

# **Nonmedical Anabolic-Androgenic Steroid Use: Prevalence, Attitudes, and Social Perception**

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*I dedicate this thesis to the memory of my late mum Mary Ekoa Obo*

## **Scientific Environment**

I completed this dissertation at the Department of Psychosocial Science of the Faculty of Psychology, University of Bergen. I was affiliated to the Graduate School of Clinical and Developmental Psychology. I was also a member of both the Bergen Group for Treatment Research, and the Addiction Group.

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## Abbreviations

AAS	Anabolic-Androgenic Steroid(s)
ANOVA	Analysis of Variance
CMA	Comprehensive Meta-Analysis
EPO	Erythropoietin
FFM	Five-Factor Model
FIFA	Fédération Internationale de Football Association
HBM	Health Belief Model
IBM	Integrated Behavioral Model
IPT	Implicit Personality Theory
LSD	Fisher's Least Significant Difference
MANOVA	Multivariate analysis of variance
MAS	Material Affluence Scale
MOOSE	Meta-analysis of Observational Studies in Epidemiology
NEO FFI	NEO Five-Factor Inventory
NEO PI	NEO Personality Inventory
PBT	Problem Behavior Theory
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SCM	Stress Coping Model
SCT	Social Cognitive Theory
SLT	Social Learning Theory
SPSS	Statistical Package for the Social Sciences
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UNODC	United Nations Office on Drugs and Crime

WADA World Anti-Doping Agency

## Abstract

It is important that trends in the prevalence of illicit anabolic-androgenic steroid (AAS) use are monitored and understood globally in order to avert this public health problem. This necessitates the extension of research into AAS use to currently under-represented regions or contexts such as Africa. Additionally, although some studies have investigated the social perceptions of the personality of AAS users and nonusers through experimental designs, there is a dearth of experimental investigations of the social perceptions of the personality traits (Five-Factor Model) associated with AAS-using individuals and nonusers as well as users of ergogenic aids such as erythropoietin (EPO) and protein powder.

Three investigations were conducted to elucidate the gaps in the literature noted above. The first aim was to estimate the global lifetime prevalence rate of AAS use and investigate moderators of the prevalence rate. The second aim was to explore the attitudes of Ghanaian high school students towards AAS use. The third aim was to investigate observer perceptions of the personality of AAS users in comparison with an EPO user, a protein powder user, and a nonuser of these performance-enhancing methods.

A meta-analysis and a meta-regression analysis were performed to achieve the first aim. Included were 187 studies that provided original data on 271 lifetime prevalence rates. Studies were gathered from searches in PsycINFO, PubMed, ISI Web of Science, and Google Scholar among others. Heterogeneity was assessed by the  $I^2$  index and the  $Q$ -statistic. Random effect-size modeling was used. The global lifetime prevalence rate obtained was 3.3%. The prevalence rate for males, 6.4%, was significantly higher than the rate for females, 1.6%. Results of the meta-regression analysis indicated that athletes were associated with higher prevalence compared to high school students. Additionally, interview only studies had higher prevalence whereas studies combining interviews and questionnaires

had lower prevalence (compared to questionnaire only studies). Sampling method (nonrandom) had a significant positive association with AAS use prevalence. Moreover, male sample percentage (lower than 75%) was associated with lower prevalence compared to studies with percentage of males not provided.

The second study involved a cross-sectional survey of 2,597 (1,146 male and 1,412 female) high school students in Ghana. The response rate was 96.8%. Participants' ages ranged between 11 to 35 years ( $M = 17.2$ ,  $SD = 1.4$ ). In addition to questions about nonmedical AAS use, participants answered questions about demography and sports participation. Standard descriptive statistics and multinomial logistic regression were used to analyze the data. The lifetime prevalence of AAS use was 3.8% (4.9% for males and 3.1% for females). Moreover, 18.5% admitted that they had an acquaintance that had used or did use AAS while 6.0% of the sample disclosed that they had been offered AAS previously. However, no valid AAS name was provided by users. Use and contemplation to use AAS was also significantly higher among males, teenagers, athletes (versus recreational sportspeople and nonathletes), and ball game players (versus other sports). Participation in martial arts, and swimming had significant negative association with AAS use attitudes. Conversely, female gender, living alone, religiosity, and participation in jogging had significant positive association with AAS use attitudes.

Study 3 was an experimental investigation of ratings of the perceived personality (Five-Factor Model) of an AAS-using protagonist, an EPO-using protagonist, a protein powder-using protagonist and a nonuser of any of these ergogenic aids. The sample included 328 (236 females) non-substance use students drawn from three institutions of higher education in Norway. Participants were aged between 18 and 52 years ( $M = 21.88$ ,  $SD = 4.13$ ) and were randomly allocated into four separate experimental conditions: food ( $n = 82$ ), protein powder ( $n = 83$ ), erythropoietin ( $n = 83$ ), and AAS ( $n = 80$ ). In all four conditions,



participants were similar in number, age, and gender distribution. They rated their protagonist on the NEO Five-Factor Inventory (NEO FFI). Multivariate analysis of variance was used to analyze the data. In line with our prediction, results showed that the food protagonist was perceived as least neurotic whereas the AAS and EPO protagonists were rated as similar on neuroticism. The food and protein powder protagonists were perceived as similar on openness although higher than the EPO protagonist. Protagonists of the ergogenic aids were perceived as less agreeable than the food protagonist.

Although subject to some limitations, the results indicate that nonmedical AAS use is a serious widespread public health problem. The results also suggest a high prevalence of use and intent to use AAS among high school students in Ghana. Furthermore, the results indicate that a perception of AAS use has a negative effect on perception of the personality or social image of the user. Findings from these studies add to the existing knowledge on nonmedical AAS use. They may also be useful for public health interventions and clinical work involving AAS users.

## List of Papers

1. Sagoe, D., Molde, H., Andreassen, C.S., Torsheim, T., & Pallesen, S. (2014). The global epidemiology of anabolic-androgenic steroid use: A meta-analysis and meta-regression analysis. *Annals of Epidemiology*, 24, 383–398.
2. Sagoe, D., Torsheim, T., Molde, H., Andreassen, C.S., & Pallesen, S. (in press). Attitudes towards use of anabolic-androgenic steroids among Ghanaian high school students. *International Journal of Drug Policy*, doi:10.1016/j.drugpo.2014.10.004
3. Sagoe, D., Huang, K., Molde, H., Andreassen, C.S., & Pallesen, S. Perceived anabolic-androgenic steroid use is associated with perceived neuroticism. *Manuscript submitted for publication*.

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# Contents

SCIENTIFIC ENVIRONMENT .....	3
ACKNOWLEDGEMENTS .....	4
ABBREVIATIONS.....	5
ABSTRACT.....	7
LIST OF PAPERS .....	10
CONTENTS .....	11
<b>1. INTRODUCTION .....</b>	<b>14</b>
1.1 ANABOLIC-ANDROGENIC STEROIDS .....	14
1.2 HISTORY OF AAS.....	14
1.3 MEDICAL USAGE OF AAS .....	16
1.4 NONMEDICAL AAS USE.....	16
1.4.1 <i>Initiation</i> .....	16
1.4.2 <i>Subpopulations</i> .....	18
1.4.3 <i>Modes of Administration</i> .....	20
1.5 HARMFUL EFFECTS OF AAS USE .....	20
1.5.1 <i>Harmful Physical Effects</i> .....	21
1.5.2 <i>Harmful Psychosocial Effects</i> .....	22
1.5.3 <i>Concomitant Effects</i> .....	24
1.5.4 <i>Adolescent-Specific Effects</i> .....	25
1.6 EPIDEMIOLOGY OF AAS USE .....	25
1.7 AAS LEGISLATION.....	27
1.8 THEORETICAL MODELS OF AAS USE.....	29
1.8.1 <i>Gateway Effect</i> .....	29
1.8.2 <i>Problem Behavior Theory</i> .....	30

---

1.8.3	<i>Stress Coping Model</i> .....	31
1.8.4	<i>Social Learning/Cognitive Theory</i> .....	32
1.8.5	<i>Health Belief Model</i> .....	33
1.8.6	<i>Integrated Behavioral Model</i> .....	34
1.8.7	<i>Implicit Personality Theory and the Five-Factor Model</i> .....	36
1.9	<b>AIMS</b> .....	37
1.9.1	<i>Thesis Aims</i> .....	37
1.9.2	<i>Aims Study 1</i> .....	38
1.9.3	<i>Aims Study 2</i> .....	38
1.9.4	<i>Aims Study 3</i> .....	38
<b>2.</b>	<b>METHOD</b> .....	<b>39</b>
2.1	<b>MEASURES</b> .....	39
2.1.1	<i>Measures Study 2</i> .....	39
2.1.2	<i>Measures Study 3</i> .....	41
2.2	<b>SAMPLES AND PROCEDURES</b> .....	42
2.2.1	<i>Included Studies and Procedure Study 1</i> .....	42
2.2.2	<i>Sample and Procedure Study 2</i> .....	44
2.2.3	<i>Sample and Procedure Study 3</i> .....	45
2.3	<b>STATISTICAL PROCEDURES</b> .....	46
2.3.1	<i>Statistical Procedure Study 1</i> .....	46
2.3.2	<i>Statistical Procedure Study 2</i> .....	47
2.3.3	<i>Statistical Procedure Study 3</i> .....	48
<b>3.</b>	<b>RESULTS</b> .....	<b>49</b>
3.1	<b>RESULTS STUDY 1</b> .....	49

---

3.2	RESULTS STUDY 2.....	50
3.3	RESULTS STUDY 3.....	53
<b>4.</b>	<b>DISCUSSION.....</b>	<b>54</b>
4.1	MAIN FINDINGS .....	54
4.2	IMPLICATIONS .....	57
4.2.1	<i>Implications for Practice</i> .....	57
4.2.2	<i>Implications for Future Research</i> .....	59
4.3	STRENGTHS AND LIMITATIONS .....	60
4.3.1	<i>Strengths</i> .....	60
4.3.2	<i>Limitations</i> .....	60
4.4	CONCLUSIONS .....	62
	<b>REFERENCES .....</b>	<b>63</b>
	<b>APPENDIX A.....</b>	<b>89</b>

# 1. Introduction

## 1.1 Anabolic-Androgenic Steroids

Anabolic–androgenic steroids (AAS) are a group of hormones that includes testosterone and its synthetic derivatives (Pope & Brower, 2009). AAS have two main effects on the body. First is the anabolic or ‘muscle building’ effect which includes increased protein synthesis resulting in muscle growth. The other effect is androgenic or ‘masculinizing’ and includes sperm production, deepening of the voice, and growth of pubic hair. Although the pharmaceutical industry has developed substances that have mainly anabolic effects and low androgenic effects referred to as ‘anabolic steroids’, both effects of AAS are inseparable (Pope et al., 2013). As defined above, the term ‘AAS’ is used in this thesis in reference to testosterone and its synthetic derivatives, which have both anabolic and androgenic effects. The focus in this thesis is on the nonmedical use of AAS. AAS must be distinguished from substances used in clinical settings such as corticosteroids, which may be mistaken by lay people for AAS, but that have neither anabolic nor dependence potential (Pope & Kanayama, 2012).

## 1.2 History of AAS

Over a long period of time, humans have used various kinds of substances to boost their performance. In ancient and medieval times, the muscle building and masculinizing effects of testes were examined through observation of the effects of castration on animals, and the consumption of human and animal organs to improve performance (Newerla, 1943). In 1767, John Hunter successfully transplanted a cock’s testis into the abdomen of a hen but noticed no significant changes in the hen (Setchell, 1990). Following the exploits of John Hunter, Arnold Berthold in 1849 experimented with roosters and came to the conclusion that

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the testis secretes substances into the bloodstream thereby influencing behavior and sexual physiognomy (Freeman, Bloom, & McGuire, 2001).

After a series of trials, Charles Edouard Brown-Séquard reported enhanced physical strength, psyche, and appetite after injecting himself with a concoction derived from guinea pig and dog testicles (Brown-Séquard, 1889). Oskar Zoth and Fritz Pregl received the Nobel Prize in Chemistry in 1923 after injecting themselves with a substance extracted from bull testicles and showing that receiving such injection led to increase in muscle strength (Dotson & Brown, 2007). After other scientific forays, testosterone [‘testo = testes, ster = sterol, one = ketone’ (David et al., 1935)] was synthesized (Butenandt & Hanisch, 1935; Ruzicka & Wettstein, 1935). For their exploits in testosterone synthesis, Butenandt and Ruzicka won the Nobel Prize in chemistry in 1935 (Freeman, Bloom, & McGuire, 2001).

Synthetic forms of testosterone, now referred to as AAS, were later derived (Kopera, 1985) and allegedly tested on German soldiers to boost their aggressiveness in battle (Wade, 1972). This allegation has however been disputed in a recent analysis (Reinold & Hoberman, 2014). It is also alleged that German athletes were administered testosterone for enhanced physical strength and performance during the 1936 Berlin Olympics (Francis, 1990). The widespread use of AAS for sports purposes is however attributed to the 1954 World Weightlifting Championships where it is alleged the Soviet Union’s team doctor disclosed to the US team doctor that the Soviet weightlifters were using testosterone as an ergogenic aid (Todd, 1987). Other athletes soon began using AAS to boost their physique and performance in sports. Before the 1960s and 1970s, AAS use was limited to elite athletes and bodybuilders (Ljunqvist, 1975; Yesalis & Bahrke, 1995). Since the 1970s, the use of AAS has spread from elite athletes and bodybuilders into the less athletically active or non-athletic population (Maravelias et al., 2005).

## 1.3 Medical Usage of AAS

By 1889, Brown-Séquad's concoction, derived from the guinea pig and dog testicles and named "Elixir of Life", gained popularity and was administered by over 12,000 physicians (Freeman, Bloom, & McGuire, 2001). Around the 1930s and 1940s, AAS were used clinically in the treatment of disorders including depression, melancholy, and psychosis (Altschule & Tillotson, 1948; Bahrke et al. 1990; Danziger et al., 1944). Today, AAS are used clinically in the treatment of disorders including male hypogonadism, anemia, osteoporosis, breast cancer, chronic obstructive pulmonary disease, and muscle wasting in HIV patients (Bhasin & Javanbakht, 1999; Bhasin et al., 2006; Ferreira et al., 1998; Johns, Beddall, & Corrin, 2005). However, the effectiveness of AAS in the treatment of some of these disorders has been debated (Kanayama et al., 2007a; Rabkin et al., 2004).

## 1.4 Nonmedical AAS Use

As noted previously, since the 1970s the use of AAS has spread from elite athletes and bodybuilders into the general population. Thus, use of AAS is now a general population phenomenon.

### 1.4.1 Initiation

The initiation of AAS use has attracted the attention of researchers and clinicians for several decades. In a recent survey of a representative sample of Norwegian 17-year-olds, Sagoe et al. (2015) found that aggression, depression, extraversion, conscientiousness and use of snus are associated with adolescents' exposure to AAS milieu. Other factors associated with the initiation of AAS use include male gender (Handelsman & Gupta, 1997), alcohol abuse (Wichstrøm, 2006), conduct disorder (Pope, Kanayama, & Hudson, 2012), depression (Pallesen et al., 2006), disordered eating (Irving, Wall, Neumark-Sztainer, &



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Story, 2002), narcotic use (Wichstrøm & Pedersen, 2001), negative body image (Pope, Kanayama, & Hudson, 2012), participation in power sports (Kanayama, Pope, Cohane, & Hudson, 2003), peer influence (Brower, Blow, & Hill, 1994), poor social support (Kanayama et al., 2003), and use of nutritional or dietary supplements (Hildebrandt, Harty, & Langenbucher, 2012).

In a recent systematic analysis of interviews, focus group discussions, and case reports of the experiences of AAS users, Sagoe et al. (2014a) found that most users initiate AAS use before age 30. Moreover, before their AAS use debut, the most conspicuous characteristic of AAS users was involvement in sports, especially power sports such as bodybuilding and weightlifting. Other noticeable features of users prior to initiating AAS use were maladaptive relationships (e.g. poor parental connectedness, divorce, and having suffered sexual abuse such as rape) psychopathology (e.g. depression), negative self- and body image, deviant behavior, and abuse of other drugs. It was also evident that users obtain AAS mainly from the illicit market as well as their family and friends.

Additionally, the main motives for the initiation of AAS use were for improved sports performance, better appearance, and enhanced muscle/strength. Other motives were enhanced: aggression, concentration, confidence, personal security, and sexual attraction. Moreover, AAS were typically used for psychological well-being, securing sports scholarships, occupational (unsporting) activities, and physiological recovery or preventing injury. Drives for the initiation of AAS use included coaches' or trainers' approval, curiosity, family influence, use by famous athletes portrayed in the media, peer influence, and use of AAS as a sport or social norm (Sagoe et al., 2014a).

## 1.4.2 Subpopulations

There have been several attempts at identifying or describing subpopulations of AAS users. These attempts are summarized in Table 1.

Table 1: Studies describing subpopulations of AAS users.

Author(s)	Subpopulations			
Brower (1989)	Athletes	Aesthetes	Fighting elite	
Lenahan et al. (1996)	Sports users	Recreational users	Occupational users	
Korkia (1997)	Competitive bodybuilders	Recreational bodybuilders	Competitive sportspeople	
Peters et al. (1997)	Sports related users	Body image users	Occupational users	Adolescents
Evans-Brown and McVeigh (2008)	Sports competitors	Aesthetic users	Occupational users	
Evans-Brown et al. (2012)	Sports competitors	Cosmetic users	Occupational users	Treatment users
Enaker (2013)	Competitive athletes	Body image users	Occupational users	Competitive bodybuilders

It can be deduced from Table 1 that the subgroups described by the proponents have some similarities and dissimilarities. The reason for these divergences is that the subgroups have been presented anecdotally without systematic analyses of data. Importantly, the incongruence highlights a gap in the categorization of AAS users. In consideration of this gap in the literature, Sagoe et al. (2014b) systematically synthesized studies regarding the experiences of AAS users and identified four main subpopulations: aesthetic or cosmetic users, occupational (non-sporting) users, psychological users, and sports users (See Table 2).

Table 2: Subgroups of AAS users, examples, and motives for use (Sagoe et al., 2014b).

Subgroup	Example	Motive
Aesthetic/cosmetic users	Male models, strippers, persons with body image problems	Appearance/body image, sexual attractiveness
Occupational (non-sporting) users	Criminals, security workers (e.g. doormen, police, soldiers), male models/strippers	Aggression, muscle/strength, occupational/work, personal security, sexual attraction
Psychological users	‘Addicts’, persons with concentration, self-esteem, and other psychological problems	Concentration, confidence, psychological well-being/satisfaction
Sports users	Competitive and recreational sportspeople (bodybuilders, footballers, ‘track-and-field’ athletes, weightlifters, wrestlers)	Aggression, muscle/strength, physiological recovery/injury prevention, sports, sports scholarship

Aesthetic or cosmetic users such as male models and individuals with body image syndromes use AAS mainly for the purposes of enhancing their appearance or body image and to attract potential sex partners. Occupational users such as people engaged in criminal activities, and security workers including doormen and members of the armed forces indulge in use of AAS mainly to boost their work or occupational functioning. Additionally, psychological users such as persons with self-esteem and other mental health issues use AAS in order to attain a sense of psychological well-being or gratification. Furthermore, sports users engage in use of AAS as a means of boosting their sports performance. Sports users include both competitive and recreational sportspeople. The proponents acknowledge the possibility that some individuals may belong to one or more categories.

### 1.4.3 Modes of Administration

Users commonly inject AAS intramuscularly or take AAS pills orally. Use of AAS typically takes place in phases known as ‘cycles’. There are two main kinds of cycles. The ‘on cycle’ is the AAS use phase whereas the ‘off cycle’ is the AAS abstention phase. The purpose of the ‘off cycle’ is to avert AAS tolerance and reduce the possibility of side-effects as well as normalize the activity of natural hormones. AAS users also engage in ‘stacking’ – the combination of different injectable and oral AAS. Similar to the above is ‘blitz-cycles’ where users constantly change AAS in order to prevent tolerance and androgen receptor down-regulation (Sagoe et al., 2014c). Another mode of AAS use is ‘blast and cruise’ or ‘bridging’. Here, users do not have an ‘off cycle’ but switch between phases of high dose intake (blast) and low dose intake (cruise). Moreover, many users combine AAS use with the use of licit and illicit substances as found in a recent systematic analysis of the AAS literature (Dodge & Hoagland, 2011; Sagoe et al., 2014c). Furthermore, doses of AAS typically taken orally or injected by users are supraphysiological (Pope & Kanayama, 2012).

## 1.5 Harmful Effects of AAS Use

Use of anabolic-androgenic steroid(s) (AAS) has been linked to positive effects such as improved sports or occupational performance, physical appearance, mood, confidence, sexual arousal, and self-esteem (Evans, 2004; Sagoe, Andreassen, & Pallesen, 2014a) in some users. However, the preponderance of human and animal studies has provided evidence of the physical and psychosocial harms of AAS use. These debilitating effects may be permanent or temporary and thus reversible with abstinence (Blue & Lombardo, 1999). Additionally, as noted above, AAS users consume supraphysiologic doses, usually over 10 to 100 times therapeutic doses (Trenton & Currier, 2005), hence exacerbating the risks of debilitating effects as these harms are a function of not only age and gender but, importantly,

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the dosage and duration of use as well as type of AAS (Landry & Primos, 1990; Pagonis et al. 2006).

### **1.5.1 Harmful Physical Effects**

#### *General Physical Effects*

AAS use has been associated with premature mortality and suicides (Darke, Torok, & Duflou, 2014; Di Paolo et al., 2007; Thiblin et al., 1999, 2000). However, AAS probably has the greatest effect on the cardiovascular system (Pope & Kanayama, 2012). In this regard, AAS use has been linked to cardiovascular disorders including cardiomegaly, cardiomyopathy, elevated blood pressure, fibrosis, ischemic heart disease, left ventricular hypertrophy, and myocardial infarction. Other general effects of AAS use include abnormal swelling, alopecia, male pattern baldness, hepatotoxicity, hypogonadism, infertility, oily skin and hair, severe acne, and tendon ruptures (Chahla, Hammami, & Befeler, 2014; Darke, Torok, & Duflou, 2014; Fineschi et al., 2007; Gårevik et al., 2014; Kovac et al., 2014; Kuipers, 1998; Kuipers, Wijnen, Hartgens, & Willems, 1991; Parkinson & Evans, 2006; Pope et al., 2013).

#### *Male-Specific Physical Effects*

In males, AAS use has been linked to changes in libido, erectile dysfunction and impotence, growth of mammary glands, gynecomastia, reduced natural testosterone and gonadotropic hormones, and sperm motility (Bonetti et al., 2008; Hoffman & Ratamess, 2006; Kovac et al., 2014; Kuipers, 1998).

#### *Female-Specific Physical Effects*

AAS use in females has been associated with breast atrophy, clitoromegaly, deepening of voice, hirsutism, male-pattern baldness, menstrual disorders and infertility

(Bonetti et al., 2008; Hoffman, 2002; Kuipers, 1998; Pope & Kanayama, 2012; Pope et al., 2013).

## **1.5.2 Harmful Psychosocial Effects**

### *Mood Disorders and Aggression*

AAS use has been associated with mood syndromes as well as increased aggression and criminal behavior including murder. In a comparison of AAS users and nonusers, Pope and Katz (1994) found that AAS use is associated with mood syndromes such as mania, hypomania, and major depression. Other studies have corroborated the association between AAS use and mood syndromes (Pagonis et al., 2006; Trenton & Currier, 2005). The relationship between AAS use and aggressive behavior as well as criminality has also been examined. Beaver et al. (2008) in a study of a nationally representative sample of adolescents in the US found that compared with nonusers, male lifetime AAS users had greater involvement in violent behaviors even after controlling for previous violent behavior, polypharmacy, and the interaction of violent behavior and polypharmacy. In a similar population-based study, Lundholm et al. (2015) established that lifetime use of AAS is strongly associated with conviction for a criminal offence although this association diminished after controlling for polypharmacy. Animal studies (Clark & Henderson, 2003; Hall, Hall, & Chapman, 2005; McGinnis, 2004) have also corroborated the association between AAS use and aggressive behavior established in human studies.

However, the association between AAS use and mood disorders as well as aggression and criminality has to be treated with caution. It is plausible that mood disorders are influenced by other psychosocial factors (Pope & Kanayama, 2012). In addition, other studies have found no association between AAS use and aggressive behavior (Bhasin et al., 1996; Malone, Dimeff, Lombardo, & Sample, 1995; Pope, Kouri, & Hudson, 2000).

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Accordingly, it is still not clear whether aggression is an antecedent or consequence of AAS use (Dunn, 2015; Lundholm, Frisell, Lichtenstein, & Langstrom, 2015). In sum, the association between AAS use and mood syndromes as well as aggressive and criminal behavior currently remains unclear.

### ***Dependence/Addiction***

Like other psychoactive drugs, there is evidence of the dependence-producing effect of AAS (Brower, Blow, Beresford, & Fuelling, 1989). It has been found that AAS users have a high risk of experiencing dependence with an estimated 30% of users experiencing dependence (Kanayama et al., 2009a). As in other chemical addictions, AAS dependence occurs in a pattern where users proceed from casual use or typical ‘cycling’ to a nearly nonstop pattern of use notwithstanding experiencing harmful effects such as those previously described. Moreover, AAS dependence is characterized by withdrawal symptoms such as depression (Brower, 1997). As found in human studies, results from animal studies also indicate that AAS can be addictive (Kanayama et al., 2009b; Wood, 2008). An instrument of strong validity and reliability has been developed for the assessment and diagnosis of AAS dependence (Pope et al., 2010) although other researchers have questioned the construct validity of AAS dependence (Hildebrandt et al., 2011). The epidemiological literature suggests that about 1 million Americans aged 13 to 50 years are addicted to AAS (Pope et al., 2014).

### ***Polypharmacy***

Besides dependence, AAS use has been associated with polypharmacy or polydrug use in systematic reviews of the AAS literature (Dodge & Hoagland, 2011; Sagoe et al., 2014c). In a recent systematic analysis of qualitative studies (Sagoe et al., 2014c), the main ancillary or supplementary substances used by AAS users were alcohol, amphetamine/meth, cannabinoids, clenbuterol, cocaine, ephedra/ephedrine, growth hormone, human chorionic

gonadotropin (hCG), insulin, and thyroxine. Analgesics/opioids, anti-oestrogens, dietary/nutritional supplements, and diuretics were also commonly identified classes of substances. These non-AAS substances were used mainly to enhance the effects of AAS, combat the side-effects of AAS such as elevated blood pressure and gynecomastia, and for recreational or relaxation purposes, as well as for sexual enhancement. Nonetheless, the association between AAS use and polydrug use remains unclear (Dodge & Hoagland, 2011; Sagoe et al., 2014c).

### ***Stigma***

The preponderance of literature on the effects of AAS use focuses on the physical or psychiatric effects in users. However, some researchers have been interested in how use of AAS affects the social image of users. In this regard, Schwerin and Corcoran (1992) found in an experimental study that AAS-using bodybuilders are perceived more negatively than nonusers. Similarly, tertiary students perceived an AAS-using bodybuilder similarly to a cocaine user and more negatively than a non-using athlete (Schwerin & Corcoran, 1996; Van Raalte et al., 1993). In another experimental investigation using physical education students, Chantal et al. (2009, 2013) found that an AAS user was perceived as egoistic. In the same study, participants perceived the AAS-using athlete negatively on aggression and sportspersonship. It can therefore be deduced that apart from the harmful psychophysical effects previously discussed, AAS use has a stigmatizing effect on users.

### **1.5.3 Concomitant Effects**

As noted previously, users usually combine supraphysiological doses of AAS with various ancillary or supplemental substances mostly obtained from the illicit market (Evans-Brown, McVeigh, Perkins, & Bellis, 2012; Sagoe et al., 2014c). Because most of these substances are illegal, production usually happens in ‘underground laboratories’



characterized in most cases by insanitary conditions. This leads to accidental or deliberate pollution with toxic chemicals and pathogens thereby causing harm to users. Additionally, some persons use unsterile equipment for injecting these substances. Hence, users may experience poisoning and injection site injury as well as bacterial and fungal infection. Another concurrent effect is the transmission of blood borne viruses such as hepatitis B or C and HIV (Hope et al., 2013, 2014; Sagoe et al., 2014c).

### **1.5.4 Adolescent-Specific Effects**

Adolescence is a fragile developmental stage. Hence, AAS use by adolescents is alarming (Sagoe et al., 2015). This is due to the fact that apart from the harmful effects discussed above, adolescent AAS users may experience stunted growth (Kicman & Gower, 2003), brain and neurological disorders (Cunningham, Lumia, & McGinnis, 2013), and possible permanent alteration of cognition as well as emotional reactivity (Hildebrandt, Langenbucher, Flores, Harty, & Berlin, 2014).

## **1.6 Epidemiology of AAS Use**

Available evidence (Sagoe et al., 2014d) indicates that prevalence studies of nonmedical AAS use started emerging around the 1970s in Scandinavia (e.g. Ljunqvist, 1975; Solberg, 1974). Due to the fact that nonmedical AAS use during this period was mainly limited to competitive athletes (Yesalis & Bahrke, 1995), these studies and those that soon followed in the United Kingdom (e.g. McKillop, 1987) and the United States (e.g. Yesalis, 1988) were limited to competitive athletes, especially bodybuilders and weightlifters. Lifetime prevalence rates for competitive athletes reported in these early studies ranged from 1.1% (Bosworth et al., 1987) to 44.0% (Frankle et al., 1984).

With concerns regarding the spread of nonmedical use of AAS from elite athletes into the general population during the latter part of the 1980s, epidemiological investigations were extended to high school and college students in the United States. In this regard, Johnson et al. (1989) reported lifetime prevalence of 5.8% for high school students while Krowchuk et al. (1989) found a lifetime prevalence of 1.4% in high school athletes. Additionally, Pope (1988) reported lifetime prevalence of 2.0% in college students.

Since the 1990s, epidemiological investigations of AAS use have spread from Western countries to non-Western regions such as Africa (e.g. Lambert, Titlestad, & Schwellnus, 1998) and the Middle East (e.g. Angoorani et al., 2012). These studies have reported varying prevalence rates. Importantly, they show that nonmedical AAS use is not limited to Western contexts.

It is important to note that the preponderance of epidemiological studies support the cliché in the field that nonmedical AAS use is more prevalent in males than females. A plausible explanation for this is that the masculinizing effects of AAS such as hirsutism dissuade females from initiating or continuing use (Kanayama et al., 2007a; Pope & Kanayama, 2012).

With the accumulation of evidence on the prevalence of illicit AAS use, researchers have over the past few years conducted systematic reviews of the epidemiological literature. Generally, it is estimated that 14% to 39% of adult professional athletes have used a doping substance (de Hon, Kuipers, & van Bottenburg, 2014). Specifically, Pope et al. (2014) found that in the United States, between 2.9 to 4 million individuals aged 13 to 50 years have used AAS at least once with about 1 million experiencing AAS addiction. Moreover, Abrahin, de Sousa, and Santos (2014) found prevalences ranging between 2.1% and 31.6% in their analysis of the Brazilian AAS epidemiological literature. Furthermore, in a Nordic-specific

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meta-analysis, Sagoe et al. (2014e) found an overall lifetime prevalence of 2.1% with Sweden recording the highest lifetime prevalence (4.4%), followed by Norway (2.4%), Finland (0.8%), Iceland (0.7%), and Denmark (0.5%).

It must be noted however that epidemiological investigations of AAS use, mostly based on anonymous self-reports or surveys, are occasionally affected by ‘false positive’ responses, leading to inaccurate prevalence estimates (Kanayama et al., 2007b). Consequently, as in primary studies, systematic reviews of the prevalence literature are not insulated from such shortcoming.

## 1.7 AAS Legislation

There has been increasing legislation in many parts of the world in an attempt to combat AAS use. In the United Kingdom, the Misuse of Drugs Act of 1971 classified AAS as a class C drug. Accordingly, the export and import as well as distribution of AAS is illegal unless done with a Home Office license. AAS are a prescription only drug in the United Kingdom and possessing AAS for medicinal use is not unlawful provided they are not counterfeit (Tidy, 2014).

The United States also passed the Anabolic Steroid Control Act in 1990 categorizing AAS as a Schedule III controlled drug and criminalizing their nonmedical supply or distribution. This act was amended in 2004 wherein prohormones were added to the list of controlled substances. In December 2014, the Designer Anabolic Steroid Control Act was passed in the Senate. This act has updated the Drug Enforcement Administration’s list of controlled substances with 27 ‘new’ AAS and facilitates the addition of and control of ‘new’ AAS. The act also permits the collection of and analysis of suspected products for their AAS

content, and authorizes criminal prosecution for incorrect labeling of AAS-containing products.

Many other countries have legislation and penalties for the nonmedical use and distribution of AAS: Australia (Australian Institute of Criminology, 2011), Canada (Council on Drug Abuse, 2012), Cyprus, Denmark, Sweden, Poland, and the Netherlands (Anti-Doping Denmark, 2012), France (Laure, Binsinger, & Lecerf, 2003), Germany (Anti-Doping Convention, 2010), Italy (Paoli & Donati, 2012), Norway (Pallesen et al., 2014), Russia (Russian Anti-Doping Agency, 2011), and Spain (Associated Press, 2013).

However, the legal framework against the nonmedical use and distribution of AAS appears weak in many parts of Africa (Child, 2014; Isaboke, 2014) and the Middle East (Al-Ghalib, 2005; Billingham, 2014; Swan, 2014; Wazaify et al., 2014). Moreover, despite some efforts by law enforcement agencies, some countries in Asia, Europe, and South America (Government Accountability Office, 2005; Hough, 2014; Neves, Marcheti, & Caldas, 2013) have been identified as hubs for the illicit production and distribution of AAS facilitated by a booming online market (Evans-Brown, McVeigh, Perkins, & Bellis, 2012; Kraska, Bussard, & Brent, 2010).

Additionally, the following major sports bodies have explicitly banned the use of AAS in their codes: Association of Tennis Professionals, International Association of Athletics Federations, International Federation of Association Football (FIFA), International Olympic Committee, Major League Baseball, National Basketball Association, National Football League, and National Hockey League. AAS are also on the World Anti-Doping Agency's (2014a) list of prohibited substances. In this regard, with recent evidence that the androgenic and performance-enhancing effects of AAS may persist in the long-term, it was suggested that WADA's 2-year ban for athletes testing positive for AAS and other

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prohibited substances be reexamined and longer bans be given (Egner, Bruusgaard, Eftestøl, & Gundersen, 2013). Accordingly, WADA's (2014b) new code, enforceable from January 2015, has extended the ban from 2 years to 4 years.

Furthermore, it has been argued that the spread of the 'war on doping' from the arena of professional sports into the larger society may have serious negative effects for both sport and society. One of these effects is the control of the 'doping market' by criminal groups leading to the production and distribution of fake or contaminated AAS thereby harming unsuspecting users as previously discussed (Fincoeur, van de Ven, & Mulrooney, 2014). Hence, it has been suggested that the use of AAS and other doping substances be decriminalized with Portugal as a successful model (Fincoeur, van de Ven, & Mulrooney, 2014; Murkin et al., 2014)

## 1.8 Theoretical Models of AAS Use

Various theories have been propounded in the attempt to elucidate the phenomenon of drug use. Although these theories are not AAS-specific, they provided useful insight into AAS use. Some of these theories are discussed next.

### 1.8.1 Gateway Effect

In a study of the trajectory of drug use, Kandel (1975) identified a regular sequence where users of alcohol and cigarette proceeded to use of cannabis and then to use of 'harder' drugs such as cocaine, heroin, and lysergic acid diethylamide. Hence, Kandel (1975) propounded the gateway effect or hypothesis, which suggests that using licit or less harmful drugs precedes or increases the potential risk of using 'harder' or more harmful drugs (Pudney, 2002). Typical gateway drugs include alcohol, cannabis, and tobacco (Choo, Roh, and Robinson 2008; Golub & Johnson, 2001). Particularly, alcohol, amphetamine, cannabis,

cocaine (Sagoe et al, 2014c) and dietary or nutritional supplements (Hildebrandt, Harty, & Langenbucher, 2012) have been identified as potential gateway drugs for use of AAS.

Additionally, a reverse gateway effect has been identified where AAS use precedes use of other narcotic drugs (Hoff, 2012). Indeed, although AAS use is positively related to use of alcohol, illicit drugs, and licit performance enhancing drugs, the directional association between AAS use and the use of cannabis and tobacco remains unclear (Dodge & Hoagland, 2011). Hence, there is a contest regarding whether the gateway effect is causal or correlational in nature (Baumrind, 1983; Fergusson, Boden, & Horwood, 2006). Moreover, as Beenstock and Rahav (2002) indicate, it is not clear whether the gateway effect is a function of vulnerability or exposure. That is, are persons vulnerable to use of supplements also vulnerable to AAS use, or does use of supplements expose people to AAS use?

### **1.8.2 Problem Behavior Theory**

As a plausible response to the ‘vulnerability or exposure’ question posed above in relation to the gateway effect, Jessor and Jessor (1977) proposed problem behavior theory (PBT). An important element of PBT is ‘problem behavior syndrome’ which suggests that involvement in one problem behavior such as cocaine use is associated with involvement in other problem behaviors including alcohol and other drug use, sexual precocity, and delinquency together with reduced conventional or socially-approved behavior such as religiosity and academic achievement (Jessor & Jessor, 1977). Problem behavior is explainable by the social ecology of youth culture in which behaviors are usually learnt and practiced together as a means of obtaining peer approval and signaling maturity or the attainment of adult status (Jessor, 1992).

PBT is made up of three related components that influence involvement in or abstinence from problem behavior. First is the perceived-environment system which includes proximal (e.g. peer influence) and distal (e.g. parental connectedness) social factors. Second is the personality system which includes social cognitions, beliefs, values, expectations, and attitudes. Third is the behavior system, comprising problem and conventional behaviors. The configuration of instigations and controls within and across these components influences involvement in problem behavior. Accordingly, PBT posits that adolescents' involvement in problem behaviors is due to nonalignment with positive parental and societal standards or influence, whereas conventional behavior is upholding the traditional standards of society such as religiosity and academic achievement.

PBT has received convincing empirical support (Allen, Leadbeater, & Aber, 1994; Donovan, Jessor & Costa, 1988) and is one of the most influential theories of dysfunctional behavior (Steinberg & Morris, 2001). Particularly, PBT has received empirical support in the AAS use literature. For instance, Miller et al. (2002, 2005) found that AAS use is associated with abuse of alcohol, cocaine, and marijuana, as well as aggressive and violent behavior, plus precocious sexual activity in adolescents. In addition, Pallesen et al. (2006) found that AAS use and association with AAS-using acquaintances is strongly related to misuse of alcohol, nicotine, and narcotics in adolescents.

### **1.8.3 Stress Coping Model**

Stress has been identified as an important element in the development of psychopathology, including drug use and dependence, across the life span (Grant et al., 2014; King & Chassin, 2008). The stress coping model (SCM; Wills & Hirky, 1996; Wills & Shiffman, 1985) suggests that drug use serves to combat stress: reducing negative feelings and increasing positive feelings even if effective only in the short term (Shiffman 1982;

Wills & Shiffman, 1985). Thus, in terms of SCM, AAS use can be viewed as an effort to overcome negative feelings emanating from psychological problems such as depression and low self-esteem, body dysmorphic disorder, and poor sports or occupational performance. Conversely, AAS use can be viewed as a means to increasing positive feelings from enhanced sports or occupational performance, better physique and increased strength, improved concentration and confidence, personal security, and speedy recovery from injury (Sagoe et al., 2014a). SCM is similar to chronobiological control theory (Hochhauser, 1978) which posits that drugs are used in order to deal with feelings of physiological or psychological inadequacy and achieve perceptions of control.

#### **1.8.4 Social Learning/Cognitive Theory**

Social learning theory (SLT) was propounded by Miller and Dollard (1941) and built on by Bandura (1977). SLT suggests that observing and modelling the behaviors, attitudes, and emotional reactions of others such as parents, peers, and significant others is important in the development of behavior such as drug use. Hence, association with drug-using individuals is deemed to increase the possibility of initiating and continuing drug use. The initiation of and continual use of AAS use can therefore be understood as emanating from association with and observation of the AAS-using culture of elements in the AAS-using community such as peers or teammates and coaches (MacKinnon et al., 2001; Sagoe et al., 2014a).

Bandura (1986) later rearticulated SLT as social cognitive theory (SCT). SCT suggests that individuals intentionally function or engage in behavior (Bandura, 2005). An important element of SCT is the triadic reciprocal determinism model (Wood & Bandura, 1989) which states that behavioral, environmental, and personal factors act together to influence behavior. In this regard, AAS use can be construed as influenced by behavioral



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factors (e.g. involvement in power sports), personal factors (e.g. negative body image) and environmental factors (e.g. pressure from AAS-using peers) supported by results of a recent synthesis of qualitative studies on AAS use (Sagoe et al., 2014a).

### **1.8.5 Health Belief Model**

Propounded in the 1950s by American social psychologists (Rosenstock, 1966, 1974) in the attempt to explain why people did not participate in health programs, the health belief model (HBM) has become one of the most popular theories in the field of health promotion (Glanz, Rimer, & Viswanath, 2008). HBM posits that an individual's health-related behavior is influenced by some concurrent factors or beliefs: (a) that he/she can successfully engage in a health-related behavior (self-efficacy), (b) that he/she is vulnerable (perceived susceptibility) to a serious illness or disorder (perceived severity), and (c) that engaging in the health behavior in (a) would alleviate the illness or disorder (perceived benefits) at no, or at a reasonable cost, and by transcending perceived barriers (e.g. monetary cost, discomfort, pain etc.). Additionally, 'cues to action' such as information from elements in a person's social network on how to execute the behavior are deemed to activate or stimulate the health behavior (Glanz, Rimer, & Lewis, 2002; Rosenstock, Strecher, & Becker, 1988).

Accordingly, HBM suggests that an individual may use AAS due to the belief that he/she can successfully use AAS with cues from AAS-using peers, he/she is vulnerable to or suffering from a disorder (e.g. body dysmorphic disorder), and that use of AAS may be more beneficial in dealing with this disorder compared to the cost (e.g. cost of obtaining AAS, pain from injection, and side effects) (Jalilian & Allahverdipour, 2012; Sagoe et al., 2014a).

The predictive effectiveness of HBM on behavior has received some empirical support (Carpenter, 2010; Zimmerman & Vernberg, 1994). However, the authors of these studies have cautioned the applicability of the entire model in explaining behavior. For instance,

Carpenter (2010) found that although perceived barriers and perceived benefits strongly predicted behavior, perceived severity weakly predicted behavior whereas perceived susceptibility did not predict behavior. Figure 1 presents a conceptual diagram of HBM.

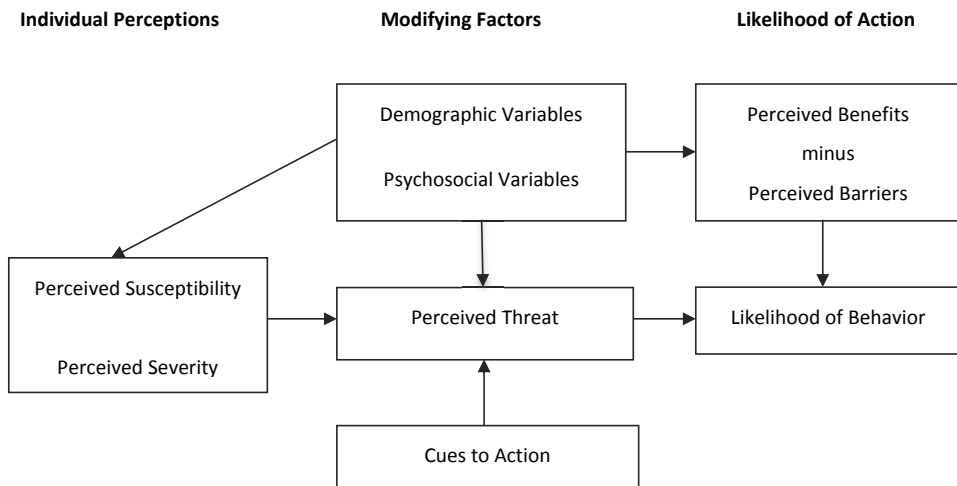


Figure 1: The health belief model.

### 1.8.6 Integrated Behavioral Model

The integrated behavioral model (IBM) also known as integrative model of behavioral prediction (Fishbein, 2000, 2008) is the most recent formulation of the theory of reasoned action (TRA; Fishbein & Ajzen, 1975) following its articulation as the theory of planned behavior (TPB; Ajzen, 1985). According to TRA, the most important predictor of behavior is intention which is influenced by attitude toward carrying out the behavior and normative belief (injunctive and descriptive) as well as motivation to execute the behavior. Hence, inferring from TRA, AAS use can be interpreted as a function of a positive attitude towards AAS use as well as the potential user's belief that people in his/her environment endorse AAS use.

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TPB extends TRA with the introduction of perceived behavioral control (efficacy beliefs and self-efficacy) – the perceived ability to execute behavior. The introduction of the self-efficacy variable is meant to account for situations where a person may not have complete control over the execution of a behavior. Accordingly, in terms of TPB, an additional construct to the example used above in relation to TRA is that the potential user must believe that he/she is able to administer AAS (e.g. through injection or orally in the ‘recommended’ doses).

Although TRA and TPB have been criticized as having limited applicability to the prediction of behavior (Werner, 2004), the theories have been identified as effective predictors of various health behaviors and intentions (Albarracin et al., 2001; Bosompra, 2001; Downs & Hausenblas, 2005; Hardeman et al., 2002; Kautonen, Gelderen, & Fink, 2013; Montaña & Taplin, 1991; Webb & Sheeran, 2006).

As an extension of TRA and TPB, IBM posits that skills and environmental constraints moderate the relationship between intention and behavior. IBM therefore adds that people execute their intentions when they have the necessary skills in an environment that does not hinder the execution of the behavior. Thus, ‘skills’ and a ‘conductive environment’ are deemed indispensable to the intention-behavior link. Hence, an important dimension to the example noted above is that the potential user must have (a) the ‘skills’ to use injection equipment or swallow AAS in the ‘recommended’ doses, (b) in a conducive, and not necessarily legal, environment. Figure 2 presents a conceptual diagram of the IBM.

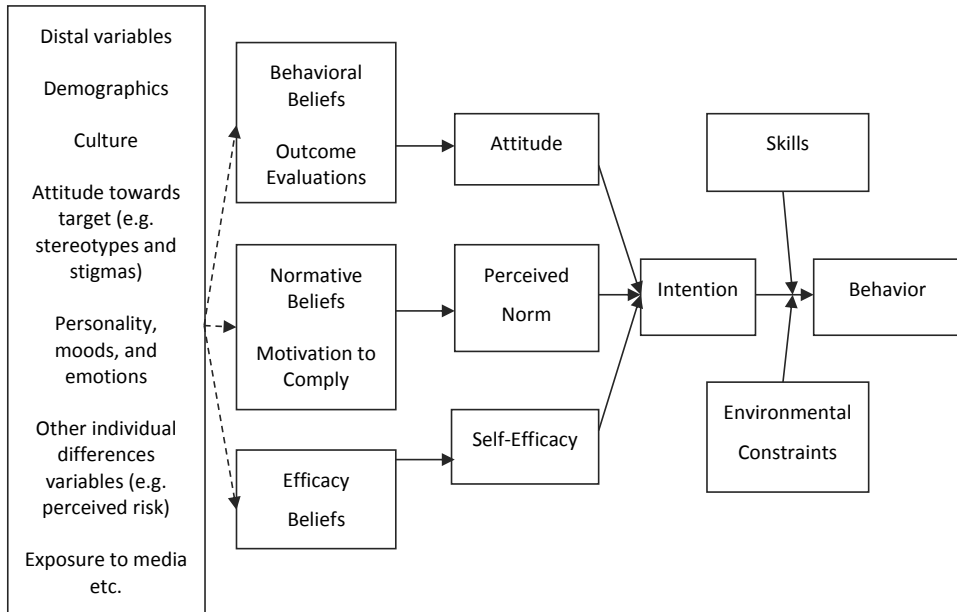


Figure 2: The integrated behavioral model.

### 1.8.7 Implicit Personality Theory and the Five-Factor Model

Bruner and Tagiuri (1954) coined the expression ‘implicit personality theory’ (IPT) to explain how observers link or relate people’s attributes or traits (Schneider, 1973). IPT refers to assumptions or expectations that traits and behaviors co-occur (Borkenau, 1992). IPT can also be deemed as corresponding to a set of assumptions about why people behave the way they do (Schneider, 1973). If exposure to a group’s member or symbol elicits a negative response, this is regarded as signifying prejudice (Brauer, Wasel, & Niedenthal, 2000). IPT has been applied in experimental studies of how AAS users are perceived (Chantal et al., 2009, 2013; Schwerin & Corcoran, 1992, 1996; Van Raalte et al., 1993), as previously elucidated in relation to the stigmatizing effects of AAS use.

For several decades, the Five-Factor Model (FFM) has been applied to assess implicit personality through self- or observer-ratings of healthy (McCrae et al., 2004; McCrae &

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Terracciano, 2005) as well as ‘indisposed’ (Saulsman & Page, 2004) individuals. The FFM is a reliable and well-validated categorization of personality (Costa & McCrae, 1992). It has five dimensions: neuroticism (a tendency to easily experience negative emotion or feelings), extraversion (a tendency to be sociable or outgoing), openness to experience (a tendency to be imaginative, intelligent, and appreciate art), agreeableness (a tendency to be caring and cooperative), and conscientiousness (a tendency to be efficient, well-organized, and dependable). The FFM has basis in scientific evidence and evades problems usually associated with personality categorization (Widiger, 2005).

It is noteworthy, however, that despite the merits and wide application of the FFM, there is a lack of studies using the FFM to examine observers’ perception of AAS users’ personality.

## 1.9 Aims

### 1.9.1 Thesis Aims

It can be inferred from the literature reviewed above that although there is available prevalence data for some populations, there is a paucity of evidence on the global prevalence of AAS use. It is therefore imperative that further studies are conducted especially in contexts where there is a paucity of research such as Africa. The foregoing reviewed literature further shows a dearth of evidence on observer perceptions of the personality of AAS users on the well-validated Five-Factor Model (FFM). This thesis sought to contribute to the literature by examining the global prevalence of AAS use, Ghanaian high school students’ attitudes towards AAS use, and the construal of the personality or social image of AAS users. Three investigations, reported in this thesis, were conducted to address these gaps in the literature.

### **1.9.2 Aims Study 1**

The central aim of Study 1 was to investigate the global lifetime prevalence of AAS use. A second aim was to compare prevalence rates across sample type, gender, age, region, assessment method, sampling method, and publication year. Another aim was to investigate the predictive effect of the above study characteristics on the global lifetime AAS use prevalence.

### **1.9.3 Aims Study 2**

Study 2 sought to investigate AAS use prevalence among Ghanaian high school students. Other aims were to elucidate AAS use attitudes among: (i) males and females, (ii) athletes, recreational sportspeople, and nonathletes, and (iii) persons who participate in various sporting disciplines. A final aim of Study 2 was to investigate the predictors of Ghanaian high school students' AAS use attitudes.

### **1.9.4 Aims Study 3**

The main aim of Study 3 was to examine people's perceptions of the personality characteristics (FFM) of an AAS user, individuals who use EPO, and protein powder, as well as an individual who uses neither of these performance-enhancing methods. Another aim was to compare personality ratings of the above-mentioned individuals.

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## 2. Method

### 2.1 Measures

#### 2.1.1 Measures Study 2

##### *Demographics*

Living situation was assessed with the question “How many of your parents do you live with?” Response options were ‘both parents’ scored ‘2’, ‘one parent’ scored ‘1’, and ‘none’ scored ‘0’.

Religious involvement was assessed with the question “How important is religion in your life?” Response choices were ‘very important’ scored ‘3’, ‘important’ scored ‘2’, and ‘not important’ scored ‘1’.

Parental education was assessed by means of two items, separately for the participants’ mother and father: “What is the highest level of education of your mother/father?” The same response alternatives were presented for both items: ‘university or polytechnic’ scored ‘3’, ‘senior high school/technical/vocational’ scored ‘2’, ‘junior high school’ scored ‘1’, and ‘no education’ scored ‘0’. Subsequently, a dichotomous variable was computed for each parent indicating whether the parent’s highest education was higher than senior high school (‘yes’ scored ‘1’ and ‘no’ scored ‘0’).

Socioeconomic status was assessed with the Material Affluence Scale (MAS; Doku et al., 2010). The MAS is a 9-item instrument designed for assessing socioeconomic status in Ghanaian adolescents. The MAS items cover household assets (e.g. fridge/freezer, television, computer, and car) and housing characteristics (e.g. type of house, building material, and the availability of electricity). An example item is “Do you have your own room?” Response options are ‘yes’ (1) and ‘no’ (0). Total scores lower than 3 were

categorized as 'poor', scores between 3 and 7 were categorized as 'average', and scores above 7 were categorized as 'affluent'. The Cronbach's alpha of the MAS was .65.

### *Sports Participation*

Participants provided information about whether they belonged to: (a) any of their school's sports teams (yes/no), (b) any other sports team (yes/no), or (c) participated in any sport during their free time (yes/no). 'Yes' responses were scored '1' and 'no' responses were scored '0'. Participants also selected the sport(s) they participated in from a list of popular sports in Ghanaian society: aerobics, athletics, ball sports (football, basketball, volleyball etc.), canoeing, jogging, martial arts, rackets (tennis, squash, golf etc.), spinning, swimming, and weightlifting. Participants were categorized into 3 groups: athletes (members of at least one sports team), recreational sportspeople, and nonathletes.

### *Use of AAS*

Participants indicated whether: (a) they had ever used AAS (yes/no), (b) anyone had ever offered them AAS (yes/no), and (c) they personally knew anyone who used or had ever used AAS (yes/no). 'Yes' responses were scored '1' and 'no' responses were scored '0'. Kanayama et al.'s (2007b) recommendations were adhered to in order to combat false-positive responses. Accordingly, AAS were verbally explained or defined to participants in detail. It was also indicated that questions about AAS use referred specifically to use without the prescription of a doctor or health worker. In addition, an item on the questionnaire demanded that participants name the particular AAS they used or had used.

Participants also indicated whether they: (a) thought using AAS would improve their performance in sports or exercise (yes/not sure/no), (b) would use AAS if using it would increase their size or strength (yes/not sure/no), and (c) would use AAS if using it would



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help them secure sports scholarships (yes/not sure/no). ‘Yes’ responses were scored ‘3’, ‘not sure’ scored ‘2’, and ‘no’ scored ‘1’.

### **2.1.2 Measures Study 3**

#### *Demographics and Experimental Scenarios*

Participants provided their ages and gender. An allegory, in Norwegian, was presented with differences only in what was consumed by the protagonist. See Appendix A.

#### *NEO Five-Factor Inventory*

The observer-rating version of the NEO Five-Factor Inventory (NEO FFI, Costa & McCrae, 1992) is a 60-item version of the NEO Personality Inventory (NEO PI, Costa & McCrae, 1985) designed for the assessment of the five personality dimensions (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness). It contains descriptive statements answered on a 5-point scale ranging from 0 (very inaccurate) to 4 (very accurate). Total scores are computed by totaling ratings on the 12 corresponding personality items. A total of 28 NEO FFI items are reverse-worded. Possible total scores on each personality trait range from 0 to 48. Mean T-scores for the NEO FFI is 50, and 10 points denote one standard deviation. With reference to the United States general population norms, T-scores equal to or higher than 56 are categorized as ‘high’, T-scores between 45 and 55 are categorized as ‘average’, while T-scores lower than 45 are categorized ‘low’ (Costa & McCrae, 1992; Rudow, Iacoviello, & Charney, 2014). Cronbach’s alphas were .78 for neuroticism, .74 for extraversion, .61 for openness to experience, .76 for agreeableness, and .83 for conscientiousness.

## 2.2 Samples and Procedures

### 2.2.1 Included Studies and Procedure Study 1

#### *Search Strategy and Inclusion Criteria*

PsycINFO, PubMed, ISI Web of Science, and Google Scholar were systematically and comprehensively searched for research literature published between 1970 and July 2013. “anabol\*”, “steroid\*”, and “doping” were each combined with “preval\*”, “epidem\*”, and “incidence” as keywords for the literature search. Three hundred and eleven ( $n = 311$ ) full-text articles were retrieved for further evaluation from a total of 16,626 hits. Studies that met the following inclusion criteria were included: (a) studies contained original estimate(s) of lifetime prevalence of AAS use, (b) studies were published between 1970 and July 2013, and (c) studies were published in English. One hundred and sixty two ( $n = 162$ ) studies satisfied the inclusion criteria after scrutinizing the 311 full-text articles retrieved. References of relevant articles were also searched for potential unidentified studies.

Grey literature presenting original lifetime prevalence rates of AAS use was also searched for in online databases and websites. Calabria et al. (2009) suggest that if data from a representative National study exists for a country, studies similar in sample and method should not be included in the analysis in order to avoid duplicating studies. Consequently, the Monitoring the Future Surveys (Johnston et al., 2013a, 2013b), and the Youth Risk Behavior Survey (Lippe et al., 2008) were used as representative of similar National surveys of AAS use among adolescents and youth in the United States of America, Commonwealth of the Northern Mariana Islands, Republic of Palau, and Commonwealth of Puerto Rico. In addition, The European School Survey Project on Alcohol and Other Drugs (Andersson et al., 2007; Hibell et al., 2000, 2004, 2007, 2012), a survey including about 35 European countries conducted every fourth year since 1995 was relied on as representative of similar

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National surveys of European adolescents. The search for grey literature yielded a total of 25 new articles.

Thus, the literature search yielded a total of 187 articles. In addition to the recommendation of Calabria et al. (2009) noted above, guidelines and recommendations of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher et al., 2009) and the Meta-analysis of Observational Studies in Epidemiology (MOOSE; Stroup et al., 2000) group were adhered to in the search for literature.

### ***Data Extraction***

A standardized data extraction form was designed unto which the following study characteristics were extracted: author name and publication year, country, and region of research, type of sample (prisoners and arrestees, recreational sportspeople, athletes, drug users, nonathletes, and high school), assessment method (questionnaires, interview, or both), sampling method (random or nonrandom), sample size (total, male, and female), age of participants (range, mean, and standard deviation), response rate, and lifetime prevalence rate of AAS use reported (male, female, and overall).

Two reviewers conducted the data extraction independently. Using the Kappa statistic, inter-rater reliability analysis was performed in SPSS version 20 (IBM Corp., 2011) to examine consistency of extraction between the two reviewers. Results of the analysis indicated very good agreement between the two reviewers (Kappa = 0.854,  $p < .001$ ) (Viera & Garrett, 2005). The two reviewers reached agreement on discrepant extractions through discussion and further review of the contentious articles.

## 2.2.2 Sample and Procedure Study 2

### *Sample*

Of Ghana's ten regions, the Central Region was selected for the study. The Central Region has seventeen 'districts' and two were selected for the study: Cape Coast Metropolitan Assembly and Komenda Edina Eguafo Abrem Municipal Assembly. The two 'districts' have a total of seventeen senior high schools. Five of them were randomly selected for the recruitment of participants.

From the five senior high schools, 2,683 students were invited to participate in the study with 2,597 completing and returning the questionnaire. This yielded a response rate of 96.8%. The final sample therefore comprised of 2,597 students (1,146 male, 1,412 female, 39 not disclosed). Participants ranged in age from 11 to 35 years with a mean age of 17.2 years ( $SD = 1.4$ ). In terms of sports participation, 1,431 of the participants identified themselves as athletes, 819 were recreational sportspeople, 339 were nonathletes while 8 did not provide information about their sports involvement.

### *Procedure*

The study was a cross-sectional survey by means of a self-report questionnaire. Before the commencement of data collection, cluster or area random sampling was used in selecting the five senior high schools. Next, permission and information letters were sent to school principals. All principals consented to data collection in their schools. After the school principals had acquiesced to the request, they discussed the study with assistants and some teachers of their schools.

Arrangements were made for data collection on a date and time that was convenient for the participating schools. On the day agreed for the data collection, introductory formalities were performed class by class by the senior housemaster/housemistress of the

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school or his/her representative. It was verbally explained to students in English and Fantse (the local language), class by class, the purpose of the data collection and what would happen to the information collected, assuring the students personal anonymity and confidentiality. Students were informed that participation was voluntary and that they would be compensated with pens, pencils, and notebooks for their participation. In addition, the questionnaire package (the informed consent form, the information letter, and the questionnaire) indicated that respondents did not have to provide their names, described how to complete the questionnaire, and also indicated the estimated time for completing the questionnaire.

With the help of teachers and research assistants, the questionnaires were distributed to students who had volunteered to participate in the study. Clear and adequate instructions regarding the completion of the questionnaire were provided in writing at the beginning of each section. Participants also had the opportunity to obtain explanations on the content and completion of the questionnaire. Questionnaires were completed anonymously and returned in bulk.

### **2.2.3 Sample and Procedure Study 3**

#### ***Sample***

Participants were 328 non-substance use students (236 females) of three institutions of higher education in Bergen, Norway. Their ages ranged between 18 and 52 years ( $M = 21.88$ ,  $SD = 4.13$ ). They were randomly assigned to four independent experimental groups: AAS ( $n = 80$ ), EPO ( $n = 83$ ), food ( $n = 82$ ), and protein powder ( $n = 83$ ).

#### ***Procedure***

After agreeing to take part in the study, an instruction for completing the questionnaire, one of four versions of a storyline, and the observer-rating version of the NEO

FFI were arranged and distributed to students. Participants read the narrative describing a student's daily activity. What the protagonist consumed before training was varied in four ways in the story: food (1st condition), protein powder (2nd condition), EPO (3rd condition), and AAS (4th condition). Several copies of the questionnaire package were distributed among participants but they were instructed to take a package each. Hence, each participant had the opportunity to respond to only one of the four stories yielding four independent groups. Participants provided their ages and gender as well as personality ratings of their story's protagonist based on the NEO FFI. In order to ensure that participants did not discover differences in the storylines, some measures were taken. First, all questionnaires had similar front page (instruction). This helped disguise variations in the storyline. Moreover, participants were instructed to avoid communicating with each other while reading and responding to the questionnaire.

## 2.3 Statistical Procedures

### 2.3.1 Statistical Procedure Study 1

Funnel plot as well as trim and fill functions (Duval & Tweedie, 2006) were used in examining publication bias via Comprehensive Meta-Analysis version 2.0 (Biostat Inc., 2005). The calculation of prevalence rates and confidence intervals were conducted under the random effects model for the principal reason that random effects results have a higher external validity compared to the fixed effects model (Borenstein et al., 2009). The  $Q$ -statistic and the  $I^2$  index were used in the assessment of the heterogeneity of the prevalence rates. Using the  $Q$ -statistic under the random effects model, subgroup analyses were conducted for all moderator variables separately to assess statistical differences in prevalence rates between the subgroups. Due to the high number of subgroup comparisons, Bonferroni correction was used to reduce the probability of committing type I errors.

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Comprehensive Meta-Analysis version 2.0 (Biostat Inc., 2005) was used for the meta-analysis.

In order to discover predictors of the overall prevalence rate, a meta-regression analysis was conducted under a random effects model. The moderator variables included in the meta-regression analysis were: publication year (1970-1979, 1980-1989, 1990-1999, 2000-2013), region (Africa, Asia, Europe, Middle East, North America, Oceania, South America, and Trans- Region), sample type (athletes, high school, drug users, nonathletes, prisoners and arrestees, recreational sportspeople), age range [ $\leq 19$  years,  $> 19$  years, and studies with overlapping range of ages (trans-age range)], sampling method (random and nonrandom), assessment method (interviews, questionnaires, or both) and the percentage of males in the sample ( $> 75\%$ , percentage of males in the sample  $\leq 50\%$ ,  $> 50\%$  to  $\leq 75\%$ , and the percentage of males not provided). Because the predictors were categorical, the categories were dummy coded as 0 or 1. The category with the highest number of studies was used as a reference category for each predictor. Comprehensive Meta-Analysis 2.0 is incompatible with categorical predictors. Thus, the meta-regression analysis was conducted in SPSS version 20 (IBM Corp., 2011) using macros developed by Lipsey and Wilson (2001).

### **2.3.2 Statistical Procedure Study 2**

Standard descriptive statistics were used to determine frequencies in levels of experience of AAS, and attitudes towards AAS use in demographic and sports variables. In addition, chi-square tests were used to evaluate proportional differences in AAS experience and attitudes according to various demographic and sports variables. Furthermore, multinomial logistic regression analysis was conducted to identify factors related to attitudes towards use of AAS: (a) for improved sports performance, (b) for enhancement of physique

and strength, and (c) to facilitate securing a sports scholarship. SPSS version 20 (IBM Corp., 2011) was used for analyzing the data.

### **2.3.3 Statistical Procedure Study 3**

First, personality ratings (raw scores) were transformed into T-scores. Age and gender differences between participants in the four groups were examined using one-way between-groups ANOVA and Chi square test for independence respectively. The influence of the experimental condition, gender, and the interaction between the experimental condition and gender was tested using multivariate analysis of variance (MANOVA). Post-hoc analysis was conducted using Fisher's Least Significant Difference (LSD) test. Mean personality T-scores were compared with general population norms from the United States (Costa & McCrae, 1992; Rudow, Iacoviello, & Charney, 2014). The data was analyzed using SPSS version 20 (IBM Corp., 2011).



### 3. Results

#### 3.1 Results Study 1

A total of 187 articles were identified. Of these, 16 articles contained multiple prevalence rates totaling 84. Thus, in total, 271 separate lifetime prevalence rates published between 1974 and 2013 were identified in the literature. The preponderance of studies was conducted in Western countries: North America ( $n = 126$ ), Europe ( $n = 81$ ), and Oceania ( $n = 38$ ). Inspection of the funnel plot and application of the trim and fill function in Comprehensive Meta-Analysis version 2.0 (Biostat Inc., 2005) indicated that there was no publication bias.

The overall lifetime prevalence obtained was 3.3%. The prevalence rate for males (6.4%) was significantly higher than the prevalence rate for females (1.6%).

The region with the highest prevalence of AAS use was the Middle East: 21.7%, followed by South America: 4.8%, Europe: 3.8%, North America: 3.0%, Oceania: 2.6%, Africa: 2.4%, and Asia: 0.2%. The prevalence for Trans-Regional studies was 6.0%.

The group with the highest overall prevalence of AAS was recreational sportspeople: 18.4%, followed by athletes: 13.4%, prisoners and arrestees: 12.4%, drug users: 8.0%, high school students: 2.3%, and nonathletes: 1.0%.

In addition, adolescents ( $\leq 19$  years) had a higher overall prevalence, 2.5%, than those over 19 years old: 1.9%. The prevalence rate for studies with samples comprising both adolescents and over 19-year-olds was 4.6%.

Studies conducted with only interviews had the highest overall prevalence rate: 11.1%, followed by studies conducted with only questionnaires: 3.0%, and studies that used both (interviews and questionnaires): 1.8%.

Studies that sampled participants nonrandomly had a significantly higher overall prevalence rate, 11.4%, than studies that sampled participants randomly, 2.4%.

Publication years 1970 to 1979 had the highest overall prevalence rate: 9.2%, followed by 1980-1989: 7.8%. In addition, publication years 2000 to 2013 had a slightly higher prevalence rate, 3.2%, than 1990 to 1999: 2.9%.

From the meta-regression analysis, athletes were associated with higher prevalence in comparison with high school students. Moreover, in comparison with questionnaire only studies, studies using only interviews were associated with higher prevalence whereas studies using both interviews and questionnaires were associated with lower prevalence. In addition, sampling method (nonrandom) was positively associated with AAS use prevalence. Furthermore, in comparison with studies with the proportion of males not provided, proportion of males in samples ( $\leq 50\%$ , and  $> 50\%$  to  $75\%$ ) were related to lower prevalence. Together, these variables accounted for 41.1% of the variance in the overall AAS use prevalence rate.

## 3.2 Results Study 2

The lifetime prevalence of AAS use was 3.8% (males = 4.9%, females = 3.1%) with 18.5% of the sample reportedly knowing an AAS user while 6.0% had previously been offered AAS. Athletes had a prevalence of 4.6% whereas recreational sportspeople and nonathletes had the same prevalence: 3.0%. None of those who admitted AAS use provided a valid name of the AAS they had used.

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Additionally, AAS users were significantly older and had a higher percentage of males compared to nonusers [age:  $\chi^2(1) = 9.7, p < .01$ , Cramer's  $V = .062$ ; gender:  $\chi^2(1) = 6.4, p < .05$ , Cramer's  $V = .050$ ].

Moreover, the proportion of males who indicated their intent or indifference towards use of AAS for improvement of their sports performance was higher than the proportion of females [yes: males = 14.1%, females = 10.2%; not sure: males = 50.9%, females = 48.9%;  $\chi^2(2) = 14.2, p < .001$ , Cramer's  $V = .075$ ].

Similarly, the proportion of males who professed the intention or nonchalance with respect to using AAS to increase their physique or strength was higher than the proportion of females [yes: males = 14.8%, females = 11.6%; not sure: males = 35.9%, females = 30.6%;  $\chi^2(2) = 18.7, p < .001$ , Cramer's  $V = .086$ ].

There was no significant proportional difference between males and females on attitude towards use of AAS to boost the chances of securing sports scholarships. Likewise, the proportionate differences between nonathletes, recreational sportspeople, and athletes did not reach statistical significance.

However, the percentage of individuals who indicated that they would use AAS to increase their size or strength was higher among athletes (14.3%) followed by recreational sportspeople (12.3%), and nonathletes (9.3%). Also, a higher proportion of athletes (35.0%) were indifferent about the use of AAS to increase their size or strength compared to nonathletes (31.2%), and recreational sportspeople (30.0%). The inter-group comparison showed the proportional differences as significant:  $\chi^2(4) = 17.0, p < .01$ , Cramer's  $V = .057$ .

In addition, the proportion of individuals who stated that they would use AAS to help them secure sports scholarship was similar among athletes (13.8%), recreational

sportspeople (13.8%), and nonathletes (13.4%). However, a higher proportion of athletes (31.7%) were not sure about using AAS to secure an athletic scholarship followed by nonathletes (27.3%), and recreational sportspeople (25.5%). The proportional differences were significant:  $\chi^2(4) = 11.0, p < .05$ , Cramer's  $V = .046$ .

The proportion of students who believed that using AAS will improve their sports performance was similar, and statistically significant, among spinners (22.2%) and martial artists (21.3%) albeit higher than swimmers (15.3%). The proportions of swimmers (17.1%) and weightlifters (16.5%) who admitted their intention to use AAS to enhance their physique were similar but higher than the proportion of ball sports participants (14.3%). Additionally, the proportion of martial artists who admitted their intention to use AAS in order to enhance the possibility of securing sports scholarships (24.7%) was significantly higher than the proportion of weightlifters (17.5%).

Female gender significantly predicted a negative attitude towards use of AAS for better sports performance. Moreover, parental absence and jogging were significantly associated with a nonchalant attitude towards use of AAS for better sports performance. Parental absence, jogging, and swimming significantly predicted a negative attitude towards use of AAS for enhanced physique. Additionally, parental absence, religious involvement, and jogging were significantly associated with an indifferent attitude towards use of AAS for better physique. Finally, martial arts participation was significantly related to negative as well as indifferent attitudes towards use of AAS to enhance the possibility of securing sports scholarships.

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### 3.3 Results Study 3

Regarding neuroticism, the food protagonist was rated least ( $M = 54.63$ ,  $SD = 5.62$ ) in comparison with the AAS and EPO protagonists who were perceived as similar: [AAS:  $M = 57.09$  ( $SD = 5.99$ ), EPO:  $M = 57.55$  ( $SD = 7.74$ )].

In addition, the protein powder and food protagonists were rated similarly on openness to experience: [protein powder:  $M = 35.36$  ( $SD = 6.82$ ), food:  $M = 35.23$  ( $SD = 7.22$ )] albeit higher than the EPO protagonist ( $M = 32.58$ ,  $SD = 6.45$ ).

Moreover, the food protagonist was rated as most agreeable ( $M = 42.65$ ,  $SD = 11.02$ ) followed by the protein powder protagonist ( $M = 39.27$ ,  $SD = 9.11$ ), the AAS protagonist ( $M = 37.41$ ,  $SD = 8.82$ ), and the EPO protagonist ( $M = 37.11$ ,  $SD = 9.06$ ).

There was no significant age or gender difference between participants in the four conditions. Similarly, there were no significant between-group differences for gender or the interaction of the experimental condition and gender.

Compared with general population norms from the US, mean neuroticism T-scores for the food protagonist was 'average' while the AAS and EPO protagonists' were 'high'. On the other hand, mean conscientiousness T-scores were 'average' while those for extraversion, openness, and agreeableness were 'low'.

## 4. Discussion

### 4.1 Main Findings

The main objectives of this thesis was to investigate the global lifetime prevalence of AAS use, and contribute to existing knowledge on the prevalence and attitudes towards AAS use among youth, as well as the construal of the personality or social image of AAS users. In this regard, three investigations were conducted. Study 1 is a meta-analytic investigation of the global prevalence of AAS use, and correlates of AAS use prevalence. Additionally, Study 2 is the first to examine the prevalence and attitudes towards AAS use in Sub-Saharan African, particularly Ghanaian, high school students. Study 3 is also the first to investigate observer perceptions of the personality of AAS users, non-users, and users of EPO and protein powder using the Five-Factor Model.

Study 1 showed that the global lifetime prevalence rate of AAS use is 3.3%. Due to the paucity of epidemiological evidence on AAS use in non-Western cultural contexts found in Study 1, Study 2 sought to contribute to the evidence base through a pioneering exploration of attitudes towards AAS use among Ghanaian high school students. The prevalence rates of AAS use found in Study 2 are similar to rates reported in similar studies from South Africa (Gradidge, Coopoo, & Constantinou, 2011), Australia (Dunn & White, 2011), Brazil (Andrade et al., 2012), Croatia (Kokkevi et al., 2008), Northern Mariana Islands and Puerto Rico (Lippe et al., 2008), and the United States (Miller et al., 2005).

Although subject to some limitations such as differences in samples studied within periods of comparison in Study 1, it can be inferred that the prevalence of AAS use dropped in the 1990s compared to the 1980s. This finding may be due to concern over AAS use and the enactment of landmark legislation against AAS use in many countries in the 1990s such

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as the 1990 Anabolic Steroid Control Act in the US, and the 1991 Act Prohibiting Certain Doping Substances in Sweden as previously discussed. Nonetheless, the increase in prevalence of AAS use between 2000 and 2013 compared with the 1990s is disturbing.

Moreover, the high global lifetime prevalence for high school students found in Study 1, as well as the high prevalence of lifetime use, exposure and contemplation among Ghanaian adolescents found in Study 2 is alarming. Altogether, the above findings indicate that use of AAS is a pervasive global public health problem.

When lifetime prevalence was examined by gender, males had a significantly higher prevalence than females in both Studies 1 and 2. Moreover, the percentage of males in samples significantly predicted prevalence in Study 1. In addition, AAS users consisted of a higher percentage of males in Study 2. Similarly, more males believed that the use of AAS would lead to an improvement in their sports performance and physical size or strength in Study 2. Indeed, female gender was associated with a negative attitude towards use of AAS for improved sports performance. In sum, these findings corroborate the common position in the field that use of AAS is higher among males than females. As noted previously, a possible explanation for this assertion is that the androgenic effects of AAS, such as hirsutism, deepening of the voice, and male-pattern baldness, do not encourage use of AAS by females (Pope & Kanayama, 2012).

Study 1 also showed that the regions with the highest prevalence of AAS use are the Middle East and South America. This finding may be due to the fact that most studies in these regions relied on self-reports from athletes and recreational athletes who have been found to be major users of AAS (Baker et al., 2008; Grace, Baker, & Davies, 2008). The fact that AAS and other human enhancement drugs are easily available on the illicit market and over-the-counter in the Middle East (Billinghurst, 2014; Swan, 2014; Wazaify et al., 2014;

Yeboah & Yeboah, 2014) and South America (Abrahin, de Souza, & Santos, 2014; Neves, Marcheti, & Caldas, 2013) may also explain this finding.

Additionally, in Study 1, use of AAS was shown to be most prevalent among recreational sportspeople and athletes, and least prevalent among nonathletes. Similarly, the proportions of athletes and recreational sportspeople who expressed their intention to use AAS in order to enhance their physique and strength were higher than the proportion among nonathletes although sports participation was not associated with use of AAS for improved sports performance in Study 2. Again, sample type (athletes) significantly predicted prevalence in Study 1. Altogether, these findings are consistent with evidence connecting sports participation to use of AAS (Dodge & Jaccard, 2006; Sagoe et al., 2014a) as could be inferred from the stress coping model (Wills & Hirky, 1996; Wills & Shiffman, 1985) that AAS are sometimes used in order to increase positive feelings from enhanced sports or occupational functioning (Sagoe et al., 2014a, 2014b). Additionally, in light of the health belief model, sports-motivated or associated AAS use can be perceived as emanating from the sportsperson's belief that his/her poor sports performance is a serious problem – perceived susceptibility and severity, that he/she can successfully use AAS (self-efficacy) in order to boost his/her sports performance – perceived benefits, despite the risk of failing a doping test – perceived barriers, upon the recommendation of his coach and AAS-using teammates – cues to action (Jalilian & Allahverdipour, 2012; Sagoe et al., 2014a).

Moreover, the high prevalence among prisoners and arrestees as well as drug users found in Study 1 supports evidence connecting AAS use to polypharmacy and criminality (Dodge & Hoagland, 2011; Lundholm et al., 2015; Sagoe et al., 2014c). In light of problem behavior theory (Jessor & Jessor, 1997), the present result corroborates previous findings



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linking AAS use to involvement in other deviant and risky behaviors (Miller et al., 2002, 2005; Pallesen et al., 2006; DuRant et al., 1995).

In line with the prediction in Study 3, the AAS user as well as the EPO user was perceived as significantly higher on neuroticism compared to the nonuser who was rated as ‘average’ on neuroticism with reference to US general population norms (Costa & McCrae, 1992; Rudow, Iacoviello, & Charney, 2014). Persons rated high on neuroticism have been found to have negative thoughts and feelings as well as various physical and psychological problems including substance use and dependence (Fridberg et al., 2001; Lahey, 2009). It can therefore be inferred that, apart from the enervating physical and psychological consequences previously discussed, perceptions of AAS use harms the social image or personality of the perceived user in line with findings from previous investigations (Chantal et al., 2009, 2013; Long, 1991; Schwerin & Corcoran, 1992; Van Raalte et al., 1993). This finding is explainable by the negative attitude towards AAS use and use of other doping methods in Norway (Breivik, Hanstad, & Loland, 2009; Skretting, 1993) as well as the illegal status of AAS use in Norway (Pallesen et al., 2014).

## 4.2 Implications

### 4.2.1 Implications for Practice

Findings from the studies included in the present thesis have important consequences for policymakers and health care professionals. In sum, findings from Study 1 indicate that nonmedical AAS use should be considered a major global public health problem. This is particularly the case in Ghana where Study 2 shows that a high proportion of Ghanaian high school students/youth have either used or been exposed to AAS use, with a sizeable proportion of nonusers contemplating use. Accordingly, there is the need for interventions by

policymakers and public health officials to combat this problem. Such public health interventions are necessary with the increased availability of AAS on the illicit market, especially the internet (Sagoe et al., 2014a).

Hence, anti-doping sensitization should be included in drug abuse education. Such interventions must take into consideration the finding from Study 2 that a large proportion of intended beneficiaries have links to users and contemplators who may misinform adolescents regarding the debilitating consequences of AAS use (Petróczi, Dodge, Backhouse, & Adesanwo, 2014; Sagoe, 2012; Sagoe et al., 2014a).

Additionally, in line with the finding from Study 3 that AAS use has a negative effect on perceptions of the personality or social image of the perceived user, anti-AAS use or anti-doping interventions should highlight this finding. This recommendation is consistent with findings from a recent review of adolescent-tailored preventive interventions (Petróczi et al., 2014) which found that messages addressing the harmful effects of AAS use on perceptions of the social image or personality of the user may be a more efficient mode of combating AAS use rather than highlighting only the harmful psychophysical effects of AAS use.

Besides anti-doping sensitization, it has been found that adolescent athletes are less likely to use a doping drug if the drug is likely to be detected by a drug test (Martin & Anshel, 1991). Hence, doping tests may be useful for combating students' use of AAS and other doping methods as a means of boosting the chances of securing sports scholarships.

Policymakers and clinicians or health workers involved in the effort to combat AAS use must consider these findings in developing preventive as well as treatment or therapeutic interventions for AAS users and at-risk populations.

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## 4.2.2 Implications for Future Research

There were diverse self-report measures of AAS use in the studies included in Study 1. It is therefore recommended that researchers use a standardized measure of AAS use devoid of the problems associated with self-report measures of AAS use. Moreover, results of Study 1 indicate the need for more epidemiological investigations of AAS use especially in Africa, the Middle East, South America, and Asia where there is a paucity of research. These efforts can contribute to future updates of the global prevalence estimates presented in Study 1.

It is also recommended in relation to Study 2 that future studies move towards a standard scale for assessing attitudes towards AAS use. Future studies should also investigate further how the ambition of securing sports scholarships influences students' decision to initiate AAS use. Additionally, future longitudinal investigations of high school students/adolescents and youth as well as other occupational groups the world over may provide useful psychological and epidemiological insight into AAS use.

Those who participated in Study 3 were tertiary education students in Norway. In consideration of indication that populations may possibly differ in perceptions of AAS users (Van Raalte et al., 1993), future studies with other populations such as athletes and security workers in the public and private sectors may contribute to available knowledge. Similarly, gender differences in the perception of AAS users' personality may be examined in future investigations through the use of a female protagonist. There is also the need for investigations into the influence of sources of doping methods on the perception of users' personality. Additionally, perceptions of the personality of persons who resort to 'legitimate' or 'permissible' ergogenic aids (e.g. dietary or nutritional supplements, or the services of sports psychologists) is an area that future studies may wish to explore. These

recommendations should be incorporated in future investigations especially in non-Western cultural contexts where there is a dearth of AAS research as found in Study 1.

## 4.3 Strengths and Limitations

### 4.3.1 Strengths

Study 1 represents the first-ever global epidemiological investigation of illicit AAS use. Hence, findings from Study 1 are the most reliable basis for developing interventions and future research. Other strengths of Study 1 include its global framework, the large number of both included studies and participants, and the analysis of the data using both meta-analysis and meta-regression analysis.

Similarly, Study 2 is a pioneering exploration of prevalence and attitudes towards AAS use among high school students/adolescents in sub-Saharan Africa, and Ghana in particular. The large sample and very high response rate are also notable strengths of Study 2.

The use of an experimental design with participants similar in group or condition size, age, and gender are strengths of Study 3. Moreover, the use of an implicit measure of prejudice and a well-validated personality measure (NEO FFI) is a notable strength of Study 3. Another merit of Study 3 is personality comparisons of the AAS user to the nonuser, the EPO user, and the protein powder user.

### 4.3.2 Limitations

One limitation of the studies included in this thesis has to do with the validity of self-reported AAS use. Kanayama et al. (2007b) have raised concerns about the validity of self-reported AAS use in epidemiological studies. Thus, problems associated with self-reported

AAS use such as the difficulty with differentiating AAS from over-the-counter supplements, especially when done retroactively, may have influenced the findings of Studies 1 and 2.

With reference to Study 3, it is not clear if personality ratings are influenced by the person making the ratings or by what is being rated (McCrae & Terracciano, 2005). Thus, observer perceptions are not insulated from the problems associated with self-reported AAS use.

Accordingly, the findings of Study 3 based on observer perceptions may also suffer from the validity issues facing self-reported AAS use discussed above.

Moreover, Studies 1 and 2 investigated lifetime prevalence of AAS use. Lifetime prevalence has some notable limitations. First, lifetime prevalence is usually higher than current prevalence due to the likelihood of cessation of use after initiation. Second, due to its retroactive nature, lifetime use is more susceptible to recall bias in comparison with current use. Third, in contrast to current use, it is difficult to validate lifetime use objectively using tests of, for instance, urine or blood samples (Pagonis, Angelopoulos, Koukoulis, & Hadjichristodoulou, 2006).

Another limitation of the studies included in this thesis is their generalizability. It is evident from Study 1 that there is a paucity of epidemiological studies of AAS use in many world regions, especially in Africa, Asia, the Middle East, and South America. This limits the generalizability of prevalence rates estimated for these regions. In Study 2, all five senior high schools from which data was collected were recruited from the Central Region of Ghana. Thus, findings from Study 2 may not be generalizable to high school students/adolescents in other regions in Ghana or parts of sub-Saharan Africa. Additionally, in Study 3 participants were tertiary students in Norway. Study 3's findings may face generalizability issues with Van Raalte et al.'s (1993) indication that different populations may perceive AAS users differently. Similarly, in the absence of Norwegian general

population norms for the NEO FFI, mean T-scores from Study 3 were compared to US norms. In the interpretation of this comparison, consideration must be given to potential contextual differences between Norway and the United States.

## 4.4 Conclusions

Findings from three investigations of AAS use are presented in this thesis. Results of Study 1 indicate that AAS use is a global public health problem that should attract the attention of public health officials and researchers the world over. Results of Study 2 also indicate a high prevalence of use as well as intention to use AAS among Ghanaian high school students. Moreover, results of Study 3 suggest that perceived use of AAS has debilitating consequences on public opinion of the personality of the perceived user. Findings from these studies have implications for AAS-related preventive and therapeutic interventions. Findings from these studies also elucidate areas that future investigations on AAS use can address.

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## Appendix A

The alarm clock rang. N put it in a 5-minute snooze. He repeated this six times before getting up. He showered, ate breakfast and got ready to go to the reading hall. He met a fellow student at the bus stop. N said hello to his fellow student and began a lively conversation with him. The bus arrived and N entered. After a few stops, a man with a big dog got onto the bus. The sight of the big dog gave N some palpitations and discomfort. When the bus stopped at the reading hall, there was a lady with a pram next to N. N did not offer to help her off the bus with the pram, and hurried off instead. When N finally came to the reading hall, he sat down at his usual place. He had sorted textbooks and notes in a neat and tidy order on the shelf in front of him. At 12:00, N went for a lecture. The lecture was about various complicated theories, but N nevertheless followed closely. When N returned to the dormitory that afternoon, one of those he lived with started to clean the kitchen. Despite the fact that it actually was this person's turn to be in charge of the kitchen, N still helped to cleanup. N enjoyed training at the gym and later packed his gym bag with the items he would need for his training session at the gym. Prior to this, he took [*food (1st condition), protein powder (2nd condition), EPO - a blood doping agent (3rd condition), anabolic steroid (4th condition)*]. He chose the shortcut across the cemetery on the way to training, even though it was dark and the cemetery was poorly lit. This did not bother him. On his way into the gym, he noticed that posters were displayed advertising courses in creativity. N had no interest in this and did not read the posters further. He then entered the fitness center and exercised. After returning home from training, N went through his usual evening routine and went to bed.

