Nutritional, medicinal, and performance enhancing supplementation in dance

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Abstract

The aims of the current study were to: a) investigate the reported prevalence of nutritional, medicinal, and performance enhancing substance use in dance, including any gender or professional status differences, and b) examine the amount of importance dancers place on potential sources of information regarding supplementation. Methods involved administering an anonymous survey to 371 male (n = 83) and female (n = 286) UK-based dancers (M_{age} = 20.87 years). Use of at least one supplement was reported by 91.9% of the dancers surveyed, and prevalence rates were highest for multivitamins, over-the-counter painkillers, and high energy drinks. Prevalence of use varied from low to high for specific nutritional and medicinal supplements, whereas very low levels of supplementation were seen for all performance enhancing supplements. Numerous forms of supplementation were more prevalent in male and professional dancers in comparison to female and amateur dancers, respectively. Across all categories of supplementation, physiotherapists and GPs/physicians were considered to be important sources of information on supplementation, whereas non-dance friends were considered to be the least important source of information. In conclusion, the current study provides much needed information on nutritional, medicinal and performance enhancing supplementation in dancers, and identifies key sources of information for dancers on all forms of supplementation.

Keywords: Supplements, Gender, Ergogenic Aids, UK, Dance

Introduction

Research in the athletic domain suggests athletes often look to support and facilitate their training and performance using a variety of nutritional, medicinal, and performance enhancing substances (e.g., de Hon, Kuipers, & van Bottenburg, 2015; Lazic et al., 2011). Regarding nutritional and medicinal substances, polypharmacy – or the inappropriate and excessive use of nutritional and medicinal substances (see Baylis, Cameron-Smith, & Burke, 2011) has been linked with an increased likelihood of potentially serious health consequences (e.g., Chen, Biller, Willing, & Lopez, 2004; Palmer et al., 2003; Yetley, 2007). Similarly, use of performance enhancing substances has also been associated with negative health consequences (Casavant, Blake, Griffith, Yates, & Copley, 2007). Although prevalence of and information sources for nutritional supplement use has started to be investigated in dance populations (Brown & Wyon, 2014), very little is known regarding the use of medicinal and performance enhancing substances in this group, nor what information sources inform any use (see Sekulic, Peric, & Rodek, 2010). As such, the overarching aim of the current study was to investigate the prevalence of nutritional, medicinal, and performance enhancing substance use in dancers, as well as the importance placed on a range of potential information sources regarding use of these substances.

As alluded to above, it is possible to categorise substances taken to facilitate athletic performance into three broad categories: nutritional, medicinal and performance enhancing substances. Nutritional – or dietary – substances have been defined as orally consumed products taken for the purpose of supplementing one's normal diet and include substances such as vitamins, minerals, macronutrients (e.g., carbohydrate and protein supplements) and creatine monohydrate (U.S. Food and Drug Administration, 1994). In contrast, medicinal substances are defined as drugs or other preparations designed to prevent or treat disease (Oxford Dictionary, 2015) with a drug being defined as a chemical substance that through interaction with biological target/s can alter the body's biochemical systems and examples are painkillers, diuretics and decongestants (Mottram & Chester, 2015). Finally, performance enhancing substances are those that appear on the World Anti-Doping Agency (WADA) list of substances prohibited for use in sport (Mottram & Chester, 2015) and include substances such as ephedrine stimulants, oral and injectable anabolic androgenic steroids, and beta-blockers (WADA, 2015).

When considering prevalence of use for nutritional, medicinal and performance enhancing substances, availability is an important consideration. Although health (e.g., Casavant et al., 2007), moral (Erickson, McKenna, & Backhouse, 2015), and legal (Boardley

& Grix, 2014) issues may potentially influence decisions regarding supplementation, ease of availability may also influence prevalence of use. As well as being easier to access, substances that are freely available may have an increased prevalence not just because they are easier to access, but because such availability may lead potential users to think they are safe to use. Availability is of particular relevance to medicinal supplements, as some are freely available (i.e., over-the-counter [OTC] medicines), whereas others require certification via a medical professional (i.e., prescription medicines; Petróczi & Naughton, 2009). Performance enhancing substances are also likely to be more difficult to obtain than nutritional supplements or OTC medicines. As such, availability may be an important consideration when considering prevalence of use for nutritional, medicinal and performance enhancing substances.

Research to date has highlighted the importance of determining prevalence of use for nutritional supplements in athletic domains. In the realm of sport, athletes from a variety of sports have reported rates of nutritional supplement use ranging from 32 to 90% (Baylis et al., 2001; Giannopoulou, Noutsos, Apostolidis, Bayios, & Nassis, 2013; Lazic et al., 2011; Ronsen, Sundgot-Borgen, & Maehlum, 1999; Schroder, Navarro, Mora, Seco, Torregrosa, &Tramullas, 2002; Sundgot-Borgen, Berglund, & Torstveit, 2003). Such prevalence rates are important because research has shown more than 10% of freely available nutritional supplements may be contaminated with performance enhancing substances such as stimulants and anabolic steroids (Baume, Mahler, Kamber, Mangin, Saugy, 2006; Geyer, Parr, Koehler, Mareck, Schanzer, & Thevis, 2008; Geyer, Parr, Mareck, Reinhart, Schrader, & Schanzer, 2004). As such, those who take nutritional substances may risk inadvertently taking substances they had not intended to.

As well as the potential for inadvertently taking unintended substances, it is also important to determine use of nutritional supplements due to the suggestion that such use may sometimes act as a gateway to use of prohibited substances. For instance, Boardley and Grix (2014) and Martinez and Bilard (2003) have both described processes based upon athlete accounts whereby initial use of legal nutritional substances may lead to use of prohibited substances for some athletes. Support for such a process is seen in research that has shown that nutritional supplement users are more likely to be prohibited substance users and also have different attitudes toward doping in comparison to non-users of nutritional supplements (Backhouse, Whitaker, & Petróczi, 2013; Mazanov, Petroczi, Bingham, & Holloway, 2008; Papadopoulos, Skalkidis, Parkkari, & Petridou, 2006). As such, it is also important to understand prevalence of nutritional supplement use across different populations because

such use may place users at increased risk of progressing to use of substances that may potentially be harmful to health when taken in certain combinations or quantities.

As identified earlier, dancers represent one population where there is limited knowledge available on nutritional supplement use. The first study to look at this was conducted by Stensland and Sobel (1992), who found 60% of US-based dancers reported use of vitamin or mineral supplements in a relatively small (N = 106) sample of ballet, jazz, and modern dancers. Next, in a study of UK dancers involving 1056 dancers from across a range of formats, Laws (2005) found 63% of dancers reported using supplements, with 56% reporting use of vitamin supplements, 20% iron supplements, and 20% calcium supplements. Subsequently, in a study of 127 adolescent ballet dancers, Burckhardt, Wynn, Krieg, Bagutti, and Faouzi (2011) found 57% of dancers reported taking multi-mineral supplements, vitamin supplements, or both, whilst 13% reported using calcium supplements. Finally, Brown and Wyon (2014) used an online survey to collect data on nutritional supplement use in 334 dancers from 53 countries, finding 50% of dancers reported using nutritional supplements regularly. Of those reporting regular use, 60% reported using vitamin C (60%), 67% multivitamins, 72% caffeine, 21% whey protein and 14% creatine. Thus, based upon the fairly limited information available, it would seem prevalence of nutritional supplement use in dancers is at a comparable level to that seen in sport. However, more research is needed to increase the available data, especially given two of these studies are over ten years old and as such prevalence rates may have changed since then.

Use of medication to support training and performance represents another potential form of supplementation that is currently understudied in dancers. Given the severe demands placed upon dancers that may put them at increased risk of injury (see Allen, Ribbans, Nevill & Wyon, 2014; Jacobs, Hincapie, & Cassidy, 2012), dancers may at times use pain relief medications to help with pain management. Also, given dance represents a discipline that is thought to promote a focus on aesthetic build and low body weight (see Amorim et al., 2015), there may be an increased use of medicines (e.g., diuretics, laxatives) that may facilitate weight loss in dance populations compared to the general population. Evidence from other athletic disciplines such as elite sport suggests inappropriate and excessive use of medications does occur, and may make adverse drug events and interactions with potentially serious consequences more likely (e.g., Lazic et al., 2011; Tscholl, Feddermann, Junge, & Dvorak, 2008a; Tscholl, Junge, & Dvorak, 2008b). The work of Sekulic and colleagues also suggests medicinal substances may be used by dancers. For instance, in one study seven of 25 (i.e., 28%) professional Croatian ballet dancers reported using painkillers often or regularly

(Sekulic et al., 2010). In contrast, only 10 of 43 (i.e., 23%) Latin and standard coupled dancers from Serbia reported any use of painkillers, with only one dancer reporting using them often (Sekulic, Kostic, Rodek, Damjanovic, & Ostojic, 2009). As such, research is needed using larger and more diverse samples to increase our knowledge of prevalence of medicinal supplementation in dance to determine whether some dancers may be putting themselves at risk through excessive or inappropriate use of such substances.

A third and final understudied form of supplementation in dance relates to the use of performance enhancing substances. The severe physical demands associated with dance mentioned previously may potentially lead to some dancers considering adopting their use. For instance, this may be driven by attempts to prevent or facilitate recovery from injury. Alternatively, such use could be driven purely by a desire to improve performance through an impact on physical attributes such as strength and power. Given dance is not a sport the use of such substances by dancers is not controlled under the auspices of WADA as it is in sport. However, any dancers who do use products such as ephedra, anabolic androgenic steroids, or beta-blockers to support their training and/or performances are still at increased risk for the harmful side effects reported by some users (e.g., Andrews, Sudwell, & Sparkes, 2005; Olrich & Ewing 1999). Prevalence data from elite sport based upon self-reports has reported prevalence rates in the region of 5–15% (Laure, 1997). Within dance, 19% of Latin and standard coupled dancers from Serbia and 44% of professional Croatian ballet dancers acknowledged they would use performance enhancers in certain circumstances (Sekulic et al., 2009, 2010). Although these findings are informative, the small homogeneous samples involved mean further research that investigates the prevalence of performance enhancing substance use in dance populations is needed.

Importantly, prevalence for use of certain supplements may be moderated by gender. For instance, it is possible that differences between male and female dancers regarding the physical and aesthetic demands placed upon them may lead to disparity in the prevalence of use for certain supplements. For instance, strength and associated muscularity are requirements for male dancers (see Allen et al., 2012), whereas for female dancers high levels of all round physical fitness and not strength in particular are required, and low body weight/adiposity are often encouraged (Amorim et al., 2015). These proposed differences in physical and aesthetic requirements are supported by research that has shown male dancers to have a significantly higher BMIs than female dancers (Wyon, Hutchings, Wells, & Neville, 2014). As such, males may be more likely to use supplements associated with facilitating strength gains (e.g., protein powders, creatine monohydrate) whereas females may have an

increased likelihood of using substances thought to assist with weight and body fat loss (e.g., diuretics, laxatives).

Another potential moderator of prevalence for use of some supplements is professional status. Professional dancers are likely to have a higher workload and experience greater external expectation than amateur dancers, as well as having to perform when not fully fit due to contractual obligations. Given this, professional dancers may be more likely to utilise supplements thought to assist with a high work load and physical conditioning (e.g., energy drinks, protein supplements), prevent and cope with illness (multivitamins, herbal remedies), help with pain management (e.g., OTC and prescription painkillers), and facilitate aesthetic requirements (e.g., diuretics, laxatives). Support for this contention can be found in the sport literature, where studies have reported increased supplementation in high performance athletes compared to those performing at a lower level (Erdman, Fung, & Reimer, 2006; Giannopoulou, Kostantinos Noutsos, Apostolidis, Bayios & Nassis, 2013).

As well as increasing knowledge of dancers' use of nutritional, medicinal, and performance enhancing substances, it is also important to further understanding on potential sources of information regarding supplement use in dance. Given the considerable number of substances available to athletes and ambiguity regarding their relative efficacy, the importance of obtaining accurate information concerning supplementation has been highlighted in the literature (e.g., Hoffman, Faigenbaum, Ratamess, Ross, Kang, & Tenenbaum, 2008; Sundgot-Borgen et al., 2003). Such research has demonstrated that in Norwegian elite athletes the coach is the main advisor regarding nutritional supplementation (Sundgot-Borgen et al., 2003), whereas US adolescent students reported receiving most of their information from parents and teachers (Hoffman et al., 2008). In dance, friends and dance colleagues have been identified as informing dancers' decisions when selecting which supplements to take (Brown & Wyon, 2014). However, Brown and Wyon (2014) only investigated dietary supplements and not medicinal or performance enhancing substances. Also, research in sport and exercise has shown that athletes often differentiate between friends based on whether they train and compete with them when it comes to discussing issues relating to performance enhancement (see Boardley & Grix, 2014; Boardley, Grix, & Harkin, 2015). As such, further research is needed to investigate potential information sources on supplementation in dance that both takes a more nuanced approach and also investigates medicinal and performance enhancing substances alongside nutritional supplements.

Based upon the reviewed literature, the current study had two aims. The primary aim was to investigate the reported prevalence of nutritional, medicinal, and performance enhancing substance use in dance. When addressing this aim, we categorised supplements as a training supplement if was freely available (e.g., multivitamins, OTC painkillers), as a prescription supplement when a prescription from a doctor was required (e.g., prescription painkillers, prescription diuretics) and as a performance enhancing supplement if the substances was prohibited by the International Olympic Committee at the time of data collection. Based on potential moderation of supplement use by gender or professional status, we also examined potential gender and professional status differences for prevalence of use for all supplements. The second aim was to examine the amount of importance dancers placed on potential sources of information regarding which supplements to take, when to take them, and in what quantity.

Method

Participants

Participants were 371 male (n = 83) and female (n = 286) dancers (two did not indicate sex) sampled from 24 dance companies across England. Dancers ranged in age from 17.00 to 42.33 years (M = 20.87, SD = 3.84), had danced for an average of 12.12 years (SD = 5.67), practiced/danced for an average of 5.15 hours/day (SD = 2.72), and had been with their current company for an average of 1.59 years (SD = 2.43). Dance formats included mixed (n = 138), musical theatre (n = 123), break dancing (n = 24), contemporary (n = 12), jazz (n = 5), and street dance (n = 1), with 68 dancers electing to not indicate their dance format. Amateur (n = 255), ex-professional (n = 3), and professional (n = 81) dancers were represented in the sample, with 32 dancers choosing not to indicate their status.

Survey Instrument

The survey consisted of 98 questions focusing on: (a) demographic information (e.g., age, gender, dance format), (b) training supplement (explicitly defined as “over-the-counter substances such as non-prescription vitamins, proteins, amino acids, and creatine taken to help you prepare for performances more effectively or to recover more quickly from training/injury”) use, (c) prescription supplement (explicitly defined as “substances that you cannot buy over the counter and require a prescription from a doctor to obtain, taken to help you prepare for performances more effectively or to recover more quickly from training/injury”) use, (d) performance enhancing supplement (explicitly defined as “substances or methods prohibited by the International Olympic Committee but not controlled in dance and taken to help you prepare for performances more effectively or to

recover more quickly from training/injury") use, and (e) importance of potential sources of information for training, prescription and performance enhancing supplements.

Questions concerning supplement use specifically asked each subject to indicate which of a series of substances "you use or have used in the past" with response options of "*currently using*", "*previously used*" or "*never used*". Specific substances included in each of the three sections can be found in the results section. As such, "currently using" responses collectively represent a true-point prevalence rate, as they indicate the total number of identified cases in a specific population at a given point in time (de Hon et al., 2015). In contrast, "previously used" responses represent a lifetime prevalence rate, as responses did not relate to a specific point in time or time period (Harmer, 2010). Regarding the importance of potential sources of information for the three categories of supplements, each subject was asked to indicate how important each potential source was regarding gathering information on which supplements to take, when to take them, and in what quantity. Subjects were provided with 11 choices (i.e., Books/Magazines, Internet, Supplement Supplier, Dance Master, Physiotherapist, Dance Friend/s, Non-Dance Friend/s, Sibling/s, Strength & Conditioning Coach, GP/Physician, and Parent/s) and asked to indicate the importance of each using a scale from 1 (*no importance*) to 7 (*extreme importance*).

Procedure

Before the study commenced, ethical approval for it was first obtained from the ethics committee of the first author's institution. Then, dance company leaders were then contacted by email and/or telephone by a trained research assistant to inform them of the nature of the study and request the opportunity to invite dancers from their company to participate. For leaders who gave their permission, arrangements were made for a convenient opportunity to visit and speaker with the dancers. Data collections occurred at dance companies, either prior to or following a scheduled practice, and were conducted by the research assistant. Dancers from each company were addressed as a group, and informed about the nature of the investigation, what participation involved, and the rights of study participants. Dancers were then made aware (verbally and in writing) that nobody other than the research team would have access to their responses at any stage and that participation was completely anonymous, before being provided with an opportunity to ask questions. Those agreeing to participate were then asked to provide their informed consent by generating and inputting a unique ID Code, and to retain the ID Code in case they wished to withdraw their data subsequent to participation (possible for up to three months following participation). Consenting participants were then instructed to complete the survey privately and individually.

Statistical analysis

Percentage current, past, and none use for each type of supplement within each of the three categories of supplement was first calculated. Then, to test gender and status effects on supplement use, binary logistic regressions were conducted for each individual supplement. In addition, five further logistic regressions were carried out; three included the category of supplement (i.e., training, prescription, performance-enhancing) as the dependent variable, and two further analyses investigated potential predictors of supplements groups based on their association with attempts to Gain Mass and Strength (GMS; i.e., low carb / high protein powder, amino acids, weight-gain powder, creatine monohydrate), or cause Weight and Fat Reduction (WFR; i.e., fat burners, high-energy drinks, ephedra, caffeine pills). For all regression analyses, past and current use were collapsed into a single "ever used" category. Regression coefficients (*B*), their associated standard errors (*SE*), and odd ratios (OR) are reported when significance at the $p < .05$ level was met, along with descriptive percentage figures (see Table 2). Following this, descriptive statistics were calculated for participants' ratings of importance for the various potential sources of information on which supplements to take, when to take them, and in what quantity. Based on the results of these analyses, multiple analysis of variance (MANOVA), followed by between-subjects univariate tests, were then conducted to test for gender and status differences on the most and least important sources of information for the three categories of supplement. SPSS 21.0 was used to conduct all statistical analyses.

Results

Percentage current, past and none use of supplements

Percentage reported current, previous and none use for all types of training, prescription and performance enhancing supplements can be found in Table 1. The reported use of at least one supplement was reported by 91.9% of the dancers surveyed. The most commonly used supplement was multivitamins which were reported to have been used by 72.2% of dancers, closely followed by over-the-counter painkillers which were reported to have been used by 70.5% of the sample. The use of training supplements was reported by 90.6% of the dancers, whereas use of prescription and performance enhancing supplements was reported by 34.0% and 4.0% of the sample, respectively. The use of supplements that help GMS was reported by 30.2% of the sample, whereas those associated with WFR was reported by 65.2% of the dancers.

Nutritional supplement use by gender and status

To test gender and status effects on supplement use, binary logistic regressions were employed for each supplement as well as for the five categories (i.e., training, prescription, performance-enhancing, GMS and WFR) of supplement defined previously; gender and status were the independent variables, and supplement type/category were the dependent variables. Non-significant effects ($p > 0.05$) for gender and status resulted for over-the-counter high energy drinks, caffeine pills, prescription diuretics, corticosteroid or local anaesthetic injections, bronchodilators, ephedrine stimulants, DMAA stimulants, oral anabolic androgenic steroids, injectable anabolic androgenic steroids, other anabolic agents, beta-blockers, peptide hormones (including growth factors & related substances), hormone and metabolic modulators, blood manipulation, performance enhancing supplements and WFR supplements. However, several significant (or approaching significant) effects did emerge. Betas, standard errors, significance levels and odds ratios for these effects can be found in Table 2, and descriptive percentage values are presented in Table 3.

Sources of information on supplement use

Means and standard deviations for participants' ratings of importance for potential sources of information on the three categories of supplements are reported in Table 4. These values indicate that for training supplements physiotherapists were considered the most important source, for prescription supplements GPs/physicians were rated as most important, whereas for performance enhancing supplements physiotherapists and GPs/physicians were held in equally high regard. Regarding the least important sources of information, non-dance friends were viewed as the least important source for all three categories of supplement.

Although not directly linked to the study aims, for descriptive purposes MANOVA – followed by between-subjects univariate tests – were then conducted to test for gender and status differences on the most and least important sources of information for each category of supplement. These analyses revealed a significant multivariate main effect for status (Wilks $\lambda = 0.95$, F (7, 291) = 2.14, $p<.05$), but not for gender (Wilks $\lambda = 0.96$, F (7, 291) = 1.65, $p>.05$) or the interaction between gender and status (Wilks $\lambda = 0.97$, F (7, 291) = 1.10, $p>.05$). Follow-up between-subject analyses for status revealed amateur dancers (M = 2.39, SD = 1.59) considered non-dance friends to be a less important source of information on training supplements than current or ex-professional dancers (M = 2.66, SD = 1.72), F (1, 297) = 4.51, $p<.05$, $\eta_p^2 = .02$, and that amateur dancers (M = 4.73, SD = 1.93) considered physiotherapists to be a more important source of information on performance enhancing supplements than current or ex-professional dancers (M = 4.26, SD = 2.09), F (1, 297) = 4.05, $p<.05$, $\eta_p^2 = .01$. In addition, there was also a marginally significant effect for non-dance

friends as sources of information on prescription supplements, F (1, 297) = 3.71, p<.06, η_p^2 = .01, with amateur athletes (M = 2.08, SD = 1.44) considering them to a less important source of information than current or ex-professional dancers (M = 2.40, SD = 1.85).

Discussion

Research in non-dance contexts has demonstrated the importance of research investigating the prevalence of nutritional (Lazic et al., 2011), medicinal (Tscholl et al., 2008a, 2008b), and performance enhancing (Laure, 1997) supplements. However, to date such research in dance is limited and largely constrained to nutritional supplements (e.g., Brown & Wyon, 2014; Laws, 2005; Sekulic et al., 2009, 2010). To help address this dearth in knowledge, the current study had two aims: a) to investigate the reported prevalence of use – and potential gender/professional status differences – for nutritional, medicinal, and performance enhancing substance use in dance and b) to examine the importance dancers place on potential sources of information regarding which supplements to take, when to take them, and in what quantity. Overall the study was successful in addressing each of these aims; over the coming paragraphs we integrate the main findings with the extant literature and consider their implications.

Use of at least one supplement was high in the current sample with 91.9% of the sample reporting use of at least one supplement at some point in their career. This rate of use is high in comparison to other studies that have reported values ranging from 49% (Brown & Wyon, 2014) to 78% (Laws, 2005). However, it is important to note that in the current study we examined prevalence for a much broader range of substances, and that this 91.9% includes previous as well as current use. Although it is not possible to make direct comparisons between studies, as a whole the studies that have investigated supplement use in dance populations demonstrate widespread use of supplementation of some form in this population.

Of the freely available supplements – categorised as training supplements – multivitamins had the highest prevalence, with 36.9% of participants currently using them, and a further 35.3% reporting using them previously. This finding corresponds well with the findings of past studies with dancers that have also reported multivitamin use to be particularly prevalent (Brown & Wyon, 2014; Stensland & Sobal, 1992). Sport-based studies have also reported multivitamins to be one of the most prevalent forms of supplementation (e.g., Lazic et al., 2011). As such, it would seem use of multivitamins is fairly widespread across different athletic populations. Interestingly, such use is in contrast with research that has investigated the efficacy of such supplementation (Telford, Catchpole, Deakin, Hahn, &

Plank, 1992). More specifically, Telford et al. (1992) found no benefit for athletic performance when supplementing athletes from four sports with vitamins and minerals over a seven to eight month period. Relevant position statements on supplementation also discourage the use of vitamin and mineral supplements unless athletes are known to have a dietary deficiency (Rodriguez, DiMarco, & Langley, 2009). As such, further work is needed to fully understand why so many dancers take multivitamins, and also to ensure dancers are appropriately advised on when use of these supplements is appropriate.

Use of OTC painkillers was also reported quite widely, with 27.0% of participants reporting using them at the time of data collection, and a further 43.5% having previously used them. This relatively high prevalence is consistent with work in sport that has estimated use of painkillers such as non-steroidal anti-inflammatory drugs (NSAIDs) to be considerably higher in elite athletes than in the general population (Berglund & Sundgot-Borgen, 2001). This finding supports our contention that the physical demands of dance may dictate that many dancers frequently experience pain during practice and performance, and feel the need to use painkillers to help manage this pain. Given the side effects associated with some OTC painkillers, such as the gastric irritation associated with use of NSAIDs (Lippi, Franchini, & Guidi, 2006), this is a worrying finding that clearly warrants further attention in the future.

The one other supplement that was used quite widely was high energy drinks, with 59.7% of participants reporting their use at some time. This finding contrasts with that of Brown and Wyon (2014), who reported just 22% of those who used any supplement indicating they used energy drinks. However, Brown and Wyon (2014) sampled from dancers internationally, with 53 different nations represented. In contrast, the current study was conducted solely with UK-based dancers. As such, it is possible that prevalence of energy drink use is higher in the UK than in other nations. Further, Brown and Wyon (2014) didn't provide respondents with a "previously used" option as we did, with the least frequent response choice being 1-2 days/week followed by "never". As such, it is possible that dancers who had previously used energy drinks but were not doing so at the time of data collection chose the "never" option due to the lack of a more appropriate response option. Certainly, the 17% who reported currently using high energy drinks in the present study compares more favourably with the 22% of dancers who selected one of the three current use response options offered by Brown and Wyon (2014). As such, more research is needed to determine whether there is a true different in energy drink use between UK dancers and those from other countries, or whether the apparent differences are due to use of contrasting survey instruments between the two studies that have investigated this issue.

The second category of supplements investigated currently was that of prescription supplements. Of the six supplements in this category, use of prescription painkillers was most prevalent with 1.9% of dancers reporting their use at the time of data collection, and a further 18.9% having used them previously. This finding provides further evidence that the physical demands of dance may dictate that pain is something that many dancers experience, and that OTC and prescription painkillers may be utilised as a way to help cope with this pain. This is consistent with research that found that as many as 53% of dancers who suspect an injury report continuing to dance, with 18% of those who continued to dance taking painkillers in response to the injury (Laws, 2005). Further, a review of relevant sport literature identified consistently higher rates of prescription painkiller use by athletes compared to non-athletes, occurrence of inappropriately high doses, and simultaneous use of several different painkillers (Alaranta, Alaranta, & Helenius, 2008), suggesting relatively high rates of prescription painkiller use occurs in other athletic disciplines and not just dance. Although we didn't distinguish between different types of painkillers (e.g., NSAIDs, analgesics-anaesthetics), or the doses that they were taken in, future research investigating these issues would help elucidate the potential effects of painkiller use in dancers.

The final category of supplementation investigated was that of performance enhancing supplements. The supplements/methods in this category had the lowest prevalence rates, with ever-use prevalence rates of less than 1% for all such supplements except for beta blockers, which had been used by 1.6% of dancers at some point. This is considerably below the 5-15% of elite athletes who self-reported use of performance enhancing substances/methods (Laure, 1997) which is particularly interesting when one considers the controls in place in elite sport to deter doping that are not in place in dance. Further, the current findings contrast markedly with those for other unregulated athletic disciplines such as bodybuilding, where prevalence rates tend to be considerably higher (e.g., Litt & Dodge, 2008). That a lack of regulation in dance does not appear to lead to increased prevalence can be explained through a number of possibilities. For instance, the contrasting aesthetic goals between dancers and bodybuilders may lead dancers to avoid use of substances that may be perceived as leading to undesirable muscle gain. A further possibility is that cultural differences (e.g., ethical values, social norms) may explain this disparity. Alternatively, dancers may not be aware of – or motivated by – the potential performance benefits of using performance enhancing substances. However, there is some evidence that a significant percentage (19-44%) of dancers in certain dance populations would consider using doping substances if it guaranteed them success (Sekulic et al., 2009, 2010). Thus, although

prevalence of performance enhancing supplement use was low in the present study, given the findings of past research, and the serious health consequences associated with their use, medical professionals are still encouraged to be watchful for any signs of potential use. This is especially the case when one dancer in the current study reported currently or previously using seven of the nine forms of supplementation in this category.

Our categorisation of certain substances based upon their prohibition in sport raises the question of whether use of such substances should be treated similarly in dance. Obviously there are parallels between sport and dance in terms of athletic requirements (e.g., strength, power, flexibility) that mean substances outlawed in sport (e.g., anabolic steroids, ephedrine stimulants) may benefit performance in dance. However, it is important to acknowledge that unlike sport, dance is a performing art and performance enhancing substances banned in sport (e.g., beta-blockers such as propranolol) are used in other art forms (e.g., music; see Brantigan, Brantigan, & Joseph, 1982) without apparent need for proscription. Further, although at the professional level there is undoubtedly competition between dancers for roles and rank, during performances dancers are not looking to outperform an opponent as a sportsperson would. Moreover, dancers are looking to express themselves through their movements rather than achieve some specified outcome as in sport. As such, although there are some similarities between the two disciplines, there are also clear differences between sport and dance that suggest dance as a discipline shouldn't automatically adopt a stance on performance enhancing substance use based on that seen in sport.

An important consideration that may inform any policy decisions in dance relating to performance enhancing substance use is the potential for detrimental health consequences. Although many substances banned in sport are therapeutic in origin and can be used in clinical practice with few or no reported side effects (e.g., Kerr & Congeni, 2007), negative health effects can occur when supraphysiological doses in excess of those utilised in clinical practice are employed (Casavant et al., 2007). Also, the prevalence of diuretic and laxative use reported in the current study – presumably to help achieve aesthetic ideals (see Amorim et al., 2015) – suggests some dancers may be prepared to potentially forfeit their health to achieve success in dance. More work is clearly needed to determine accurate estimates of frequency and volume of use for substances that have the potential to be harmful to health. However, depending on the findings of such work there may be an argument for controlling use of some substances in dance based on potential health consequences. If research does support the need for such measures, careful thought would have to be given on how to

encourage safe supplementation, especially given the issues with the implementation of anti-doping policy in sport (see Houlihan, 2004).

Potential gender differences in supplementation were also investigated, with the relevant analyses demonstrating a higher prevalence of use for a number of supplements (i.e., low carb/high protein powders, amino acids, weight gain powders, fat burners, creatine monohydrate, and OTC painkillers) in males compared to females. With the exception of OTC painkillers all of these supplements are associated with attempts to increase muscular appearance and strength, reflected in the significantly higher prevalence for GMS supplements as a group. As proposed in the introduction, this difference may be driven by male dancers' attempts to gain the strength required to perform male-specific aspects of performance (e.g., lifting female dance partners) that female dancers do not require (see Allen et al., 2012). It was encouraging to find no increased prevalence of WFR supplementation in females compared to males, suggesting that females were not particularly driven to use certain supplements in an attempt to achieve aesthetic requirements such as low body weight and body fat associated with female dancers (Amorim et al., 2015).

Differences based on professional status were also identified, with current or previously professional dancers reporting higher prevalence of use for a wide range of supplements compared to amateur dancers. Such differences were apparent for a range of freely available training (e.g., multivitamins, amino acids, OTC diuretics and laxatives) and prescription (e.g., prescription painkillers, laxatives and decongestants) supplements, as well as for use of training, prescription, GMS and any supplements when grouped. This supports our contention that increases in workload and physical conditioning associated with the transition to professional status may lead to an increase in supplementation to help cope with these demands. The higher prevalence of supplement use in professional dancers compared to amateur dancers is consistent with research in sport which has indicated increased use of various dietary supplements at higher levels of competition (Erdman et al., 2006; Giannopoulou et al., 2013). However, our findings extend beyond those conducted in elite sport, as they also indicate greater prevalence of non-dietary supplement use such as diuretics, laxatives, painkillers and decongestants in current or past professionals compared to amateurs. These findings suggest similar research in sport may be warranted, to help determine whether the differences in dietary supplement use across levels of competition extend to non-dietary supplements such as those investigated presently.

A secondary aim of the current study was to investigate dancers' ratings of importance for a range of potential information sources regarding supplement use. Findings

relating to this aim demonstrated that physiotherapists and GP/physicians were rated as the two most important sources of information for all three categories of supplement. This contrasts with the findings of Brown and Wyon (2014) who reported that use of dietary supplements was most influenced by friends and colleagues, and that dance teachers were more influential than doctors or health care professionals. However, Brown and Wyon asked just one question relating to what influenced dancers' decisions when selecting dietary supplements, which contrasts with the current approach whereby we asked dancers to rate importance for a range of potential sources of information for use of training, prescription, and performance enhancing supplements. This more detailed approach suggests that – for UK dancers at least – doctors and health care professionals are viewed as important sources of information for all three categories of supplement. The distinction made between dance and non-dance friends (based on the work of Boardley & Grix [2014]) also proved worthwhile, as dancers reported dance friends to be more important sources of information for all three categories of supplement.

Limitations and Future Directions

One important limitation of the current study was the potential for under reporting of certain forms of supplementation due to the self-report technique employed. More specifically, self-report assessment of socially sensitive behaviours such as performance enhancing supplement use may result in prevalence rates lower than the true rate (de Hon et al., 2015; Striegel, Ulrich, & Simon, 2010). This is because people are thought to hold back when self-reporting attitudes or behaviours that may be perceived as socially undesirable (e.g., Goldstein, 1960). As such, although the anonymous nature of data collection and the fact use of performance enhancing supplements is not controlled in dance may have weakened this effect in the current study, the actual prevalence of performance enhancing supplement use may have in reality been higher than that reported by participants. Future researchers are encouraged to replicate the current study using alternative approaches such as the Randomised Response Technique (RRT) which are specifically designed to prevent socially desirable responding when collecting prevalence data on socially sensitive behaviours. Importantly, the RRT has been shown to be a valid approach for the collection of prevalence data relating to performance enhancing substance use (see de Hon et al., 2015). A further limitation is that we only collected data at one point in time, and didn't assess volume or frequency of supplement use. As such, future researchers may wish to investigate whether the types of supplements used, and frequency and volume of use, change across the performance season, perhaps in line with changes in workload.

Conclusion

The current study provides evidence of widespread use of nutritional and medicinal supplementation in dancers, but low prevalence for use of performance enhancing substances. Higher prevalence rates were found for male and professional dancers in comparison to female and amateur dancers, respectively, for numerous forms of supplementation. Finally, physiotherapists and GP/physicians were seen as important sources of information for all types of supplementation studied. In sum, although the current study makes an important contribution to knowledge and understanding on prevalence of supplement use in dance, it also highlights the need for further research on prevalence rates and potential influences of supplementation in dance. By providing evidence of some forms of supplementation that may have the potential to be harmful to dancers' health, it also demonstrates a need for dance as a discipline to consider how dancers may be supported optimally to protect their health. Such debates have clear relevance to – and may be informed by – contemporary work on human enhancement more broadly (see Savulescu, ter Meulen, & Kahane, 2011).

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Table 1. Percentage current, previous and none use of supplements (*N* = 371)

Training Supplements			
Supplement	Current	Previous	Never
Multivitamins	36.9	35.3	27.8
Low carb / high protein powder	13.0	14.1	72.9
Amino acids	2.5	4.9	92.6
Weight gain powder	1.6	3.0	95.4
Fat burners	3.2	8.4	88.4
High energy drinks	17.0	42.7	40.3
Caffeine pills	1.1	13.5	85.4
Creatine	1.1	2.2	96.8
Over the counter painkillers	27.0	43.5	29.5
Over the counter diuretics	1.1	3.8	95.1
Over the counter laxatives	1.9	6.8	91.4
Herbal remedies	10.8	19.7	69.5
Prescription Supplements			
Supplement	Current	Previous	Never
Prescription painkillers	1.9	18.9	79.2
Prescription diuretics	0.8	0.0	99.2
Prescription laxatives	0.5	3.2	96.2
Corticosteroid or local anaesthetic injections	0.3	10.5	89.2
Prescription decongestants	1.1	5.4	93.5
Bronchodilators	4.1	4.9	91.1
Performance Enhancing Supplements			
Supplement	Current	Previous	Never
Ephedrine stimulants	0.5	0.3	99.2
DMAA stimulants	0.0	0.3	99.7
Oral anabolic androgenic steroids	0.0	0.3	99.7
Injectable anabolic androgenic steroids	0.3	0.0	99.7
Other anabolic agents	0.0	0.3	99.7
Beta blockers	0.5	1.1	98.4
Peptide Hormones, growth factors, and related	0.0	0.5	99.5
Hormone and metabolic modulators	0.5	0.3	99.2
Blood manipulation	0.3	0.5	99.2

Table 2. Betas, standard errors, significance levels, and odds ratios for significant or marginally significant logistic regressions (*N* = 371)

Supplement type / category	Gender				Status			
	β	SE	*p*	*OR*	β	SE	*p*	*OR*
Multivitamins	-	-	-	-	-.079	0.32	<.05	1:0.45
Low carb/high protein	1.11	0.28	<.001	1:3.04	-0.83	0.28	<.01	1:0.44
Amino acids	0.81	0.45	<.08	1:2.24	-1.75	0.45	<.001	1:0.17
Weight gain powder	2.28	0.60	<.001	1:9.80	-	-	-	-
Fat burners	-	-	-	-	-0.90	0.36	<.05	1:0.41
Creatine monohydrate	2.31	0.70	<.01	1:10.04	-2.27	0.70	<.01	1:0.10
Over-the-counter painkillers	0.58	0.31	<.06	1:1.79	-	-	-	-
Over-the-counter diuretics	-	-	-	-	-0.95	0.50	<0.06	1:0.39
Over-the-counter laxatives	-	-	-	-	-1.30	0.41	<.01	1:0.27
Herbal remedies	-	-	-	-	-0.95	0.27	<.001	1:0.39
Prescription painkillers	-	-	-	-	-0.87	0.30	<.01	1:0.42
Prescription laxatives	-	-	-	-	-1.41	0.62	<.05	1:0.25
Prescription decongestants	-	-	-	-	-0.91	0.44	<.05	1:0.40
Training supplements	-	-	-	-	-1.68	0.74	<.05	1:0.19
Prescription supplements	-	-	-	-	-0.91	0.26	<.01	1:0.40
Any supplement	-	-	-	-	-2.24	1.03	<.05	1:0.11
GMS supplements	1.04	0.28	<.001	1:2.83	-1.05	0.27	<.001	1:0.35

Note. - indicates no significant effect of gender/status on reported use of this supplement type or category. GMS = Gain Mass and Strength.

Table 3. Percentage figures for significant or marginally significant logistic regressions (*N* = 371)

Supplement type/category	Gender				Status			
	Male		Female		Never Professional		Ever Professional	
	% Never Used	% Ever Used	% Never Used	% Ever Used	% Never Used	% Ever Used	% Never Used	% Ever Used
Multivitamins	-	-	-	-	32.9	67.1	17.9	82.1
Low carb / high protein powder	54.2	45.8	78.2	21.8	78.0	22.0	60.7	39.3
Amino acids	87.8	12.2	94.0	6.0	96.4	3.6	82.1	17.9
Weight gain powder	85.5	14.5	98.2	1.8	-	-	-	-
Fat burners	-	-	-	-	90.6	9.4	81.0	19.0
Creatine monohydrate	89.2	10.8	98.9	1.1	98.8	1.2	89.3	10.7
Over-the-counter painkillers	21.7	78.3	31.6	68.4	-	-	-	-
Over-the-counter diuretics	-	-	-	-	96.0	4.0	90.4	9.6
Over-the-counter laxatives	-	-	-	-	94.5	5.5	83.3	16.7
Herbal remedies	-	-	-	-	74.4	25.6	54.8	45.2
Prescription painkillers	-	-	-	-	84.3	15.7	70.2	29.8
Prescription laxatives	-	-	-	-	98.0	2.0	92.9	7.1
Prescription decongestants	-	-	-	-	94.5	5.5	88.1	11.9
Training supplements	-	-	-	-	12.2	87.8	2.4	97.6
Prescription supplements	-	-	-	-	71.8	28.2	52.4	47.6
Any supplement	-	-	-	-	10.6	89.4	1.2	98.8
GMS supplements	51.8	48.2	74.8	25.2	76.5	23.5	53.6	46.4

Note. - indicates no significant effect of gender/status on reported use of this supplement. GMS = Gain Mass and Strength.

Table 4. Descriptive statistics for ratings of importance on potential information sources regarding supplement use (N = 371)

	Training Supplements		Prescription Supplements		Performance Enhancing Supplements	
Potential Source of Information	*M*	SD	*M*	SD	*M*	SD
Books/Magazines	3.49	1.76	2.91	1.81	3.16	1.88
Internet	4.22	1.97	3.42	1.98	3.58	1.97
Supplement Supplier	3.81	2.06	3.67	2.05	3.67	2.04
Dance Master	4.77	1.92	4.14	1.97	4.54	1.98
Physiotherapist	**5.33**	**1.73**	4.71	1.98	**4.67**	**1.93**
Dance Friend/s	4.00	1.81	3.19	1.88	3.64	1.91
Non-Dance Friend/s	2.60	1.76	2.27	1.63	2.30	1.60
Sibling/s	2.82	1.84	2.42	1.72	2.37	1.62
Strength & Conditioning Coach	4.95	1.78	4.38	1.92	4.47	1.93
GP/Physician	5.04	1.78	**5.03**	**2.02**	**4.66**	**2.00**
Parent/s	3.80	2.03	3.34	2.05	3.12	2.00

Note. Possible scores ranged from 1 (*No Importance*) to 7 (*Extreme Importance*), and the full range of possible responses was provided for all source/supplement combinations. Emboldened values represent the most importance source, whereas underlined values represent the least important source.