viewed through this framework it becomes clear that AAS use can be a complex behavior with many influential environments and relationships impacting on a diverse population in different ways and at different times. The implications of findings for engaging with people who use AAS and delivering interventions are discussed, such as the identification of important transition times and influencing norms within social groups and communities.

Keywords: anabolic androgenic steroids; performing enhancing drugs; socioecological framework; drug education and prevention; decision making

Word count: 4,691

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Introduction

Anabolic androgenic steroids

Anabolic androgenic steroids (AAS) are the most prominent of a range of substances used to modify appearance and performance. Global prevalence has been estimated at 6.4% amongst males (Sagoe, Molde, Andreassen, Torsheim, & Pallesen, 2014) with use increasingly common outside of sporting environments (McVeigh & Begley, 2016; Pope, Kanayama, et al., 2014; Sagoe, Molde, et al., 2014). Although AAS can be used without harmful consequences in clinical settings, far greater doses are observed outside these environments (Pope, Kanayama, et al., 2014) where the quality of substances purchased cannot be controlled. Evidence increasingly suggests that this use is associated with a wide range of acute and chronic adverse health consequences (Pope, Wood, et al., 2014) and consequently interventions are required to reduce harmful use of AAS and improve health outcomes for those using them.

The socioecological model

In order to understand a behavior it is important to recognise that it does not exist in isolation, but is part of a wider system of intra- and inter-personal beliefs, behaviors, contexts and cultures (Michie, Atkins, & West, 2014). Like many other theories of behavior the socioecological model recognizes the influence of personal characteristics and immediate social influences, but also emphasizes the role of wider physical, social and cultural factors. The socioecological model places individuals within complex physical and social systems and suggests that health and behavior are a consequence of interactions between these individuals and their immediate and distal environments and experiences (Bronfenbrenner, 1986; Stokols,

1992). This is important because to develop effective interventions researchers should consider both individuals and the complex systems and environments in which they operate, and the interactions that occur between them (Sniehotta et al., 2017). The socioecological framework suggests interventions need to address multiple levels in order to achieve sustained behavior change (Sallis & Owen, 2015). However, it appears that behavioral interventions have tended to focus solely on individual and intrapersonal factors and rarely sought to influence community, institutional and societal level factors (Golden & Earp, 2012) which has also been identified with AAS interventions (Bates et al., 2017).

Aim and purpose

A body of evidence has been developed over the past three decades pointing towards a variety of factors that influence choices relating to AAS use amongst different groups and in different environments. Together these studies have highlighted the variability amongst people who use AAS, but there are a lack of frameworks bringing this evidence together to stimulate and guide interventions. This work attempts to address this by bringing together quantitative and qualitative research examining experiences and beliefs about AAS to present AAS use through a socioecological framework. Frameworks of this nature have been successfully applied to understand and guide policy relating to a variety of behaviors such as violence (Smith Slep, Foran, & Heyman, 2014), physical activity (Elder et al., 2007) and smoking (Corbett, 2001) where, as with AAS, decisions may be effected by factors at different levels. Discussing the different influences on AAS use and how these influences interact to effect decision making in one framework will support the development and implementation of interventions, such as those that aim to prevent or reduce use of AAS or to improve health outcomes and healthy behaviors amongst users.

Methods and approach

Researchers have sought to increase understanding on AAS use over the past three decades. Recently, three systematic reviews of the literature (Brennan, Wells, & Van Hout, 2016; Nicholls et al., 2017; Sagoe, Andreassen, & Pallesen, 2014) have identified the motivating and risk factors for AAS use within this literature. This article builds upon this work by bringing together the evidence identified on AAS decision making within these three reviews, alongside additional studies within this evidence base, into one framework.

Articles included within these three reviews were examined to identify factors that influenced AAS decision-making. Evidence from studies of all methodological designs were eligible to be included within the framework. This included studies predominantly based upon interviews and surveys that focused on any population or setting (such as, but not restricted to bodybuilders, gym members, elite or non-elite athletes, prisoners, young people) and considered AAS use in any non-medical context. The reference lists of studies included within the three reviews were reviewed to identify additional relevant studies and citation searching was carried out to identify newer articles not included within these reviews.

Identified articles were reviewed and where study findings related to causes or influences on AAS use, including those relating to initiation, continuation and cessation, these were extracted. These factors were grouped together thematically and then organized using a socioecological framework. The framework, presented in figure 1, presents use of AAS as the result of the interaction between an individual's biological and demographic characteristics, beliefs and experiences; the norms, attitudes and pressures in their social networks and relationships; the institutions and environments where these social relationships occur; the characteristics of the communities they experience; and the norms and policies of the wider society these influences exist within. Relevant theoretical concepts and evidence from outside

the AAS evidence base was brought into the discussion of the framework alongside the evidence identified in this study to provide context to findings within each layer of the framework.

[Figure 1 here]

Findings: Levels within the framework

The factors identified as influencing AAS use are presented here through the levels in the framework. The originator of the theory of ecological systems, Urie Bronfenbrenner, updated his model to include what he termed the chronosystem to allow for the influences of time and environments that individuals experience at different points in their life (Bronfenbrenner, 1986). To understand AAS use it must be accepted that individuals will move in and out of different leisure environments, workplaces, social networks and communities over their lifetime. At many important transition points in their life (e.g., starting a career, entering higher education), individuals will be exposed to new influences in new settings and these can all effect their decision-making. Therefore, within each level in the framework the impact of time and experiences is recognized.

Individual level

Prevention interventions for AAS have typically focused on changing individual level factors (Bates et al., 2017) and evidence suggests that attitudes, beliefs and personal traits do contribute to decisions about AAS use. Recent work has sought to develop a typology of male AAS users based around their individual characteristics (Christiansen, Vinther, & Liokaftos, 2016). The typology includes four ideal types, but recognizes that there is much further variation in characteristics and approaches to AAS use. Beliefs about appearance and AAS (Bloodworth, Petroczi, Bailey, Pearce, & McNamee, 2012; Judge et al., 2012; Lucidi et al., 2008) and their

use by others (Woolf, Rimal, & Sripad, 2014) have been identified as important and attitudes are likely to be reinforced or changed through personal experience over time. It is commonly identified that individuals may initiate use of AAS to overcome perceived genetic physical limitations (Grogan, Shepherd, Evans, Wright, & Hunter, 2006; Hanley Santos & Coomber, 2017; Kimergård, 2014; Van Hout & Kean, 2015). This suggests that biological factors such as muscularity and body shape that can be achieved through natural and chemical means, as well as the body's response to AAS, will influence decision-making. It has also been suggested that some individuals may be more susceptible to AAS dependence due to biological characteristics. For example, variations relating to the neuroendocrine system and neurotransmitter mechanisms may increase or reduce vulnerability to severe withdrawal symptoms following cessation of AAS (Kanayama, Brower, Wood, Hudson, & Pope, 2009). Certain demographic factors have also been associated with AAS. Use is more prominent amongst males, and while initiation occurs within a wide age range it is most likely before age 30 (Sagoe, Andreassen, et al., 2014).

Factors such as high drive for muscularity or muscle dysmorphia (Jampel, Murray, Griffiths, & Blashill, 2016; Zelli, Lucidi, & Mallia, 2010), holding masculine values (Keane, 2005), valuing traditional male roles (Kanayama, Barry, Hudson, & Pope, 2006) and low levels of self-esteem (Blank, Schobersberger, Leichtfried, & Duschek, 2016; Nicholls et al., 2014) have been associated with increased likelihood of AAS use. Other personal factors identified include a history of abuse or bullying (Dennington, Dillon, Finney Lamb, & Larance, 2008; Petrocelli, Oberweis, & Petrocelli, 2008), the tendency for risk taking behaviors (DuRant, Escobedo, & Heath, 1995; Pedersen & Wichstrøm, 2001) and moral disengagement (Judge et al., 2012; Mallia et al., 2016). The SE framework recognizes the significance of these individual level factors, but suggests that they become more important in, and can be influenced by, certain environmental and social contexts.

Social network level

The evidence points towards the importance on AAS use of relationships and social networks in many different environments. Mixing with others who use AAS can be influential through normalizing and providing access to AAS (Boardley & Grix, 2014; Dennington et al., 2008; Maycock & Howat, 2005), and facilitating the diffusion of information (Grogan et al., 2006; Kimergård, 2014; Maycock & Howat, 2005). Similarly, the increased acceptability of, and positive attitudes towards, AAS by significant others (Lucidi et al., 2008; Zelli, Mallia, & Lucidi, 2010), and, for athletes in their support team such as coaches, trainers and medical staff (Hoffman et al., 2008; Madigan, Stoeber, & Passfield, 2016; Nicholls et al., 2014; Stilger & Yesalis, 1999) are likely to impact on use. Pressure from peers (Midgley, Heather, & Davies, 1999; Wroble, Gray, & Rodrigo, 2002) as well as perceived pressure to use AAS in order to compete with peers who are already doing so may also encourage uptake and continued use (Canadian Centre for Ethics in Sport, 1992; Grogan et al., 2006; Olrich & Ewing, 1999; Petrocelli et al., 2008).

A substantial body of evidence points towards the importance of the social benefits from AAS use as contributing towards behavior. The desire to fit in and gain approval is likely therefore to be important in initiation, while positive reinforcement and a sense of belonging may drive continued use. Work exploring the experiences of individuals who use AAS has consistently identified social recognition and peer approval as important benefits from the physique gains achieved with the help of AAS (Dennington et al., 2008; Hanley Santos & Coomber, 2017; Kimergård, 2014; Olrich, 1999; Olrich & Ewing, 1999; Petrocelli et al., 2008; Ravn & Coffey, 2016). Researchers have documented the importance of socialization associated with AAS use amongst groups such as body builders (Maycock & Howat, 2005, 2007) and doormen (Monaghan, 2003). The influence of others from networks of AAS users extends beyond their

substance use into lifestyle and behavior (Fussell, 1991; Maycock & Howat, 2007). Additionally, in an AAS culture a shared perception of safety regarding risky practices may support increased risk taking in these environments (Kimergård & McVeigh, 2014a). Comparisons can be made with the 'risk environments' theorized for other groups who use drugs where belonging to a group with similar values and beliefs helps rationalize risk and make it acceptable (Rhodes, 1997, 2009).

The association between AAS use and enhanced social status and belonging has also been identified in online communities (Smith & Stewart, 2012). The growth of the internet has increased the amount of information available on AS, which may enhance feelings of capability and safety amongst users (Kimergård, 2014) and make available information that previously would have been predominantly transferred within sub cultures. Online forums are popular amongst many AAS users and facilitate the sharing of experiences and information (Smith & Stewart, 2012). Further, AAS are easily purchased online from a number of websites (McBride, Carson, & Coward, 2016).

Institutional level

Social environments and organisations are settings where important information is disseminated, interactions occur and relationships develop that are particularly influential to AAS use. Participation in competitive or non-competitive weight training and sports where strength and physique are important are risk factors (Nicholls et al., 2017) and gym and sporting environments are perhaps most frequently discussed in relation to AAS. Where use is common, the acceptability (Boardley & Grix, 2014; Dennington et al., 2008) and normalization (Boardley & Grix, 2014; Dennington et al., 2008; Grogan et al., 2006; Hanley Santos & Coomber, 2017) of AAS in that environment appears to facilitate use in others and provides access to suppliers and information providers. Environments and institutions where AAS use

is seen as normal, acceptable (by both users and non-users) and beneficial may be conducive to initiating and continuing use. Individuals who otherwise would not have considered using AAS, for example a young person entering a gym or competitive sporting environment may find peers having a significant impact upon their AAS decision making.

'Normalization' effects have also been identified in the workplace (Hanley Santos & Coomber, 2017). The occupational use of AAS has been discussed relating to professions such as police officers (Hoberman, 2015, 2017; Turvey & Crowder, 2015), doormen (Maycock, 1999; Maycock & Howat, 2007; Midgley, Heather, & Davies, 2001; Monaghan, 2003) and army personnel (Hoberman, 2017). This may help to achieve the strength and size perceived to be important for dealing with risky scenarios and to achieve the physique expected by employers and colleagues. Similarly, in prison environments prisoners may feel that projecting strength is important for reasons of safety, with this population identified as one of the most 'at risk' groups for using AAS (Sagoe, Molde, et al., 2014). Within certain environments the perceived benefits from AAS may outweigh any perceived risks in a way that might not occur outside of that context.

Community level

Individuals and institutions should be considered within the context of the communities they exist within. Cohen and colleagues (D. A. Cohen, Scribner, & Farley, 2000) identified four categories of structural factors within communities that influence health behaviors including i) the availability of consumer products, ii) physical structures, iii) social structures and iv) cultural messages. According to Cohen's model, the enforcement of policies and laws, access to environments and institutions conducive to or accepting of AAS, community norms about and prevalence of AAS and access to healthcare services impact upon AAS behaviors of the local population.

Access to and prevalence of environments such as those discussed in the institutional level will vary between communities. Examples may include the increased prevalence of hard-core bodybuilding gyms or manual occupations in more deprived or working class areas. Further, manual occupations have been linked with masculine and physical cultures and traditional male roles (Dolan, 2011; Nixon, 2009). These masculine values are evident at the community level and can be reinforced amongst boys from an early age (Evans, Frank, Oliffe, & Gregory, 2011) and in more working class communities may particularly be associated with toughness and success (Dolan, 2011). The relationship between AAS and socioeconomic status is not straightforward, however: Individuals who use AAS are more likely to be employed than those who use other illicit drugs and rates of educational achievement, employment and income amongst AAS using populations have been demonstrated to be comparable or better than average (J. Cohen, Collins, Darkes, & Gwartney, 2007; Westerman et al., 2016). Purchasing AAS along with nutritional supplements and other substances often used concurrently to further enhance physique or manage AAS side effects (Sagoe et al., 2015) for long periods of time, along with additional costs such as gym membership and equipment, indicates that a commitment to the bodybuilding lifestyle can be expensive.

The availability of appropriate healthcare services and the level of engagement between health professionals and the local population of AAS users will influence health seeking behaviors, information provision and treatment opportunities. In countries such as the UK and Australia needle and syringe programmes are a common source of injecting equipment (Dunn, Henshaw, & McKay, 2016; Kimergård & McVeigh, 2014b) and with AAS associated with a range of acute and chronic adverse effects (including those associated with needle sharing) healthcare is important. However many users may be reluctant to engage with healthcare services (Zahnow, McVeigh, Ferris, & Winstock, 2017) and report concerns about stigma, knowledge and attitudes of health professionals that may reduce contact (Dunn et al., 2016). Men with

strong masculine values may be reluctant to engage with the health care system (Courtenay, 2000; Springer & Mouzon, 2011). Further, where healthcare coverage is inadequate this can have adverse health effects for AAS users (Griffiths, Henshaw, McKay, & Dunn, 2017).

Societal level

At this final level factors are included that together generate the societies that AAS users exist within, and promotes norms and expectations regarding body image, gender stereotypes and AAS use. These concepts have been explored extensively by Harrison Pope and colleagues. They suggest that increases in body insecurity and desire to increase muscularity amongst males in many parts of the world over the past decades reflect Western societal expectations regarding the male physique and unrealistic body ideals that AAS may help to reach towards (Pope, Phillips, & Olivardia, 2000). Pope suggests this is reflected in portrayals of strong men, such as the increasingly muscular physiques of male action heroes and children's toys. Research with men who use AAS has suggested that some were influenced by images and portrayals of AAS and muscular physiques in media such as men's and fitness magazines (Dennington et al., 2008) and social media (Van Hout & Kean, 2015) and AAS prevalence is higher worldwide in regions where muscularity is associated with masculine values (Sagoe 2014). It is clear however that most men who are exposed to such images and ideals will not go on to use AAS and it is important to consider why these portrayals resonate with some individuals but not with others. This may reflect the interacting influences of other factors explored in this framework such as values and beliefs regarding muscularity, masculinity and AAS inherent in communities and individuals.

The role of media and cultural influences may be in promoting muscular and lean body ideals, rather than explicitly AAS, and different forms of media exposure have been associated with attitudes and expectations relating to muscularity and body dissatisfaction. For example,

exposure to increasingly muscular and lean images of male characters in video games has been linked to body and muscle dissatisfaction and more muscular body ideals (Agliata & Tantleff-Dunn, 2004; Barlett, Vowels, & Saucier, 2008; Harrison & Bond, 2007). Similarly, depictions of men on television and film are typically more muscular and lean than the average man (Dallesasse & Kluck, 2013; Lin, 1998; Morrison & Halton, 2009) and time spent watching television has been associated with increased drive for muscularity (Cramblitt & Pritchard, 2013). When individuals feel unable to match these body standards reinforced through cultural representations of the male physique they may be more likely to use AAS. Indeed, the prevalence of AAS amongst western in comparison to Eastern cultures is indication of the importance of these cultural factors (Kanayama & Pope, 2011). A recent study identified a positive correlation between the level of news coverage regarding AAS use amongst athletes and celebrities and public interest in AAS in Peru, as measured through internet searches (Avilez, Zevallos-Morales, & Taype-Rondan, 2017). This raises the question of how the public responds to media coverage of high profile cases of AAS use and prevalence in the general population. It is possible that increased coverage in AAS and establishes perceptions of normality and acceptability, and behavioral theories have long pointed to the influence that belief about the prevalence of a behavior holds.

Finally, there are many examples of policies that can influence AAS use. Most sporting organisations ban AAS alongside other performance enhancing drugs (PEDs) (WADA, 2017), with drug testing policies commonly implemented for elite sportspeople as part of efforts to reduce PED use. These are seen as a deterrent by some athletes but not others (Overbye, 2017) and some athletes may seek alternative PEDs not identified through testing procedures or exploit exemption policies allowed for those with legitimate medical conditions (Harper & Donnor, 2017). The effectiveness of these policies may be influenced by factors within other levels in this framework such as attitudes of individuals and their significant others towards

drug testing and consequences of being caught. Governments can influence the availability and acceptability of AAS through laws, which vary by country. For example, in the UK personal possession is legal while supplying AAS is an offence and there are restrictions on importing AAS purchased outside of the UK or online. In the USA possession is illegal, unless prescribed. The commissioning and funding of services or materials designed to educate or to reduce harm associated with AAS, such as clinics, needle and syringe programmes, or information websites and hotlines are examples of public policies that may influence AAS use and related behavior.

Discussion

This framework helps us understand the association between AAS use and a range of factors that change over time as users experience new environments and develop new relationships and social networks. Further, this provides a framework through which to view routes for interventions to influence behavior and outcomes related to AAS use. To date, interventions have focused predominantly on individual level factors within school environments (Bates et al., 2017). As illustrated here however there are many other potential environments worthy of attention, and other influencing factors to consider when planning such interventions. For example there may be merit in changing knowledge and beliefs about body norms and AAS, but prevention efforts that fail to also recognise the importance of wider behavioral systems, for example social networks and the environments these networks are formed and interact in, are unlikely to achieve sustained benefits. Conversely, focusing on the wider systemic levels without considering individual behaviors is also likely to lead to ineffective interventions (Sniehotta et al., 2017) and people who use AAS represent a diverse population with different motivations, experiences and backgrounds.

A number of environments influence decisions relating to AAS such as gyms and sports clubs, workplaces, prisons, and healthcare services. Recognizing that these environments represent

dynamic ecological systems with individuals at the center and identifying the processes that drive AAS behaviors within them may help to support the development of effective interventions (Hawe, Shiell, & Riley, 2009). Throughout this article examples are provided that demonstrate how levels in the framework interact and help to explain why some factors may influence some individuals more than others at different times. A key concept underpinning the framework is the influence of time and experiences. It is expected that as individuals age and experience critical life events and new environments the factors that influence their decision making explored within this ecological framework will change. The timing for interventions will be important and approaches delivered at important transition times, such as upon entering environments where AAS are normalized or following injury or an adverse health outcome associated with AAS use, may be more likely to have a preventative or habit breaking impact.

While a broad range of factors influencing AAS use has been identified, the relative strength of these different factors at different times and for different populations is unclear. Studies to date have tended to explore potential predictors and causes of AAS use without seeking to compare these and future research could seek to quantify this to support interventions to focus on the most appropriate influencing factors for specific populations. The recent typology of AAS users (Christiansen et al., 2016) increases understanding of the types of people who use these substances and suggests that there is great variation in their characteristics, motives and approach. Therefore it is likely that the factors that influence decision making within this diverse population will vary greatly also. Using the typology and this framework together to identify which factors are more influential for different groups will help to continue recent progress in increasing understanding of AAS use and informing the responses of health professionals and policy makers.

Although the literature that informs this framework represents a substantial amount of evidence, it is likely that as the evidence base develops further this framework will require modification. For example, the majority of research in this field focuses on factors relating to the initiation of AAS and there is less investigation of later decisions such as changes in use, transitioning from oral to injectable AAS and cessation. Much of the research has focused on athletes, bodybuilders and strength training environments and may not represent many of this diverse population. Groups such as gay men, older men and those in prison environments may not be represented in this framework. Females also take AAS, but it cannot be assumed that they do so for the same reasons as men. Additionally it is clear that researchers to date have frequently focused on understanding individual and social influences on AAS use, and evidence at the community and organizational levels within this framework is more limited. Researchers seeking to understand health behaviours are becoming increasing aware however of the importance of exploring the wider systems in which individuals exist (Hawe et al., 2009; Peters, 2014) and further exploration of environmental factors will provide valuable context to understand AAS decision making.

Certain factors appear particularly influential across multiple levels in the framework. Perceived normalization and acceptability of AAS amongst social groups in different environments and communities appears to facilitate initiation and continued use and exposure to norms regarding related concepts such as masculinity and muscularity also appear important. Establishing healthy and desirable injunctive norms amongst groups and communities or correcting false descriptive norms about AAS prevalence may therefore be beneficial. Related to this, the role of significant others (for example peers, competitors or colleagues) as information providers, motivators and in reinforcing behavior and the desire to achieve recognition and social capital appears influential in a range of environments. The influence of other users is clear, and suggests that peers and influential others could have a positive role in

delivering harm reducing and health promoting information to others in their networks and environments. More research on the dynamics of the social networks of users and their environments and investigating the diffusion of information within them may help understanding of how these relationships might be utilized. However, it remains important to consider these social networks in the context of the complex systems that people who use AAS operate within. Decisions are not the result of any one level of the system alone (De Savigny & Adam, 2009) and using this framework to explore factors across the different socioecological levels, and their interaction, will help ensure that those looking to understand AAS use or develop interventions account for this complexity.

Conclusion

Using an ecological approach, this framework suggests that use of AAS is the result of the interaction of many factors at the individual, social network, institutional, community and societal levels that are likely to change over time. Increasing understanding of AAS use will support the development of effective interventions designed to prevent or reduce associated harms and interventions that recognise the influence of factors at the individual level and across the wider behavioral system may be more effective. The influences of peers, social networks and norms about AAS, muscularity and masculinity, particularly in the context of environments where AAS are associated with success or social rewards, appear particularly worth of attention.

Declaration of interest statement

The authors report no conflict of interest

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Figure 1. A socioecological framework for understanding anabolic steroid use