The time devoted to sport activities is associated with different risk of exercise addiction and alcohol use disorder

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Abstract

Although sport activities have beneficial effects on health, excessive practice can lead to exercise addiction (EA). Previous studies have shown comorbidity between EA and alcohol use disorder, but how we could conciliate this observation with the positive effects of sport requests further research. This study aims to investigate the relationship between a proxy of alcohol use disorder and sport practice, more specifically focusing on EA, in a representative sample of the French population.

Two thousand and two participants were recruited online and selected to represent the French adult population. Participants were asked to answer questions regarding sport activity, with the EAI questionnaire investigating exercise addiction, and alcohol consumption, with the CAGE questionnaire investigating a proxy of alcohol use disorder (score≥2).

Alcohol use and alcohol use disorder were associated with a higher risk of exercise addiction and with more time devoted to collective sports (such as football) and two-person sports (such as tennis). The risk of alcohol use disorder seems to increase with the level of physical activity for collective sport, but to decrease for individual sports (such as running).

Results support the hypothesis that the time devoted to different types of sport have different risks for exercise addiction (individual sports being more clearly concerned) and alcohol use disorder (especially for collective sports). Furthermore, the observed association between sport addiction and alcohol use disorder showes that the detrimental effect of sport on the risk of alcohol use disorder could be mediated by high level of sport activities. The social dimension of collective sports should be further investigated to facilitate preventive approaches.

Key words: exercise addiction, alcohol, sport, addiction, physical activity

Introduction

Sport is widely recognized and promoted as a positive factor regarding lifetime and health (Wen et al., 2011; Allegre, Therme & Griffiths, 2017). Practice of all types of sport has beneficial effects regarding physical conditions, such as cardiovascular aspects (Ozemek et al., 2019) as well as psychiatric conditions, such as anxiety disorders, depression and addictive disorders (Cooney et al., 2013).

However, despite these positive outcomes highlighted by health professionals, literature also points out that excessive practice can become harmful. In 1970, Baeckland was the first to underline this hypothesis, and from then emerge the concept of "exercise addiction" (EA).

During the next five decades this concept was further established, and described as physical (Hailey & Bailey, 1982) and psychological (Chan et al., 1988) withdrawal symptoms consequently to the interruption of physical exercise, and a set of specific symptoms (Griffiths et al., 2005) such as mood modifications, tolerance, conflict regarding close relationships, family and professional obligations, and risk of relapsing after a period of abstinence. According to substance use disorders criteria in the DSM 5, EA is currently defined by the presence of recurring patterns of physical exercises (i.e. compulsions), leading to physical and/or psychological distress (Down, Hausenblas & Nigg, 2004).

In a previous study conducted among sport clubs' members (Bingol et al., 2016), EA was more frequently observed in certain types of sports (such as boxing, Mai Tai and fight) than others (such as handball, football and basketball). Furthermore, a systematic literature review conducted by our team suggested that different types of sports are differently associated with EA vulnerability; endurance (i.e. a more individual rather than collective type of sport) being associated with the highest proportion of EA (Di Lodovico & Gorwood, 2019).

Literature also highlight that exercise addiction can be associated with psychiatric comorbidities such as depression and anxiety (Murray, McKenzie et al., 2013; Chapman & De Castro, 1990). However, there is a large variability among previous studies on the prevalence of EA (Szabo et al., 2015), and few epidemiologic data are available regarding the general population (Petit & Lejoyeux, 2013). Moreover, factors associated with a higher risk of EA still need to be further determined (Mayolas et al., 2017).

On the other hand, in the field of addiction, sport is frequently used as a therapeutic tool by medical professionals, and its therapeutic properties have been previously investigated

during withdrawal process (Ellingsen et al., 2018) or consolidation of abstinence (Weinstock et al., 2017). Previous literature regarding the beneficial effect of sport in substance use disorders mainly focuses on Alcohol Use Disorder (AUD). A recent meta-analysis (Giesen et al., 2015) aiming to investigate the benefit of sport intervention on AUD highlighted beneficial effects such as reduction of craving intensity, longer duration of abstinence, and lower frequency of consumptions.

Leasure and his colleagues (2015) recently questioned the benefit of sport for all patients, and proposed instead to adapt sport intervention according to patients' profile regarding request for treatment, motivation to quit, and modality of consumption (i.e. compulsive versus impulsive drinking). Furthermore, few studies have been focusing on investigating the risk of dependence-transfer from alcohol to physical exercise, despite this risk has already been shown in a large study (Conroy et al., 2015).

Previous studies showed that exercise addiction may co-occur with other behavioral addiction (Lejoyeux et al., 2008; Muller et al., 2015; Villella et al., 2011), and eating disorders appears to be one of the most frequently disorders co-occurring with EA (Bamber et al., 2003). Co-occurrence between substance use disorders (SUD) and behavioral addictions has also been supported by many studies (Di Nicolas et al., 2014), but the relationships between SUD and EA appears more obscure, and contradictory results emerge from the literature. In a study conducted among substance users, a significant part of patients had an history of intense sport practice (Jacobs et al., 1993), and 15% to 20% percent of patients with EA suffered nicotine, alcohol or illicit drug use disorder (Aidman & Woollard, 2003; Sussman, Lisha & Griffiths, 2011). Previous results converge regarding substances associated with potential increas of athletic performances, such as amphetamines, cocaine or caffeine (George, 2000; National Institute on Drug Abuse, 2009).Tobacco or alcohol appears to draw more divergent results (Allegre, Souville, Therme & Griffiths, 2006; Szabo et al., 2018; Lejoyeux et al., 2008; Martin et al., 2008), and to our knowledge, no study aimed to specifically investigate the relationship between EA and AUD, especially distinguishing the different types of sport.

This study aims to investigate the relationship between the time devoted to sport practice, its potential association with exercise addiction, and alcohol use disorder, using a proxy generated by the CAGE questionnaire, in a large representative sample of the French general population. The main hypothesis was that there would be a significant association between the risk of exercise addiction, the time devoted to physical activity, and alcohol use.

We also hypothesize that certain types of sports might be more at risk, and more specifically we expect that individual sports (vs. collective sports) would be associated with higher risk of EA.

Method

Participants and procedure

This study was conducted by a French institute (GFK ® ISL CR France) during eight consecutive days, analyzing 2002 individuals selected for their capacity to represent the French adult population, based on age, gender, socio-professional statute and geographical location. All participants were 18 years old or older, and were extracted from a panel of 60,000 French citizens (Online Panel GfK® ISL).

Participants were recruited onlinefollowing the usual procedure of the institute. They were asked to answer a specific set of questions regarding socio-demographic characteristics, sport activity and alcohol consumption.

All participants received a letter of information and gave their written consent to participate. The study was conducted according to ethics recommendations in the Helsinki declaration (World Medical Association, 2013).

Assessments

Socio-demographic data

Participants were asked to answer socio-demographic questions regarding age, gender, professional and marital status, and geographical location.

Sport activity

Sport activity has been assessed with weekly duration of sport practice and types of sport (collective sports such as football or rugby, two-person sports such as tennis or squash, and individual sports such as jogging or athleticism).

Sport practice intensity was assessed using quantitatively for the three types of sports, and categorized, for reason of simplicity, as: "*no physical activity*" (0min/week), "*low level of physical activity*" (1 to 120min/week), "*medium level of physical activity*" (121 to 240 min/week) and "*high level of physical activity*" (more than 241 min/week).

Finally, participants were asked to answer the *Exercise Addiction Inventory* (EAI) (Griffiths, Szabo & Terry, 2005), a self-reported inventory investigating the risk for exercise addiction. The EAI includes 6 items, and answers are given on a 5-point Likert scale from "*strongly agree*" to "*strongly disagree*". Our sample was divided in two groups: people not at risk of developing EA (EAI score<23), and people at risk of developing EA (EA score>23), as proposed by the author (Griffiths, Szabo & Terry, 2005).

Alcohol consumption

Alcohol consumption has been assessed by measuring frequency of consumptions and by the CAGE questionnaire (Mayfield et al., 1974), a self-report questionnaire including 4 items: (1) "*Have you ever felt you should cut down on your drinking?*", (2) "*Have people annoyed you by criticizing your drinking?*", (3) "*Have you ever felt bad or guilty about your drinking?*", (4) "*Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover?*". Answers are given on a Yes/No scale. The CAGE is a widely used screening instrument (Reid et al., 1999) that has been shown to demonstrated good psychometric properties among the general population (Dhalla & Kopec, 2006). A total score of 1 is considered as "*at risk for AUD*", and 2 or greater as a valid proxy of alcohol use disorder (Dhalla & Kopec, Fiellin et al., 2000). Our sample was divided in two groups: people with a proxy of alcohol use disorder (CAGE score ≥2) were compared with the rest of the sample (CAGE score ≤ 1).

Data analysis

Data analysis was conducted with SPSS (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Descriptive analysis was performed on quantitative data (mean, standard deviation) and qualitative data (percentage). Data analysis includes: (1) chi-square test and Cochran-Armitage test in order to investigate frequency differences between groups, (2) comparison analysis using analysis of variance and t-test, and (3) correlation analysis and linear regression analysis. Previously, normal distribution of variables was checked using Kolmogorov-Smirnov Test.

Results

Socio-demographic characteristics and descriptive analysis are presented in *table 1*.

Socio-demographic characteristics

A total of 2,002 participants replied to the survey, and Chi-square test indicate that they were not significantly different from the French population according to gender, age, socio-professional and marital status and geographical location ($p>.05$). Among all participants, 51.25% of them were female, 59.04% were currently working, and the mean age was 45 years old (SD=16).

Alcohol consumption

Three-hundred and fifteen participants (15.73%) can be consider as having alcohol use disorder (CAGE superior or equal to 2). They have a higher frequency of drinking compared to others participants ($t=15.75$, $df=2000$, $p<.01$), and a higher proportion of men (64.13%, $\chi^2=35.37$, $df=1$, $p<.01$).

Physical activity

Nine hundred and eighty-six participants (49.25%) declared having no sport activity. Concerning the rest of the sample, the median value was one hour per week for two-person sport, two hours per week for both individual and collective sports, and three hours per week for all types of sports (*table 1*).

In our sample, 103 participants (5.4%) can be consider at risk of exercise addiction (EAI>23). Those participants were younger ($t=6.43$, $df=1$, $p<.01$), have a slightly higher proportion of men ($\chi^2=2.48$, $df=1$, $p=.07$) and practiced more types of sports ($t=8.64$, $df=1$, p $p<.01$). They were not evenly distributed among the different types of sport ($\chi^2=25.59$, $df=2$, p $p<.01$), individual sports being the most represented (69.90%) among participants with exercise addiction, followed by collective sports (48.54%) and two-person sports (34.95%) (*table 1*).

Compared to participants not at risk of exercise addiction, they engage significantly more frequently in sport practice ($p<.01$), and especially in collective sports ($p<.01$) and two-person sports ($p<.01$) (*table 2).*

Relationship between alcohol consumption and physical activity

Having no physical activity was not associated with an increase frequency of alcohol use disorder, when considering all types of sport together ($\chi^2<1.02$, $df=1$, $p=.31$). As shown in *figure 1*, when merging all types of sport, frequency of alcohol use disorder seems to decrease between no physical activity and medium physical activity, but to increase for intense physical intensity, although no significant effect of time devoted to sport on alcohol problems was observed (Armitage $\chi^2=0.86$, $df=1$, $p=.36$).

Interestingly, the risk of alcohol problems seems to increase with the level of physical activity for collective sport (χ^2=20.27, df=1, p<.01), and to decrease for individual sports (Armitage χ^2=7.00, df=1, p=.01), and have an inverse U-shape for two-person sports (Armitage χ^2=9.45, df=1, p<.01) (*Figure 1*).

Participants at risk of developing alcohol problem have significantly higher EAI scores (p=.04), and engage more frequently in collective sports (p<.01) and two-person sports (p=.05), but less frequently in individual sports (p=.02). However, Cohen's *d* interpretation indicates that those differences can be considered as small (*table 2*).

Participants at risk of developing EA have significantly higher CAGE scores (p<.01) (*table 2*). Post-hoc test following analysis of variance between types of practice frequency indicated that participants with low level of physical activity had lower CAGE scores than participants with medium and high level of physical activity, for collective sports (F=11,34, df=2001, p<.01) and two-person sports (F=7.19, df=2001, p.<.01).

Among our sample, 34 participants (1.70%) are both at risk of developing EA (EAI>23) and at risk of developing alcohol problems (CAGE>1). They were significantly younger than the rest of the sample (t=3.61, df=2000, p<.01). Compared to participants with only risk of developing EA or risk of developing alcohol problems, they had significantly higher CAGE and EAI scores (F=1863,22, df=2, p<.01 and F=102.63, df=2, p<.01) and engaged more frequently in sport practice (F=12.93, df=2, p=.03).

CAGE scores were slightly and positively correlated with EAI scores (r=.06, p=.01), and with total time devoted to collective sports (r=.11, p<.01) and to two-person sports (r=.08, p<.01). EAI scores were significantly and positively correlated with total time devoted to two-person sports (r=.12, p<.01),total time devoted to all types of sports (r=.52, p<.01), and alcohol consumption frequency (r=.05, p=.01). Alcohol frequency consumption was also slightly correlated with total time devoted to collective sports (r=.06, p=.01), individual sports (r=.05, p=.03), two-person sports (r=.10, p<.01) and all types of sports (r=.08, p<.01).

Based on these correlations, linear regression analyses were conducted. When controlling for age and sex, CAGE scores were positively predicted by total time devoted to collective sports (p<.01).

Discussion

The main goal of this study was to investigate the relationship between sport activity, including exercise addiction, and alcohol use, including a proxy of alcohol use disorder, among a representative sample of the French population. Key results indicate that longer duration of practice is associated with higher risk of developing physical exercise addiction and alcohol use disorder, and that participants at risk of developing exercise addiction are also more at risk of developing alcohol use disorder.

As in previous studies (Muller et al., 2015; Martin et al., 2008), these results suggest that exercise addiction and more time devoted to sport activity may be consider a potential risk factor of developing alcohol disorder. This may be surprising considering that sport if frequently presented as a protective factor against alcohol consumption (Giesen et al., 2015; Conroy et al., 2015; Leasure et al., 2015; Vancampfort et al., 2015; Damian & Mendelson, 2017; Ejsing et al., 2014), but these findings would be coherent with the fact that both EA and alcohol use disorder are associated with syndromic entities such as borderline personality disorder (Marmet, Studer, Rougemont-Bucking & Gmel, 2018; Sloan et al., 2017), or specific eating disorders (Thompson-Memmer, Glassman & Diehr, 2019).

However, these results need to be considered carefullyas the relationship between EA and alcohol disorder appears rather small. This could be explained by the fact that our study took place among the general population, and we may expect more powerful results among specific or clinical populations such as athletes or patients with alcohol disorders. Moreover, findings suggest that the risk of developing alcohol use disorder could be better explained by the time devoted to collective sports than by other types of exercise.

Alcohol consumption frequency and risk of developing alchohol disorder appears higher in two-person and collective sports. In other words, results could suggest a positive relationship between the presence of social interaction in sport and the probability of alcohol problems, which could be explained by specific social drinking habits in team-sports. For example, in a previous study conducted among polysubstance users, Elligsen and his colleagues (2018) founded that football did not provide the protective effect for craving as observed in others types of sports.

Regarding individual activities, results suggest that a low to medium level of practice could have a protective effect on risk of alcohol problem, but an intense level of practice could enhance risk of alcohol disorder. Although this result was not significant, our findings generally support the idea that different types of sports are differently associated with alcohol problems.

Finally, people at risk of developing exercise addiction engage more frequently in collective sports and two-person sports, but not in individual sports; despite individual sports being the most represented among participants at risk of developing EA. This support the idea that different types of sports are not equally associated with the risk of developing EA (Bingol et al., 2016).

This study has some limitations. Firstly, no personality or syndromic variables have been investigated, which could represent important bias regarding exercise addiction or alcohol use disorder (Sloan et al., 2017; Levit et al., 2018; Freimuth, Moniz & Kim, 2011; Di Lodovico & Gorwood, 2019). Secondly, all data were collected from self-reported questionnaires, which are sensitive to poor insight or cognitive impairments. Finally, the relationship between AUD and EA is probably the consequence of complex interactions, as pointed out by Vacampfort and his colleagues (2015). More specific assessments could have provided more accurate answers of the relationship between alcohol and sport addiction.

Futher studies are needed to better understand the relationship between physical activity and alcohol use, by investigating specific types of sports, history of practice, personality profiles, alcohol consumption context or alcohol use in specific population such as sport clubs' members. This could help understand why and how sport practice appears to be protective against alcohol disorders in some case, and could be considered a risk factor in others. From those works, athletes at risk of developing EA or/and AUD could benefit from prevention strategies which could be implemented during sports meetings or events.

In conclusion, this study support the idea that intense sport practice could be associated with a higher risk of developing exercise addiction and alcohol disorder, and highlight that all types of sports are not equally associated with these risks. A specific "social risk factor" should could be investigated in order to determine how collective sports can promote alcohol consumption.

References:

Allegre, B., Souville, M., Therme, P., & Griffiths, M. (2006). Definitions and measures of exercise dependence. *Addiction Research & Theory*, *14*(6), 631–646.

Allegre, B., Therme, P., & Griffiths, M. (2007). Individual Factors and the Context of Physical Activity in Exercise Dependence: A Prospective Study of "Ultra-Marathoners." *International Journal of Mental Health and Addiction*, *5*(3), 233–243.

Baekeland, F. (1970). Exercise deprivation. Sleep and psychological reactions. *Archives of General Psychiatry*, *22*(4), 365–369.

Bamber, D., Cockerill, I., Rodgers, S., & Carroll, D. (2003). Diagnostic criteria for exercise dependence in women. *British Journal of Sports Medicine*, *37*(5), 393–400.

Bingol, E., & Bayansalduz, M. (2016). Evaluating the Level of Exercise Dependence and Psychological Resilience of Athletes from Different Branches. *The Anthropologist*, *24*(3), 827–835.

Central nervous system stimulants. (2000). *Best Practice & Research Clinical Endocrinology & Metabolism*, *14*(1), 79–88.

Chan, C. S., & Grossman, H. Y. (1988). Psychological effects of running loss on consistent runners. *Perceptual and Motor Skills*, *66*(3), 875–883.

Chapman, C. L., & De Castro, J. M. (1990). Running addiction: measurement and associated psychological characteristics. *The Journal of Sports Medicine and Physical Fitness*, *30*(3), 283–290.

Conroy, D. E., Ram, N., Pincus, A. L., Coffman, D. L., Lorek, A. E., Rebar, A. L., & Roche, M. J. (2015). Daily physical activity and alcohol use across the adult lifespan. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, *34*(6), 653–660.

Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., McMurdo,

M., & Mead, G. E. (2013). Exercise for depression. *The Cochrane Database of Systematic Reviews*, *9*, CD004366.

Damian, A. J., & Mendelson, T. (2017). Association of Physical Activity with Alcohol Abuse and Dependence in a Nationally-Representative U.S. Sample. *Substance Use & Misuse*, *52*(13), 1744–1750.

Di Lodovico, L., & Gorwood, P. (2019). The relationship between moderate to vigorous physical activity and cognitive rigidity in anorexia nervosa. *Psychiatry Research*, 112703.

Di Lodovico, L., Poulnais, S., & Gorwood, P. (2019). Which sports are more at risk of physical exercise addiction: A systematic review. *Addictive Behaviors*, *93*, 257–262.

Di Nicola, M., Tedeschi, D., De Risio, L., Pettorruso, M., Martinotti, G., Ruggeri, F., Swierkosz-Lenart, K., Guglielmo, R., Callea, A., Ruggeri, G., Pozzi, G., Di Giannantonio, M., & Janiri, L. (2015). Co-occurrence of alcohol use disorder and behavioral addictions: relevance of impulsivity and craving. *Drug and Alcohol Dependence*, *148*, 118–125.

Downs, D. S., Hausenblas, H. A., & Nigg, C. R. (2004). Factorial Validity and Psychometric Examination of the Exercise Dependence Scale-Revised. *Measurement in Physical Education and Exercise Science*, *8*(4), 183–201.

Drug, nicotine, and alcohol use among exercisers: Does substance addiction co-occur with exercise addiction? (2018). *Addictive Behaviors Reports*, *7*, 26–31.

Ejsing, L. K., Becker, U., Tolstrup, J. S., & Flensborg-Madsen, T. (2015). Physical activity and risk of alcohol use disorders: results from a prospective cohort study. *Alcohol and Alcoholism (Oxford, Oxfordshire)*, *50*(2), 206–212.

Ellingsen, M. M., Johannesen, S. L., Martinsen, E. W., & Hallgren, M. (2018a). Effects of acute exercise on drug craving, self-esteem, mood and affect in adults with poly-

substance dependence: Feasibility and preliminary findings. *Drug and Alcohol Review*, *37*(6), 789–793.

Ellingsen, M. M., Johannesen, S. L., Martinsen, E. W., & Hallgren, M. (2018b). Effects of acute exercise on drug craving, self-esteem, mood and affect in adults with poly-substance dependence: Feasibility and preliminary findings. *Drug and Alcohol Review*, *37*(6), 789–793.

Fiellin, D. A., Reid, M. C., & O'Connor, P. G. (2000). *Screening for alcohol problems in primary care: a systematic review*. Centre for Reviews and Dissemination (UK).

Freimuth, M., Moniz, S., & Kim, S. R. (2011). Clarifying Exercise Addiction: Differential Diagnosis, Co-occurring Disorders, and Phases of Addiction. *International Journal of Environmental Research and Public Health*, *8*(10), 4069–4081.

Giesen, E. S., Deimel, H., & Bloch, W. (2015). Clinical exercise interventions in alcohol use disorders: a systematic review. *Journal of Substance Abuse Treatment*, *52*, 1–9.

Griffiths, M. (2005). A "components" model of addiction within a biopsychosocial framework. *Journal of Substance Use*, *10*(4), 191–197.

Griffiths, M. D., Szabo, A., & Terry, A. (2005). The exercise addiction inventory: a quick and easy screening tool for health practitioners. *British Journal of Sports Medicine*, *39*(6), e30–e30.

Jacobs, D. R., Ainsworth, B. E., Hartman, T. J., & Leon, A. S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine and Science in Sports and Exercise*, *25*(1), 81–91.

Leasure, J. L., Neighbors, C., Henderson, C. E., & Young, C. M. (2015). Exercise and Alcohol Consumption: What We Know, What We Need to Know, and Why it is Important. *Frontiers in Psychiatry*, *6*.

Lejoyeux, M., Avril, M., Richoux, C., Embouazza, H., & Nivoli, F. (2008). Prevalence of

exercise dependence and other behavioral addictions among clients of a Parisian fitness room. *Comprehensive Psychiatry*, *49*(4), 353–358.

Levit, M., Weinstein, A., Weinstein, Y., Tzur-Bitan, D., & Weinstein, A. (2018). A study on the relationship between exercise addiction, abnormal eating attitudes, anxiety and depression among athletes in Israel. *Journal of Behavioral Addictions*, *7*(3), 800–805.

Nationale Institute on Drug Abuse (2009). InfoFacts: Steroids (Anabolic-Androgenic). National Institutes of Health: Washington, DC, 1-4. Available online: http://www.drugabuse.gov/PDF/Infofacts/Steroids09.pdf (accessed on 22 August 2011).

Marmet, S., Studer, J., Rougemont-Bücking, A., & Gmel, G. (2018). Latent profiles of family background, personality and mental health factors and their association with behavioural addictions and substance use disorders in young Swiss men. *European Psychiatry: The Journal of the Association of European Psychiatrists*, *52*, 76–84.

Martin, J. L., Martens, M. P., Serrao, H. F., & Rocha, T. L. (2008). Alcohol Use and Exercise Dependence: Co-Occurring Behaviors Among College Students? *Journal of Clinical Sport Psychology*, *2*(4), 381–392.

Mayfield, D., McLeod, G., & Hall, P. (1974). The CAGE questionnaire: validation of a new alcoholism screening instrument. *The American Journal of Psychiatry*, *131*(10), 1121–1123.

Mayolas-Pi, C., Simón-Grima, J., Peñarrubia-Lozano, C., Munguía-Izquierdo, D., Moliner-Urdiales, D., & Legaz-Arrese, A. (2017). Exercise addiction risk and health in male and female amateur endurance cyclists. *Journal of Behavioral Addictions*, *6*(1), 74–83. https://doi.org/10.1556/2006.6.2017.018

Modolo, V. B., Antunes, H. K. M., de Gimenez, P. R. B., De Mello Santiago, M. L., Tufik, S., & de Mello, M. T. (2011). Negative addiction to exercise: are there differences

between genders? *Clinics*, *66*(2), 255–260.

Müller, A., Loeber, S., Söchtig, J., Te Wildt, B., & De Zwaan, M. (n.d.). Risk for exercise dependence, eating disorder pathology, alcohol use disorder and addictive behaviors among clients of fitness centers. *Journal of Behavioral Addictions*, *4*(4), 273–280.

Müller, A., Cook, B., Zander, H., Herberg, A., Müller, V., ZwaanM. (2014) Does the German version of the Exercise Dependence Scale measure exercise dependence? *Psychology of Sport and Exercise*, *15*(3), 288–292.

Murray, A. L., McKenzie, K., Newman, E., & Brown, E. (2013). Exercise identity as a risk factor for exercise dependence. *British Journal of Health Psychology*, *18*(2), 369–382.

O'Brien, K. S., Forrest, W., Greenlees, I., Rhind, D., Jowett, S., Pinsky, I., Espelt, A., Bosque-Prous, M., Sonderlund, A. L., Vergani, M., & Iqbal, M. (2018). Alcohol consumption, masculinity, and alcohol-related violence and anti-social behaviour in sportspeople. *Journal of Science and Medicine in Sport*, *21*(4), 335–341.

Ozemek, C., & Arena, R. (2019). Precision in Promoting Physical Activity and Exercise With the Overarching Goal of Moving More. *Progress in Cardiovascular Diseases*, *62*(1), 3–8.

Petit, A. & Lejoyeux, M. (2013). La dépendance à l'exercice physique. *Revue Médicale de Liège*, *68 (5-6)*, 331–339.

Reid, M. C., Fiellin, D. A., & O'Connor, P. G. (1999). Hazardous and harmful alcohol consumption in primary care. *Archives of Internal Medicine*, *159*(15), 1681–1689.

Sloan, E., Hall, K., Moulding, R., Bryce, S., Mildred, H., & Staiger, P. K. (2017). Emotion regulation as a transdiagnostic treatment construct across anxiety, depression, substance, eating and borderline personality disorders: A systematic review. *Clinical Psychology Review*, *57*, 141–163.

Sussman, S., Lisha, N., & Griffiths, M. (2011). Prevalence of the Addictions: A Problem of

the Majority or the Minority? *Evaluation & the Health Professions*, *34*(1), 3–56.

Szabo, A., Griffiths, M. D., de La Vega Marcos, R., Mervó, B., & Demetrovics, Z. (2015). Methodological and Conceptual Limitations in Exercise Addiction Research. *The Yale Journal of Biology and Medicine*, *88*(3), 303–308.

The influence of self-reported exercise addiction on acute emotional and physiological responses to brief exercise deprivation. (2003). *Psychology of Sport and Exercise*, *4*(3), 225–236.

Thompson-Memmer, C., Glassman, T., & Diehr, A. (2019). Drunkorexia: A new term and diagnostic criteria. *Journal of American College Health: J of ACH*, *67*(7), 620–626.

Vancampfort, D., De Hert, M., Stubbs, B., Soundy, A., De Herdt, A., Detraux, J., & Probst, M. (2015). A systematic review of physical activity correlates in alcohol use disorders. *Archives of Psychiatric Nursing*, *29*(4), 196–201.

Vancampfort, D., Van Damme, T., Probst, M., Firth, J., Stubbs, B., Basangwa, D., & Mugisha, J. (2017). Physical activity is associated with the physical, psychological, social and environmental quality of life in people with mental health problems in a low resource setting. *Psychiatry Research*, *258*, 250–254.

Villella, C., Martinotti, G., Di Nicola, M., Cassano, M., La Torre, G., Gliubizzi, M. D., Messeri, I., Petruccelli, F., Bria, P., Janiri, L., & Conte, G. (2011). Behavioural addictions in adolescents and young adults: results from a prevalence study. *Journal of Gambling Studies*, *27*(2), 203–214.

Weinstock, J., Farney, M. R., Elrod, N. M., Henderson, C. E., & Weiss, E. P. (2017). Exercise as an Adjunctive Treatment for Substance Use Disorders: Rationale and Intervention Description. *Journal of Substance Abuse Treatment*, *72*, 40–47.

Wen, C. P., Wai, J. P. M., Tsai, M. K., Yang, Y. C., Cheng, T. Y. D., Lee, M.-C., Chan, H. T., Tsao, C. K., Tsai, S. P., & Wu, X. (2011). Minimum amount of physical activity for

reduced mortality and extended life expectancy: a prospective cohort study. *Lancet (London, England)*, *378*(9798), 1244–1253.

World Medical Association (2013), World Medical Association Declaration of Helsinki. *Journal of the American Medical Association*, 310(20): 2191-2194.

Table 1. *Sociodemographic characteristics and descriptive analysis of 2002 subjects from the general French population assessed for sport activities and alcohol use disorder*

	Total (N=2002)	**CAGE >1** (N=315)	**CAGE <1** (N=1687)	**EAI>23** (N=103)	**EAI<23** (N=1899)	**CAGE>1 et EAI>23** (N=34)
Age (SD)	45 (16)	44.99 (15.12)	44.85 (16.10)	37.11 (12.37)	45.29 (16.02)	35.12 (11.71)
% of women	51.25%	35.87%	54.12%	43.69%	51.66%	41.18%
Currently working (%)	59.04%	69.84%	57.02%	78.64%	55.98%	85.29%
CAGE score (SD)	44.87 (15.95)	2.51 (.63)	.15 (.35)	.97 (1.29)	.49 (.93)	2.62 (.85)
CAGE >1 (%)	15.73%	100%	0%	33.00%	14.80%	100%
EAI score (SD)	.52 (.95)	16.58 (5.31)	15.97 (4.71)	23.73 (2.12)	15.54 (4.34)	25.74 (1.85)
EAI >23 (%)	5.4%	1.08%	0.40%	100%	0%	100%
Numbers of sports (%)						
No sport activity	49.25%	53.02%	48.55%	15.53%	51.08%	14.71%
One type of sport	31.22%	25.71%	39.48%	40.78%	37.12%	29.41%
Two types of sport	15.08%	11.43%	8.77%	18.45%	8.69%	25.53%
All types of sports	4.45%	9.84%	3.20%	25.24%	3.11%	32.35%
Time devoted to sport per week (%)						
Individual sports						
Regular practice	45.15%	41.59%	45.82%	69.90%	43.81%	67.65%
0 min	54.85%	58.42%	54.18%	30.10%	58.19%	32.35%
1 to 120 min	23.43%	26.35%	22.88%	44.66%	22.27%	44.12%
121 to 240 min	11.24%	8.57%	11.74%	10.68%	11.27%	11.76%
>240 min	10.49%	6.67%	11.20%	14.56%	10.27%	11.76%
Two-persons sports						
Regular practice	9.94%	15.24%	8.95%	34.95%	8.58%	35.29%
0 min	90.06%	84.76%	91.05%	65.05%	91.42%	64.71%
1 to 120 min	7.69%	11.43%	6.99%	26.21%	6.69%	26.47%
121 to 240 min	1.40%	2.86%	1.26%	4.85%	1.21%	5.88%
>240 min	0.85%	0.95%	0.83%	3.88%	0.68%	2.94%
Collective sports						
Regular practice	13.34%	21.27%	14.70%	48.54%	11.43%	70.59%
0 min	86.66%	78.73%	88.14%	51.46%	88.57%	29.41%
1 to 120 min	8.84%	13.65%	7.94%	30.10%	7.69%	38.24%
121 to 240 min	2.75%	3.91%	2.54%	8.74%	2.42%	11.76%
Total						
Regular practice	51.70%	49.57%	52.28%	84.47%	49.92%	85.29%
0 min	49.25%	53.02%	48.55%	15.53%	51.08%	14.71%
1 to 120 min	19.83%	18.41%	20.09%	18.45%	19.90%	23.53%
121 to 240 min	14.78%	11.74%	15.35%	31.08%	13.90%	20.59%
>240 min	16.30%	16.83%	16.00%	34.95%	15.11%	41.18%

Table 2. *Comparison analysis between participants with (CAGE>1) versus without AUD (CAGE<1), and between participants at risk of EA (EAI>23) versus not at risk of EA (EAI<23).*

	Comparison between CAGE>1 and CAGE<1					**Comparison between EAI>23 et EAI<23**				
	Mean difference (SD)	***Test t (p)***	***Confidence interval***		***Cohen's d***	***Mean difference (SD)***	***Test t (p)***	***Confidence interval***		***Cohen's d***
			Min	*Max*				*Min*	*Max*	
CAGE score	-2.37 (.03)	**-94.59 (<.01)**	-2.42	-2.32	4.68	-.48 (.10)	**-4.99 (<.01)**	-.67	-.29	.43
EAI score	-.61 (.30)	**-2.08 (.04)**	-1.19	-.03	.12	-10.19 (.43)	**-23.65 (<.01)**	-11.03	-9.34	2.98
Time devoted to collective sports	-27.34 (6.77)	**-4.04 (<.01)**	-40.62	-14.05	.17	-77.29 (11.08)	**-6.98 (<.01)**	-99.02	-55.57	.40
Time devoted to two-persons sports	-5.85 (2.94)	**-1.98 (.05)**	-11.63	-.07	.12	-31.98 (4.81)	**-6.65 (<.01)**	-41.42	-22.54	.47
Time devoted to individual sports	29.71 (12.18)	**2.44 (.02)**	5.82	53.61	.17	-30.03 (20.10)	-1.49 (.12)	-69.45	9.39	.16
Time devoted to all sports	-3.47 (14.72)	-.24 (.81)	-32.35	25.40	.01	-139.31 (24.07)	**-5.79 (<.01)**	-186.51	-92.11	.52
Alcohol consumption frequency	-1.63 (.11)	**-14.60 (<.01)**	-1.85	-1.41	.93	-.20 (.19)	-1.06 (.29)	-.58	.17	.11

Figure 1. *Time devoted to sport per week and risk of alcohol use disorder (according to CAGE score)*

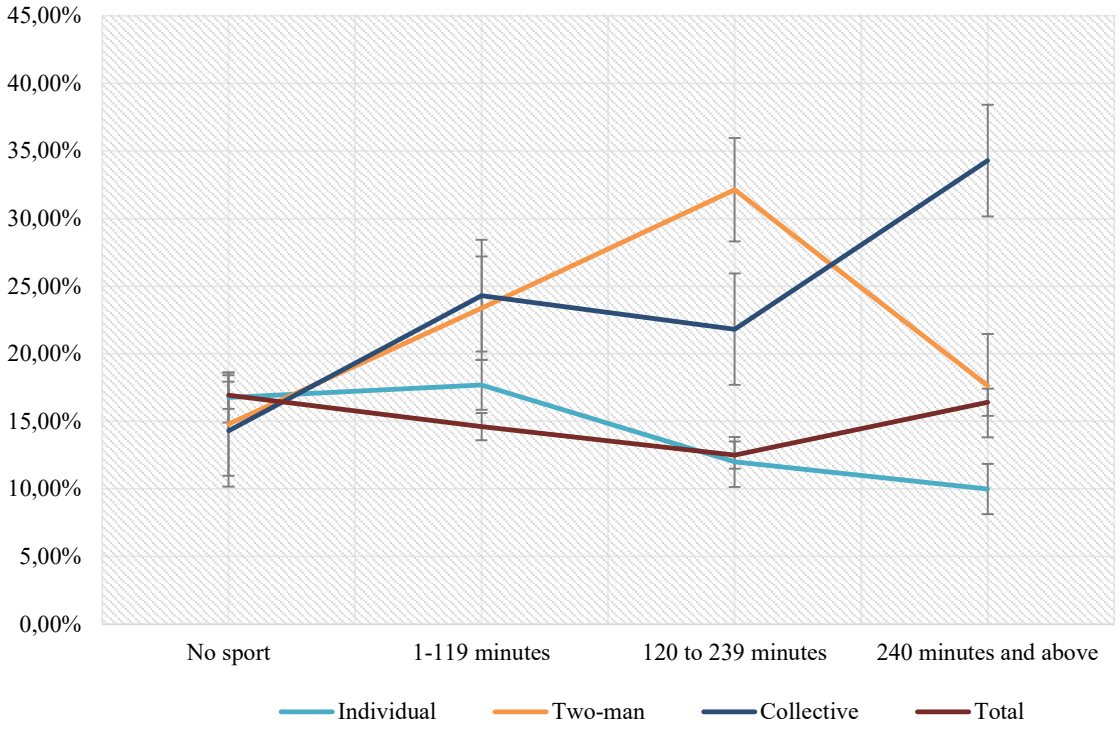

Table 3. *Linear regression analysis: predictive effect of CAGE scores and EAI scores on time devoted to sport and alcohol consumption frequency*

DV	IV	R^2	β	B	t (p)	CI 95%	
						Min	Max
CAGE scores	Total time devoted to collective sports		.00	.08	**3.65 (<.01)**	.00	.00
	Total time devoted to two-persons sports		.00	.03	1.34 (.18)	.00	.00
	Age		-.01	-.08	**-3.69 (<.01)**	-.01	-.00
	Sex		-.10	-.05	**-2.17 (.03)**	-.17	-.01
EAI scores	Total time devoted to all types of sports		.01	.28	**13.11 (<.01)**	.005	.01
	Total time devoted to two-persons sports		.01	.10	**4.15 (<.01)**	.01	.01
	Age		-.05	-.16	**-7.56 (.00)**	-.06	-.04
	Sex		-.57	-.06	**-2.72 (.01)**	-.98	-.16

DV = dependant variable; IV = independant variable; CI = confidence interval