Substance Use & Misuse, 50:139–147, 2015

ISSN: 1082-6084 print / 1532-2491 online
DOI: 10.3109/10826084.2014.958859

informa
healthcare

ORIGINAL ARTICLE

Prevalence and Correlates of Anabolic–Androgenic Steroid Use in a Nationally Representative Sample of 17-Year-Old Norwegian Adolescents

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***Background*: Anabolic–androgenic steroid (AAS) use has been identified as a serious public health problem. *Objectives*: This study investigates the prevalence and correlates of AAS use among Norwegian adolescents. *Methods*: In 2012, a nationally representative sample of 2,055 17-year-old adolescents (963 males and 1,088 females) participated in a survey. The response rate was 70.4%. In addition to questions about AAS use, participants completed the Parental Monitoring Scale, the Family Relations/Cohesion Scale, the Alcohol Use Disorders Identification Test C, the Mini-International Personality Item Pool-Five-Factor Model, the Eysenck Narrow Impulsiveness Subscale, the Arnett Inventory of Sensation Seeking, the Short-Form Buss–Perry Aggression Questionnaire, the Hospital Anxiety and Depression Scale, and the UCLA Loneliness Scale. They also answered questions about demography, gambling, smoking, snus, and narcotic use. Descriptive statistics and logistic regression were used to analyze the data. *Results*: The lifetime prevalence of AAS use was 0.30% (0.52% in males and 0.09% in females), while current prevalence was 0.25%. Moreover, 19.39% of the sample reported having an acquaintance who used or had used AAS. Having an acquaintance who used or had used AAS was significantly related to snus use, depression, aggression, extraversion, and conscientiousness in both univariate and multivariate logistic regression analyses. *Conclusions/Importance*: Our findings suggest a high prevalence of AAS use among Norwegian adolescents and denote the significance of social, personality, and health factors in adolescents' exposure to AAS milieu.**

Keywords anabolic–androgenic steroid, prevalence, Norway, adolescents, correlates

INTRODUCTION

Nonmedical anabolic–androgenic steroid (AAS) use was primarily limited to elite athletes and bodybuilders preceding 1980. However, in last few decades, the use of AAS has spread into the general population and is no longer limited to elite athletes and bodybuilders (Kanayama, Hudson, & Pope, 2008; Sagoe, Molde, Andreassen, Torsheim, & Pallesen, 2014). AAS are mainly used for increased muscle or physical strength, improved physical appearance, and enhanced sports performance (Sagoe, Andreassen, & Pallesen, 2014). Other motives for AAS use include increasing/boosting: aggression, the possibility of securing sports scholarships, concentration, confidence, occupational (non-sporting) functioning, personal security, psychological balance, physiological recovery or injury prevention, and sexual attraction (Sagoe, Andreassen, & Pallesen, 2014). AAS are presently used worldwide by millions of individuals, many of whom have no athletic ambitions (Kanayama, Hudson, & Pope, 2010; Parkinson & Evans, 2006; Sagoe et al., 2014).

Long-term AAS use has been associated with cardiovascular pathology, hypertrophy of sebaceous glands, and alopecia (Kuipers, 1998; Kuipers, Wijnen, Hartgens, & Willems, 1991; Urhausen, Albers, & Kindermann, 2004). In males, long-term AAS use has been associated with male-pattern baldness, reductions in the levels of endogenous testosterone and gonadotropic hormones, growth of mammary glands, gynecomastia, sperm motility, and changes in libido among other syndromes (Bahrke &

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Yesalis, 2004; Bonetti et al., 2008; Hoffman & Ratamess, 2006; Kuipers, 1998; Pope & Kanayama, 2012; Sehgal, Aggarwal, Srivastava, & Rajput, 2006). In addition to the aforementioned side effects, females may experience hirsutism, deepening of voice, clitoris hypertrophy, breast atrophy, menstrual disorders, and male pattern baldness as irreversible consequences of AAS misuse (Bonetti et al., 2008; Hoffman, 2002; Kuipers, 1998; Pope & Kanayama, 2012).

Psychologically, long-term AAS use has been mainly associated with aggression (Kanayama, Hudson, & Pope, 2008). Many AAS users also experience depressive symptoms upon withdrawal (Malone & Dimeff, 1992). There is also evidence of AAS dependence or addiction, where some individuals use AAS almost continuously disregarding its enervating consequences (Pope & Kanayama, 2012; Pope et al., 2013). AAS use is further associated with polypharmacy, as users resort to the use of other substances to either combat the side effects or enhance the effects of AAS, and to lose body fat (Dodge & Hoagland, 2011; Kanayama, Hudson, & Pope, 2008; Pope & Katz, 1988; Pope, Kouri, & Hudson, 2000).

Although AAS use by athletes is worrying, especially to the sporting community, concern has also been expressed over the higher levels of use occurring among recreational sportspeople (Baker, Thomas, Davies, & Graham, 2008) and by those who use AAS for aesthetic purposes (Bahrke & Yesalis, 2004; Monaghan, 2002). Moreover, there is concern emanating from the findings of studies of adolescents that indicate a high prevalence of AAS use. This is because apart from the harmful effects of long-term AAS use outlined above, use of AAS may also result in brain and neurological disorders, particularly in adolescence (Cunningham, Lumia, & McGinnis, 2013).

In a recent global epidemiological investigation, the lifetime prevalence of AAS use for high school students was 2.3% (Sagoe et al., 2014). In a study of Australian adolescents, the lifetime prevalence of AAS use for males was 3.1% and 1.7% for females (Dunn & White, 2011), whereas the corresponding figures from another study of American adolescents were 1.7% and 1.1% respectively (Lorang, Callahan, Cummins, Achar, & Brown, 2011). In a study of Norwegian adolescents, Wichstrøm and Pedersen (2001) found lifetime prevalence of 1.2% in males and 0.6% in females. In addition, Wichstrøm (2006) found a lifetime prevalence of 1.9%, while Pallesen, Jøsendal, Johnsen, Larsen, and Molde (2006) found a lifetime prevalence of 2.1% in Norwegian adolescents.

In order to avert the problem of AAS use, it is important that trends in the prevalence and etiology of AAS use are monitored and understood. Moreover, exposure to substances usually precedes substance use and misuse. Indeed, social learning theory suggests that behavior spreads in a community through the process of observational learning from media and models such as family, friends, and significant others (Bandura, 1977). According to Zinberg (1974), substance use is learnt unconsciously as part of a living experience. Hence, an investigation of both spread and prevention of AAS use in social milieu is an indispensable part of the goal of understanding and combating this public health problem. Moreover, investigations of the characteristics of persons who have acquaintances using AAS are warranted, as such investigations may assist in the understanding of the correlates of exposure to AAS (Pallesen et al., 2006). The present study sought to investigate the prevalence and predictors of adolescent exposure to AAS. This study uses data collected in a nationally representative sample of 17-year-old adolescents in Norway. The second goal was to investigate the correlates of adolescent exposure to AAS.

METHODS

Participants

The initial sample comprising 3,000 (1,500 males) adolescents was randomly selected from the Norwegian National Registry. Of the 3,000 adolescents contacted, 2,059 completed the questionnaire yielding a response rate of 70.4% (i.e. 2,059 of 2,923 adolescents), excluding 54 who could not be reached due to invalid addresses and 23 whose parents informed us that their children were unable (e.g., intellectual disability) to take part in the study. Four respondents were further excluded because they were less than 17 years of age. Thus, the final sample comprised 2,055 adolescents consisting of 963 males and 1,088 females. Four participants did not indicate their gender. The mean (M) age of the sample was 17.0 years ($SD = 0$). The average number of siblings was $M = 2.11$ ($SD = 1.38$). Table 1 presents the distribution of the scores of categorical predictor variables.

Measures

The survey questionnaire contained items assessing demographic information such as age, gender, living situation, and parents' education. Participants also provided information about (a) whether they had ever used AAS (yes/no), (b) whether they were currently using AAS (yes/no), (c) for how many months had they used AAS, and (d) whether they had an acquaintance who used or had ever used AAS. They also provided information about whether or not they had ever smoked cigarettes, used narcotics or snus, or had gambled in the previous month.

Alcohol misuse was assessed using the Alcohol Use Disorders Identification Test C (AUDIT C; Saunders et al., 1993). AUDIT C has three items to be answered along a 5-point response scale scored from 0 to 4. An example item is "How often do you have a drink containing alcohol?" Response options ranged from "never" (0) to "4+ times per week" (4). A total score was computed with a score of 5 or above indicating alcohol misuse. AUDIT C yielded a Cronbach's alpha of .77.

Participants' perceived level of parental monitoring was measured using the Parental Monitoring Scale (PMS; Silverberg & Small, 1991). The PMS has six items (e.g., "If I am going to get home late, my parents expect me to call them") answered along a 5-point response scale ranging from "never" (1) to "always" (5). Three items were reverse scored. A total score was computed by adding participants' scores across all items. The PMS was found to have a Cronbach's alpha of .85.

TABLE 1. Demographic distribution of categorical predictor variables

Variables	Frequency	%
Gender		
Female	1,088	53.0
Male	963	47.0
Living situation		
Both parents	1,271	62.0
Single parent	418	20.4
Shuttling between parents	187	9.1
Alone	53	2.6
Household/dormitory	21	1.0
Other	100	4.9
Father's education		
≤ High school	219	11.0
> High school	1,174	89.0
Mother's education		
≤ High school	163	8.1
> High school	1,851	91.9
Alcohol		
AUDIT C < 4	281	19.4
AUDIT C ≥ 5	1,170	80.6
Cigarrete		
No	1,788	87.3
Yes	259	12.7
Snus		
No	1,669	81.5
Yes	378	18.5
Narcotics		
No	1,641	80.9
Yes	387	19.1
Past month gambling		
No	1,530	74.5
Yes	523	25.5
Anxiety		
HADS Anxiety ≤ 7	1,490	73.7
HADS Anxiety > 7	531	26.3
Depression		
HADS Depression ≤ 7	1,809	89.5
HADS Depression > 7	212	10.5

The Family Relations/Cohesion Scale (FRCS; Oregon Mentors, 2013) was used to assess the perceived level of family cohesion. Items are answered on a 4-point Likert scale from "not true" (1) to "always true or almost always" (4) (e.g., "Family members like to spend free time with each other"). An index family cohesion score was computed by adding participants' scores on the six items. The Cronbach's alpha for FRCS was .84.

Personality was measured with the Mini-International Personality Item Pool-Five-Factor Model (Mini-IPIP; Donnellan, Oswald, Baird, & Lucas, 2006). The Mini-IPIP is a 20-item short form of the 50-item International Personality Item Pool-Five-Factor Model measure (Goldberg, 1999). Each of the Big Five personality dimensions of extraversion, agreeableness, conscientiousness, neuroticism, and intellect/imagination were assessed by the following five example items: "I don't talk a lot," "I sympathize with others' feelings," "I get chores done right away," "I get upset easily," and "I have difficulty understanding abstract ideas." All items are answered on a 5-point scale ranging from 1 (very inaccurate) to 5 (very accurate). For each of the personality traits, an index score was calculated by summing participants' responses on the corresponding items. Cronbach's alpha values were .79 for extraversion, .71 for agreeableness, .66 for conscientiousness, .65 for neuroticism, and .62 for intellect/imagination.

Impulsivity was assessed with the Eysenck Impulsivity Scale—Narrow Impulsiveness Subscale (EIS-nI; Eysenck & Eysenck, 1977). The EIS-nI has 13 items about specific impulsive behaviors (e.g., "Do you often buy things on impulse?"). Respondents indicate whether they typically act as the question describes (yes) or not (no). "Yes" responses were coded as "1" and "no" responses were coded as "0." An index impulsivity score was computed by adding the scores across all items. Cronbach's alpha was .74.

Sensation seeking was measured by means of the 20-item Arnett Inventory of Sensation Seeking (AISS; Arnett, 1994). The AISS measures two dimensions of sensation seeking: novelty and intensity. Respondents indicate how well statements describe them on a 4-point Likert scale ranging from "Describes me very well" (4) to "Does not describe me at all" (1) (e.g., "When I listen to music, I like it to be loud"). The Cronbach's alpha of the AISS was .64.

Aggression was measured with the seven-item Short-Form Buss–Perry Aggression Questionnaire (BPAQ-SF; Diamond & Magaletta, 2006). The BPAQ-SF consists of the following four subscales: physical aggression, verbal aggression, anger, and hostility. In this study, we used items from the physical and verbal aggression subscales only. Respondents rated the items on a 5-point scale ranging from "very unlike me" (1) to "very like me" (5) (e.g., "I have trouble controlling my temper"). The BPAQ-SF had a Cronbach's alpha of .82.

Anxiety and depression were assessed with the 14-item Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS consists of two subscales: a seven-item anxiety subscale and a seven-item depression subscale. "I feel tense or wound up" and "I feel cheerful" are example items for assessing anxiety and depression, respectively. All items are rated on a 4-point scale scored from 0 to 3. Thus, an index score was computed for each subscale with a score of 7 or above on either subscale indicating clinical anxiety or depression. Cronbach's alphas were .76 for HADS anxiety and .69 for HADS depression.

Loneliness was measured with Robert's UCLA Loneliness Scale (RULS-8; Roberts, Lewinsohn, & Seeley, 1993). RULS-8 has eight items answered along a 4-point scale ranging from "never" (1) to "often" (4) (e.g., "I lack companionship"). Four items were reverse-coded and a composite score was computed by summing participants' responses on all items. RULS-8 yielded a Cronbach's alpha of .76.

Procedure

An initial sample comprising 3,000 17-year-old adolescents (1,500 males) was randomly selected from the Norwegian National Registry and contacted by mail with

an invitation to participate in the study. The invitation letter described the purpose of the study, indicated that the study was conducted by researchers at the University of Bergen, Norway, assured respondents that the information they provided would be kept confidential, and mentioned that all participants would receive a gift card worth NOK 200 (about € 27) as compensation for participating in the study. The questionnaire package was sent after a week of sending the invitation letter. The package included an introductory letter with sections on confidentiality, informed consent, the questionnaire, and an instruction document on how to complete and return the questionnaire in a pre-paid envelope. Those who acquiesced to the request to participate could choose either completing an online version of the questionnaire (web link provided in the instruction document) or the paper version. Two reminders were sent to those who did not reply.

Statistical Analysis

The data were analyzed using SPSS version 20 (IBM Corp., 2011). Descriptive statistics were used to generate frequencies for categorical predictors. We planned to use univariate and multivariate logistic regression analyses to identify factors related to the two dependent variables (lifetime use of AAS, and having an acquaintance who used or had ever used AAS). The predictor/independent variables were gender, number of siblings, grade point average, living situation, father's education, mother's education, parental monitoring, family cohesion, aggression, personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and intelligence/imagination), impulsivity, sensation seeking (novelty and intensity), loneliness, alcohol use (AUDIT C score < 4/AUDIT C score ≥ 5), smoking (yes/no), snus use (yes/no), narcotic use (yes/no), past month gambling (yes/no), symptoms of anxiety (HADS anxiety score ≤ 7/HADS anxiety score > 7), and symptoms of depression (HADS depression score ≤ 7/HADS depression score > 7).

RESULTS

Prevalence of AAS Use

The estimated lifetime prevalence of AAS use was 0.30% (95% Confidence Interval (CI) = 0.28−0.32). In addition, current prevalence was 0.25% (95% CI = 0.23−0.30). The estimated prevalence of AAS use for males was 0.52% (95% CI = 0.47−0.53) and 0.09% (95% CI = 0.084−0.096) for females. Furthermore, 19.39% (95% CI = 19.37–19.41%) of the sample reported having an acquaintance who was a current or former AAS user.

Predictor Analysis

Due to very low lifetime and current prevalence rates found in this study, we could not conduct predictor analysis for these prevalence rates. We, however, conducted predictor analysis for having an acquaintance who used or had ever used AAS.

Thus, Table 2 shows the results from logistic regression analysis for having an acquaintance who used or had ever used AAS. This criterion was significantly related to admitting snus use, HADS depression score of above 7, aggression, extraversion, and conscientiousness in both univariate and multivariate logistic regression analyses. Living situation, paternal education above high school, AUDIT C score higher than 4, cigarette smoking, illicit narcotic use, past month gambling, HADS anxiety score of above 7, number of siblings, grade point average, parental monitoring, family cohesion, neuroticism, intelligence/imagination, impulsivity, and sensation seeking (novelty and intensity) were only significantly related to lifetime use of AAS by an acquaintance in the univariate logistic regression analysis. Gender, maternal education, agreeableness, and loneliness were unrelated to lifetime use of AAS by an acquaintance in both univariate and multivariate logistic regression analyses.

DISCUSSION

The lifetime prevalence of adolescent AAS use in this study (0.3%) is the lowest estimate reported by any Norwegian study to date. It is lower than the previous estimates of 0.8%, 1.9%, and 2.1% reported by Wichstrøm and Pedersen (2001), Wichstrøm (2006), and Pallesen et al. (2006) respectively. The overall lifetime prevalence is however similar to rates reported in studies from the United States (Field et al., 2005), Brazil (De Micheli & Formigoni, 2004), and South Africa (Schwellnus, Todd, & Juritz, 1992).

The lifetime prevalence of AAS use in males is comparable to similar studies from the United States (Field et al., 2005) and Germany (Wanjek, Rosendahl, Strauss, & Gabriel, 2007). In addition, the lifetime prevalence of AAS use in females is similar to the rate reported by Pallesen et al. (2006). It is also similar to the rates reported in studies from the United States (Kanayama, Boynes, Hudson, Field, & Pope, 2007), Sweden (Kindlundh, Isacson, Berglund, & Nyberg, 1998), Iceland (Thorlindsson & Halldorsson, 2010), South Africa (Lambert, Titlestad, & Schwellnus, 1998), and Brazil (Andrade et al., 2012). The results also corroborate the popular position that prevalence of AAS use is significantly higher in males than in females (Sagoe et al., 2014).

Some factors may explain our finding of a low prevalence rate of AAS use among Norwegian adolescents. The age of our sample is the first factor. Unlike the studies of Norwegian adolescents mentioned previously, we sampled only 17-year-old adolescents. In line with evidence that the majority of AAS users begin using AAS in their twenties (Kanayama, Brower, Wood, Hudson, & Pope, 2009; Kanayama, Pope, Cohane, & Hudson, 2003; Miller et al., 2005), the low prevalence rate is understandable. Indeed, Pope et al. (2013) indicate that only about 2% of AAS users have their AAS debut before the age of 17, and only about 6% start using before the age of 18. In contrast, about 30% of AAS users initiate use before the age of 21. It can therefore be inferred that even a slight difference in the age distribution of adolescent participants between studies can yield a very large difference in the

TABLE 2. Logistic regression analysis of predictors of having an acquaintance who uses or has used AAS

Variables	Odds ratios (95% confidence interval) Crude	Adjusted[a]
Gender		
Female	1.00[b]	1.00[b]
Male	1.15 (0.92–1.44)	1.21 (0.83–1.75)
Living situation		
Both parents	1.00[b]	1.00[b]
Single parent	1.60 (1.22–2.10)*	0.95 (0.65–1.39)
Shuttling between parents	1.57 (1.08–2.28)*	1.44 (0.89–2.33)
Alone	2.01 (1.09–3.73)*	2.37 (0.83–6.81)
Household/dormitory	4.64 (1.95–11.06)*	4.92 (0.95–25.59)
Other	1.29 (0.77–2.16)*	1.24 (0.57–2.69)
Father's education		
≤ High school	1.00[b]	1.00[b]
> High school	0.72 (0.51–1.00)*	0.80 (0.50–1.28)
Mother's education		
≤ High school	1.00[b]	1.00[b]
> High school	0.87 (0.59–1.29)	0.88 (0.49–1.60)
Alcohol		
AUDIT C < 4	1.00[b]	1.00[b]
AUDIT C ≥ 5	2.13 (1.49–3.07)*	1.16 (0.74–1.81)
Cigarretes		
No	1.00[b]	1.00[b]
Yes	2.98 (2.25–3.94)*	0.99 (0.65–1.51)
Snus		
No	1.00[b]	1.00[b]
Yes	3.14 (2.45–4.02)*	1.69 (1.18–2.43)*
Narcotics		
No	1.00[b]	1.00[b]
Yes	2.29 (1.78–2.95)*	1.12 (0.78–1.59)
Past month gambling		
No	1.00[b]	1.00[b]
Yes	1.34 (1.05–1.71)*	0.93 (0.67–1.30)
Anxiety		
HADS Anxiety ≤ 7	1.00[b]	1.00[b]
HADS Anxiety > 7	1.65 (1.30–2.09)*	1.22 (0.83–1.80)
Depression		
HADS Depression ≤ 7	1.00[b]	1.00[b]
HADS Depression > 7	1.93 (1.40–2.67)*	1.65 (1.00–2.72)*
Personality		
Extraversion	1.48 (1.29–1.70)*	1.43 (1.13–1.80)*
Agreeableness	1.01 (0.85–1.18)	1.01 (0.77–1.31)
Conscientiousness	0.85 (0.73–0.98)*	1.40 (1.12–1.76)*
Neuroticism	1.32 (1.15–1.51)*	1.10 (0.87–1.39)
Intelligence/imagination	1.38 (1.13–1.70)*	1.11 (0.84–1.47)
Sensation seeking		
Novelty	1.90 (1.44–2.52)*	1.51 (0.98–2.34)
Intensity	2.29 (1.78–2.93)*	1.19 (0.75–1.67)
Number of siblings	1.07 (0.99–1.16)	1.07 (0.95–1.20)
Grade point average	0.68 (0.59–0.80)*	0.93 (0.74–1.17)
Parental monitoring	0.63 (0.54–0.73)*	0.95 (0.75–1.21)
Family cohesion	0.70 (0.57–0.85)*	0.92 (0.66–1.28)
Aggression	1.11 (1.09–1.13)*	1.06 (1.03–1.10)*
Impulsivity	1.19 (1.14–1.24)*	1.04 (0.97–1.10)
Loneliness	1.04 (0.99–1.09)	1.05 (0.98–1.12)

Notes: $^{*}p < .05$.
[a]Odds ratios adjusted for all other variables in the table.
[b]Reference class.

prevalence of AAS use. Specifically, our finding that 0.3% of 17-year-old Norwegian adolescents have initiated AAS use suggests that many more may initiate use in their mid-twenties. Thus, although the 0.3% estimate in the present study seems quite low, it indicates that in fact rates of AAS use are high in Norway considering the very young age of our sample.

In addition, the percentage of adolescents having an acquaintance who uses or has used AAS (19.4%) is much lower than the rate (27.9%) reported in a similar Norwegian study by Pallesen et al. (2006). Again, the very young age of our sample is a plausible explanation for the low rate in our study. Nevertheless, this finding indicates that thousands of adolescents have been exposed to AAS. Thus, use of AAS should be considered a serious public health problem in Norway.

Our finding that aggression is significantly related to adolescent exposure to AAS suggests a connection between aggressive adolescents and aggressive and violent behavior of AAS users (Beaver, Vaughn, DeLisi, & Wright, 2008; Kanayama, Hudson, & Pope, 2008). Thus, AAS users may be serving as models for aggressive adolescents. Indeed, aggression has been found to be a significant predictor of AAS use in a study of Norwegian adolescents (Wichstrøm & Pedersen, 2001).

Of the Big Five personality traits, extraversion and conscientiousness were significantly related to exposure to AAS. The association between extraversion and exposure to AAS is explainable by evidence that extraverted behavior facilitates the initiation and maintenance of social relationships (Ashton, Lee, & Paunonen, 2002), broadcasts social characteristics to others (Anderson & Shirako, 2008), and increases person's rate of exposure to communicable syndromes (Schaller & Murray, 2008).

Taylor and de Bruin (2006) define conscientiousness as the extent of effectiveness with which an individual strategizes, organizes, and carries out tasks. Given that conscientious individuals are described as being well organized, reliable, and purposeful (Taylor & de Bruin, 2006), it was not surprising that conscientiousness had a significant negative association with exposure to AAS in the univariate logistic regression analysis. However, conscientiousness was positively associated with exposure to AAS in the multivariate logistic regression analysis. It could however be argued that conscientiousness contributes to exposing adolescents to AAS users in their social network due to the motivation to appear socially competent and free of distress. This viewpoint is supported by evidence that low conscientious adolescents with relatively high exposure to adverse life events are more socially competent whereas adolescents who are high on conscientiousness have lower levels of social competence (Shiner & Masten, 2012). We found further support for this proposition in the result that depression is significantly associated with exposure to AAS. This finding indicates that depression may be an antecedent of AAS use rather than a consequence as suggested previously (Corrigan, 1996; Pope & Katz, 1992). It is however worth noting that the cross-sectional design used in the present study does not enable us to conclude upon any causal relationship between depression and exposure to AAS.

In addition, our finding that use of snus or moist snuff is significantly associated with exposure to AAS lends support to evidence that exposure to AAS occurs as part of a pattern of substance use and risk-taking behavior (Miller et al., 2005). However, exposure to AAS was associated with gambling, impulsivity, sensation seeking, alcohol, cigarette, and narcotic use only in the univariate logistic regression analysis. Nevertheless, the association between exposure to or actual use of AAS and polypharmacy-cum-risk-taking behavior is well established (Dodge & Hoagland, 2011; Miller et al., 2005; Pallesen et al., 2006).

Moreover, gender was not associated with exposure to AAS, indicating that both male and female adolescents are at equal risk of exposure to AAS. Given the established relationship between male gender and AAS use (Sagoe et al., 2014), this result is surprising. Nonetheless, this result corroborates the finding of Pallesen et al. (2006). The relative gender equality in Norwegian society is a plausible explanation for our finding. Similarly, the relative socioeconomic equity in Norwegian society may also explain why socioeconomic status was not associated with exposure to AAS. Furthermore, there is preponderant evidence that AAS users have histories of low parental involvement or connectedness (Sagoe, Andreassen, & Pallesen, 2014). It was thus surprising that parental monitoring and family cohesion were not associated with exposure to AAS in the present study.

Strengths and Limitations

Some strengths of the present study are the inclusion of a large nationally representative sample with a very good response rate, and several well-validated measures. Nevertheless, some limitations ought to be noted. First, the lifetime and current prevalence rates discovered in this study were very low. Hence, our ability to determine correlates of AAS use among adolescents was restricted. Thus, we investigated correlates of adolescents' exposure to AAS use. The cross-sectional survey used in the present study also hindered the drawing of causal conclusions. Moreover, although self-reports have the advantage of eliciting data from a large number of individuals in an ethical and relatively inexpensive manner, there is concern regarding the validity of reporting on a self-administered survey, especially when self-reports are not validated against objective criteria or data from other sources. Indeed, Kanayama et al. (2007) highlight the exaggeration of AAS use prevalence rates emanating from responses to unclear and sometimes invalid questions. In addition, the suspicion of AAS use by others may also suffer from the validity issues associated with self-reported AAS use discussed above.

Implications for Practice and Future Research

Anabolic–androgenic steroid use prevention programs to a large extent target elite "latter-stage" adolescent athletes (Elliot et al., 2004; Goldberg et al., 2000; Mottram, Chester, & Gibson, 2008), and also primarily focus

on fear-arousing appeals, emphasizing the debilitating effects of AAS use (Lombardo & Sickles, 1992). However, as many adolescents have access to models who use AAS, the messages of serious harmful consequences may not be perceived as tangible (Pallesen et al., 2006), particularly when use may be entrenched at the latter stages of adolescence. Education also needs to be directed at adolescents who may have a tendency toward high-risk behavior. Once it is determined that an adolescent has used one substance, education about the harmful effects of AAS use should also be addressed.

Moreover, it is important that AAS education be included in interventions and campaigns against substance use. We also recommend that future studies explore the relationship between exposure to AAS and exposure to other substances. Future studies should also explore how the correlates of adolescent exposure to AAS operate after the initiation and/or discontinuation of AAS use. Furthermore, we recommend that future studies move toward using longitudinal designs in prevalence studies of AAS use not only in adolescents but also in other age and occupational groups.

CONCLUSIONS

Although subject to some limitations, our findings indicate a high prevalence of AAS use among Norwegian adolescents. The prevalence rates in the present study are similar to the results from other epidemiological studies of adolescents. Our results also suggest that snus or dipping tobacco use, depression, aggression, extraversion, and conscientiousness are important correlates of adolescents having AAS milieu. Hence, our findings demonstrate the significance of social, personality, and health factors in adolescents' exposure to AAS or development of AAS milieu. These findings may be useful to health practitioners, educators, parents, and other stakeholders in educating youth and improving AAS use interventions.

Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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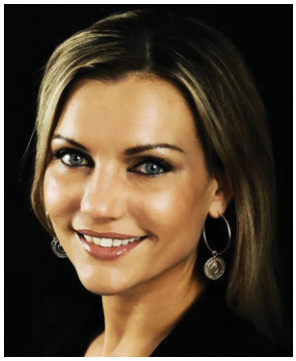

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GLOSSARY

Anabolic–androgenic steroid (AAS): A group of hormones, including testosterone and its synthetic derivatives, increasingly being misused by some healthy persons mainly for the improvement of sports performance as well as enhancement of physical appearance and strength.

Correlate/predictor: A factor or variable that has an influence or effect on an outcome variable.

Prevalence: Fraction of a population or group exhibiting a risk factor, disorder, or condition. It is usually presented as percentage.

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