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**The Relationship Between Dancer's Training, Diet,
Nutrition and Performance.**

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The Relationship Between Dancer's Training, Diet, Nutrition and Performance.

Abstract:

The study at present intended to investigate and examine the relationship between a dancer's training, diet and nutrition. The effect this has on one's ability to balance energy intake with expenditure and the subsequent effect on peak, or optimal, performance and training levels was a key feature of this study. A secondary objective was included within the study: does appetite and hunger play a role in influencing energy homeostasis and are these impacted by dance training. Dance training was hypothesised to play a role in influencing a dancers ability to balance their energy, with their diet and nutritional intake playing the biggest role in effecting energy homeostasis. It was expected to see dancers eating within a somewhat severe calorie deficit to their total energy requirements. It was also hypothesised that hunger levels would rise after training, whereas appetite levels would maintain or decrease. Data was collected via two methods; a questionnaire for the wider dance population to complete (of which there were 25 female respondents and 4 male) and a more focused sample group of 6 females who gave self reported activity logs and food diaries from a 4 day period in which they were training. It was concluded that dancers are indeed eating in a calorie deficit resulting in suboptimal training and performance levels. Indeed hunger levels did increase, as expected, however appetite levels varied with some presenting an increase and others a decrease.

Key words/phrases: Energy Expenditure, Energy Intake, Energy Homeostasis, Appetite, Hunger, Optimal Training and Performance, Total Energy Requirements

Introduction:

‘Dance is an art in time and space’ (Cunningham, Undated); it exists purely at that moment. In that space. An expressive art form. Cunningham, a renowned contemporary choreographer, also adds that ‘the object of the dancer is to obliterate that’ (Cunningham, Undated). The word obliterate itself starts to denote the true physicality and pressure/tension dancers are required to put on their bodies; dance scientists Sarah Beck, Emma Redding and Matthew Wyon (2015) note in an article found in *Frontiers in Psychology* that dance activity is most often described as ‘complex, diverse, non-steady state, intermittent, of moderate to high intensity, and with notable differences between training and performance intensities and durations’ (Beck, Redding, Wyon, 2015). Consequently, homeostatic control - ‘a relatively stable equilibrium between interdependent elements’ (Lexico, 2020) - of energy balance, commonly described as energy homeostasis, is essential in dancers to maintain personal health, but also in aiding the sustaining of peak/optimal performance levels. A study involving female contemporary dancers, in 2017, found that ‘energy balance and appropriate macronutrient intake are essential for maintaining the demands of training, performance and recovery’ (Brown et al., 2017), therefore comparably dance is not too dissimilar to many sports. Macronutrients will be discussed within the literature review.

Research into aesthetic sports, such as Gymnastics, indicates low levels of body and fat mass are considered important for artistry/expression and kinetic efficacy by athletes, yet optimal performance is negatively impacted by this (Sundgot-Borgen and Garthe 2011). Again, dancers are not dissimilar; a slender or lean physique is almost seen as imperative to success. Dance/USA Taskforce on Dancer Health in 2011 note this to be due to dance being a visual art form, also stating 'the concept of line, definition of the limbs in space, and bodies light enough to be lifted overhead are of paramount importance' (Dance/USA Taskforce on Dancer Health, 2011). Under fuelling the body when in dance training is often common, not necessarily as an intention by the dancers (Birtwistle, 2018). The impacts of under-fueling, or expending more energy than your intake are vast; low energy levels, deficiencies, low bone density (Siddique, 2013; Brown, D. 2017; Melin et al. 2015; Brown, M et al. 2017) and in severe cases of malnutrition, catabolism - where the body breaks down its fat, muscles and organs to survive after the body has depleted all carbohydrate, protein and fat stores. It is therefore of the utmost importance that dancers are aware of this and balance their expenditure with their intake.

Appetite and hunger are not mutually exclusive of one another; they often coincide together. However this is not always the case. Research into appetite and hunger's effect on the ability to maintain energy homeostasis within dancers is extremely limited. Knowledge in this area may allow an insight into the factors responsible for continued unbalance between dancers intake and expenditure. It also opens up the possibility to have conversations with dancers and find out why their diet is the way that it is.

The aim and purpose of this study was to examine the impact dance training has on energy homeostasis in dancers - energy and dietary intake against energy expenditure. The secondary objective is to examine the effect appetite or hunger has on dancers' energy balance. Achieving the aim of this study was possible due to various forms of data collection; primary data was collected via 6 female dancers completing a four day food and exercise journal and additional data was sourced through a questionnaire designed specifically for this research. Secondary data was sourced and presented as a literature review.

Hypotheses:

It was originally hypothesised that most dancers will be in an energy deficit - a negative energy imbalance - with dancers' hunger increasing, but appetite maintaining or diminishing after being negatively impacted by dance training.

However, there is the potential for appetite to increase also, resulting in potential for overfueling, again, causing an energy imbalance. Furthermore, both appetite and hunger could decrease, creating the risk of severe energy deficits within dancers.

This study will collect data in two forms, therefore the results will be presented in two sections, A and B.

Literature Review:

Within Stewart Truswell. and Jim Mann's 2017 book - The Essentials of Human Nutrition 5th edn. - they defined essential human nutrition as relating to the effect any component found in food has on an individual. The science behind human nutrition starts physiologically and biochemically - the processes involved in nourishment ('how substances in food provide energy or are converted into body tissues' (Truswell and Mann, 2017, p.3). Secondly, it involves the understanding and knowledge of diseases or illnesses that occur due to malnourishment - excess or insufficient nutrients (NHS, 2020). Malnourishment can also occur when energy intake, via food and/or supplements, is exceptionally lower than the energy expenditure. It is also apparent that nutrition relates to why and what motivates people to eat the foods that they do; a clear indication that psychological and sociological factors can influence a human's diet, subsequently impacting their nutrition. The extent of nutrition scopes even further to how food affects human function: 'foetal health and development, resistance to infection, mental function, and athletic performance' (Truswell and Mann, 2017, p.3). Generally speaking, according to Truswell and Mann nutrition research has become focused on achieving and maintaining optimal health. Similarly, Lean and Combet (2017) agree, writing human nutrition is 'the study of nutrients vital to health and how the body uses these to promote and support growth, maintenance and reproduction of cells' (Lean and Combet, 2017).

Nutrition is also about why people choose to eat the foods they do - the study of food habits overlaps with social sciences i.e. psychology for example. The self

determination theory's (Deci and Ryan, 1985:2000) quality of motivation has been linked with influencing 'cognitive processes such that those with controlled types of motivation will be susceptible to post-exercise consumption of pleasurable but unhealthy foods' (Hardcastle et al, 2015). This could suggest that this research may find unhealthy, but pleasurable foods in most of the participants food records - highlighting the possibility motivation has an effect on dancer's diet/nutrition, and consequently their physical health.

Typically nutrients can be separated into two sections - macronutrients and micronutrients (Astley and Finglas, 2016). Macronutrients are what provide our bodies with the energy we need to function (kcal); they additionally supply essential structures and support materials for the body in the form of amino acids and lipids. They come in three different forms: carbohydrates, proteins and fats (Gibney et al. 2009). Micronutrients are split into two categories: vitamins and minerals and include sodium, iron, vitamin C to name a few. Typically found in food in small quantities (mg or mmg's), they are considered essential and vital to human function; without these in your diet - a deficiency - it can prove fatal, as body function will inevitably begin to fail (Lean and Combet, 2017).

Truswell and Mann speak in their (2017) book about different methods for measuring the dietary and nutritional intake of individuals, highlighting the pro's and con's regarding each method. They note food diaries as one option - the most common and reliable method in collecting dietary intake for individuals. It was highlighted that collecting the barcodes of foods eaten each day was an aid used to support the

reliability and validity of food diaries. For gaining data in this study, food diaries may be used, more so an online food diary app that allows barcode scanning to retrieve data for participant ease. It additionally increases the validity. However, they state that validity increases with the addition of more days recorded, with seven days being their guide. They also question the credibility of food diaries, stating 'unless the subject is confined within a special research facility under constant observation the answer can never be 100% accurate' (Truswell and Mann, 2017, p.4). Other methods highlighted were dietary history and food frequency questionnaires. These two methods may be useful to gain trends in typical foods consumed at any given point, by specific populations. Having said that, it could be argued they aren't truly representative, due to individuals' memory recall and their strive to provide the right answer to the researcher. These methods may be used in this study.

When researching nutrition for performance, most reliable research was apparent to be within the sport sector, such as soccer, judo and wrestling (Kirkendall, 1993; Fogelholm et al., 1993) to name a couple. Beck et al. (2015) note that a key strategy in enhancing performance focuses on 'optimizing intakes of macronutrients, micronutrients, and fluids, including their composition and spacing throughout the day' (Beck et al., 2015). A key part of understanding the impact dance training has on performance and nutrition, therefore, may be in collecting macro/micronutrients data from participants, as a feature of creating food diaries. Additionally, it indicates sourcing the types of foods eaten could be useful data to collect, in order for this research to advise appropriate recommendations in combating the negative effect of dance training on nutrition and energy balance. Current recommendations suggest

that intermittent and prolonged exercise, lasting longer than 90 minutes, requires an athlete to consume 10-12g of carbohydrates, per kg of body mass, per day in the 36/48hrs prior (Burke et al, 2011). America's most decorated female gymnast, Simone Biles, announced to online site Women's Health that she trains in two 3 hour sessions per day (Biles, 2016); this is noticeably longer than the 90 minute block mentioned previously, highlighting that an athlete typically trains for significantly longer periods of time. This increases the need for carbohydrates, in particular, within an athletes diet to enable prolonged optimal performance levels within the individual. Comparably, the director of the Central School of Ballet - Sara Matthews - states that students in dance training typically train for 7 hours a day, six days a week (Matthews, 2012); Matthews indicates that dance training significantly increases the individuals need for increased carbohydrate levels to sustain energy balance and performance. To completely understand dance training's impact on the performance of dancers and their energy balance, nutritional health and diet, it is clear that a fundamental aspect of this research will be in the collection and analysis of the participants daily exercise/training.

In 'Raising the barre: how science is saving ballet dancers' (2018) dietician Jacqueline Birtwisle speaks of the impact a dancer's training can have on their health and nutrition, noting that often a dancer's diet will be 'a constant battle between quality, bulk, availability and speed of digestion' (Birtwisle, 2018). The complications of an unbalanced, non nutritional and underfuelling diet are evidently extensive for dancers - vitamin D deficiency (Siddique, 2013; Brown, 2017), the female athlete triad (Doyle-Lucas, Akers and Davy, 2010; Melin et al. 2015) ,

disordered eating and insufficient bone mass (Brown et al. 2017) to name just a few. These complications can progressively worsen over time if a consistent imbalance is maintained, potentially limiting a dancer's career. It is noticeable that most of the research around the effects of nutrition on dancers is centred around Ballet and less so contemporary and other styles. This study has the potential to examine the effects of dancers' nutrition within a variety of styles giving a more generalised, and style specific, conclusion; Brown et al. (2017) writes that it is 'not appropriate to assume that literature regarding one dance style is relevant and directly transferable to the other' (Brown et al. 2017).

Recommendations regarding a dancer's nutritional intake is noticeably different to that of a non athletic person and varies from other sports. The International Association for Dance Medicine and Science (IADMS) write in their Nutrition Resource Paper (2016) that typically a dancer should require 55-60% of their diet as carbohydrates, 12-15% as protein and 20-30% as fats (IADMS, 2016). Similarly, dance nutritionist Jasmine Challis describes the ideal composition of macronutrients in dancers as a minimum of 50% carbohydrates, 12-15% proteins and no more than 30-35% fats (Challis, 2014). It is evident that carbohydrates fuel the body in training for up to around 90 minutes of vigorous activity, before converting to burning fat stores to produce energy (Eberle, 2013), whereas fat accounts for 70% of energy required at rest. Consuming the correct amounts is necessary for physiological function; it's what provides the body with its energy, therefore allowing the dancer's body to meet the demands of their intense training. As IADMS put it, 'Consuming the right amounts and types of food and fluid will provide the body with the "high

performance fuel” necessary to achieve optimal training benefits and peak performance’ (IADMS, 2016). This could be described as an attempt to control energy homeostasis.

Katarina Melzer, in 2011, wrote an article published in the European E-Journal of Clinical Nutrition and Metabolism explaining and investigating the utilisation of macronutrients for energy; ‘blood glucose, glycogen, plasma fatty acids and intramuscular triglycerides, present major sources for energy production’ (Melzer, 2011), highlighting the importance of these within a diet. She notes that approximately 92% of energy that is stored within the body is from fats. Considerably smaller is carbohydrates at only 8%. This denotes that when training at a moderate to high level, it’s essential to follow dietary recommendations to replenish energy stores after oxidation and regain the correct balance, consequently balancing the expenditure relatively to your intake.

The conclusion that dancers are continually found to be within a negative energy balance has been replicated in a variety of studies. Brown et al (2017) concluded that female contemporary dance artists are ‘at risk of energy deficiency, particularly during scheduled training’ (Brown et al, 2017). These warnings and findings have been continually expressed throughout recent times; Hamilton et al. (1987), Kaufman et al. (2002) and Min & Lee (2008) all express a concern in finding negative imbalances between dancers expenditure and intake, highlighting the possible repercussions this can lead to if continued. It is important to note that the majority of

studies available have examined energy balance within ballet dancers, not contemporary providing a gap within research.

A recent study from 2019, in Korea, by Kim et al. (2019) examined energy balance and appetite regulating hormones in female professional ballet dancers. It was concluded by the researchers that leptin and ghrelin (appetite suppressing and increasing hormones) levels significantly increased between the first blood analysis (pre performances) and the second, after performance. They also noted that although energy intake increased after performances, the intake was below their energy requirements creating an imbalance in energy expenditure and intake. They also conclude that elevation in leptin levels, the hormone responsible for suppressing appetite, are as a result of continued negative energy balance (Kim et al., 2019). It is important to note that these findings were based on Korean nationals; there's the possibility these results may not be truly representative of the wider dance population - diets, religion and body composition may differ in Korea to, say, the UK.

Research into exercises' effect on appetite and hunger suggests a variety of things; Broom et al. (2009) suggests that appetite regulating hormones ghrelin and peptide YY regulate the participants appetite during and after exercise, but were inconclusive on whether the exercise induced changes to the hormones had an effect on actual food intake (Broom et al. 2009). Hagobian et al. (2009) supports this concept even further by concluding from their study that, females in particular when exercising, the physical activity alters appetite regulating hormones in a 'direction expected to stimulate energy intake' (Hagobian et al. 2009). Vatenzever-Ozer et al (2011)

contrasts this by concluding that aerobic exercise reduces appetite, reducing acylated ghrelin levels over a longer period of time (Vatenezer-Ozen et al. 2011). If this is the case it leads to the potential of dancers developing severe negative energy balances, consequently impacting optimal performance levels and health levels in a negative manner. There is also possibility in disordered eating presenting itself within dancers if prolonged suppressed appetite manifests in the dancers.

Methodology:

There were several methods used to collect data in this study. Participants were recruited through publicising the research and need for participants on social media, via email and face to face conversations. Before agreeing to take part, all participants were required to read and sign a consent form (a blank copy can be found in Appendix, labelled A.1). This outlined the purpose of the study, what data would be collected, and why, as well as their rights regarding anonymity and to withdraw. In total, 35 participants (male = 4, female = 31) took part in this study.

The first method that was used to collect data (Section A of this study) was via a questionnaire; the questionnaire contained both quantitative and qualitative questions, consisting of five sections: Personal Information, Pre-dance, Post-Dance, Diet/Health and Appetite/Hunger (a copy of the questionnaire can be found in Appendix, labelled A.2). It was designed by combining elements that prior research had suggested were useful in analysing nutrition/health, such as hydration, sleep, food sources etc. with Graaf et al. (2004) explaining that not only internal factors affect your nutrition and health, but external, or conditioned, factors/cues also

determine this to a degree. The questionnaire also contained Visual Analogue Scales (VAS)/Numerical Rating Scale (NRS) as research showed these methods to be a reliable and reproducible technique in gaining subjective data (Douglas and Leidy, 2019).

The personal information section consisted of questions relating to them as individuals, for example 'From the following, please select your age' and 'On average how many hours of dance do you do?'. This was mainly designed to help build a clear demographic of the participants involved. The next section of the questionnaire related to pre-dance; the pre-dance section revolved around lifestyle and health/nutrition before a dance session, asking questions such as 'do you eat at least 2 hours before a dance session?' and 'on average, the night before a dance session how much sleep do you get?'. This component was designed with the intention of learning habitual patterns and trends between dancers, pre-dance, with a health and nutrition based focus. The following segment of the form, post-dance, has the exact same format and questions as the previous - except relating to post-dance. The fourth section was more specific in relation to their diet and health as an individual, as well as in a dance context. Some of the questions used are, 'On a typical day how much water do you drink on average' and 'On average, how many calories would you say you consume in a day that you dance?'; the questions used within this component collected data that is representative of the dancer's diet and health, both in a dance and non dance context. Using FFQ and dietary history style questions will allow the data to be fairly accurate, as found in the review of literature. To finish, the questionnaire looks at appetite and hunger - the purpose of this section relates

purely to the individual's perception/subjective opinion, regarding their appetite and hunger in a dance related context. This section included questions like, 'During a dance session, do you notice that your appetite increases, decreases or stays the same?' and 'During a dance session, do you feel the need to snack in breaks or throughout the dance session to fulfil your appetite and or hunger?'. Once designed, it was distributed to different platforms, where any participant could take part for a period of 3 weeks. There were a total of 29 responses, 25 female and 4 male.

The next approach that was used (Section B) was more individual based. A total of six female dancers completed exercise logs (blank copy found in Appendix, labelled A.3), designed by the researcher, as well as self-reported and weighed food diaries using the application MyFitnessPal, to standardise the collection of data. This was collected over a consecutive 4 day period in which they were in dance training. The application MyFitnessPal was chosen, due to the food logger being able to scan barcodes to add food to the diary, which research showed supports the validity (Truswell and Mann, 2017). The exercise logs contained four sections to be completed daily. These were: 'How long have you been dancing for today?', 'On the following scale please rate the intensity of your dancing today', 'What style/s did you dance in today?' and 'Did your appetite or hunger increase or decrease at all after training?'. These pieces of information allowed a physical activity level (PAL) to be assigned to each individual when working out their Total Energy Requirement (TER). TER has the possibility to be worked out in a couple of ways, namely the Schofield method and Harris-Benedict method; it was decided to use the Harris-Benedict method due to Schofield's method not taking into consideration PAL (Unknown,

2005). PAL was calculated by averaging the daily amount of hours each dancer undertook dance training over a four day period; 0-30 mins = little, 31-90 mins = light, 91-180 mins = moderate, 181-270 mins = hard, 271+ mins = very hard. TER was calculated using the Harris - Benedict formula found below:

Male: $66.5 + (13.75 \times \text{weight, kg}) + (5.0 \times \text{height, cm}) - (6.76 \times \text{age, years})$

Female: $655.1 + (9.56 \times \text{weight, kg}) + (1.85 \times \text{height, cm}) - (4.68 \times \text{age, years})$

PAL: little to no exercise = $\times 1.2$, light exercise = $\times 1.375$,

moderate exercise = $\times 1.55$, heavy exercise = $\times 1.725$,

very heavy exercise = 1.9 (Pearson, 2016, p. 5)

It was also designed to allow an insight into the training load of dancers, and whether they perceived their appetite and hunger to increase or decrease - or stay the same. Food diaries are essentially records of the amount of actual food intake; they can be used to measure and reflect on a person's appetite, although the consistency and degree of reliability is questioned by Graaf et al. (2004). These were completed over a four day period. At the end of the four days, their height, weight and body composition were obtained for use in the analysis.

Height was measured using a standard measuring tape, while weight and body composition were measured using Bioelectrical Impedance Analysis (BIA) scales - Salter® Bluetooth Smart Analyser Pro. BIA is a noninvasive and straightforward method used in estimating body composition; by sending a minute alternating current through the body, the electrical impedance of body tissues is determined, therefore resulting in Total Body Water (TBW) being found (National Institutes of Health Technology, 1994). Once TBW has been obtained, body fat and fat-free mass can

be estimated also. The reliability and validity of BIA is mixed, with research showing both the positives and negatives it holds. A 1985 study by Jackson et al. found that BIA was a reliable method in collecting body composition, with similar results from BIA tests as the skinfold fat test and hydrostatic methods (Jackson et al. 1985). Moon (2013) concludes in their study examining BIA techniques in finding body composition of athletes that there is 'promise for estimating body composition in athletes' (Moon, 2013). However, analysing body composition is not a key component or element of this research; it is on the other hand a good indication, for the researcher, of the participants body composition.

Results:

Section A:

For the purpose of this study, participants will be labelled alphabetically if a direct quote is taken from one of their qualitative responses.

Table 1 - Participant Demographic/Characteristics

Gender Ratio (f:m)	25:4
Average Age Range	18 - 24
Nationalities	American - 1, British - 6, English - 9, Indian - 1, Italian - 1, Latvian - 1, New Zealand - 1, Scottish - 1, Welsh - 8
Average Hrs Dancing Per Week	8hrs
Style Range	Contemporary, Ballet, Jazz, Hip Hop, Commercial, Musical Theatre, Indian Classical, Modern, Lyrical, Capoeira, Physical Theatre

Within the questionnaire there was a broad range of participants within the dance industry that took part. The gender ratio was in favour of female participants at a ratio of 25: 4. The average and most popular age range of the participants was 18-24, however there were participants within the ranges 25 - 34 and 35 - 44, although these were limited. It is noted that the majority of participants identified with a nationality located within the United Kingdom, however there were participants identifying with nationalities from across the world. It is unknown whether these reside in the relating countries or here within the UK. Averaging the participants' responses on how many hours per week they are dancing, it was found they trained for 8hrs (sd= ± 3 hrs). There was a very broad range in styles reported, however the most common style reported was within the Contemporary style.

Figure 1 - Eating Habits Pre Dance

Before you take part in a dance session, do you have anything to eat?
29 responses

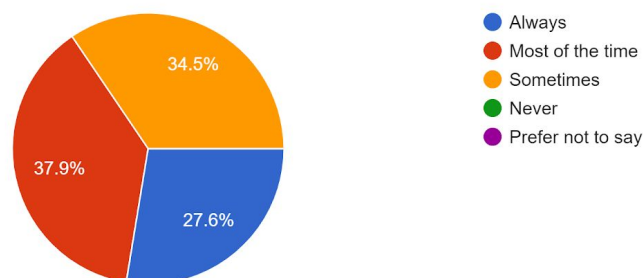


Figure 2 - Eating Habits Pre Dance part 2

Do you eat at least 2 hours before a dance session?

29 responses

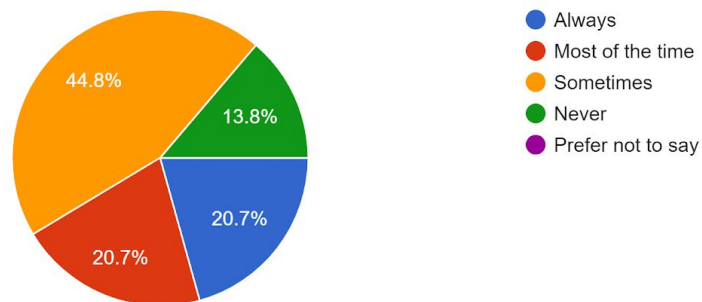
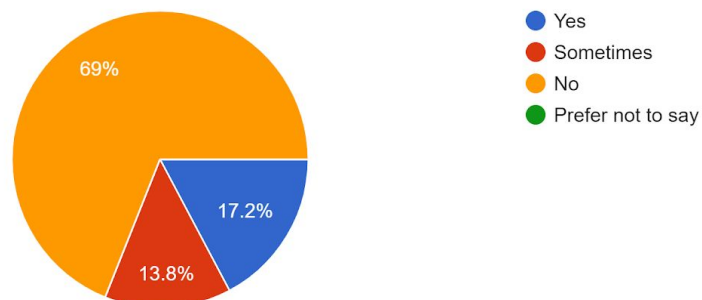


Figure 3 - Supplementation Habits Pre Dance

Before a dance session, do you take any form of supplementation, such as protein shakes, vitamins etc.?

29 responses



From this data it is apparent that a large majority of participants are at some point not consuming any energy prior to their dance training, with 10 participants claiming they sometimes eat before a session and 11 participants claiming they do so most of the time. Even more concerning is the fact over half of the participants are not eating 2 hours before their session begins, more than likely debilitating their energy levels for the class ahead. Supplementation seems to be lacking within the participants with

a huge majority (just over two thirds/69%) not taking any form of supplementation. Educating dancers on the necessity of supplementation, particularly vitamin D and calcium, would be of huge benefit to the dancers and can be concluded from these results.

As part of the research into pre dance habits, the participants were asked to list typical foods they would eat prior to a dance session. The results were all pretty similar and generally included easily digestible carbohydrates including bananas, cereals with milk, porridge, wholemeal bread and fruits. It is also evident that some dancers were very considerate of the types of food they were eating before the sessions, with one participant noting they aim to have an all round macronutrient based food - 'Usually something including carbs, protein and fats, like an egg/mayo sandwich or a protein bar and a sandwich' (Participant A, 2020). Participant B also gave a detailed account as to their thought process behind their food choices -

'Whether I eat before/what I eat before a dance session is dependent on the time of the class in relation to normal meal times and how long until the dance session starts. If I have time to digest a full meal I will eat this prior to a session and make an effort for it to include slow release carbs to help maintain my energy. If I have less time or I have already eaten a meal, I often have home made smoothies and cereal bars or rice cakes and similar products. I always try to have something healthy with as few processed sugars as possible, and grains or nuts so it doesn't sit heavy in my stomach. Also to be able to maintain energy and not have a sugar crash' (Participant B, 2020).

It can be concluded that there is a clear thought process and knowledge, potentially subconscious, behind the majority of the food choices dancer's are eating prior to exercise. However, there is definite improvement needed within the participants in the consistency and timing of their eating habits prior to a dance session in order to sustain their energy levels at an optimal level. This is clear when participants that selected they took part in more than one session a day mostly listed their energy levels to have been negatively impacted, claiming they felt 'fatigued', 'drained' and 'tired'.

Figure 4 - Eating Habits Post Dance

After a dance session, do you have anything to eat?
29 responses

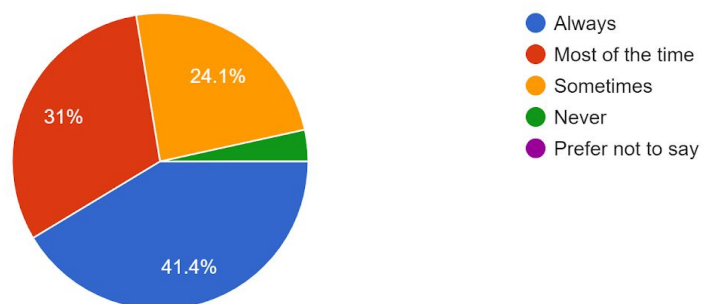
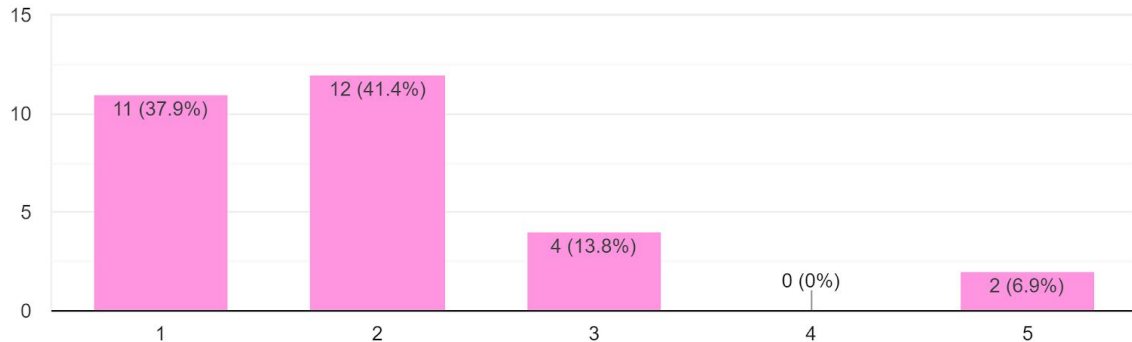


Figure 5 - Eating Habits Post Dance part 2

On average, how quickly do you eat after a dance session?

29 responses



X-Axis; How many hours it takes for a meal or food to be consumed, Y-Axis; Number of participants

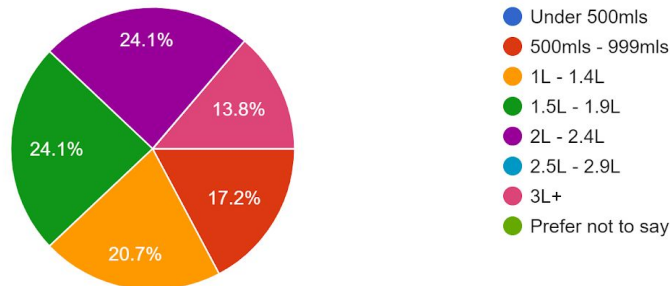
According to the participants' responses shown in figure 4, less than half of them always have something to eat after a dance session (41.4%). That leaves 58.6% of participants at some point not eating and refuelling their bodies after their training - answers were based on a typical basis highlighting that this is recurrent. However, although refuelling after training isn't always achieved by all, it can be said that 72.4% of people are either always or most of the time eating after training. From the data I would suggest that those who stated that they either never or sometimes eat after training are the participants struggling to find energy and reporting their energy levels to be low on a regular basis.

Figure 5 highlights that the majority (79.3%) of participants are refuelling within the recommended two hour window post exercise, with almost 38% eating within the first hour. A small minority report to first refuel up to 5 hours after exercise, seriously limiting their bodies in restoring their glycogen stores. A high amount of participants recorded that after a session they generally felt energised. Although this could be due to endorphin release, the question - is the restoration and consumption of glycogen after exercise at least partly responsible for sustained energy highs after exercise? - is raised. To enhance this conclusion and answer the question, a further study would be required through measuring endorphin levels, glycogen levels post workout (pre eating) and measuring these again after eating. Alongside this subjective statements from participants on their energy levels would be required to create a comparison. There is also the possible conclusion that those reporting high energy levels at the end of a session have a slower metabolism, resulting in the slower release of energy to the system; if this continues post exercise they are still gaining energy. When looking at the foods listed pre dance session, it can be concluded that the complex, slow releasing carbohydrates they are consuming (such as bananas and grain based cereals) are likely to affect and impact the energy levels post exercise if training at a moderate rate and short period of time.

Figure 6 - Average Daily Hydration

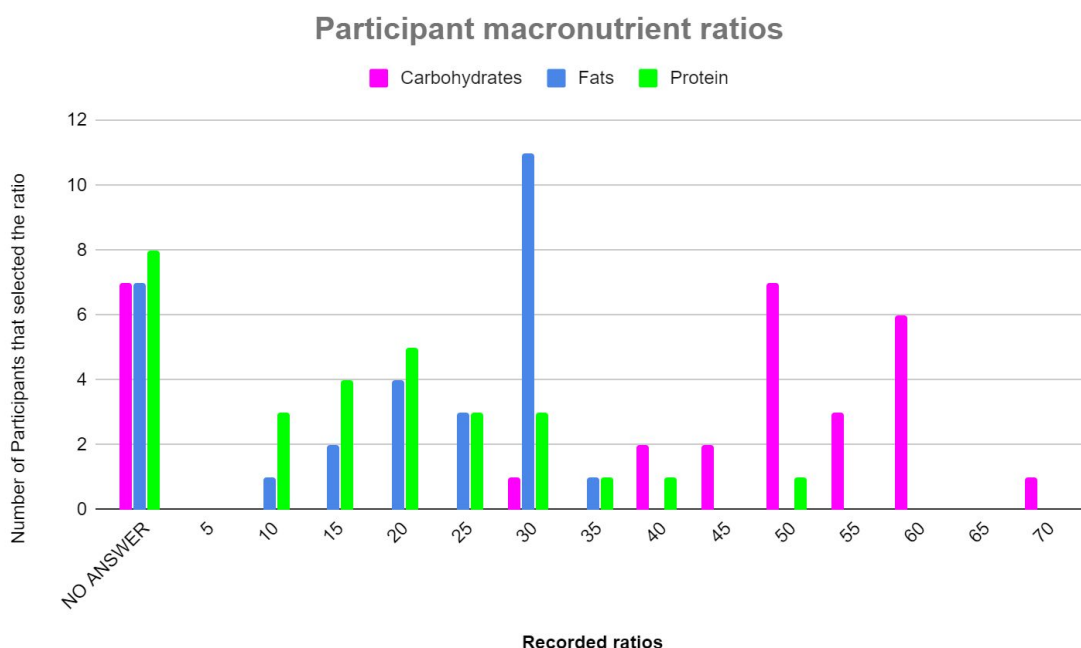
On average how much water do you drink on a daily basis?

29 responses



In general, it is apparent from figure 6 that 62% of participants are severely under drinking by not drinking the recommended two litres. This has been described as severe due to the fact when dancing, perspiration occurs, therefore losing essential body water; this needs replacing and adding on to the recommended two litres of water. Only 37.9% of participants (11 people) are consuming above the recommended daily water intake.

Figure 7 - Typical Macronutrient Ratios



Out of the 22 participants that answered the question regarding their macronutrients composition/ratio (shown in figure 7) it is apparent that the majority are consuming the correct composition of macronutrients in their diet. It can be noted that these figures are subjective and no food diaries or entries were taken to average their true composition. From the participants' subjective views, 19 of them are eating within the recommended intake of fats, for dancers; only 3 are under eating when relating to fats. In terms of carbohydrates, a lower proportion of the participants are consuming within the recommended range; 16 participants are within range. One participant is over consuming carbohydrates with their estimation of 70% of their diet being from carbohydrates; 5 participants are under consuming carbohydrates. It is clear that less of the participants are consuming the correct composition of proteins; only 7 are eating within the recommended guidelines. 14 participants are potentially over consuming in proteins, with 6 of them claiming their diet consists of over 30% of protein.

Figure 8 - Average Calorie Intake During a Dancing Day

On average, how many calories would you say you consume in a day that you dance?
29 responses

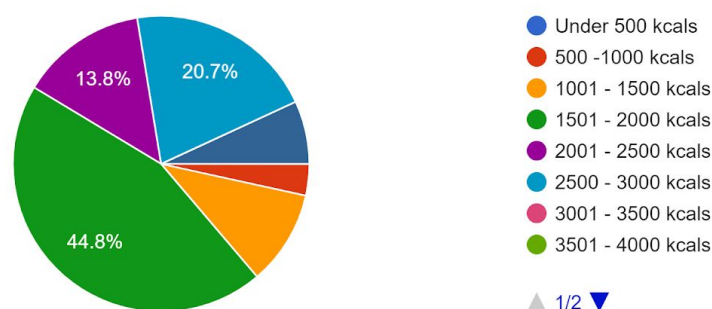


Figure 9 - Participant Awareness of Food Recommendations for Dancers

Are you, as a dancer, aware of the daily recommendations for food intake - specifically when training?

29 responses

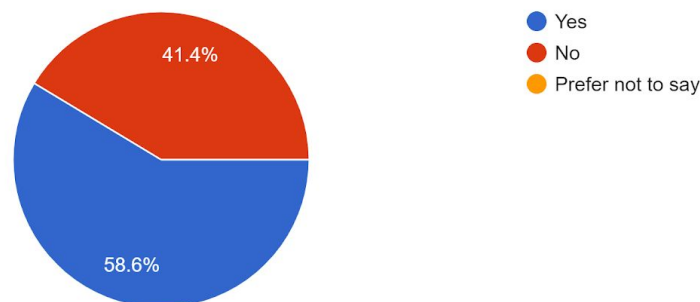
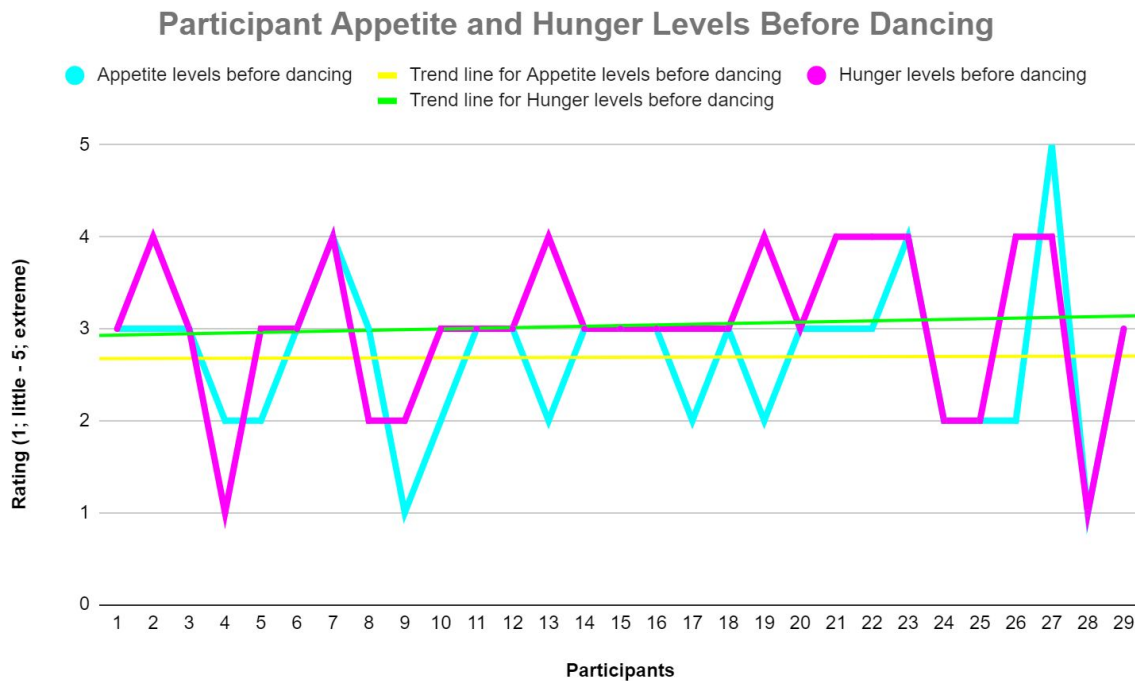


Figure 8 highlights a large proportion of participants are consuming under 2000kcal a day; almost certainly significantly lower than their total energy requirement (TER), however this can't be concluded without gaining information on their TER.

Concerningly, there is a participant consuming below 1000 kcal in a day that they are physically active, suggesting a severe energy imbalance. This is more than likely limiting their optimal performance levels. The demographic suggests that most participants are within the 18-24 age bracket, highlighting the fact that these individuals are still developing and in need of a higher calorie intake; this is not evident in the average calorie intake they perceive to consume. The high percentage of participants under eating suggests limited knowledge of what they should be consuming; this is contradictory to the high percentage (58.6%) that claim an understanding of the recommendations for dancers, shown in figure 9. It can be concluded that, combined with the data from figure 7, participants are mostly aware of recommended dietary compositions, but are either misinformed or lacking

knowledge in consumption for their total energy requirements. Overall this suggests dance training has a negative impact on energy homeostasis within dancers, as judgements by participants on their calorie requirements are lower than required.

Figure 10 - Appetite and Hunger Levels Pre Dance



Pre dance, it is clear that the majority of participants rated their appetite levels within the range of 2-4, with an average rating of 2.7. This suggests their appetite, or desire to eat, is somewhat on the mind prior to exercise - this could be due to lack of energy prior to the activity. It is clear, again, that the majority rate their hunger between the ranges of 2-4, with a slightly higher tendency to rate at a 3 or 4. The average can be calculated as a score of 3. A higher hunger score (physical discomfort or weakness caused by a lack of food), suggests that dancers are entering a dance session with a lack of energy for the body to oxidise, therefore resulting in suboptimal performance levels.

Figure 11 - Appetite and Hunger Levels Post Dance

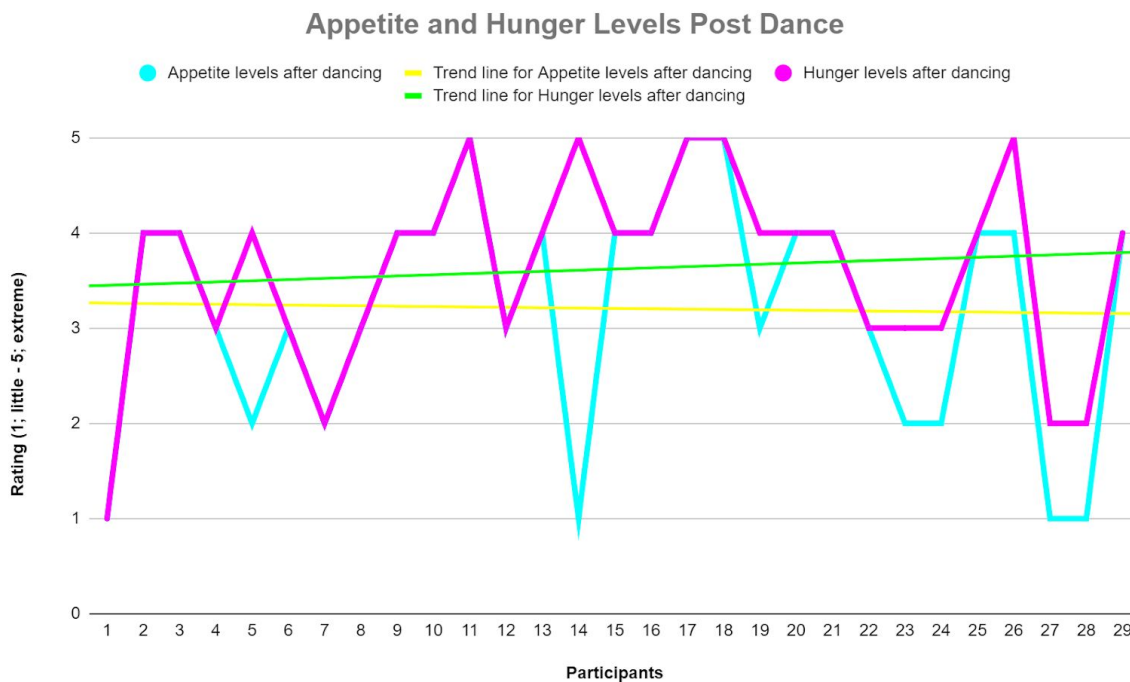


Figure 11 highlights that post dance hunger levels are significantly impacted with most participants rating their hunger between 3-5. The average hunger rating was calculated as 3.6, a rise of 0.6. The increase in hunger levels can be concluded to be as a result of dance training; expenditure of energy elevates hunger intensity. Appetite on the other hand has a broader variety of ratings, with more participants noting a lower ranking than before exercise. However, their average rating has raised by 0.5, to average at 3.2. This suggests that appetite levels are variant from participant to participant, with a tendency to slightly increase. This could be due to different metabolic rates between participants. There is also the possibility that the type of dance the participants are undertaking is partially responsible; dance training potentially is much more interchangeable between aerobic and anaerobic systems, resulting in further ghrelin release and leptin reduction. Aerobic exercise involves the use of oxygen to break down glucose and can be maintained for long periods of

time; anaerobic exercise therefore is without oxygen - oxygen supply is lower than the demand so can only be maintained for intense short periods of time (Bowling and Pletcher, 2016).

A question asked within the questionnaire was 'During a dance session, does your hunger or appetite levels affect your energy levels?'. The results were mixed with some participants stating no they didn't, however there were large numbers of participants claiming hunger had an impact on their energy levels, alongside other symptoms. Participant D claims, 'If I'm hungry I lose energy' (Participant D, 2020), an answer that was recorded by 12 other participants. Other symptoms hunger brings, listed by participants, are 'hunger headaches' (Participant E, 2020) and 'lack in concentration and focus' (Participant F, 2020). It can be concluded that appetite has little effect on a dancer's training and performance, however hunger does have an effect. Hunger can be seen to limit energy levels and diminish focus and concentration levels, therefore limiting the dancers ability to perform and train at optimal levels.

Section B:

For the protection of participants, all data has been anonymised where names had been given. They have each been assigned a numerical number ranging from 1 - 6. Data was initially screened for any anomalies that could have adversely affected the conclusion, reliability and validity of these results. For reader ease and analysis, Kcals have been rounded to the nearest whole number.

Table 1 - Participant Characteristics

	GENDER	AGE	HEIGHT (CM)	WEIGHT (KG)	Bone Mass (Kg)	Body Fat (%)	Muscle Mass (%)	Body Water (%)
1	Female	20	156	53.8	2.7	21.3	41.2	58.4
2	Female	20	150	47.5	2.3	20.4	42.3	60
3	Female	19	154	53	2.6	21.4	41.2	58.4
4	Female	24	166	65.2	3.3	24.9	38.1	54.2
5	Female	39	164	65.1	3	29.4	34.9	50.8
6	Female	19	152	93.8	2.7	55.1	28.9	40.1

Table 2 - Basal Metabolic Rate, Total Energy Requirement and Energy Input

	BMR (KCALs)	PAL	TER (KCALs)	EI (KCALs)	EI-TER (KCALs)
1	1364	Moderate (x1.55)	2,114	1092	-1022
2	1293	Hard (x1.725)	2230	1297	-933
3	1358	Hard (x1.725)	2343	1190	-1153
4	1473	Moderate (x1.55)	2283	1334	-949
5	1398	Hard (x1.725)	2412	1617	-795
6	1744	Hard (x1.725)	3008	1100	-1908

Table 1 indicates a strong positive correlation between height (in cm) and weight (in kg) within the participants, with the exception of participant 6. As height increases so does weight. Participants 1 - 5 all have an average percentage of body fat and muscle mass. Participant 6, however, has a relatively high percentage of body fat - almost double that of their muscle mass.

Table 2 shows a significant difference between TER and EI, highlighting the fact all participants are in a negative energy balance. Participant number 5 has the smallest calorific difference between their intake and requirement (or expenditure), yet their PAL was rated hard; participant 4 however rated moderate, with a difference in calories of 949 - this is only 154kcal different to participant 5. Participant 6 had a hard PAL and an energy difference of 1908kcal, the largest calorific difference

between the participants. This information suggests there is no real correlation between PAL or intensity and predicting the extent of a positive or negative energy difference. This also implies that dance training isn't the sole factor to influence a dancer's intake and that there are other factors to consider. The participants had a 1127kcal (sd= $\pm$ 400kcal) difference between their EI and TER, again highlighting the extent and significant deficit within the dancers. The average BMR between the 6 participants is 1438kcal; almost 80% of their average BMR is not being consumed.

Table 3 - Average Macronutrient Composition Over a 4 Day Period

	1	2	3	4	5	6	Average of 6
Carbs %	48	54	60	71	60	49	57
Protein %	16	13	11	12	21	15	15
Fat %	36	33	30	17	20	37	28

Table 4 - Average Nutritional Intake Over a 4 Day Period

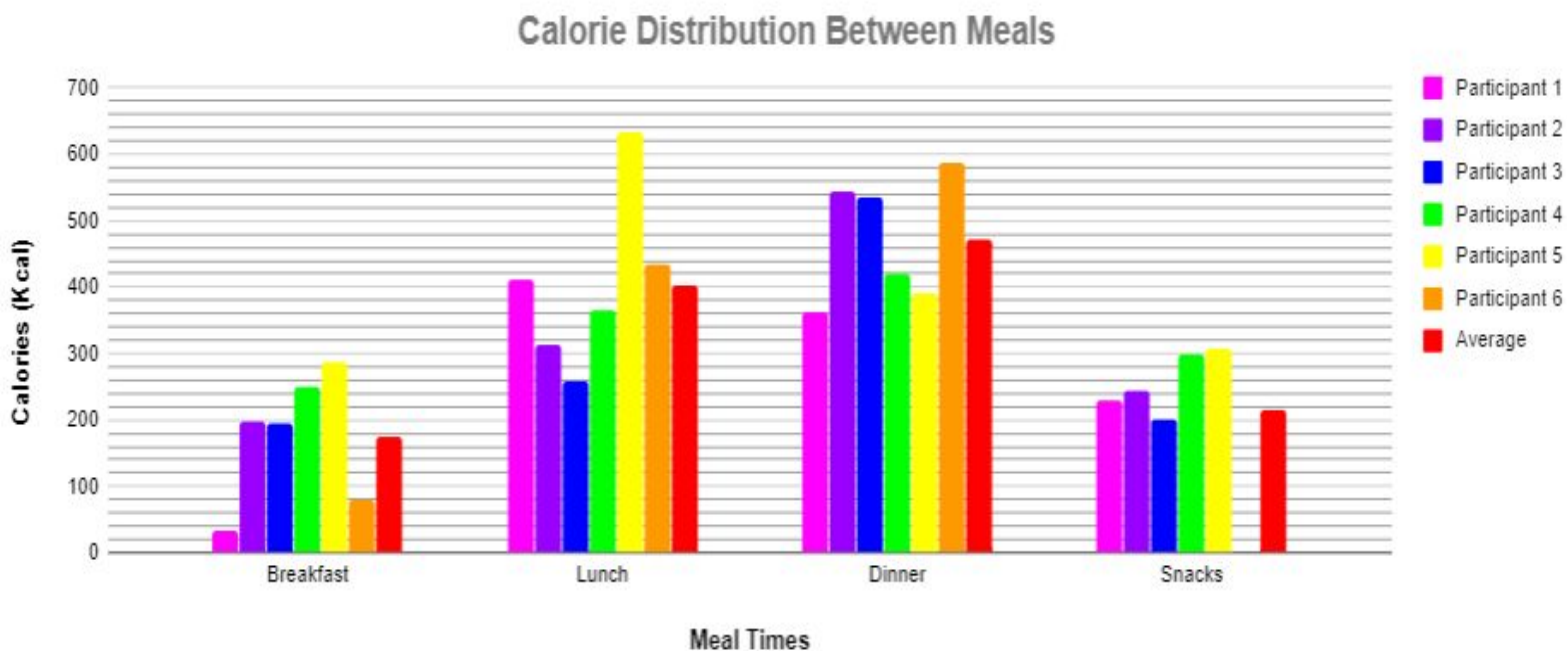
	1	2	3	4	5	6	Average
Protein (g)	40	44	29	41	67	40	43 $\pm$ 13
Carbohydrates (g)	133	179	151	234	189	123	168 $\pm$ 41
Fiber (g)	8	17	12	22	16	11	14 $\pm$ 5
Sugar (g)	16	59	42	97	72	17	50 $\pm$ 32
Fat (g)	43	50	36	27	67	46	45 $\pm$ 13
Saturated Fat (g)	11	16	14	13	27	19	16 $\pm$ 6
Polyunsaturated Fat (g)	1	3	3	0	2	0	2 $\pm$ 1
Monounsaturated Fat (g)	2	2	2	1	9	0	3 $\pm$ 3
Trans Fat (g)	0	0	0	0	0	0	0
Cholesterol (mg)	46	18	0	45	39	69	36 $\pm$ 24
Sodium (mg)	936	1270	1072	1529	730	1224	1127 $\pm$ 279
Potassium (mg)	81	958	505	890	523	1079	673 $\pm$ 372
Vitamin A (%)	9	10	7	117	26	8	29 $\pm$ 43
Vitamin C (%)	10	5	2	222	22	20	47 $\pm$ 86
Calcium (%)	10	43	14	76	29	10	30 $\pm$ 26
Iron (%)	20	18	10	74	11	12	24 $\pm$ 25

Data in table 3 has been rounded to the nearest whole number for ease in analysis.

Analysing the macronutrients (from table 3) across the four days, per participant, it was clear that the percentages of their macronutrient composition were similar to, or within, the recommended daily averages for diet composition. However, although they are within compositional ranges, this data is not truly representative of a healthy diet; all participants are under eating as seen in table 2. As participants are ranging correctly at current, there is a possibility that if consumption by participants was to increase in terms of calories then it would be in line with their current eating habits, therefore resulting in compositional ranges staying somewhat similar.

The results clearly show from table 4 that on average all participants are consuming a significantly low amount of either, or both, vitamins and minerals. Participant 4 has the highest intake of both vitamins and minerals with a deficit mainly in minerals calcium and iron. The rest of the participants are below recommended intake, highlighting a deficit in most essential vitamins and minerals. It is also evident that all participants are eating a relatively low quantity of foods containing monounsaturated and polyunsaturated; trans fat was consumed by none of the participants. Again, participant 4 had the least amount of fat within their diet, suggesting their energy at rest is going to be somewhat lower than the other participants, not dramatically however.

Figure 1 - Average Calorie Distribution Across a 4 Day Period



It is apparent from figure 1 that breakfast is the least significant and calorific meal for all participants; in fact all participants, with the exception of participant 6, gain more calories from snacking throughout the day than their breakfast meals. For most, calorie intake increases throughout the day, from meal to meal with dinner showing the highest intake. The exception to this is participants 1 and 5 who both gain the most calories from their lunch meals. Based on the average of the 6 participants, the ratio of calorie distribution between meals (in Kcals) is 174:403:473:214. This further supports the fact an evening meal is where participants are gaining most of their energy; it can be said that participants are somewhat aware of the need to refuel their bodies after a day of physical activity. It's evident that participants are consuming little energy before their training begins, with their breakfast meals; this potentially could limit their energy levels within their daily training. This could be because the participants are concerned of possible side effects related to eating

before training i.e. bloating and sickness, however this study cannot conclusively confirm this without further data as to why they ate what they did.

Table 5 - Average Activity Duration, Intensity Rating and Appetite; Hunger After Exercise

	Hrs/Mins Average Per Day	Intensity Rating Average	Appetite; Hunger Average After Exercise
1	2hrs 8 mins	6	Increase; Increase
2	4hrs 23 mins	7	Increase; Increase
3	4hrs 23 mins	7	Increase; Increase
4	2hrs 41 mins	6	Increase; Increase
5	4hrs 15 mins	7	Increase; Decrease
6	3hrs 45 mins	6	No change; No change

From this data it can be concluded that appetite in particular seemingly increases after training. Participant 6 is the exception to this. The desire to eat food after training could relate to several factors. Data shows that they are training at a moderate to high intensity, based on their judgements, for a prolonged period of time (longer than 90 minutes); their desire for food could increase due to depletion of energy stores resulting in a fatigued feeling throughout the body. Combine this with their under-fueling of the body prior to their training, it can be concluded that, for most, appetite increases when the body is under fuelled prior to moderate and prolonged physical activity. It could also be argued that psychological factors are a factor in appetite increase, instead of training - an increased appetite could be as a result of the time of day; as conditioned meal times get closer, appetite could increase. Subjective accounts could have enhanced the conclusion of this. Additionally, participants may know the importance of replenishing their body with more energy after exercise, so appetite increase may be as a result of knowledge

affecting the psychological system. Participant 6 shows no change; this could be as a result of their higher body fat percentage, resulting in more energy stores that can be used.

Dance training's impact on hunger levels, the physical discomfort caused by lack of food, however is less conclusive. Most participants reported an increase in hunger, however participants 5 and 6 reported either no change or a decrease in these levels. Participant 5 had the highest intake of calories prior to their training and also the highest intake of calories from snacking. This could conclude that their energy levels were not completely depleted after exercise, resulting in no discomfort or fatigue. Similarly, participant 6 has higher levels of fat stores available to fuel the body, again resulting in no increase to their physical fatigue and discomfort by a lack of energy from food.

Discussion:

In this study, the impact dance training has on a dancers ability to maintain energy balance was examined and investigated. Essentially questioning, are dancers eating in a deficit or overeating as a result of their training? The secondary objective of the study was to examine the effect of dance training on dancers appetite and hunger levels. It was hypothesised that dancers would be eating in a deficit, causing an imbalance in energy; the results from this study are in line with this hypothesis. It can be concluded that dancers within both section A and B of this study presented with negative energy balances, although this cannot be fully conclusive in section A, due to no collection of total energy requirements. Regarding the secondary objective the results suggest that dance training has a significant impact on hunger levels within dancers, however appetite levels are variant.

It is inferred from these findings that dance training cannot be seen to have sole responsibility for dancers ability to perform and train at optimal levels. Section A confirms to an extent that dancers are not meeting energy requirements of their sessions, stating things like 'I lack energy towards the end of a session' (Participant G, 2020) and a common trend of words like 'fatigue' and 'tired' seen within their answers. Training is therefore instead seen to be a factor adding to this inability, as other factors are presented to influence this from these results.

One factor, other than training itself, is participants' dietary/nutritional intake. This research has shown that although dancers are intaking the correct composition of macronutrients, or energy types, this is at a lower calorie level to their requirements.

Prior research suggested that dancers should be consuming 50-60% of their calories through carbohydrates, 12-15% from proteins and 20-35% from fats. The majority of participants, both in section A and B, are consuming these ratios, however it is noted that these ratios are proportional to a lower calorie intake. This can therefore be concluded to be a factor limiting dancers energy balance, consequently impacting optimal training levels. Common effects recorded by prior research on energy imbalance include the female athlete triad, osteoporosis, disordered eating, severe fatigue and weakness and reduced psychological/cognitive functions (Brown, 2017; Doyle-Lucas et al. 2010; Fogelholm et al. 1993; Koutedakis and Jamurtas 2004).

It is evident also, from section B, that dancers are generally under consuming in micronutrients. All participants were consuming low levels of either minerals, vitamins or both. This is supported and apparent from the results of section A also, that dancers are unaware of any micronutrient deficiencies, with 58.6% selecting they were unaware. Sousa, et al. (2013) note that 'poor micronutrient status [in dancers] is due to their restricted energy intake' (Sousa et al. 2013), also stating dancers would benefit from micronutrient supplementation, i.e. vitamin D, calcium, iron and vitamins A and C. The importance of micronutrients for dancers is high; for example 'Vitamins A (beta carotene), C and E function as antioxidants that are necessary for the repair of overstressed muscles and are needed to help muscles recover from strenuous activity. Vitamin D is important in bone formation' (IADMS, Undated). This importance seemingly doesn't translate towards dancers, with almost all participants in section A claiming to not take any form of supplementation. This has the potential to severely impact optimal training levels, due to increased risk of

injury. It would be recommended to dancers to consult with dieticians to inform themselves on how to intake higher levels of micronutrients within their diets, or if not possible at least consider the use of supplementation.

Contrary to King, Tremblay and Blundell (1997), hunger levels within the participants, both in Section A and B, are seen to increase after exercise. Section A concludes there is an average rise of 0.6 in hunger levels, with more participants rating their hunger levels at a 4 or 5 than before exercise where participants typically rated at a 3. Complex physiological systems balance energy homeostasis, 'comprising afferent signals and efferent effectors' (Druce and Bloom, 2006); the physical symptoms of hunger are responsible for the initiation of food intake to balance the expenditure. Lower fat levels within participants could be seen as the reason why hunger levels increase with ghrelin levels being higher in leaner bodies (Druce and Bloom, 2006). Participant 6 of section B claimed there were no changes in their appetite or hunger after exercise; their body fat percentage was significantly higher than other participants, strengthening the argument weight/body fat has a huge influence in hunger, consequently negatively impacting energy homeostasis. Dance training therefore has potential to limit dancers (with higher body fat) ability to maintain a balance in their energy expenditure and intake.

Exercise's impact on ghrelin levels has conflicting research available; studies conclude it causes an increase (Jurimae et al. 2011), some say a decrease (Vestergaard et al. 2007) and not surprisingly, some say it stays the same (King et al. 1997). Kim et al. (2019) report that although ghrelin levels are mainly affected or

influenced by an individual's nutritional state, exercise also affects appetite regulating hormones. This study supports the idea exercise does in fact increase hunger levels with an increase.

Although hunger levels are said to increase after training, supported by the scientific evidence of increased ghrelin production, it is clear further education to dancers is needed. Participants in section B all recorded an increase in their hunger levels (bar participant 6), yet all participants presented a severe deficit in calorie intake (1227 ± 400 kcal). This suggests that even though hunger after dance training is at an increase, calorie consumption is still minimal resulting in the imbalance of energy. Education on nutritious high calorie foods that can be eaten in smaller quantities may be of benefit to dancers. A possible future study could examine satiety and fullness hormone levels during post training meals to establish training's impact on the ability to balance energy.

Appetite showed to vary within participants, with more participants noting a lower appetite level after exercise, than before exercise. One possibility for those that reported their appetite to decrease, could be related to their metabolism of glycogen and fat. Typically, glycogen stores tend to be used up after approximately 90 minutes of moderate exercise (Eberle, 2013). Once glycogen stores are depleted, the body converts to oxidising fat - a by-product of the metabolism of fat are ketones (Murray and Rosenbloom, 2018). Ketones have been extensively researched and reported to suppress appetite with Gibson et al (2015) concluding individuals following ketogenic diets are less hungry and have a diminished desire to eat. This has been reported to

be as a result of anorexigenic effects (increased production of cholecystokinin - a hormone responsible for the increased feeling of fullness) and a reduction in orexigenic systems (ghrelin production) (Paoli et al. 2015). It can be suggested that those reporting appetite loss after training are storing lower levels of glycogen, resulting in a quicker change to metabolising fat, therefore releasing ketones for longer. This concept would need further investigation through blood analysis to determine accurate ketone levels throughout exercise. Alternatively urine analysis could be an alternative. The effects of training on lowering dancers appetite are therefore negative, as it has potential to lower food intake and unbalancing energy homeostasis. Educating dancers on the importance of refuelling after a session, regardless of appetite, is consequently essential to allow the individuals to maintain energy balance and optimal performance/training levels.

Limitations:

A limitation of section A was the inability to collect participants' total energy requirements, limiting the ability to conclude on a wider scale whether dancers are all within a negative energy balance. Combined with the analysis of section B's TER, it can be inferred however that they are with a large percentage of participants stating that they ate below 2000 kcals in a day they danced. If this study was repeated in the future, it would benefit from gaining participants height, weight and activity level to calculate TER.

Another limitation in the ability to generalise these results was the demographic of section A. Unfortunately, a low response rate from the male dance population was received. This consequently limits the ability to conclude the results are inherent of all genders, and more so for a female population. If this was to be replicated in the future, ensuring a more equal balance between the genders would allow the results to be generic for the wider dance community.

The reliability in the respondents answers in the questionnaire can be questioned; questions can be interpreted by the participants in a different manner to which they are meant. Additionally questions that ask for an estimation, such as the question 'How many Kcals do you typically consume on a day you dance?' may not be accurate representations of their true calorie intake for example, as many people may not take into consideration drinks and some meal additions such as condiments. As a result, although the data shows that the dancers are consuming small levels of calories in section A, it can be argued this is not truly representative as there is possibility the information provided is miscalculated by the participants or inaccurate.

One area of this study that could have been improved, and limited the study's reliability and validity, was the length of Section B's data collection. The data was collected over a four day period; if this study was to be repeated it would benefit from a longer period of data collection - previous studies suggest that a seven day period is most representative of a participants week (Brown et al. 2017). Alternatively, to minimise the risk of inaccuracy from participants due to the potential long windedness of completing these documents for seven days, this study could have

collected data in a longitudinal manner, collecting four days of data at a time, three times a month apart.

Within data collection in section B, another area that limits these results to be conclusive of a wider population is the small sample size. A small sample size decreases the reliability in enabling generalisation of the results to a wider population; if this section of the study was to be repeated, it would be imperative to increase the sample size. Additionally, the sample included must contain a near equal, if not equal, proportion of male to female participants; this time around this section only included female participants so the data cannot be conclusive of male populations also.

If the study was to be repeated again, a longitudinal format would better enhance the current findings with larger sample sizes and an equal gender ratio deepening the findings further.

Conclusion:

Overall, the data collected supports previous studies (Brown et al. 2017; Kim et al. 2019) in highlighting dancers are at risk, and most already doing so, from severe negative energy balances with clear dietary and nutritional deficiencies. This combined together consequently has clear limiting effects on dancers ability to perform and train optimally, showcasing increased risks at potential injury and long term health issues. Although advice and recommendations are available to dancers

it is apparent these recommendations are not adhered to posing long term risk to the dancing body, potentially limiting dancers careers.

It is also concluded that dance training has somewhat an effect on appetite and hunger levels. This supports Jurimae et al. (2011) and Kim et al. (2019) in concluding hunger levels seemingly increase after training. On the other hand it's apparent appetite seems to be variant after training showing no real correlation between training and appetite. Appetite and hunger however do show a correlation in impacting energy homeostasis; both present the opportunity to negatively impact dancers energy balance, affecting energy intake.

It can be recommended for dancers to increase their calorie intake in proportion with the same compositional values of macronutrients they currently intake. It would also be recommended for dancers to consider supplementation for their micronutrients, due to considerable deficiencies presented in this study. Regardless of appetite and hunger levels of training, it is imperative for dancers to consume high calorie foods or meals to edge closer to a stable energy homeostatic balance. This will enable the dancers to train and perform at optimal levels, with a diminished risk of injury due to lack of energy and nutrition.

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Appendix:

A.1

Dear dancer,

My name is Luke and I am a student at the University of Wales Trinity Saint David, in my third year of the BA Dance degree. For my dissertation, I will be investigating pre-professional dancers' energy balance with a particular interest in how appetite/hunger affects this. I will be writing a detailed analysis of my findings, presented in a study format. The study will be available for you to read.

There are several methods I will be using to collect various information, all to aid a detailed analysis and understanding of the subject area. The first piece of information I will obtain is your weight, through an individual time slot that will be arranged. This is necessary for me to obtain your basal metabolic rate (BMR) and calculate total energy expenditure.

As part of the study, I will require you to start making food diaries for four days that you are dancing. I require you to do this via the app MyFitnessPal, downloadable on all app stores. This allows me to workout your energy input, as well as an insight into the dietary value of pre-professional dancers diets and the impact it may or may not have on your appetite. Alongside this, I will require you to fill out a daily exercise log provided to you, for the four days you create your food diaries. This will be simple to complete and take no longer than 30 seconds to fill out each day, asking questions like 'How many hours were you dancing for today?' and 'On the following scale please mark the intensity of your training today from 1-10'.

All data collected will be anonymised and no names will be used within the writing of the findings. Personal data, including contact details, will be stored away securely via password protection that only I will have access to and I will be abiding to GDPR regulations. Note that if the University requests to view any personal details, I shall contact you directly beforehand. All personal data will be deleted after the study is complete. If at any point within the process you wish to withdraw yourself from the research you will be supported in your decision and any data collected for yourself will be erased.

If you have any questions at any point of the process, I am more than happy to answer them for you, so please do get in contact.

Many thanks,

Luke Ames

1701262@student.uwtsd.ac.uk

07939174214

I have read the above statement and I do give my consent to take part in the study and have my data, that's collected, used for analysis. I also give consent to my personal details being safely stored until the study is complete.

Name:

Signature:

Date:

Email/Mobile:

Age:

Gender:

Diet, Nutrition and Dance

My name is Luke and I am a student at the University of Wales Trinity Saint David, in my third year of the BA Dance degree. For my dissertation, I will be investigating dancer's energy balance with a particular interest in how appetite/hunger affects this. I will be writing a detailed analysis of my findings, presented in a study format. The study will be available for you to read.

One form of data will be collected via this questionnaire. The questions will be categorised into FIVE sections: Personal Information, Pre-dance, Post-dance, Dietary/Health and lastly Appetite/Hunger. The questions asked will be presented to you in a variety of formats, such as selecting from multiple choice, marking on a scale and there will be opportunities for you to express extra detail in written responses. This questionnaire should take you between 5 - 10 minutes.

All data collected will be completely anonymous and no names will be used within the writing of the findings. Personal data will be stored away securely via password protection that only I will have access to and I will be abiding to GDPR regulations. All personal data will be deleted after the study is complete. If at any point within the process you wish to withdraw yourself from the research you will be supported in your decision and any data collected for yourself will be erased. If you have any questions at any point of the process, I am more than happy to answer them for you, so please do get in contact via email to 1701262@student.uwtsd.ac.uk.

*Required

I have read the above statement and I do give my consent to take part in the study and have my data, that's collected, used for analysis. I also give consent to my personal details being safely stored until the study is complete. *

☐ Yes

☐ No

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Diet, Nutrition and Dance

*Required

Personal Information

This section will ask you a series of questions, related to yourself, that will help myself to understand the demographic for this study.

What gender do you most identify with? *

- ☐ Female
- ☐ Male
- ☐ Prefer not to say
- ☐ Other: _____

From the following, please select your age *

- ☐ Under 18
- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 54+
- ☐ Prefer not to say

Please select from the following the nationality that you most identify with. *

- ☐ English
- ☐ Welsh
- ☐ Scottish
- ☐ Irish
- ☐ British
- ☐ Prefer not to say
- ☐ Other: _____

Please select your employment status *

- ☐ Unemployed
- ☐ Self-employed
- ☐ Part time worker
- ☐ Full time worker
- ☐ Student
- ☐ Retired
- ☐ Prefer not to say

On average how many hours of dance per week do you do? *

- | | | | | | | | | | | | |
|-----|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1hr | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | 10hrs+ |

What style or styles of dance do you do? *

Your answer _____

Do you take part in any other form of exercise? If so, please write the type of exercise below. *

Your answer

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Pre-dance

This section will ask a series of questions related to your pre-dance habits and practices.

Before you take part in a dance session, do you have anything to eat? *

- ☐ Always
- ☐ Most of the time
- ☐ Sometimes
- ☐ Never
- ☐ Prefer not to say

Do you eat at least 2 hours before a dance session? *

- ☐ Always
- ☐ Most of the time
- ☐ Sometimes
- ☐ Never
- ☐ Prefer not to say

Please provide a short sentence listing the sorts of food you would eat typically before a dance session. If you do not eat before hand or would prefer not to say, please answer N/A. *

Your answer _____

Before a dance session, do you take any form of supplementation, such as protein shakes, vitamins etc.? *

- ☐ Yes
- ☐ Sometimes
- ☐ No
- ☐ Prefer not to say

If you answered yes or sometimes, please provide details of any supplements you use. If you would prefer not to say or you previously answered no then please write N/A. *

Your answer _____

Before a dance session, how much water do you consume typically? *

Your answer _____

The night before a dance session how much sleep do you roughly get on average? *

- | | | | | | | | | | | | |
|--------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 hour | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | 10 hours+ |

Do you often do any other form of exercise before a dance session? *

- ☐ Always
- ☐ Most of the time
- ☐ Sometimes
- ☐ Never
- ☐ Prefer not to say

If you answered ALWAYS, MOST OF THE TIME or SOMETIMES in the previous question, would you say this has an affect on your energy levels? Please provide a statement defining the affect you perceive this has on your energy levels. If you would prefer not to say or answered NEVER then please write N/A. *

Your answer

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Post-dance

This section will ask a series of questions related to your post-dance habits and practices.

After a dance session, do you have anything to eat? *

- ☐ Always
- ☐ Most of the time
- ☐ Sometimes
- ☐ Never
- ☐ Prefer not to say

On average, how quickly do you eat after a dance session? *

- | | | | | | | |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Up to 1 hour | ☐ | ☐ | ☐ | ☐ | ☐ | Up to 5 hours+ |

Please provide a short sentence listing the types of foods you would typically eat after a dance session. If you would prefer not to say please answer N/A. *

Your answer _____

After a dance session, do you take any form of supplementation, such as protein shakes, vitamins etc.? *

- ☐ Yes
- ☐ Sometimes
- ☐ No
- ☐ Prefer not to say

If you answered yes or sometimes, please provide details of any supplements you use. If you would prefer not to say or you previously answered no then please write N/A. *

Your answer _____

After a dance session, how much water do you typically consume? *

Your answer _____

The night after a dance session how much sleep do you roughly get on average? *

1 2 3 4 5 6 7 8 9 10
1 hour ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ 10 hours+

After a dance session, how would you describe your energy levels? Please provide a short statement of the affect a dance session has on your energy levels. *

Your answer _____

Do you often do any other form of exercise after a dance session? *

- ☐ Always
- ☐ Most of the time
- ☐ Sometimes
- ☐ Never
- ☐ Prefer not to say

If you answered ALWAYS, MOST OF THE TIME or SOMETIMES in the previous question, would you say this has an affect on your energy levels? Please provide a statement defining the affect you perceive this has on your energy levels. If you would prefer not to say or answered NEVER then please write N/A. *

Your answer

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Diet/Health

In this section you will be asked questions relating to your diet and health.

On average how much water do you drink on a daily basis? *

- ☐ Under 500mls
- ☐ 500mls - 999mls
- ☐ 1L - 1.4L
- ☐ 1.5L - 1.9L
- ☐ 2L - 2.4L
- ☐ 2.5L - 2.9L
- ☐ 3L+
- ☐ Prefer not to say

On a typical day, what is the ratio of carbohydrates, fats and protein in your diet, e.g. 55:30:15? *

Your answer _____

After dancing, please list your top source of carbohydrates, fats and proteins. If you would prefer not to say, please enter N/A. *

Your answer _____

On average, how many calories would you say you consume in a day that you dance? *

- ☐ Under 500 kcals
- ☐ 500 -1000 kcals
- ☐ 1001 - 1500 kcals
- ☐ 1501 - 2000 kcals
- ☐ 2001 - 2500 kcals
- ☐ 2500 - 3000 kcals
- ☐ 3001 - 3500 kcals
- ☐ 3501 - 4000 kcals
- ☐ 4001+ kcals
- ☐ Prefer not to say

Are you, as a dancer, aware of the daily recommendations for food intake - specifically when training? *

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

Are you aware of any vitamin/mineral deficiencies that you may have? *

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

Please provide any supplements you may take for deficiencies. If this is not relevant, enter N/A. *

Your answer _____

Do you smoke? *

- ☐ Yes
- ☐ Sometimes
- ☐ No
- ☐ Prefer not to say

Do you have any medical conditions that may affect your energy levels, such as depression, chronic fatigue etc.? *

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

Do you have any medical conditions that may affect your digestive system, such as irritable bowel syndrome, Crohns disease etc. ? *

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

Do you have any medical conditions that may affect your diet, such as diabetes etc. ? *

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

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Appetite/Hunger

In this section you will be asked questions relating to your appetite/hunger, in different contexts.

Appetite can be described as your desire to eat food.

Hunger can be described as a feeling of discomfort or weakness caused by lack of food.

Before a dance session, how would you typically rate your appetite levels? *

	1	2	3	4	5	
No appetite	☐	☐	☐	☐	☐	Extreme appetite

Before a dance session, how would you typically rate your hunger levels? *

	1	2	3	4	5	
No hunger	☐	☐	☐	☐	☐	Extreme hunger

During a dance session, do you notice that your appetite increases, decreases or stays the same? *

- ☐ Increases
- ☐ Decreases
- ☐ Stays the same
- ☐ Prefer not to say

During a dance session, do you notice that your hunger increases, decreases or stays the same? *

- ☐ Increases
- ☐ Decreases
- ☐ Stays the same
- ☐ Prefer not to say

During a dance session, does your hunger or appetite levels affect your energy levels? *

Your answer _____

During a dance session, do you feel the need to have snacks at the side to snack on throughout the dance session, or in breaks, to increase your energy levels? *

- ☐ Yes
- ☐ Sometimes
- ☐ No
- ☐ Prefer not to say

During a dance session, do you feel the need to snack in breaks or throughout the dance session to fulfil your appetite and or hunger? *

- ☐ Yes my appetite
- ☐ Yes my hunger
- ☐ Yes both
- ☐ Neither
- ☐ Prefer not to say

During a dance session, do you feel that drinking water helps to combat any feeling of appetite and or hunger? *

- ☐ Yes my appetite
- ☐ Yes my hunger
- ☐ Yes both
- ☐ Neither
- ☐ Prefer not to say

After a dance session, do you feel your appetite has increased, decreased or stayed the same? *

- ☐ Increased
- ☐ Decreased
- ☐ Stayed the same
- ☐ Prefer not to say

After a dance session how would you typically rate your appetite levels? *

	1	2	3	4	5	
No appetite	☐	☐	☐	☐	☐	Extreme appetite

After a dance session how would you typically rate your hunger levels? *

	1	2	3	4	5	
No hunger	☐	☐	☐	☐	☐	Extreme hunger

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A.3

Exercise Log

Day: **1** **2** **3** **4** *(Please circle correct)*

How many hours have you been dancing for? *(to the nearest 15 minutes)*

.....

On the following scale please mark where you think best describes the intensity of your day, with 1 being no effort required, 10 being an extreme amount of effort required?

1 2 3 4 5 6 7 8 9 10

In what style/genre were you dancing today?

.....

Did you feel your appetite/hunger increase or decrease after dancing?

.....

Initials: