Attitudes, choices and expenditures on dietary supplements among adult members at low-cost gymnasiums in Johannesburg

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Dissertation accepted in fulfilment of the requirements for the degree Masters of Science in Human Movement Science at the North-West University

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DECLARATION

I Amos Hatityi Svova hereby solmenly declare that this dissertation is my own work. The articles included in this study were written by me under the guidance of Dr C. Botha-Ravyse (Supervisor) and Prof. S. M. Hanekom (Co-supervisor). They are co-authors of the two articles in this dissertation, and hereby also give permission to the candidate, Amos Hatityi Svova, to include these articles as part of his Master's dissertation.

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ACKNOWLEDGEMENTS

The Lord is truly my shepherd! God knows my long journey and in Him I get strength and determination to realise my dreams.

My sincerest gratitude goes to the following people and organisations for the encouragement, support and assistance given to me:

My family and specifically my wife Irene and sons Kudakwashe, Munashe and Simbarashe Svova for whom I always persevere! To my brother Steven Mpondiwa, I will forever be grateful, for the help and encouragement especially during the data collection phase.

Dr C. Botha-Ravyse and Prof. S.M. Hanekom for believing in me and guiding me. Thank you so much for your endless encouragement and support throughout this project.

Prof. Hanlie Moss and Prof. Ben Coetzee, for the opportunity and support you offered me.

Dr Natasha Ravyse for language editing my dissertation.

To all men and women from selected Johannesburg gymnasiums who participated in this study am very grateful.

To the North-West University Faculty of Health sciences for the financial support.

DEDICATION

I dedicate this dissertation to my late brother, Leonard Svova.

ABSTRACT

Dietary supplement use is on the increase globally with people seeking to achieve health and fitness goals through supplementation use. This caused gymnasiums to become a major market for dietary supplements. However, most dietary supplements have not been scientifically proven and there are reports of possible adverse effects associated with some dietary supplements. It is, therefore, of interest to research how well-informed dietary supplement users are. Numerous researchers have given insight into dietary supplement use among athletes and members of upmarket gymnasiums. However, not much is known about dietary supplement use in low-cost gymnasiums. A study was conducted to establish factors influencing dietary supplement use in low-cost gyms, the sources of information that dietary supplement users access and how much dietary supplement users spend monthly on supplements, were investigated.

A mixed-method research design was followed at four selected low-cost gymnasiums in Johannesburg belonging to a popular fitness chain that classifies its gymnasium branches according to membership fee and services offered. Participants (n=351) were randomly selected from the four gyms. The initial stage of the study comprised of a self-administered validated quantitative survey on knowledge and attitudes regarding supplement use. In order to gain a deeper understanding of themes generated from results of the survey, eighteen participants from the survey were randomly selected to participate in three focus group discussions after which data saturation was reached.

Two articles were submitted from this study. The first article focuses on the results from the quantitative survey. Overall prevalence of dietary supplement (DS) use was 53.4%. Among males 59% were users whereas 38.8% among females used DS. Dietary Supplement use was associated with gender ($P<0.05$). Men used body-building DS such as whey protein, creatine and BCAA to gain muscle ($r=0.83$; $p<0.001$). Women ($r=0.4$; $p<0.013$), preferred weight loss supplements such as Conjugated Linoleic Acid (CLA) and vitamins $r=0.542$; ($p<0.000$). DS expenditure ($p<0.05$, effect size $r>0.5$) was positively correlated to reasons for DS use; $p<0.000$ to gain muscle $r=0.611$, to improve performance $r=0.681$, to achieve personal goals $r=0.702$ and to maintain health $r=0.522$. Among non-users, more females than males felt DS were unnecessary ($p=0.001$), against their beliefs ($p=0.000$) and that they do not trust the DS companies ($p=0.012$) Whereas more males than females agreed they felt tempted to use performance enhancing substances ($p=0.015$). The main source of information for DS users were; 51% internet and 34% friends and fellow gym members. The least consulted were physicians (4%), scientific journals (4%) and biokineticists (3%).

The second article focuses on perceptions of low-cost gym members and how these attitudes influence expenditure on DS. Dietary supplement users believe: DS are effective in achieving results faster, DS benefits outweigh the possible risks, DS are only risky to people with underlying health conditions, normal food is less nutritional because of genetic modification and that DS are cheaper as their nutritional value is measured and require no dietician.

The study concluded that DS users in low-cost gymnasiums are not adequately informed about DS and, therefore, put their health at risk and the risk of a disproportionate financial burden of spending on products with little or no benefit. As such, the study recommends that despite their cost saving drive, low-cost gymnasiums make dietitians available or conduct awareness campaigns to educate members on DS.

Key words: Dietary supplements, attitudes, low-cost gymnasium, expenditure, health, body capital

OPSOMMING

Die gebruik van dieetaanvullings neem wêreldwyd toe met mense wat hul gesondheids- en fiksheidsdoelwitte wil bereik deur aanvullings te gebruik. Dit het daartoe gelei dat gimnasiums 'n belangrike mark vir voedingsaanvullings geword het. Die meeste voedingsaanvullings is egter nie wetenskaplik bewys nie en daar is berigte oor moontlike nadelige gevolge wat verband hou met sommige voedingsaanvullings. Dit is dus van belang om te bepaal hoe goed ingelig voedingsaanvulling gebruikers is. Talle navorsers het insig gegee in die gebruik van dieetaanvulling onder atlete en lede van luukse gimnasiums. Daar is egter nie veel bekend oor die gebruik van die voedingsaanvulling in lae-gimnasiums nie. n Studie om faktore te bepaal wat die gebruik van die voedingsaanvulling in laekoste gimnasiums beïnvloed, die inligtingsbronne waartoe gebruikers van die voedingsaanvulling toegang het en hoeveel fondse gebruikers maandeliks aan aanvullings bestee, is gedoen.

n Gemengde-metode-navorsingsontwerp is gevolg by vier geselekteerde lae-koste-gimnasiums in Johannesburg, wat deel uitmaak van 'n gewilde fiksheidsketting wat sy gimnasiumtakke klassifiseer volgens die ledegeld en dienste wat aangebied word. Deelnemers (n = 351) is lukraak gekies uit die vier gimnasiums. Die eerste fase van die studie het bestaan uit 'n self-toegediende gevalideerde kwantitatiewe opname oor kennis en houdings rakende die gebruik van aanvullings. Om 'n dieper begrip te kry van temas wat uit die resultate van die opname gegenereer is, is agtien deelnemers aan die opname lukraak gekies om aan drie fokusgroepgesprekke deel te neem, waarna data-versadiging bereik is.

Twee artikels is uit hierdie studie ingedien. Die eerste artikel fokus op die resultate van die kwantitatiewe opname. Van die deelnemers het 53,4% DS-gebruik aangemeld. Onder mans was 59% gebruikers, terwyl 38,8% onder vrouens DS gebruik het. DS-gebruik is geassosieer met geslag (P <0,05). Mans gebruik liggaamsbou-DS soos wei-proteïne, kreatien en BCAA om spiere op te doen (r=0.83; p <0,001). Vroue (r=0.4; p <0,013), het aanvullings vir gewigsverlies verkies soos Conjugated Linoleic Acid (CLA) en vitamiene r=0.542; (p<0.000). DS-uitgawes (p <0,05) korreleer positief met redes vir DS-gebruik; p<0.000 om spiere te bou r=0.611, om prestasie te verbeter r=0.681, om persoonlike doelwitte te bereik r=0.702 en gesondheid te handhaaf r=0.522. Onder die nie-gebruikers het meer dames as mans aangedui dat hulle dink dat DS onnodig is p=0.001), teen hulle geloof is (p=0.000) en dat hulle nie die DS maatskappy vertrou nie (p=0.012). Aan die ander kant weer het meer mans as dames saamgestem dat hulle dit oorweeg om prestasieverbetering middels te gebruik (p=0.015). Resultate het getoon dat ras / etnisiteit 'n invloed op DS-gebruik gehad het (p <0,05). Kaukasiërs en Indiërs / kleurlinge het meer liggaamsbou DS gebruik as swartes. Meer swart mense (35,6%) as die Kaukasiërs en Indiërs / kleurlinge, vrees dat DS hul gesondheid kan benadeel, 22,5% het aangedui dat DS teen hul oortuigings is en 28,4% dat hulle nie die DS-ondernemings vertrou nie. Die belangrikste bron van inligting vir DS-gebruikers was; 51% internet en 34% vriende en medegimnasiumlede. Die minste wat geraadpleeg is, was dokters (4%), wetenskaplike tydskrifte (4%) en biokinetici (3%).

Die tweede artikel fokus op persepsies van lae-koste gimnasiumlede en hoe hulle houding uitgawes op DS beïnvloed. DS-gebruikers glo: DS is effektief om vinniger resultate te behaal, DS-voordele weeg swaarder as die moontlike risiko's, DS is slegs riskant vir mense met onderliggende gesondheidstoestande, normale voedsel het minder voedingswaarde as gevolg van genetiese modifikasie en dat DS goedkoper is omdat hul voedingswaarde gemeet word en benodig nie ‘n dieetkundige nie.

Die studie het tot die gevolgtrekking gekom dat DS-gebruikers in laekoste-gimnasiums nie voldoende ingelig is oor DS nie en dat hulle hul gesondheid in gevaar stel deur die risiko van 'n onproportionele finansiële las op produkte met min of geen voordeel inhou nie. As sodanig beveel die studie aan dat, ten spyte van hul kostebesparing, dieetkundiges beskikbaar gestel of bewusmakingsveldtogte onderneem moet word om lede oor DS op te voed.

Sleutelwoorde: Voedingsaanvullings, houdings, lae-gimnasium, uitgawes, gesondheid, liggaamskapitaal.

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LIST OF ABBREVIATIONS

A

AND- US Academy of Nutrition and Dietetics

B

BCAA-Branched Chained Amino Acids

C

CLA-Conjugated linoleic Acid

CM-Complimentary Medicine

Cr-Creatine supplements

D

DS-Dietary Supplements

F

FDA- US Food and Drug Administration

M

MCC-Medicines Control Council of South Africa

MVM-Multi-Vitamin Multi-Mineral supplements

P-Level of significance

S

SA-South Africa

SAPHRA-South African Health Products Regulatory Authority

U

UL-Upper Limit

US-United States of America

W

WADA-World Anti-Doping Agency

WHO-World Health Organisation

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This dissertation investigates the attitudes, choices and expenditures on dietary supplements among adult members at low-cost gymnasiums in Johannesburg. Chapter 1 will provide an introduction of this work; present the research question, aim and hypothesis; as well as an explanation of the layout of the dissertation.

1.2 Background and motivation

People attending and exercising regularly in gymnasiums are reported to take dietary supplements (DS) due to several factors such as: aggressive marketing strategies of DS, a recent, increased health focus as well as social pressure to attain 'ideal' physical appearance (El Khoury *et al.*, 2019:2). This has resulted in many people in gymnasiums turning to DS perceiving these products as capable of producing 'magical' results in improving physical performance and body composition in a short period of time (Goston & Correia, 2010:604). Dietary Supplements, otherwise known as nutritional supplements, are regarded to be nutritional enhancements intended to compliment a diet and provide nutrients thought to be effective in performance enhancement and improving general well-being (Sands, 2012:7; Tsochas *et al.*, 2013:17). However, an increased use of DS is cause for concern considering, among other factors, the potential for DS toxicity, nutritional imbalances and an increased risk of doping and the use of illegal substances (El Khoury *et al.*, 2019:2; Senekal *et al.*, 2019:1). Although scientific literature reports that some DS, such as creatine, are effective (Kreider *et al.*, 2017:5), the alleged benefits of some DS have not been scientifically verified. Furthermore, various potential risks are related to DS use, especially where high doses are used and DS are taken without professional supervision (El Khoury & Antoine-Jonville, 2012:2). These risks include, among others, toxicity owing to inaccurate concentrations, contamination and adverse reactions with reported cases of minor to severe health complications such as minor skin irritations, chest pain, syncope tachycardia and even death (Sands, 2012:22). The excessive use of certain DS by especially younger users (Tsochas *et al.*, 2013:17), may adversely affect their health by disrupting normal physiological and/or cell activity (Gabriels *et al.*, 2012:25).

Apart from the health-related risks of DS use, misinformed use of DS may result in the increase of "cost of health fraud" whereby DS users are purchasing products with no health benefit (Sands, 2012:18). Given the health and financial risks, it is important to determine what attitudes gymnasium members have towards DS, how much they spend on average per month on DS, which DS the users prefer and their sources of advice on DS use. Despite the need for information that pertains to these aspects, and the fact that people who exercise in commercial gymnasiums are a major target for DS manufacturers and agents (El Khoury & Antoine-Jonville, 2012:2), the researcher is aware of only one South African study by Mc Creanor *et al.*(2017), that investigated the attitudes of DS users in commercial gymnasiums located in the high-income northern suburbs of Johannesburg. There is a notion that supplementation patterns may vary depending on location, for example, between gymnasiums located in the city centre compared to those in the suburbs of Palermo in Italy (Bianco *et al.*, 2014:3) and according to geographic region (Rozga *et al.*, 2013:6). Therefore, a study on DS supplementation in low-cost gymnasiums in Johannesburg is necessary in order to broaden the geographic scope of the study of Mc Creanor *et al.* (2017).

Previous studies on DS use in commercial gymnasiums have noted that several members have a positive attitude towards DS, which they perceive as enabling them to achieve their goals (Druker & Gesser-Edelsburg, 2017:1; Mc Creanor *et al.*, 2016:57). An attitude is an individual's, "predisposition to evaluate some symbol or object or aspect of his world in a favourable or unfavourable manner" (Katz, 1960:168). Dietary Supplement users take supplements in pursuit of a well-sculpted body, which seems to be a major drive for DS use in gymnasiums (Druker & Gesser-Edelsburg, 2017:1). Furthermore, personal trainers are among the main sources of advice on DS use to gym members. Personal trainers also seem to share the same attitude as gym members that DS are important in enhancing performance and appearance, and that the benefits of using DS far outweigh any health risks (Druker & Gesser-Edelsburg, 2017:5).

On the other hand, DS users' positive attitude towards supplement use causes them to "overspend" on these supplements, perhaps implying that they are spending much more than is necessary on these supplements, resulting in a significant, rapid growth in the DS industry (Mc Creanor *et al.*, 2016:57). Consumer spending on DS has increased over the last twenty years. In the United States of America (USA) consumer spending increased almost three-fold from R92 billion on average in 1996 to R256 billion in 2002 (Malik & Malik, 2010:1). The

demand for DS in the USA has since continued grow to R384 billion in 2010 (Sands, 2012:10). In South Africa, the DS market has increased from R2.9 billion in 2014 to R3.8 billion in 2016 (Anon, 2017:34). However, the high costs of DS is a factor that needs to be considered since most of these supplements have not been scientifically proven to be effective (Sands, 2012:18). A cost analyses of DS use by people exercising in gymnasiums in the Brazilian city of Belo Horizonte showed that participants spent US $30 (R400) per month on average on DS with 49.3% of men spending over US $30 (R400) per month and 72% of women spending less than US $30 (R400) per month (Goston & Correia, 2010:607). Furthermore, DS users whose training goals are related to gaining muscle mass will spend more than R400 per month (Lieberman *et al.*, 2015:3). Results on a study on supplementation among adult gymnasium members in Johannesburg North (South Africa) showed that 73% of DS users spend between R500 and R3000 on average per month on DS (Mc Creanor *et al*., 2016:57).

Other aspects drawing researchers' interests are: DS users' preferred supplements category; factors influencing choices; and the source of information/advice on what supplements to take. Previous studies on DS usage among people exercising in gymnasiums in other countries such as Lebanon, Italy and Brazil reported that choice and reasons for DS use varied with age, gender and the motive for exercising (Bianco *et al.*, 2011:25; El Khoury & Antoine-Jonville, 2012:7; Goston & Correia, 2010:606; Morrison *et al.*, 2004:490). In this regard, Bianco *et al.* (2011:25) reported that protein supplements were the most widely consumed supplements by people exercising in gymnasiums. Women preferred natural supplements such as vitamins and minerals with health benefits for disease prevention, whereas male DS users opted for performance supplements (Attlee *et al.*, 2018:92; Ruano & Teixeira, 2020:4). Furthermore, younger male participants (aged 18-45 years) preferred protein supplements with the objective of enhancing muscle mass, whereas older participants (aged 46 years and older) opted for herbal and vitamin supplements to prevent future illnesses (Gahche *et al.*, 2017:4; Morrison *et al.*, 2004:483-485). In a cross-sectional study where randomly selected participants responded to a self-reporting questionnaire, 53% of the 64.7% DS users were men (Lacerda *et al.*, 2015:3). Of these users, 74% were between the ages of 20 to 39 years with protein and amino acids being the most consumed supplement (Lacerda *et al.*, 2015:3). In another study, 60% of the respondents of a self-administered questionnaire indicated that they started using supplements between the ages of 13 and 18 years (Mc Creanor *et al.*, 2017:3). However, it is a cause for concern that the above-mentioned supplement choices and preferences among DS users in

gymnasiums seem to be independent of the potential health risks that are associated with DS use (El Khoury & Antoine-Jonville, 2012:7).

One of the reasons why DS users are not aware of the health and financial risks that are associated with DS usage, is that the sources of information that they consult are inadequate (Druker & Gesser-Edelsburg, 2017:7). Coaches/instructors/personal trainers, friends, gymnasium training partners, personnel at health stores, and media (magazines, the Internet) seem to be the main sources of information for DS users in gymnasiums, whereas health professionals such as physicians and dietitians are the least consulted (Alshammari *et al.*, 2017:6; Hansen *et al.*, 2019:6). Researchers have shown that gymnasiums need to provide programmes to educate DS users members on the proper use of supplements since they have such poor knowledge on the effects thereof (Mc Creanor *et al.*, 2017:3).

The apparent lack of legislation governing DS is worrying. There are challenges with regulation of DS due to the sheer number of individual DS on the market (Dwyer *et al.*, 2018:8). Furthermore, it is difficult to implement regulations for DS and conventional foods on the one hand and DS and over-the-counter medicine on the other hand (Dwyer *et al.*, 2018:9). Consequently, the limited regulation of supplements has promoted product alterations in addition to the inclusion of undeclared, banned substances (Outram & Stewart, 2015:1). Reports show that some DS have incorrectly labelled quantities of declared ingredients and are contaminated with highly toxic and harmful substances such as lead and arsenic (Sands, 2012:22). Furthermore, labels of some DS make outrageous claims such as: "instant muscle gratification" and "activates metabolism shredding fat" (Gabriels *et al.*, 2012:24). However, a positive step in DS regulation in South Africa is the establishment of the South African Health Products Regulatory Authority (SAHPRA) to supersede the Medicine Control Council (MCC) (Naidoo *et al.*, 2018:3). Products, excluding capsules, tablets and soft gels will then be labelled as foodstuffs thereby falling under regulations relating to the labelling and marketing of foodstuffs while those making medicinal claims will fall under complimentary medicine (Schönfeldt *et al.*, 2015:1). The South African Health Products Regulatory Authority has since effectively replaced MCC on 1 June, 2018 and SAPHRA's 5 Year Strategic Plan for the Fiscal years 2018/19-2022/23 provides that General Regulations to the Medicines Act, published on 25 August 2017, allow for an amendment to the complimentary medicines definition and to identify "Health Supplements" as an additional group of products to be regarded falling within the complimentary medicines' definition. Such products will be called-up over time and

regulatory oversight over these types of medicines will be established. However, to date it is yet to be established if any of the dietary supplements used by athletes and people exercising in gyms have been called-up for regulatory review.

Title of dissertation

Attitudes, choices and expenditures on dietary supplements among adult members at low-cost gymnasiums in Johannesburg

1.3 Problem statement

Dietary Supplement use in gyms has increased due to members feeling pressured to use DS, amongst other factors, to achieve the modern, idealised body image. However, past studies both in SA and internationally, agree that gym members get their advice on DS mostly from non-professionals such as friends/fellow gym members and the Internet. Public health concerns are raised with reports of the possible health risks associated with DS use, coupled with the loose regulation of supplements. Gyms, particularly in SA, have been highly concentrated in wealthy suburbs in urban areas. However, the popular fitness chains in SA have in recent times expanded into less wealthy locations in the cities. Fitness clubs vary in location, membership fees and consequently serve different social and economic milieus (Doğan, 2015:442). In Riyadh, Saudi Arabia, for example, gym categories are identified as platinum, gold, silver and bronze reflecting subscription fees and services provided ranging from "luxurious to regular" (Alshammari *et al.*, 2017:4). Considering the possibility of different membership demographics depending on gym location, there is need for research world-wide to categorise the gyms when investigating the widespread of DS consumption and factors motivating use of DS. Doğan (2015:443) suggests that owing to the long duration of time members spend at gyms, there is a likelihood of them being influenced by the material and social environment with respondents concurring that gyms provide some identity by promoting a "yuppie lifestyle", "cool gym" and "more urban feel" (Doğan, 2015:451). These phrases suggest gyms may, in the long run, develop a distinct culture especially for established members. While McCreanor *et al*., (2017)'s study gives insight of DS use patterns in the upmarket gyms located in wealthier suburbs of Johannesburg North, little is known about the lower-cost clubs fast mushrooming in the less wealthy suburbs. The current research is the first of its kind to investigate DS use according to gym category. It seeks to establish the DS consumption and associated motivating factors in low-cost gyms. The research takes advantage of the recent expansion of a popular fitness chain

into less wealthy suburbs of Johannesburg offering an affordable gym brand termed *Just Gyms* owing to the reduced number of services it provides.

The rise in the global market for DS along with the health and financial risks that are associated with DS use, posed the following research questions:

- What are the **attitudes** on DS use among adult members of Johannesburg low-cost gymnasiums?
- What are the **effects** of attitudes on DS spending by adult members of Johannesburg low-cost gymnasiums?
- What are the **sources of information** on DS use by adult members of Johannesburg low-cost gymnasiums?
- What are the relationships between choices of DS used and age, gender and DS users' reasons for exercising?

1.4 Purpose statement

McCreanor *et al.* (2016:59) focused on DS users in gymnasiums located in the affluent areas of Johannesburg North where they observed a higher concentration of gymnasiums targeting wealthier people/members. The purpose of this study is to focus on the low-cost gyms in Johannesburg to give researchers a more in-depth understanding of the real situation regarding supplementation use in the wider gym-going population in Johannesburg. These low-cost gyms are a fast-emerging class of gyms that exclude costly maintenance features such as swimming pools and steam rooms in order to charge low membership rates in less wealthier areas of South Africa (Anon:7). This investigation adds to the current body of knowledge raising awareness among gymnasium members of benefits and possible risks of DS use. Moreover, results from this study together with other studies, both local and international, may highlight the need for legislation and proper regulation on the manufacturing, marketing and consumption of DS.

1.5 Research aims and objectives

The overall aim of this study is to investigate the attitudes towards DS and how such attitudes affect choice and spending on DS among adult members in Johannesburg low-cost gymnasiums.

The objectives of this study are to:

- determine attitudes on DS use among adult members of Johannesburg low-cost gymnasiums;
- determine the effects of attitudes mentioned above of adult members of Johannesburg low-cost gymnasiums on DS spending;
- determine the sources of information on DS use by adult members of Johannesburg low-cost gymnasiums; and
- determine the prevalence of DS use in low-cost gymnasiums.
- establish among adult members of Johannesburg low-cost gymnasiums, the relationships between choices of DS used and DS users' age, gender and reasons for exercising.

Hypotheses to be tested

The study is based on the following hypotheses:

- DS users in Johannesburg low-cost gymnasiums, in order to achieve their goals, display a positive attitude towards supplement use.
- There is a positive correlation between attitude of DS users in Johannesburg low-cost gymnasiums and the amount of money they spend on DS.
- Friends, gymnasium training partners and the Internet are among DS users in Johannesburg low-cost gymnasiums' most frequently used sources of information on supplementation and health professionals are the least consulted.
- There are more DS users than non-users in low-cost gymnasiums
- The choice to use DS is dependent on age, gender, level of education and socio-economic status.

1.6 Methods and procedures

The researcher utilised the following databases to complete an extensive literature search that forms the basis of Chapter 2: EBSCOhost-academic search premier; Africa-Wide Information;AHFS Consumer Medication Information; Applied Science & Technology Source;CINAHL with Full Text ;eBook Collection (EBSCOhost) ;E-Journals ;Health Source - Consumer Edition ; MEDLINE; SPORTDiscus with Full Text, and Sabinet. Other sources used

included: Google Scholar, ProQuest Dissertations & Theses Global; and Nancy Clark's Sports Nutrition Guidebook. An integrative literature review was used for this study with the researcher identifying central issues in area of DS; information on dietary supplementation starting with a global, general population and then going into greater depth concerning DS use among gymnasium members seeking to improve physical performance and alter their body composition and image. The literature search also generated research questions, hypotheses, identifying a theoretical framework and exploring research methods used successfully to answer the research question. The key words used in the literature search were **dietary supplements, attitudes, perception, knowledge, gymnasiums**.

1.7 Theoretical framework

The theoretical framework for the research is anchored in the functional theory by Daniel Katz. According to the functional approach, attitudes exist because they serve some function for the person and are developed on basis of four functions: utilitarian, ego-defensive, value expressive and knowledge (Katz, 1960:168). The diagram below (Figure 1) is an interpretation of these functions and how each of the functions could possibly explain how members of Johannesburg, low-cost gymnasiums developed attitudes towards DS.

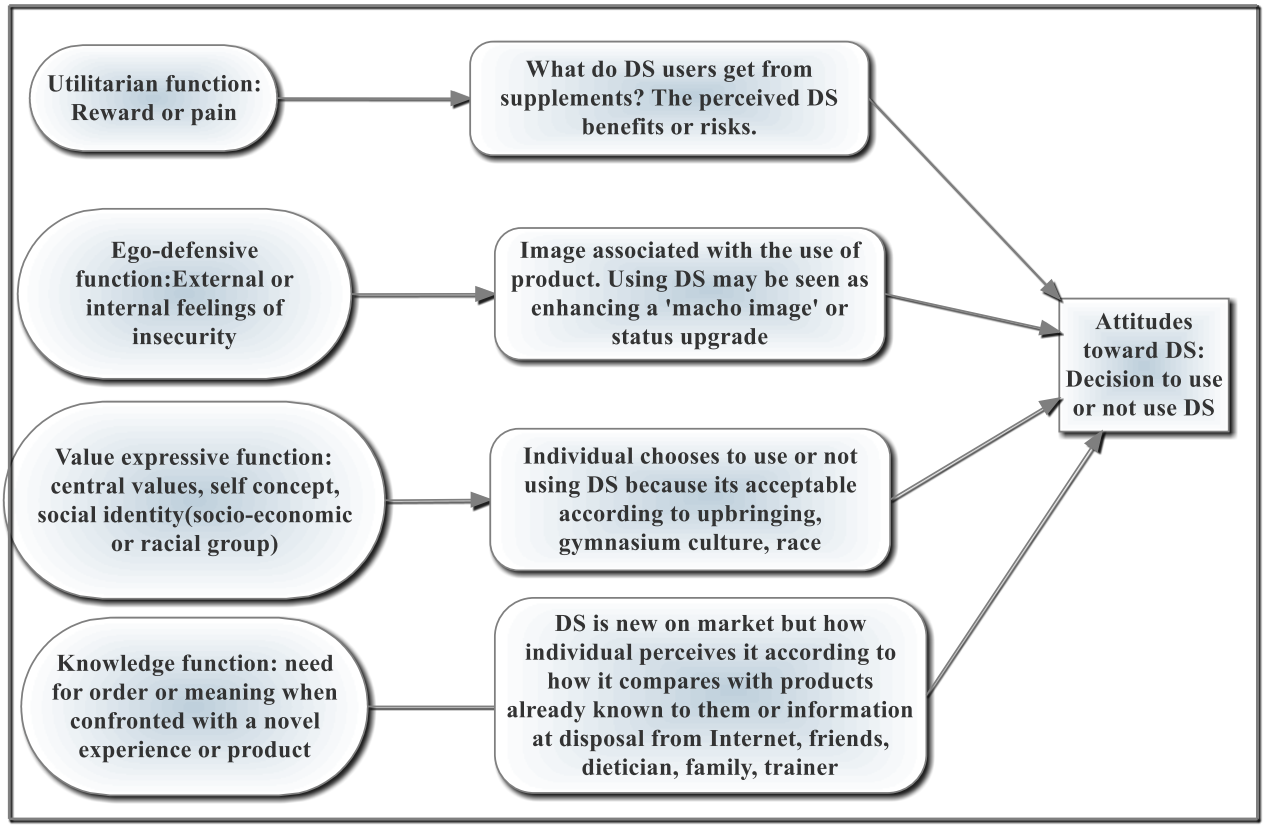

Figure 1: Major functions of attitudes and how they can influence decisions on DS use (Adapted from Katz, 1960:168)

1.8 Study design

The study used a cross-sectional design comprising of a mixed-method research approach where both qualitative and quantitative methods were utilised (Leech & Onwuegbuzie, 2009:265). Wolff *et al.* (1993:118), identified three ways of mixed research in which questionnaires (quantitative) can be used along with focus groups (qualitative) in the same research study. The research made use of an explanatory, sequential mixed-method design, which is a two-phase design where the quantitative data is collected first, followed by qualitative data collection. The purpose is to use the qualitative results to further explain and interpret the findings from the quantitative phase. For example, a survey may be used to collect quantitative data from a larger group. Members of that group may then later be selected for focus groups where they can explain and offer insights into their survey answers (Creswell & Creswell, 2017:572; Subedi, 2016). This is illustrated below (Figure 2):

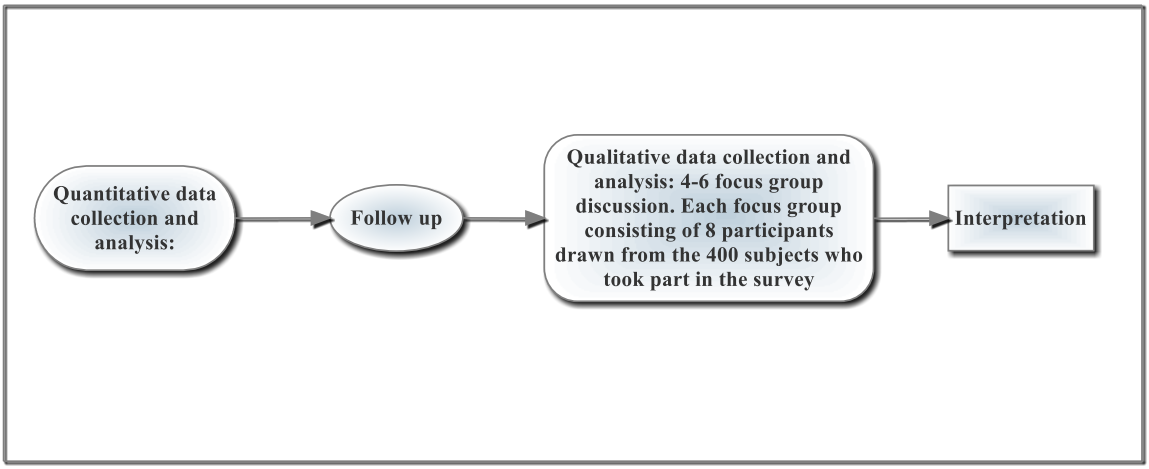

Figure 2: Explanatory sequential design (adapted from study by (Subedi, 2016:572)

The main tool that researchers employ to obtain information on DS use in different populations is self-administered questionnaires that include questions about demographic characteristics, type and frequency of DS use, reasons for DS use, main reason/s for exercising, and sources of supplementation information (Goston & Correia, 2010:605; Morrison *et al.*, 2004:482; Sands, 2012:37). Consequently, the first phase made use of a validated questionnaire by Mc Creanor *et al.* (2017), which was adopted as is due to the close similarity of their aims/objectives and to those of this study (see Appendix A. After the quantitative analyses from the survey were generated, the researcher, together with the study leaders, identified key topics in the survey that required further probing to form leading questions for the ensuing focus group discussions.

The second phase of the study was qualitative in nature and used focus group discussions where participants could express their opinions of DS in depth. An opinion is a verbal expression of an attitude and reflects the perception that drives the attitude (Katz, 1960:168) and, therefore, the current study will use a focus group discussion to probe deeper into the data gathered from the questionnaire on respondents' opinions and perceptions of DS. Therefore, leading questions for the focus group discussions (FGD) were based on findings of the attitudes section questionnaire (first phase) combined with the draft interview schedule (see section 5 of questionnaire in Appendix A and Appendix B for focus group discussion schedule). While a questionnaire can be used to gather data from a bigger sample with the advantage that findings can be expected to represent a population from where the sample was taken, a focus group discussion on the other hand, although quite vital in providing a deeper understanding of perceptions, behaviours, attitudes and feelings of participants on a given topic, is too small to generalise findings (Wolff *et al.*, 1993:118). The current research shall, therefore, make use of

a questionnaire to get a broader view of low-cost gym members' attitudes towards DS with focus groups following up to "corroborate and explore in greater depths" the information obtained in the survey (Wolff *et al.*, 1993:121). The reason for this methodological approach is that quantitative research used along with qualitative research methods enables researchers to interpret and better understand the complex reality of a given situation and the implications of the quantitative data (Mack *et al.*, 2005:2).

Figure 3 provides an outline of the research methodology.

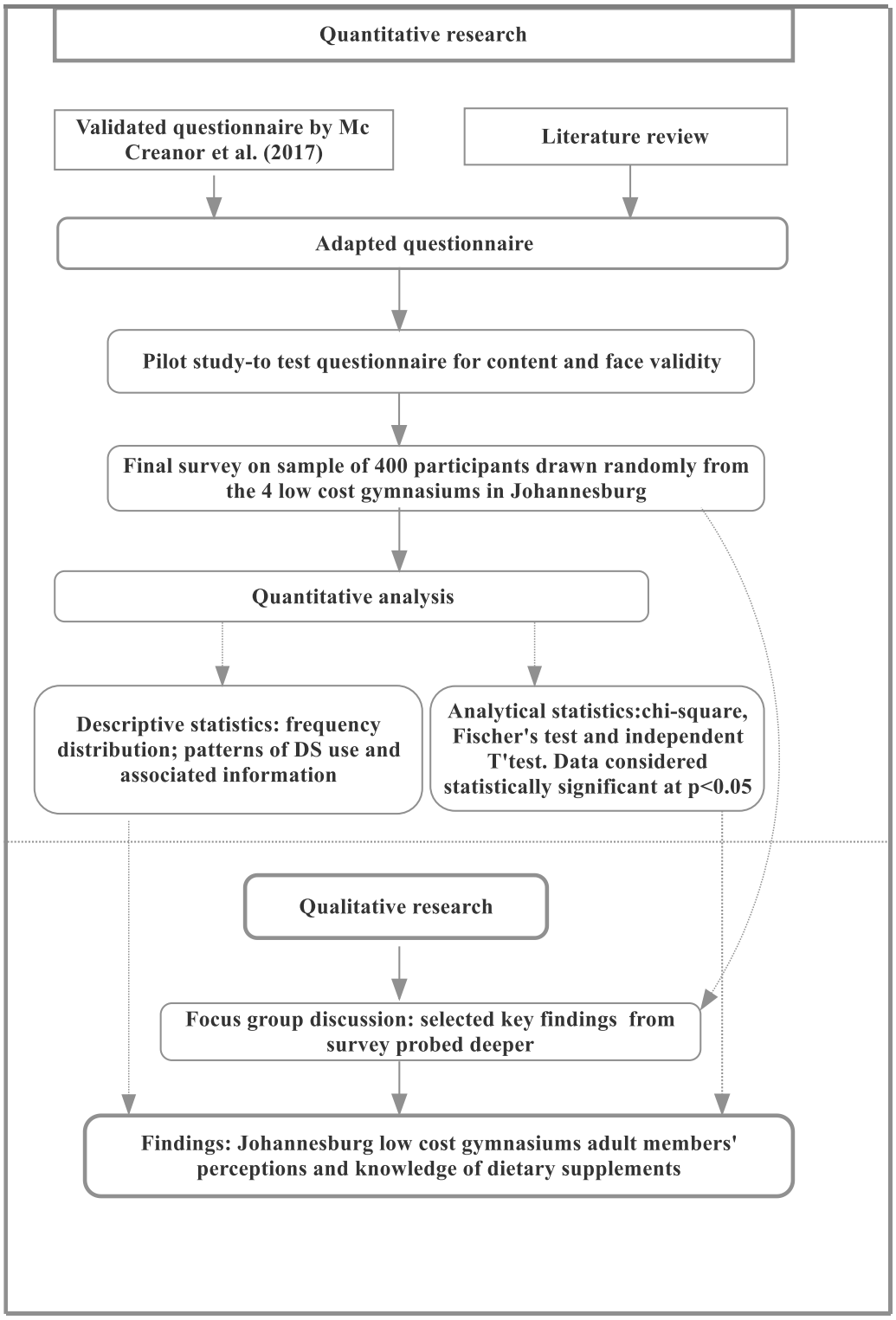

Figure 3: Conceptual framework of study (generated by the researcher)

The author of this dissertation obtained ethical permission from the Human Research Ethics Committee (HREC) (**NWU ethics number: NWU-00451-19-S1)** of the Faculty of Health Sciences of the NWU for this study before the first participants were recruited. Two consent

forms for the study's participants in the questionnaire and focus groups have been included in appendixes C and D, respectively. The measuring instruments used in the data collection phases were questionnaires followed by three focus group interviews (FGD). The questions selected for the quantitative questionnaire and FGD are shown in appendixes A and B, respectively. A statistical consultant at the North-West University was conferred with before and after the study to assist with the statistical analysis of the data.

1.8.1 Research team and contribution

Team member	Institution	Contribution
Mr A. H. Svova	MSc Human Movement Studies at Physical Activity Sport and recreation PhASRec NWU, Potchefstroom Campus	Primary researcher
Dr C. R. Botha-Ravyse	Extraordinary Senior Lecturer, PhASRec, NWU, Potchefstroom Campus	Supervisor and general project advisor
Prof. S. M. Hanekom	Acting Deputy Dean: Teaching and Learning; Faculty of Health Sciences, NWU, Potchefstroom Campus	Co-supervisor, project advisor and nutrition subject specialist
Mrs N. Matiwane	Senior Laboratory Technician, Nutrition	Principal facilitator of focus group discussions

1.9 Chapter division of this dissertation

This dissertation is written in article format. It has been edited by an accredited language editor. See Appendix I for the certificate of editing. The guidelines in the postgraduate manual of the North-West University (NWU) are applied to all technical aspects (Times New Roman font size 12) except for Chapter 3 and 4 where the journals chosen for publication's guidelines were followed.

Chapter 1: Introduction

Chapter 2: Literature review: Definition of dietary supplements, types of dietary supplements taken by general population and perceived benefits and reported adverse effects. This chapter also discusses DS use among exercising individuals; choice of DS; sources of information on DS use; reasons for use; and average monthly expenditure on DS. Lastly, the chapter discusses regulations of DS use both internationally and locally.

Chapter 3: ***Article 1***: Factors influencing DS use and sources of information on DS use among adult members of low-cost gymnasiums in Johannesburg. Published in *The South African Journal of Clinical Nutrition*.

Chapter 4: ***Article 2***: Attitudes and spending on DS by adult members at low-cost gymnasiums in Johannesburg. Published in *The African Journal for Physical Activity and Health Sciences*.

Chapter 5: Summary, conclusions, limitations and recommendations

The reference style is in the NWU Harvard style for Chapters 1, 2 and 5. Chapter 3 followed the Vancouver referencing style with superscript numbering as required by *The South African Journal of Clinical Nutrition*. Chapter 4 followed the APA 6th edition referencing style as required by *The African Journal for Physical Activity and Health Sciences*. The combined bibliography is presented at the end of the document also in the NWU Harvard style, followed by the appendixes.

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CHAPTER 2

LITERATURE REVIEW: DIETARY SUPPLEMENTS USE AMONG GENERAL POPULATION, ATHLETES AND PEOPLE EXERCISING IN GYMNASIUMS

2.1 Introduction

Dietary supplements (DS) are "ubiquitous" with approximately 90 000 products currently on the market representing a $30 billion industry in America alone where in 2013, more than half the population was reported to be taking at least one supplement (Incze & Katz, 2018:1723). Although perceived as miracle substances capable of achieving fast results with regards to health, body composition and physical performance, most dietary supplements have not been scientifically proven to be effective (El Khoury & Antoine-Jonville, 2012:2; Lacerda *et al.*, 2015:2; Mc Creanor *et al.*, 2017:2; Morrison *et al.*, 2004:482). In clinical trials, with the possible exception of specific groups such as pregnant women or those with nutritional deficiencies, DS have rarely provided any benefit compared with a normal, balanced dietary food intake (Kamangar & Emadi, 2012:2; Valavanidis, 2016:2). Dietary supplement use has grown despite insufficient evidence to demonstrate clear health benefits for most and concerns of increased health risks for several supplements being raised (Starr, 2015:1). In America, for instance, an estimated 23 000 emergency department visits annually are attributable to the use of supplements (Incze & Katz, 2018:1723). Contamination of DS has also been reported (Costa *et al.*, 2019:1114; Mathews, 2017:7; Naidoo *et al.*, 2018:1-2).The high out-of-pocket costs and regulatory concerns of DS raise the question of why so many people take supplements at all, particularly in gymnasiums, constituting the "highest density" of DS users (El Khoury & Antoine-Jonville, 2012:2).

This chapter investigates literature presented on dietary supplements. Firstly, the way dietary supplements have been defined in contemporary literature will be explored. Secondly, the chapter looks at the different types of dietary supplements that are available on the market, their respective effects and accessibility, which is followed by a review of trends in consumer spending on DS both internationally and in South Africa

(SA). The chapter will also present literature on the various reasons that motivate individuals, both recreational gymnasium users and professional athletes, to use DS and the common sources of information used to obtain information on DS use. This section will also investigate literature on the state of legislation regarding DS internationally and in SA and how it impacts on consumers' health and safety. Lastly, a review of publications on the fitness industry in SA and the rest of the world shall be conducted to establish why gymnasiums have evolved into a vibrant market for DS and how existing structures within the industry can facilitate the dissemination of professional information on DS use.

2.2 Dietary supplements

The US Food and Drug Administration (FDA) (2017) define dietary supplements as products that contain substances including metabolites, glandular, organ tissues, enzymes, amino acids, botanicals, herbs, minerals and vitamins. These substances are usually found in the form of a food item, powder, liquid, gel cap, soft gel, capsule or tablet and, consequently, are usually orally ingested. The FDA further stipulates that dietary supplements are intended for circumstances when there is some inadequacy in macro- and micronutrient intake from daily dietary intake. Besides making up for nutrient deficiency, dietary supplements as part of a healthy lifestyle, also have other intended purposes including improving physical performance, improving sleep, as well as reducing risks of chronic diseases such as cancer and heart disease (Frey *et al.*, 2017:2179; Kołodziej *et al.*, 2019:1).

DS can be categorised as nutraceuticals and also referred to as natural non-prescription health products (Spagnuolo, 2020:2). The term *nutraceutical* is a hybrid of the words 'nutrient' and 'pharmaceutical' which can be defined as food-related products with alleged health or medical benefits (Gupta *et al.*, 2016:74; Phillips & Rimmer, 2013:4323). The two branches of nutraceuticals, also referred to as food-pharma-interface owing to such products obscuring the difference between food and pharmaceuticals (Eussen *et al.*, 2011:11), are functional foods and dietary supplements. Figure 1 illustrates how functional foods and dietary supplements are perceived to be related to food and pharmaceuticals:

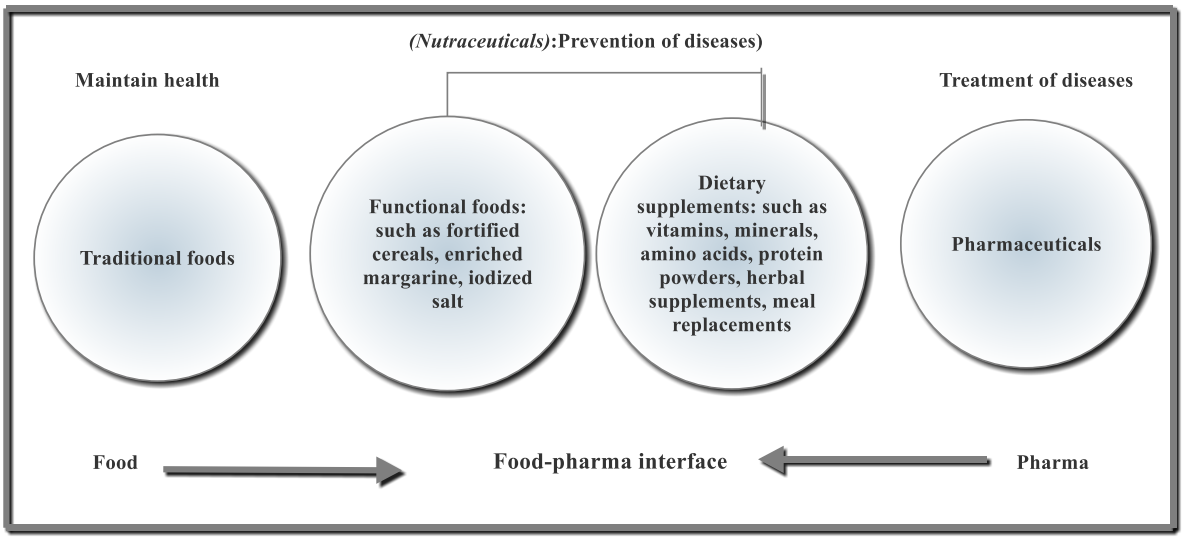

Figure 1: Functional foods and dietary supplements in relation to traditional foods and pharmaceutical drugs (Eussen *et al*., 2011:11)

Whereas functional foods are designed to be food, DS are intended to be taken in addition to daily meals for added nutrients or perceived health benefits (Phillips & Rimmer, 2013:4323). Although dietary supplements may seem to have both qualities of foods and pharmaceutical drugs, drugs are designed to treat or cure a disease and food is required to fuel the body whereas dietary supplements are largely optional as they are not needed for survival (Quinones *et al.*, 2013:329). In a study of health consciousness related to purchase of liquid milk in Bangladesh, Hoque *et al.* (2018:1) observed that consumers are becoming more health conscious, and thus have begun to consider food attributes more carefully when choosing food items based on perceived health attributes. Such health awareness among consumers with regards to nutrition could be the driving factor for increasing the demand for nutraceuticals.

2.2 Types of DS

2.2.1 Micronutrients

The US Academy of Nutrition and Dietetics (AND 2018) regards micronutrients as dietary supplements containing single or multi-vitamins (MVM). According to AND (2018) MVM are the most consumed DS in US with a third of adults aged 19 and above reportedly taking MVM followed by vitamin D at 26%, vitamin C at 11%, calcium at 9%, Vitamin B-12 at 8% and vitamin B complex at 5%. Furthermore, the motivation for use in the US for children aged 4-18 years and adults aged 19 years and above was mainly to improve overall health. However, according to AND, micronutrients are vital for haemoglobin synthesis, energy production,

maintenance of bone health and immune system and protection from oxidative damage, which could make them appealing to athletes and individuals exercising in gyms. Although micronutrients are used consistently across genders, ages and ethnic groups in the US, AND suggested that micronutrient use is more common in women than in men, and by non-Hispanic whites when compared with non-Hispanic blacks and Hispanic and Mexican Americans. Concurring with AND, Wallace *et al.* (2014:96) suggested that users in the US were likely more among females than males, older in age, non-smokers, physically active, of high income and educated.

Similar patterns of micronutrient use outside the US have been reported, for instance, among elite and sub-elite Dutch athletes and medical students in Saudi Arabia with both studies concluding that the highest percentage of micronutrient users were females, belonged to families with higher incomes and had the habit of exercising regularly (Al-Johani *et al.*, 2018:6; Wardenaar *et al.*, 2017:4). In the study by Wardenaar *et al.* (2017:10) it was noted that despite a reasonable variety of food, a basal diet alone did not supply enough micronutrients to meet the adequate intake levels and, therefore, recommended daily low doses of 50-100% of the recommended intake for MVM.

The World Health Organisation (WHO) identifies pregnant women, lactating women and young children as groups most vulnerable to micronutrient deficiencies mainly because they have a relatively greater need for vitamins and minerals and are more susceptible to the harmful consequences of deficiencies. However, some studies have singled out master athletes and female athletes as bearing greater risk of micronutrient deficiencies among a population of athletes and physically active individuals. Master athletes are aged above forty years and despite their age, continue to train as younger athletes do thereby accomplishing exceptional sporting performances especially in endurance events (Lepers & Stapley, 2016:2). Aging is associated with a reduction in enzymatic defence systems, which together with oxidative demands of endurance exercises, exposes the master athlete to oxidative stress often making it necessary for micronutrient supplementation (Brisswalter & Louis, 2014:2). The benefits of such supplementation were reported when lower muscle inflammation was observed after three weeks of strength training with micronutrient supplementation (Louis *et al.*, 2010:4).

Female athletes have an added risk of micronutrients deficiency due to, among other factors, inadequate diet, menstruation and, similar to master athletes, inflammatory response owing to

heavy physical activity (Alaunyte *et al.*, 2015:1; Biesalski Hans & Jana, 2018:4; McClung & Murray-Kolb, 2013:274). Iron, calcium and vitamin D are nutrients that when insufficient in the diet of female athletes may contribute to decrements in physical and cognitive performance as well as increased risk of injury (McClung *et al.*, 2014:389). One third of UK female athletes in a study by Alaunyte *et al.* (2015:10) experienced difficulties in meeting the average requirement for iron levels and although lacking conclusive evidence, there appears to be a need for dietary iron supplementation to balance iron, especially during adaptations to intensive training.

For most micronutrients, a dose-response curve with adverse health effects at both low and high levels of intake exists, prompting risk assessment of excess nutrient intake and recommendation of tolerable upper limits (UL) (Carlsohn *et al.*, 2011:1724). The UL is the "maximum daily intake unlikely to cause adverse health effects; therefore, exceeding the UL increases the risk of an individual experiencing a nutrient toxicity and health complications from over consumption of micronutrients" (National Institutes of Health Office of Dietary Supplements, 2014).

2.2.2 Herbal supplements

Another category of DS are herbal supplements which are extracts from seeds, gums, roots, leaves, bark, berries or flowers that contain phytochemicals such as carotenoids, polyphenols, phenolic acids, alkaloids, flavonoids, glycosides, saponins and lignans, which provide health benefits (Sellami *et al.*, 2018:1). Apart from being extensively advertised and marketed, herbal supplements are commonly used owing to long tradition of natural medicine with developing countries opting for them also because they are more accessible and affordable whereas in developed countries there is an assumption that they are more tolerated by the body than synthetic, pharmaceutical drugs. For example, in a survey in Germany, 60% of participants expressed preference for herbal supplements citing concerns about tolerability of pharmaceuticals (Sellami *et al.*, 2018:2).

Table 1 offers the top 10 herbal supplements in the US, based on data from retail sales, data provided by the market research firms SPINS and IRI, both based in Chicago, Illinois, and the Nutrition Business Journal (NBJ) (Smith *et al.*, 2017), and the top 10 herbal supplements in six

sampled European countries (Finland, Germany, Italy, Romania, Spain and the United Kingdom) in 2014 as per a consumer survey (Garcia-Alvarez *et al*., 2014:10)**.**

Table 1: Top 10 herbal supplements by country

Rank	**Top-Selling Herbal Supplements in 2017 in US**		**PlantLIBRA Consumer Survey 2014 in 6 sampled European countries**.	
	Herbal product	Latin Binomial	Herbal product	Latin Binomial
1	Horehound	*Marrubium vulgare*	Ginkgo	*Ginkgo biloba*
2	Echinaceaa	*Echinacea* spp.	Evening primrose	*Oenothera biennis*
3	Cranberry	*Vaccinium macrocarpon*	artichoke	*Cynara scolymus*
4	Ivy Leaf	*Hedera helix*	Ginseng	*Panax ginseng*
5	Turmeric	*Curcuma longa*	Aloe	*Aloe vera*
6	Black Cohosh	*Actaea racemosa*	fennel	*Foeniculum vulgare*
7	Garcinia	*Garcinia gummi-gutta* (syn. *G. cambogia*)	Valerian	*Valeriana officinalis*
8	Green Tea	*Camellia sinensis*	Soybean	Glycine max
9	Ginger	*Zingiber officinale*	lemon balm	*Melissa officinalis*
10	Fenugreek	*Trigonella foenum-graecum*	Echinacea	*Echinacea purpurea*

In a South African context, some of the common weight loss herbal supplements identified in past studies were gingko Biloba, garlic, ginseng, Soy/isoflavones (natural oestrogen) lycopene carotenoids, green tea extract, chromium picolinate, apple cider vinegar, and lemon juice (Braun & Venter, 2008:326; Van den Berg & Walsh, 2013:43).

Consumption of herbal supplements is motivated by the desire for ingredients with general health and wellness benefits and among several specific reasons for use is boosting immune system, joint health, relieving gastrointestinal disorders, skin conditions, age-related symptoms such as androgen decline, menopause and low sperm counts (Smith *et al.*, 2017:64). Furthermore, herbal supplement use for exercise and fitness related goals has been reported amongst athletes and individuals involved in physical activities. Due to bioactive compounds such as polyphenols, terpenoids and alkaloids with possible physiological effects, herbal supplements have been taken to increase muscle mass and strength, physical performance

enhancement, fatigue reduction, improve alertness and reaction time and enhance serum testosterone levels (Bach *et al.*, 2016:5; Henkel *et al.*, 2014:5; Sellami *et al.*, 2018:1).

Herbal supplements have also been used for weight loss. The World Health Organisation (WHO) in a 2018 report, estimated that as of 2016, 1.9 billion adults were overweight with at least 300 million being clinically obese. Herbal weight loss supplements are among the various interventions used by people seeking to curb problems of being overweight and obesity. The US National Institute of Health lists among other weight loss supplements common herbal supplements used for weight loss such as: Garcinia Cambodia, raspberry ketones, green coffee bean extract, glucomannan, green tea extract, forskolin, bitter orange, guar gum, hoodia gordini, white kidney bean and yohimbe.

There is a frequent assumption among herbal products consumers that natural herbal supplements are safer than synthetic drugs (Dastjerdi *et al.*, 2018:236; Sellami *et al.*, 2018:3). On the contrary, some studies have established possible toxicity associated with herbal supplements with common symptoms being jaundice, malaise, fatigue, abdominal pain, nausea, vomiting and fever (Bunchorntavakul & Reddy, 2013:6; Dastjerdi *et al.*, 2018:239; Kothadia *et al.*, 2018:4; Mazzanti *et al.*, 2015:6). Herbal toxicity maybe linked to the production quality of herbal products, risks of impurities, contaminants, adulterants, incorrect use of plant species and plant parts as well as patient factors such as co-medications, co-morbidity, self-medication without disclosure to physician and incorrect diagnosis (Amadi & Orisakwe, 2018:4). Among the non-bodybuilding herbal and dietary supplements, weight loss supplements were reported to present more adverse drug reactions (Ansari & Omar, 2017:2; Zheng & Navarro, 2015:93). Table 2 presents cases of herbal toxicity associated with herbal weight loss supplements reported in past studies.

Table 2: Case reports of adverse events associated with herbal weight-loss supplements (adapted from Pittler & Ernst, 2004:95)

Cases involving patients aged 18-48 years whose reasons for supplementing were physical activity and transformation of body image.

Patients age, gender, n	Herbal medicines, indications	Other main constituents (brand name)	Daily dose, duration	Concomitant medication	Adverse events
21 years, f 1	E. sinica, heightened alertness and prevent drowsiness	Not reported	Not reported, 'Several months'	None	Psychomotor agitation, delusional thinking, suicidal ideation
23 years, m 1	E.sinica, weight loss	Guarana, bitter orange, white willow bark, ginger, green tea, carnitine (Xenadrine RFA-1)	60 mg ephedrine, not reported	Not reported	Heatstroke resulting in multi-organ failure and death.
42 years, m 1	E. sinica, bodybuilding	Guarana, damiana, ginseng, ginger, sarsaparilla, goldenseal, nettle, gotu kola, chromium picolinate (Ripped Fuel, Metabolife, Red Bull)	1000 mg mahuang, 'many weeks'	Multivitamins, saw palmetto	Increased blood pressure and heart rate. Hypertension and tachycardia in a reservist who was taking large doses of Ephedra sinica for bodybuilding.
19, 21 years, m 2	E. sinica, bodybuilding	Kola nut, white willow bark, grapefruit, chitosan (Stacker III	Not detailed	Riboforce, ripfuel, tissue growth promoter, TheraFlu, tobacco	Shortness of breath, chest pain; it is believed ephedra may have caused cardiomyopathy in these 2 patients.' Death of one patient after re-admission with exacerbation of heart failure.
34, 48 years, f 2; 48 years, m	cambogia, not reported	Not reported	1.2 g, 3, 4 d	Not reported	Dizziness, increased appetite, dry mouth, palpitation, hepatic enzyme increase
29 years, m 1	P. cupana, bodybuilding	Gingko, kava (Guaranaginkgo Plus)	Not reported (1 flacon contains 500 mg), once	Not reported	Diffuse muscle pain, dark urine-it is believed that the methylxanthine effects of guarana and the anti-dopaminergic and neuromuscular blocking activities of kava was pathogenetically relevant.
25 years, f 1	P. cupana, not reported	Ginseng (Race 2005 Energy Blast)	55 mL, once	None	Collapse, arterial fibrillation, Death-Coroner found that the high level of caffeine was associated with the development of an intractable arrhythmia.

f = female; m = male, number after f and m = number of patients/participants

What stands out in the table above is that dietary supplements can have side effects even among young people (25-48 years). Also, adverse effects of DS can be experienced by individuals with no known underlying health problems. Lastly, data in the table shows that DS can be inherently harmful and present with adverse effects when taken alone without interacting with other drugs.

Another risk posed by herbal supplements is possible drug interactions when concurrently used with prescribed medical drugs. In a 1998 survey on use of prescription and non-prescription drug use among noninstitutionalised adults in the US, Kaufman *et al.* (2002:342) noted that 16% of people taking prescription drugs were also using at least one herbal supplement. Although majority of such interactions have negligible clinical significance, some cases pose a serious threat to public health with, for example, St John's wort reported to cause drug failure if used with anti-retroviral, immunosuppressive or anti-cancer agents (Izzo, 2012:422). This view is shared by Gunnlaugsdóttir (2016:17) who observed that common use of pharmaceutical medicine combined with supplements could lead to a dangerous adverse drug effect. Furthermore, education about supplement use is important as people often do not know the dangers of using too many supplements at a time (Gunnlaugsdóttir, 2016:17). Moreover, cases of delayed emergence, cardiovascular collapse and loss of blood related to consumption of herbal products before surgery have been documented (Izzo, 2012:422).

Although a few positive studies may be used by manufacturers of supplements to substantiate claims that they are beneficial and safe to use, but the potential for serious adverse effects as cited previously remain a concern. The side effects of herbal supplements are also worsened by a lack of standardisation of the products as well as under-reporting supplement use to care providers, and consumers delaying use of conventional medicines owing to over-reliance on herbal supplements (Sprouse & van Breemen, 2016:162).

The FDA caution herbal supplements users that 'natural' does not equal safe and faced with current vigorous and aggressive marketing of supplement products on various media platforms, its necessary for supplement users to seek guidance from qualified health professionals on safe and effective dietary supplementation.

2.2.3 Sports supplements

High incidence of lifestyle diseases has raised health consciousness world-wide with many people turning to exercise and fitness. This, however, has subsequently created a sports supplements market; arguably the fastest growing division of dietary supplements. Sports supplements are dietary supplements perceived to be ergogenic and consumed with intention to improve exercise performance and speed up recovery (Jovanov *et al.*, 2019:1; Thomas *et al.*, 2016:558). Protein supplements are considered a form of ergogenic aid taken to improve athletic performance (Maughan *et al.*, 2004:97). Although protein supplements have not proven the same athletic performance enhancing benefits as dietary protein, it is still the most common dietary supplement consumed among both amateur and professional athletes (Pasiakos *et al.*, 2014:2).

Sports supplements are consumed as sports drinks (carbohydrate-electrolyte beverages), sports gels and confectioneries, electrolyte supplements (high sodium sports drinks), protein supplements and bars or mixed macronutrient drinks (Burke, 2019:157). Sports supplements come in two forms, namely: nutritional supplements and ergogenic aids depending on their rationale for use. Ergogenic supplements are products claiming direct enhancement of sports and exercise performance other than meeting goals of everyday nutrition requirements. Typical examples of ergogenic supplements are creatine and caffeine (Burke, 2019:158).

2.2.3.1 Creatine supplements

The prospect of enhanced sport and exercise potential continues to increase the demand for DS with Creatine monohydrate (Cr) being one of the most common oral DS (Bemben & Lamont, 2005:108). Creatine is a nitrogenous organic acid that helps supply energy to body cells, particularly muscles. It is produced endogenously in the liver and can also be synthesized by a two-step process involving three amino acids; arginine, glycine and methionine (Bemben & Lamont, 2005:108). Also regarded as an ergogenic substance, when supplemented in a human diet, creatine increases intra-muscular stores resulting in improvement of exercise capacity and training adaptations (Jagim *et al.*, 2018:1).

Bemben and Lamont (2005:108) observed that most scientific literature concurs that among young and healthy males' exercise performance involving short periods of extremely powerful

activity and short resting periods, creatine supplementation improves performance. An experimental protocol in which a sample of 18 young men were randomly put in a creatine group and placebo group, after supplementation with resistance training, results showed that creatine supplementation reduced the presence of muscle damage markers such as creatine kinase, range of motion and muscle soreness thereby increasing the repeated bout effect (Veggi *et al.*, 2013:385).

In another experimental protocol involving young men aged 20-30 to show the effect of oral Cr during incremental cycling test to exhaustion, it was observed that short-term Cr loading reduced lactate levels. Furthermore, results showed a 12% increase in power output with a trend towards significance (*p=0,11*) (Oliver *et al.*, 2013:255). Although conceding the precise mechanism by which creatine enhances repeated bout effect was unknown, Veggi *et al.* (2013:383), citing past studies, argue that several mechanisms could be at play such as increases in intramuscular phosphocreatine, which stabilizes sarcolemma, reduction in inflammation and also reduction in markers of DNA damage and lipid peroxidation after resistance exercises. Benefits of Cr supplementation amongst older subjects has been reported with records mass gain, strength and functional capacity among 64 year-olds doing resistance training (Kreider *et al.*, 2017:10). Kreider *et al.* (2017:10) further suggest that Cr supplementation can help prevent sarcopenia and bone loss in older individuals.

The media report adverse effects associated with Cr supplementation to be muscle cramps, kidney impairment and liver dysfunction. However, scientific studies investigating these claims have concluded that the side effects of Cr supplements were anecdotal (Francaux & Poortmans, 2006:318). For instance, in a survey on the use of ergogenic supplements by the NCAA division 2 American college team, there were no detrimental effects to liver and kidneys associated with long term Cr supplementation (Mayhew *et al.*, 2002:456). Furthermore, Cr supplementation was also reported to be safe and tolerable among older subjects with frailty (Candow *et al.*, 2019:9; Collins, 2015:16; Longhurst, 2016:130).

However, consumers are advised to be cautious as excess Cr does burden the kidneys and regular check-ups for potential dysfunction are advisable for individuals less able to compensate for homeostatic imbalance. This view is supported by Kim *et al.* (2011:1416) who suggest high doses of Cr supplementation should not be used by those with underlying renal disease or those with potential risk of renal dysfunction consistent with diabetes, hypertension

and reduced glomerular filtration rate. A major concern, more practical for all Cr supplement consumers, could be possible contamination of the commercial Cr, hence the need to ascertain purity possibly through analytical tests to verify 'nutraceutical composition' (Francaux & Poortmans, 2006:312; Kim *et al.*, 2011:1416).

2.2.3.2 Caffeine

Caffeine is a trimethylxanthine, liquid-soluble molecule and natural alkaloid found in coffee, tea leaves, cocoa and other plants (Graham-Paulson *et al.*, 2016:214; Higgins *et al.*, 2010:214; Nawrot *et al.*, 2003:1). Caffeine is capable of passing through cell membranes and cross the blood-brain barrier giving it an ergogenic effect in stimulating the central nervous system (Graham-Paulson *et al.*, 2016:214).

Although removed from the World Anti-Doping Agency (WADA) list of banned substances, widespread caffeine supplementation has continued to attract the attention of researchers who have investigated its efficacy and safety. In a study on wheel chair sprint performance, caffeine supplementation appeared to have a psychostimulant effect, an improvement in a 1-off bout, short-term endurance with wheel chair sprint performance after consuming 4mg/kg of caffeine (Graham-Paulson *et al.*, 2016:219). In another study on effects of caffeine supplementation on peak anaerobic power output in cycle ergometer sprints, caffeine supplementation was observed to have a significant effect on peak anaerobic power output and blood lactate levels (Glaister *et al.*, 2015:405). Caffeine is mostly consumed in energy drinks.

Sports drinks, now commonly referred to as energy drinks, have evolved from being mere carbohydrate and electrolyte replacement drinks to being energy beverages containing stimulants and additives (Higgins *et al.*, 2010:1033). South Africa Business Insider of July 30 cite *Red Bull* and *Monster* as some of the common energy drinks with the giant beverage company Coca-Cola having most recently introduced, in 2019, their own brand of high-caffeine energy drinks. With caffeine as the common ingredient, energy drinks also contain taurine, guarana and vitamin B (Faris *et al.*, 2017:1; Higgins *et al.*, 2010:1033). Energy drinks are increasingly common during pre-workouts among athletes and recreationally active populations (Magrini *et al.*, 2016:667).

The excessive consumption of caffeine can lead to adverse effects such as diuresis, palpitations, arrhythmia, tachycardia, insomnia, tooth decay, restlessness, confusion, and, to some extent, mood changes and gastrointestinal disturbances (Lystrup & Leggit, 2015:e936; McGraw, 2013:68; Subaiea *et al.*, 2019:6). Higgins *et al.* (2010:1034) argued that side effects of caffeine typically manifest after consumption exceeding 200mg but Temple *et al.* (2017:10) more recently measured the toxicity threshold of caffeine to be 400mg. Furthermore, "vulnerable populations" more prone to side effects of caffeine were identified as individuals who are caffeine naïve, physiologically stressed, the young and mentally ill (Lystrup & Leggit, 2015e:936).

2.2.3.3 Ubiquinol

Ubiquinol also known as coenzyme Q10 is a naturally occurring antioxidant readily available among the most popular DS (Deshmukh *et al.*, 2019:2; Raizner, 2019:190). Possibly owing to its redox properties, ubiquinol has been reported to be an anti-aging supplement and also associated with significant increase in peak power production among young athletes (Alf *et al.*, 2013:6; Kinoshita *et al.*, 2016:26). Past studies seem to concur that ubiquinol is quite safe (Casagrande *et al.*, 2018:27; Deshmukh *et al.*, 2019:2) . However a few cases of abdominal discomfort, diarrhoea, vomiting, nausea, headache and allergic skin rashes have been reported in clinical trials involving ubiquinol supplementation (Deshmukh *et al.*, 2019:2).

2.2.3.4 Probiotics and prebiotics

The use of probiotics by the sports community and exercising individuals has been aimed at promoting health and increase training and exercise performance (Möller *et al.*, 2019:1). Furthermore, probiotics have been reported to have positive effects on disease markers including respiratory infection, immune system and gastro-intestinal health (Pyne *et al.*, 2015:16). Probiotics may therefore be helpful especially to athletes and exercising individuals prone to colds, flu and gastro-issues prevalent in endurance events such as long distance running (Pyne *et al.*, 2015:8). Prebiotics (fibre diet) have been associated with, among several other health benefits, promoting satiety which may lead to weight loss and preventing obesity (Mazloom *et al.*, 2019:5; Rouxinol-Dias *et al.*, 2016:21; Slavin, 2013:11). Unlike other dietary supplements where adverse reactions have been reported in clinical trials, probiotics have been

used safely for a very long time and risks if any have been theoretical and not linked to human subjects (Doron & Snydman, 2015:2).

2.2.4 Meal replacements

Davis *et al.* (2010:2) identified a category of weight loss supplements made up of meal/food replacement products. The term *meal replacement* applied in scientific literature includes foods such as snack bars, shakes, beverages and prepacked frozen meals consumed as sole energy source (Davis *et al.*, 2010:2; Heymsfield *et al.*, 2003:538). Fortified with vitamins and minerals, meal replacements offer a nutritionally balanced low-calorie and low-fat meal plan ideal for individuals seeking to lose or maintain body weight (Hannum *et al.*, 2004:543; Heymsfield *et al.*, 2003:2; Treyzon *et al.*, 2008:2). Advantages of meal replacement over normal meals is its consistent portion control, convenience and ease of use (Hannum *et al.*, 2004:544). Ninety-three percent of obese participants in a research study by Davis *et al.* (2010:9) lost significant amounts of weight using a meal replacement diet plan with a fixed macro-nutrient compositing, which proves it to be effective.

The disadvantage of meal replacements, however, is the monotony of eating the same or similar products, which makes it unsustainable over a long period of time (Hannum *et al.*, 2004:544). This view is shared by Davis *et al.* (2010:9), who observed that the method is unreliable for long durations as individuals who lost weight from meal replacements gained significantly more weight back after discontinuing the program compared to normal food-based dieters. Furthermore, meal replacements may lack some of the non-traditional nutrients and phytochemicals found in normal foods that are potentially important for health (Hannum *et al.*, 2004:544). A suggestion to address the two problems of meal replacements cited above would be to use a variety of prepacked frozen meals with a few simple foods to ensure that both convenience and portion control are maintained (Hannum *et al.*, 2004:544).

2.2.5 Protein supplements and amino acids

The most commonly used supplements among active individuals, particularly in gyms, are protein supplements (Bianco *et al.*, 2011:5; El Khoury & Antoine-Jonville, 2012:5; Nabuco *et al.*, 2017:167). Sport supplements can also be classified as convenience supplements when sold as meal replacements or for pre- or post-workout and commonly come in powders, drinks, bars

and capsules (Kerksick *et al.*, 2018:9). Like other dietary supplements, sports supplements have become increasingly available for online purchase. Less-credible online sources of sports supplements come with an increased risk of being contaminated with substances such as synthetic hormones, heavy metals, microbiological agents and other harmful substances (Maughan, 2012:2). Furthermore, label claims of sport supplements' content can be inaccurate and misleading to consumers (Juhn, 2003:935). This may cause supplement users to avoid caution with sports supplements and take nutrients exceeding the RDA, which may be harmful (Maughan *et al.*, 2004:96).

Studies investigating the relationship between nutrition and heavy resistance training have demonstrated that in order to maximize muscle gains, quality protein with high content of essential amino acids should be taken timeously relative to exercise. Whey protein, particularly whey isolate, has been considered as one of the highest quality proteins with high levels of essential amino acids (Ziegenfuss *et al.*, 2010:67). Although both essential and non-essential amino acids are needed by the body, essential amino acids have been reported to play an important role in muscle protein accretion with several studies identifying leucine as playing a crucial role in muscle protein synthesis (MPS) (Guimaraes-Ferreira *et al.*, 2014:1097; Ziegenfuss *et al.*, 2010:67). To maximize muscle protein accretion there should be a positive net protein balance between MPS and muscle protein breakdown (MPB) as illustrated in Figure 3.

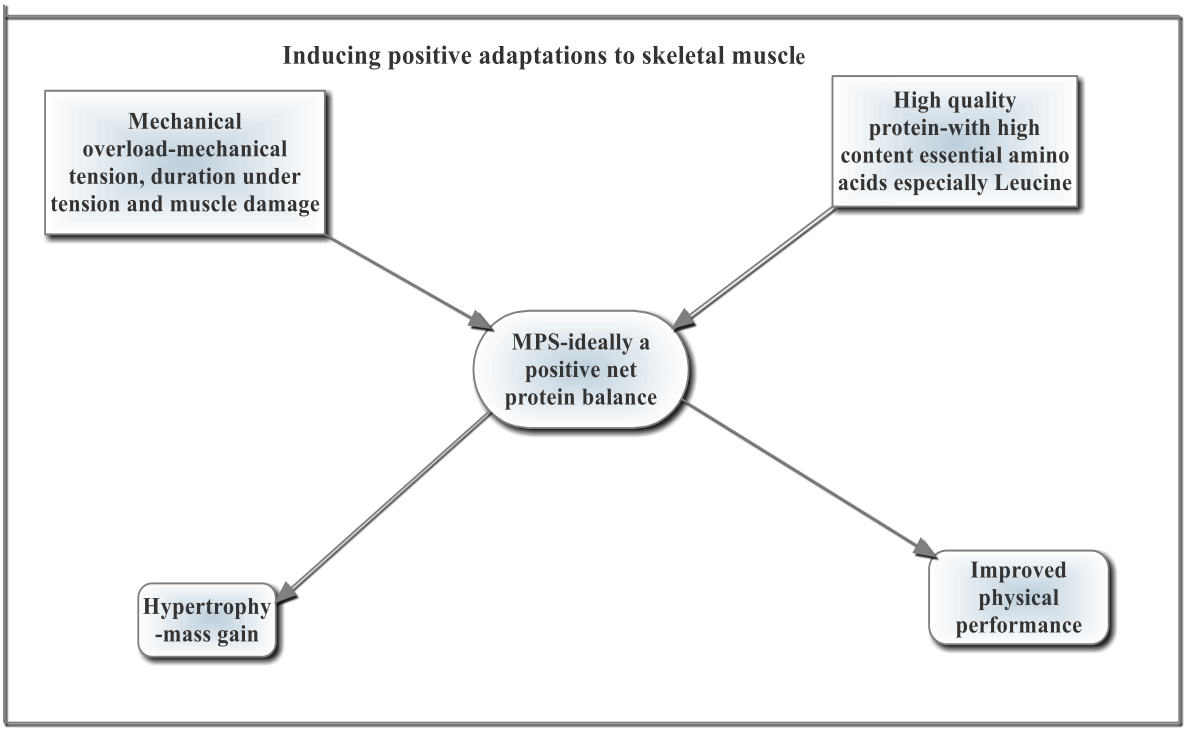

Figure 3: Balance between muscle protein breakdown and muscle protein synthesis promoting muscle net gain

It is with this view of the need to balance protein breakdown and protein synthesis that individuals wishing to enhance lean mass are advised not to train in a fasted state nor remain fasted post-exercise as there is need for protein intake to coincide with resistance training. However, the optimal amount of whey protein and whole food choices necessary to maximize muscle protein accretion have not been studied and determined (Ziegenfuss *et al.*, 2010:69).

Branched chained amino acids (BCAA) are supplements also taken by exercising individuals wishing to enhance training adaptations particularly for recovery from exercise induced muscle damage (EIMD). Although optimal timing of BCAA supplementation is unclear, short (30-minute) pre-exercise has been shown by some studies to be sufficient in reducing markers of EIMD suggesting prolonged usage to be unnecessarily costly to consumers (Waldron *et al.*, 2017:6).

Glutamine is another common supplement taken by physically active people apparently for being beneficial to over-trained and chronically fatigued individuals to boost the immune system, aid in water transport, acid-base balance buffering and muscle anabolic processes. However, the scientific evidence is not strong enough to recommend use of glutamine supplements (Gleeson, 2008:2048S). With regards to protein supplements, similar to other

supplement types discussed earlier, coaches and exercising individuals wishing to enhance training adaptations need to liaise with qualified sports nutritionists to identify nutritional strategies to optimise performance (Ziegenfuss *et al.*, 2010:70).

2.2.6 Supplement stacking

Stacking can be defined as the concurrent consumption of two or more supplements to maximize results. The practise originated among body builders and resistance trainers seeking to deal with side effects or potentiate benefits of individual supplements. Tsochas *et al.* (2013:17) report the practise of supplement stacking among young DS users. This is supported in a study of under-16 rugby players in SA where two players were reported to be taking "as many as five different supplements simultaneously" (Duvenage *et al.*, 2015:68).

While stacking may provide benefits, consumers need to be wary of doubling-up incompatible ingredients (Pearce *et al.*, 2012:954). Furthermore, stacking may result in adverse effects such as interference with nutrient absorption and a typical example being combining caffeine and iron supplements. Moreover, stacking may pose a risk of over-dosing on single ingredients from multiple sources and a typical example is toxic levels of zinc that may be consumed from the combination of daily dietary intake (15+mg), one or more multivitamin mineral supplements (15+mg), protein shake (10 mg), recovery shake (10 mg), sports bar (15 mg) and immunity supplement (5+mg); this totals over 70 mg/day, exceeding the upper safe limit of 45 mg (Pearce *et al.*, 2012:954). The health risk posed by supplement stacking is similar to the interaction of herbal supplements and medicinal drugs previously discussed.

2.3 Trends in consumption of dietary supplements

The global DS business is estimated to be worth more than $100 billion annually and has been growing at a rate of 6.8% per annum (Binns *et al.*, 2018:405). A 2018 online survey by the Council for Responsible Nutrition (CRN) observed that use of DS had risen by 10% over the decade with 75% US adults taking DS compared to 65% recorded in a 2009 survey. Furthermore, although vitamin and mineral supplements continued to be the most popular at 98%, a significant increase in the use of herbal/botanical supplements was noted with the emergence of turmeric, not known on the survey 5 years ago, now as the second most common herbal supplement. The US appears to be the most prominent consumer of DS with an industry

estimated to be worth $38 billion as of 2015. Figure 2 illustrates the 2015 DS consumption by product category:

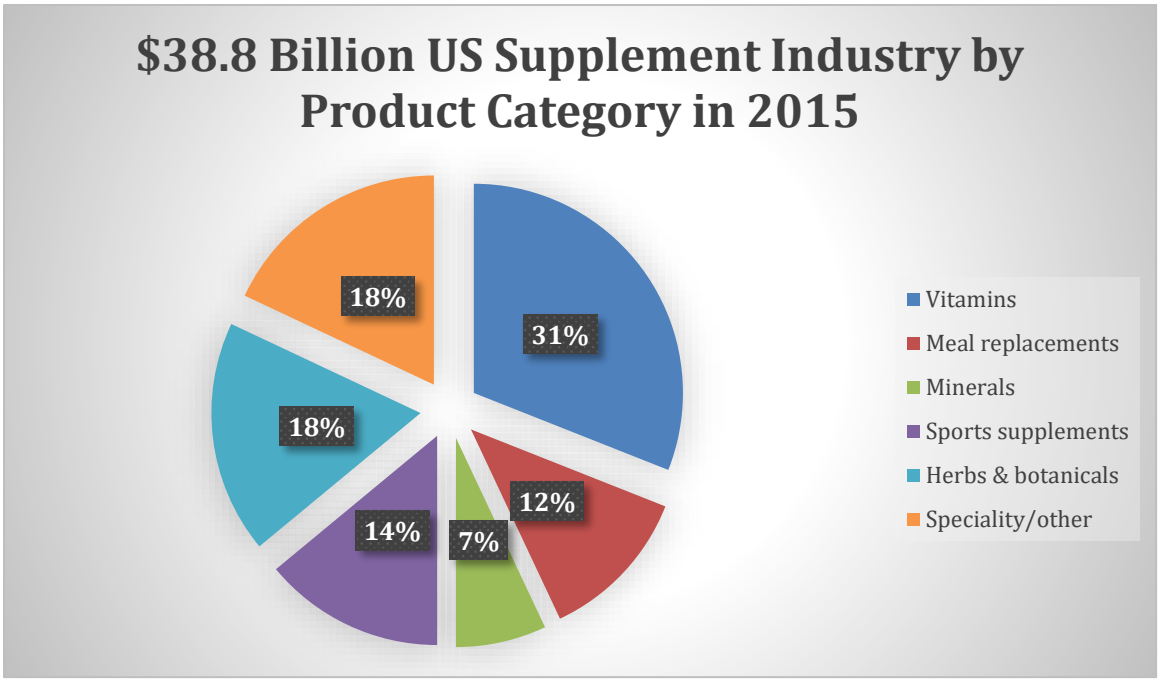

Figure 2: US supplement Industry by product category in 2015. By Nutrition Business Journal (NBJ): Supplement business report 2016

The pie chart above shows that vitamins are the most popular DS in the US followed by herbal and sports supplements. In South Africa the DS market has grown from R2,9 billion in 2014 to R3.8 billion in 2016 (Jennings, 2017:1). Although smaller than in America, the supplement industry in South Africa is growing rapidly at a rate of 7.7% annually, surpassing the average global growth trend pegged at 6.8% annually with about 46% of South Africans reported to be taking at least one supplement to boost immunity and overall well-being (Jennings, 2017:1; Naidoo *et al.*, 2018:1).

2.4 Financial cost of DS

Despite promising all kinds of health benefits, the financial costs of dietary supplements cannot be overlooked (Mc Creanor, 2016:26; Sands, 2012:4). According to the National Business Journals of 2002, 2016 and 2018; dietary supplement consumption in the US has been on a steady growth of 6.1% per annum rising from 6.5 billion in 1996 to 18 billion in 2002; 27 billion in 2010; 38.8 billion in 2016; and finally 43.5 billion in 2017 with 14 % and 11% of the expenditure on DS in 2017 attributed to sports supplements and meal replacements,

respectively (Sands, 2012:451). In a study on DS consumption in gymnasiums, women were reported to spend up to $30 per month on DS whereas by comparison, men spent more than $30 per month (Goston & Correia, 2010:607).

The US is the world's largest consumer of energy drinks with a market value of $650 million in 2005, 65% of which belongs to the popular *Red Bull* energy drink whose sales were reported to be growing by 35% annually. Data from the National Consumer panel on more than 60 000 US households' purchasing practices of DS for weight loss, muscle building and sexual function was analysed in 2012. It was observed ($p < 0.01$) that lower income households spent 2-4 times more than higher income households on DS for weight loss and muscle-building DS. Given such information, Austin *et al.* (2017:239) suggest urgent regulation of DS, arguing that a cost-benefit analysis shows a disproportionate burden to these households especially considering these DS were flagged by the FDA as dangerous due to their inherent risk of contamination.

In contrast, an Irish consumer data set examining trends in consumption of whey protein in 2014 showed that income was not a defining factor for whey protein consumption (Keogh *et al.*, 2019:6). Considering that these supplements are not cheap, this could be a sign that the demand is so strong and widespread that there is a market among those with less disposable income. It was further observed and reported in previous studies that young people spent more on whey protein but the trend seems to have changed with regards to gender as more females seem to be consuming protein supplements (Keogh *et al.*, 2019:6). Keogh *et al.* (2019:7) attribute this shift of trend to a growing realisation that whey supplementation can promote muscle recovery without necessarily building bulk mass. Moreover, the packaging of whey seemed to have been altered to suit females, for example, introduction of small and bright coloured packs (Keogh *et al.*, 2019:7).

Similar to the trend in the US, the supplement industry in SA has been quite lucrative, growing at a rate of 7.7% per annum (Naidoo *et al.*, 2018:166). Among people exercising in gymnasiums, over-spending on DS has been reported, possibly indicating consumers' underlying strong belief that DS can help them achieve their fitness and weight loss goals faster, thereby disregarding the high costs of the supplement products (Mc Creanor, 2016:57). In the study by Mc Creanor, (2016:57) as many as 49% of gym users in South Africa spent between R500 and R1500 and a further 27% spent R1500-R3000 per month on supplements indicating

that gym users strongly believe supplements can help achieve goals and resort to over-spending to maximise rewards (Mc Creanor, 2016:57).

2.5 Reasons for DS use

The most common reasons for DS use among American consumers participating in a 2014 survey, were to promote health and to fill nutrient gaps (Dickinson *et al.*, 2014:179). Health-conscious consumers are becoming increasingly interested in maintaining health and preventing consequences associated with debilitating lifestyle choices such as poor diet, minimal exercise, tobacco use, and excessive intake of alcohol (Radimer *et al.*, 2004). This has led people to conveniently seek optimum nutrition from pills to powders rather than natural food sources, even when health care professionals promote obtaining nutrients from a balanced diet (National Institutes of Health Office of Dietary Supplements, 2011). In addition, dietary supplements appeal to individuals who are more reliant on forms of self-care health methods that do not rely on expensive resources of information and treatment (Tindle *et al.*, 2005:48).

Another reason for dietary supplement use among various populations is to fill nutrient gaps (Frey *et al.*, 2017:2175; Pajor *et al.*, 2017:2703; Sirico *et al.*, 2018:6). This is especially common for those with diet restrictions or individuals in a life stage that requires increased nutrients. Vegetarians, vegans, and those following other diets restricting food group intakes may benefit from vitamin B_{12}, vitamin D, calcium, iron and zinc supplements since these nutrients are consumed in low amounts from the diet (Elorinne *et al.*, 2016:2). Another example is patients in intensive care (ICU) whom often struggle to meet nutrient adequacy from their diet and may benefit from MVM or a protein supplement (Samadi *et al.*, 2016:2). Dietary supplementation for ICU patients can help fight infections and aid recovery (Samadi *et al.*, 2016:2). Pregnant women and breastfeeding mothers are advised to supplement the diet with folate, iron, or a prenatal vitamin to support increased physiological demands (Kominiarek & Rajan, 2016:3). It is also recommended that adults over 50 years old and menopausal women consume vitamin B_{12}, calcium, and vitamin D supplements (Meehan & Penckofer, 2014:4; Milart *et al.*, 2018:175).

Many consumers use dietary supplements for managing specific health conditions (National Institutes of Health Office of Dietary Supplements, 2011). People following a complementary or alternative medical plan may choose to use dietary supplements in combination with or

instead of conventional medicine (National Center for Complementary and Integrative Health, 2016). Fish oil is commonly used to protect cardiovascular health (Mohebi-Nejad & Bikdeli, 2014:8; Weitz *et al.*, 2010:2). Antioxidant vitamins A, C, and E are related to immune function with many reporting uses for protection against heart disease and cancer (Hajhashemi *et al.*, 2010:5). Iron supplementation is commonly used by individuals with iron-deficiency anaemia (Okam *et al.*, 2017:1). The elderly and female adults aged above fifty, report a high intake of calcium and vitamin D supplements for bone support and prevention of osteoporosis (Chen *et al.*, 2014:183).

Dietary supplements are also used to improve physical performance and appearance (Muwonge *et al.*, 2017:2; Tawfik *et al.*, 2016:5). Dietary supplements related to performance enhancement are protein powders, amino acid blends, and other sport supplements are commonly used among males (Froiland *et al.*, 2004:108). Females are more likely to report reasons of dietary supplements for improved physical appearance by means of weight loss and for healthier hair, skin, and nails (Bailey *et al.*, 2010:359; Froiland *et al.*, 2004:108). However, when considering using dietary supplements, consumers are urged to take supplements tailored to suit among other factors, their age, gender, family history and stage in life (Ward, 2014:8). Furthermore, Ward (2014:8) cautions consumers to first consider the supplement's benefits against possible health risks and financial costs (risk-benefit assessment).

2.6 Attitudes towards DS

Katz (1960:168) defines attitudes as a tendency to regard someone or something as favourable or unfavourable and that these attitudes exist to serve some function for the individual. In a study of factors influencing women to take dietary supplements conducted in the UK, it was concluded that attitude was the major predictor of supplementation (Conner *et al.*, 2003:1981S). Supplement users in this study strongly believed DS would prevent illness and that taking DS would be the, "best I can do for myself" reinforcing the notion that supplements are some kind of "insurance policy" against diet-related ill health (Conner *et al.*, 2003:1981S). The main underlying attitude observed in many studies is, however, that users perceive supplementation as some measure of control over their health (Jasamai *et al.*, 2017:191; McFadden *et al.*, 2010:2).

A food supplements consumer study in the UK gives insight to attitudes most commonly associated with dietary supplement use (Anon, 2018). These are listed in Table 3.

Table 3: Attitudes towards dietary supplements in UK national survey. Food supplements consumer research of May 2018 (Anon, 2018)

Attitude	**Respondent statement**
Vitamins help boost health staving colds. They also boost energy.	*"Just to stay fit and healthy really… Protection from bugs, colds, illnesses, immune system." Female, 35-49*
Supplements replace nutrients lost as a result of ill-health or ageing.	*"I try to eat well. But then obviously, because of my job, lunch is always either fast or no, not enough, or unhealthy. So, it's that side I need to try and balance out really." Male, 18-34*
Supplements relieve symptoms of ill-health or ageing.	*"I take cod liver oil every day as I feel it helps with my joints, I don't know if it's a placebo effect but when I haven't taken it for a while my knee starts giving me problems." Male, 35-49*
Habitual supplementation.	*"I took them as a child. My mum used to tell me to take fish oils. And it seemed natural to adulthood and I've just kind of carried it on." Female, 18-34* 17 *"I haven't noticed any benefits, but I have taken them for so long that I don't want to stop in case I do start to notice a difference." Survey respondent*
Supplementation along with physical training to energize, promote recovery and general performance enhancement.	*"I take like a recovery shake; it's 4 to 1 carb protein shake just after really tough sessions. Which would maybe be like three times a week, give or take. And then things like gels and stuff like, I take during sessions if I'm doing like a long session. Just to keep my energy up." Male, 18-34*
For appearance; weight loss, condition of hair and nails. Generally, with ageing.	*"When I have a really bad hair day I take one [a hair, nails and skin supplement]." Female, 18-34* *"We're all of a similar age where some of our bodily functions are not functioning as they should do so they need a boost." Male, 65+* *"I think that the older you get you think well, I've got a few aches and pains. A bit arthritic, maybe the Fish Oil…" Female, 50-64*
To look after bodies' less urgent needs. GP or medical professionals don't have time for minor niggles.	*"Your GP doesn't have an awful lot of time for you unless you've got a sore toe or something." Female, 80*
To fortify diet as food is no longer as nutritious as before.	*"I feel we don't get all the vitamins we used to from all this processed and GM foods. Taking vitamins means I am getting what I don't get from my diet." Female, 65+*

2.7 Body image and doping

It is not just lifestyle-related diseases that are promoting DS use but the chase for a perfect, masculine or feminine body makes people willing to risk health and money by resorting to DS despite unproven efficacy or safety (Outram, 2016:96). In a study of bodily concerns of 89

college men at a north-eastern university in the US, their attitudes and concerns about their bodies were so strong that a third reported skipping a meal if they did not exercise (Hatoum & Belle, 2004:404). Furthermore, while a third took DS to burn fat another third took supplements to build muscle (Hatoum & Belle, 2004:404). Underweight men experienced bodily concerns as overweight women by viewing themselves as less desirable, more rejected, lonely and consequently dated less (Brennan *et al.*, 2010:131; Hatoum & Belle, 2004:397). Furthermore, sexual socialisation and gender stereotypes are considered in various ways, such as family, media, peers, that men must be strong with muscular physique whereas typical women possess elegance and beauty with a befitting petite body (Shoraka *et al.*, 2019:10).

There are suggestions in some studies that the media could have played a big role in raising concerns about body image and thereby promoting use of DS. Men's magazines, for instance, glorify the alpha-male by emphasising masculinity and leanness (Hatoum & Belle, 2004:397; Outram, 2016:94). On the other hand, the "ideal" woman is presented by the media as "unrealistically" thin (Mc Creanor, 2016:70). Out of 100 supplement adverts from the Australian edition of *Men's Health* magazine in 2012-2013, 60 issues featured men being physically active with well-defined body images lifting weights (Hall *et al.*, 2016; Outram, 2016). Further linking supplements to desired bodies, the magazine images were accompanied by catchy phrases such as "enhance muscle tissue", "repair", "boost" and "improve" (Outram, 2016:95). The media, particularly magazines, while promoting unrealistic 'ideal' body images, display abundant information on DS often in technical terms most readers would struggle to understand. Furthermore, simplistic translation of limited evidence on DS safety and efficacy into "dietary imperatives" in the media constitutes blatant misuse of scientific information thereby misleading consumers (Cook *et al.*, 2014). Meltzer *et al.* (2004:2) caution that reliance on supplements poses a danger of shifting focus away from critically proven methods of achieving optimum performance and health such as; sound training methods, dietary intake timing, rest, recovery and sleep patterns.

Furthermore, setting body norms, particularly among younger people, unfortunately results in body dissatisfaction. This could be worrying as a positive correlation has been observed between body dissatisfaction and use of drugs suggesting that DS could be a gateway towards use of illegal banned substances (Backhouse *et al.*, 2013:22; Yager & O'Dea, 2014:22). In a study of athletes' doping attitude, beliefs and norms in competitive situations, those using DS had a more positive attitude towards doping than non-users and strongly believed that doping

was more effective (Backhouse *et al.*, 2013:13). Such an attitude could reflect a greater willingness by those using supplements to engage in doping behaviour.

2.8 Sources of Dietary Supplement Information

The National Centre for Complementary and Integrative Health (NCCIH) recommends a health care provider as a reliable source of dietary supplement information (National Institute for Complementary and Integrative Health, 2014). This is because medical professionals are likely to know of products backed by more scientific testing and can identify any potential drug and dietary supplement interactions to avoid (US Food & Drug Administration, 2017). While most people consult with health providers for concerns related to health and well-being, that is not always the case with dietary supplements (Homan, 2018:28).

Dietary supplements, along with other natural products and mind-body practices, are a form of complementary and alternative medicine (National Centre for Complementary and Integrative Health, 2016). This is opposed to conventional medicine, which requires medical doctors and health professionals for intervention and treatment of illness or disease (Barnes *et al.*, 2008:1). Unlike conventional medicine, DS safety and efficacy is not always well-defined and information is sought more often from the Internet, news sources, family and friends rather than health care practitioners (El Khoury & Antoine-Jonville, 2012:4; Malik & Malik, 2010:3; Mc Creanor, 2016:43; Morrison *et al.*, 2004:488; Navarro *et al.*, 2017:364; Sands, 2012:26).

Social media, particularly the Internet, has become a very popular free source of information on self-initiated health products consumption such as DS (Rizvi *et al.*, 2019:2). Reliance on technology has been reported to contribute to making media a primary source of dietary supplement information especially among young adults (Homan, 2018:26; Scofield & Unruh, 2006:452). Information on DS from media is often vague and strong-worded creating 'myths' around DS which, however, may be accepted as being true among impressionable, economically disadvantaged groups and children who seem prone to overlooking product risks (McCann, 2005:223). Coaches and athletic trainers were also reported as sources of information regarding DS, especially among athletes (Burns *et al.*, 2004:248).

Health professionals are perceived by consumers as against the use of DS, which may be the reason many DS users reported in several past studies, being reluctant to consult them (Homan,

2018:26). Among those interviewed from various gyms and recreational facilities, over half admitted to choosing not to discuss their use of DS with health professionals and instead were self-prescribed (Goston & Correia, 2010:607). A possible explanation for the consumers' reluctance to consult medical practitioners could be that they perceive physicians as lacking up-to-date knowledge on modern nutrition trends and offer inappropriate and old-fashioned recommendations on diet (Pajor, 2017:95). However, in a survey carried out by food supplements consumer research of May 2018 in the UK, some respondents believed doctors, owing to very busy schedules, had no time for minor health concerns such as those over the counter remedies like DS may solve (Anon, 2018).

2.9 DS use among pregnant and lactating mothers

Nutrient requirements in the general population can be easily met through normal diet. However risk of suboptimal micronutrient intake is common during pregnancy often resulting in a need to use dietary supplements (Pouchieu *et al.*, 2013:1). Main dietary supplements taken during pregnancy and lactation are folic acid, iron, magnesium, thiamine, riboflavin, niacin and vitamin B-6, B-12, C and D (Jun *et al.*, 2020:4; Pouchieu *et al.*, 2013:1). Similar to the general population, the highest use of DS among pregnant women in the US was recorded among Non-Hispanic white, highly educated and high income women (Bailey *et al.*, 2019:6; Jun *et al.*, 2020:4; Ramírez-Vélez *et al.*, 2018:3; Wu *et al.*, 2013:6). Inadequate nutrients intake especially of folate and iron among non-users and excessive high doses among users could signify lack of professional advice among some populations (Bailey *et al.*, 2019:6; Jun *et al.*, 2020:9). Similar to other populations taking dietary supplements, there is need for health care providers to educate pregnant women on safe and effective use of dietary supplements.

2.10 DS use among adolescents and younger children

The use of DS among adolescent and younger children has been reported. In the US survey data for National Health and Nutrition in 2011-2014 showed that one third of children under the age of eighteen used DS (Jun *et al.*, 2018:4). Furthermore, similar to findings on adults and pregnant mothers using DS, DS use among children was higher among Non-Hispanic white

children from high income families (Alfawaz *et al.*, 2020:5; Jun *et al.*, 2018:4). The main reason for using DS among children under the age of 18 is reported to be maintaining health which also concurs with results from adult studies except for the gymnasium populations where protein supplements appear to be the most preferred (Jun *et al.*, 2018; Perlitz *et al.*, 2019). Several studies on use of DS among children seem to agree consumption of DS is higher among females than males (Alfawaz *et al.*, 2020:5; Jun *et al.*, 2018; Perlitz *et al.*, 2019:4; Wilson *et al.*, 2006:387). The internet, social media, coaches, family and friends are among the main sources children use for advice on dietary supplement use (Duvenage *et al.*, 2015:3; Van der Walt & Coopoo, 2016:53). According to Reeves *et al.* (2018:2) Children are particularly impressionable and vulnerable to misinformation. There is therefore need for children to be provided with professional guidance on DS possibly in schools and sports clubs.

2.11 Dietary Supplements and fitness industry in South Africa

2.11.1 Dietary supplements in South Africa

The supplements industry, in particular with regards to sports supplements, is growing rapidly in South Africa targeting mainly the fitness industry, which comprises of sports people and people exercising for recreational purposes (Naidoo *et al.*, 2018:1). This high demand for DS is being experienced at a time when the supplement industry in SA is not regulated but is rather characterised by reports of contaminated products, label discrepancies and misinformed supplement choices amongst the consumers, which has raised great concern about consumer safety requiring public debate (Naidoo *et al*., 2018:1). It is not surprising, therefore, that lately the area of supplements has caught the attention of researchers with a few looking at DS use among sports people and, to the researchers' knowledge, only one study has been conducted on DS use among the people exercising in public gymnasiums in South Africa.

A study of under-16 rugby players in South Africa, (Duvenage *et al.*, 2015:69) reported that 42% of them were taking at least one dietary supplement with some players taking a combination of supplements. The general attitude amongst these rugby players was that the quality of protein in supplements exceeded that of natural foods and that protein supplements are essential to build muscle mass (Duvenage *et al.*, 2015:69). Furthermore, the pressure to perform seemed to be the driving force for athletes to resort to using DS and illegal performance-enhancing products such as steroids (Duvenage *et al.*, 2015; Gradidge, 2011:32).

Of great concern, similar to findings in studies world-wide (El Khoury & Antoine-Jonville, 2012:4; Malik & Malik, 2010:3; Morrison *et al.*, 2004:488; Sands, 2012:26), is that the preferred source of information on DS is from unreliable non-medical staff with only 2% of the rugby players having consulted a dietitian (Duvenage *et al.*, 2015:70). Similarly, people exercising in Johannesburg North gymnasiums also received their advice mostly from the Internet and magazines (Mc Creanor, 2016:69). Mc Creanor *et al*. (2017) argue that parents and coaches could be responsible for pushing children into taking supplements, a view shared in a study by Van der Walt and Coopoo *et al.* (2016:77) in which 81% of parents from the East Rand involved in the study indicated that DS were needed to improve physical performance of their child.

Mc Creanor *et al.* (2017) also investigated the attitudes towards nutritional supplements among commercial gymnasium members in the Johannesburg North region with respect to their use, acquisition of information and knowledge of the supplement; their reasons for going to a gymnasium; attitudes towards the consumption of DS; and types of products consumed. The consumption categories and usage of at least five times per week were multivitamins (45%), protein shakes (42%), vitamin C (35%) and vitamin E (23%). The researchers were concerned that 60% of the gym members started using DS at a young age of 13-18 years, which could be an indication that the pressure to take supplements among young people is not restricted to rugby players. SAIDS caution that due to the known risks of DS, they should not be given to children below the age of 18. Given these concerns raised about DS, there is need to investigate how DS are regulated in South Africa to protect consumers.

Gabriels *et al.* (2012:22) recommend the regulation of DS in line with legislation such as the South African Consumer Protection Act 68 of 2008, which forbids manufacturers from misleading consumers when marketing their products. Another suggestion is to apply the South African Medical Control Council (SAMCC) guidelines on complimentary medicine published in August 2011 on supplement use to protect t consumers. However, the establishing of the South African Health Products Regulatory Authority (SAHPRA) to replace the SAMCC with effect from June, 2018 is believed to have resulted, in among other changes, the possible classification and regulation of products making medicinal claims such as supplements under the complimentary medicines category (Schönfeldt, 2015:1; Naidoo, 2018:3). The proposal is that under SAHPRA, DS be regarded as health supplements and regulated under the complimentary medicine category (Anon, 2015). However, such a regulation is yet to come

into effect with currently no reports or publication on SAHPRA's website on dietary supplement products recalled for regulatory review.

Labelling discrepancies is another problem associated with DS. In a study by Geyer *et al.* (2004:126), out of the 634 DS samples analysed, 15% contained banned substances not declared on the label. Athletes taking such supplements could fail WADA doping tests and be penalised. In South Africa, users of such supplements may unknowingly be in contravention of the South African Institute for Drug-Free Sport's regulations (SAIDS). SAIDS' Annual Report of 2014, states that it is the statutory body that promotes participation in sport that is free from the use of prohibited performance enhancing substances or methods that artificially enhance performance. SAIDS suggest that common misconceptions among supplement users are that DS bought from well-known stores and pharmacies are effective, safe and legal. They further point out that consumers erroneously trust supplement labels and believe that products promoted as natural are automatically safe and effective (SAIDS 2014; Mc Creanor, 2016:63). Faced with a rapid growth of the supplement industry whose market is mainly the fitness industry, there is a need to look at the current structures within the fitness industry and how they can be utilised to ensure members make informed decisions when using DS.

2.11.2 South African fitness industry

Physical inactivity is the fourth leading risk factor for global mortality accounting for 6% of deaths world-wide as well as 30% of global ischemic heart disease burden, 21% of breast and colon cancer and 27% of diabetes (WHO 2013). Consequently, South Africa, like most countries, has seen a surge in the number of gymnasiums being opened as more people realise the need for a shift towards a health-and-fitness lifestyle (Saayman & van der Merwe, 2018:2). Some medical aid schemes have partnered with gyms in promoting wellness and lifestyle changes amongst their members. An example in South Africa is the Discovery Vitality program with services that include subsidised gym fees, visits to dieticians as well as exercise specialists (Lambert *et al.*, 2009:2). Participants in the Vitality Scheme also earn points depending on recorded gym visits and participation in major fitness events such as running and cycling with participants periodically attending body assessments to check progress. Points earned are redeemable in the form of discounts on goods and services. Although meant to encourage members to stay fit, such schemes may be seen to add pressure on members perhaps causing them to turn to DS in order to pass vitality assessments and earn points.

Gymnasiums world-wide have also experienced a paradigm change from single purpose fitness centres to multi-purpose health clubs offering members a variety of options such as swimming, running, yoga, cycling, aerobics, squash courts and circuit training. Some gyms have also included specialist services such as biokineticists, physiotherapists, dietitians and fitness trainers. Exclusivity has also been a factor in the fitness industry with gyms varying in the amenities that they offer according to location, values and economic class (Andreasson & Johansson, 2014:107). In the South African context such variations are achieved in different membership pricing regimes and amenities offered by gymnasiums.

However, the South African fitness industry has not been well researched and no comprehensive inventory exists that lists all facilities comprising this industry (Draper *et al.*, 2006:93). Among many of the key players within the South African fitness industry, there seems to be a general awareness of the facilities and service providers in the larger multipurpose gyms and health clubs, but there is limited information available concerning smaller, single-purpose clubs, community-based organisations and self-employed fitness instructors (Draper *et al.*, 2006:93). In a study of Johannesburg North gyms, the wealthier suburbs of Rosebank, Bryanston and Randburg had the highest number of gym users due to having the highest density of gyms. It was also noted that 44% were Caucasian and the majority of the gym users were aged 24-28, qualified, working-class who could afford to pay the high gym fees (Mc Creanor, 2016:57). Mc Creanor. (2016:57) argue that further research needs to be conducted on expenditure on gym fees in South Africa. This view is further supported by the emerging trend in which the number of gyms in the less affluent areas in South Africa is increasing, possibly taking advantage of growing awareness of health and fitness amongst populations in these areas. This is similar to the call for gyms with affordable membership fees among the low-income black women residing in Baltimore City in the US (Epps, 2019:57).

The Fitspot Health Club business plan cites the two key players of SA fitness industry: Virgin Active (138^{+} branches) and Planet Fitness (48^{+} branches), as being on an expansion drive targeting middle- to low-income areas. For instance, Virgin Active have created a brand called Virgin Active Express targeting areas such as Alexandra and Khayelitsha (Cape town), Soweto and Thembisa (Johannesburg). Planet Fitness have also introduced low-cost, affordable multi-purpose gyms in Newtown (Johannesburg Central Business District-CBD), Glenanda, Springs, Meadowdale and Pretoria CBD. Although multi-purpose, these low-cost gymnasiums exclude

costly maintenance features such as swimming pools and steam rooms. Membership fees are, therefore, more affordable ranging between R139 and R199 per month (Fitspot:7).

Saayman and van der Merwe (2018:12) argue that the focus of fitness clubs should be two-fold: creating a healthy lifestyle and addressing sport-specific needs of their members. In the context of South Africa, of the two needs mentioned above, healthy lifestyle had the highest mean implying that fitness clubs should prioritise services such as 'diet consultation', basic training programs and properly trained staff on fitness (Saayman & van der Merwe, 2018:12). Having resident nutrition professionals at the gyms will be an extra expense on the members, which will most likely adversely affect members at low-cost gyms where affordability is key. However, El Khoury and Antoine-Jonville (2012:2) reported that gyms are increasingly becoming the main market for DS sales and it remains to be seen how much supplementation is done in low-cost vs more affluent areas. Investigating DS trends; choices, source of information and expenditure in low-cost gyms, will help explore suitable and sustainable interventions to educate members on proper nutrition and dietary supplementation that can achieve fitness goals without inadvertently compromising health. De Lyon *et al.* (2017:318) argued that fitness professionals are public health assets suggesting that the fitness industry should merge with health care to ensure optimum health solutions for the public.

2.12 Summary

The supplement industry has grown immensely over the years offering a wide range of products with purported benefits ranging from boosting general health to changing body image aggressively marketed to potential consumers. Health and fitness centres have become the biggest market for supplement products particularly multi-purpose gymnasiums that have huge memberships and with the establishment of low-cost gyms the market for supplements is expected to expand further. However, several past studies agree that most DS have no scientifically proven benefits and that uninformed use can pose health risks. The global supplement industry lacks strict regulation with past studies reporting DS adulteration, labelling discrepancies and some supplements being contaminated. Consumers, therefore, need to be adequately educated on possible risks of DS use. Research into supplementation patterns in gyms report that members rely mainly on information from non-professional sources such as media and friends. In a world faced with illness, an aging population and awareness of genetic risk factors, much emphasis is placed on maintaining wellness thereby creating a

mindset that taking medicine is something healthy people ought to do daily, which unfortunately, presupposes consumers having the ability to access appropriate knowledge and make informed choices about DS (Peacock *et al.*, 2019:12). According to Peacock *et al.* (2019:12) until consumers access reliable sources of information, the risk remains that DS users are made to believe supplements offer them solutions as effective as medicine. This makes it important for supplement users to consult health professionals such as dieticians and sports nutritionists before taking dietary supplements. However, accessibility to such nutrition experts for gymnasium members, particularly those situated in low-income areas, is very doubtful, which further puts these populations at a greater risk. Research done in the past, particularly in South Africa, have investigated DS use in gymnasiums located in high-income areas. There is a gap in existing literature about DS use in low-income areas that are being targeted in recent times by commercial gymnasium chains seeking new fitness markets in previously overlooked areas.

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CHAPTER 3

ARTICLE 1

Knowledge of adult gymnasium members on supplement use in a low-cost gymnasium chain in Johannesburg

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Prepared for submission to: The South African Journal of Clinical Nutrition

3.1 Abstract

Objective: To establish sources of supplementation information used by gym members and the relationships between choices of dietary supplements (DS) used and age, gender, and DS users' reason for exercising at low-cost gymnasiums in Johannesburg.

Design: Cross-sectional study using self-administered questionnaire.

Setting: Adult members aged 18-45 exercising at a low-cost gymnasium chain in Johannesburg.

Subjects: 351 gymnasium members comprising of 252 males and 99 females.

Outcome measures: Type of supplements used and reasons for use according to age, gender, exercise goals and race/ethnicity. Information sources on supplementation used by members taking supplements.

Results:

DS use in low-cost gyms was prevalent with more than fifty-three percent (53.4%) of participants reporting using DS in past twelve months. More than 59% among males used DS compared to 38.8% among females ($P<0.05$), thus DS use was associated with gender. Males used body-building DS such as Whey protein, creatine and BCAA to gain muscle ($P<0.001$). Women $p<0.013$, preferred weight loss supplements such as Conjugated Linoleic Acid (CLA).

A more positive attitude towards DS was associated with males than females. More males than females agreed they felt tempted to use performance enhancing substances ($p=0.015$) whereas among non-users, more females than males felt DS were unnecessary ($p=0.001$), against their beliefs ($p=0.000$) and that they do not trust the DS companies ($p=0.012$).

On reasons for coming to gym, males 76.7% aimed to gain muscle whereas more females 41.8% compared to males 25.3% joined gym with main reason to lose weight. At correlation of $p<0.05$, monthly expenditure on DS was associated with reasons for using DS and choice of DS possibly showing DS users were wiling to spend more on DS believing supplements can achieve their goals.

Main source of information for DS users were; 51% internet and 34% friends/fellow gym members. Least consulted were 4% physicians, 4% scientific journals and 3% biokineticist**.**

Conclusion

There is widespread use of DS in low-cost gyms. Use of DS is however associated with gender and exercise goals. Males are more likely to use DS than females in gyms. DS users seem oblivious of potential risks associated with DS and raising public health concern by preferring to consult unreliable sources for advice on DS.

Keywords: dietary supplements, exercise, low-cost gymnasiums, South Africa

3.2 Introduction

Dietary supplement (DS) is defined by the United States (US) Food and Drugs Association (FDA) as a product taken by mouth that contains a "dietary ingredient" intended to supplement the diet and is typically sold as tablets, soft gels, liquids, powders and bars. "Dietary ingredients" may include vitamins, minerals, herbs or other botanicals, amino acids, and substances (e.g., enzymes, organ tissues, glandular, and metabolites). Furthermore, dietary supplements may also be extracts or concentrates from plants or foods [1].

Dietary supplements are reported to be used by more than half of the US population [2] and in South Africa 46% were reported to be taking some form of daily dietary supplement to boost immunity and overall well-being [3, 4]. Despite aggressive marketing accompanied by sensational claims of health and fitness benefits, most DS have no scientifically proven efficacy, on the contrary DS have been associated with potential health risks such as adverse reactions with reported cases of minor to severe health complications; skin irritations, chest pain, syncope tachycardia and even death [5]. Furthermore, despite all the promised health benefits, the high financial cost of DS cannot be overlooked [5, 6]. This, apart from the health risks, presents DS users with an additional problem of unjustified expense given the low cost-benefit ratio [5].

However, the rising incidence of lifestyle diseases has increased people's awareness to health and prompted a shift towards healthier lifestyle and sustaining fitness. Consequently, there is a significant increase in casual recreational users and proliferation of fitness centres, many of which also engage in active promotion of DS [7]. Apart from grappling with health issues such as obesity, active individuals in fitness centres are affected by body image dissatisfaction promoted through media platforms, for example magazines such as Health, Women's health, Men's health, Shape, internet and movies where ideal men are muscular while thinness in women is widely endorsed [8].

Several studies among people exercising in gyms reported that men have been predominantly taking mass-building supplements such as protein and creatine whereas women prefer weight loss and health promoting supplements [6, 9, 10]. Of concern to health professionals and researchers has been the unreliable sources of advice preferred by DS users. The most preferred sources of information on DS by users in gyms are the internet and friends or fellow gym members, while health professionals are the least consulted [5, 11, 12].

The aim of this paper is to investigate the dietary supplementation use in low-cost gyms. Results of this research will help establish how widespread DS consumption in low cost gyms is, what factors are associated with DS use and whether financial cost of DS is a limiting factor for use.

3.3 Materials and methods

A cross-sectional study design was used and conducted at four low-cost gyms in Johannesburg.

Selection of population

Participants regardless of gender, race and social class, had to be regular members aged 18-45 years and training at least twice a week. A non-probability sampling technique, namely self-selection sampling was used to select the study population with only participants that have volunteered included in the study. A field worker at each of the four gyms approached every gymnasium member at the gym entrance throughout the day every day of the week, for at least a week distributing recruitment fliers. Recruitment targeted 100 participants from each of the four gymnasiums to make up an overall sample of 400 participants. A sample of 351 participants volunteered to be involved in the study which, through power calculation, proved to be adequate. Informed consent was obtained from all willing participants upon recruitment. The study protocol was approved by the Human Research Ethics Committee (HREC) of faculty of Health Sciences at North-West University. The ethics number is: NWU-00451-19-S1.

Selection of gyms

Gyms located in Johannesburg fitting the criteria of low-cost were targeted. These low-cost gymnasiums, although multi-purpose, exclude costly maintenance features such as swimming pools and steam rooms. Monthly membership fees are therefore more affordable ranging between R139 and R199 [13]. However, notable in the low-cost gyms is the lack of essential but often expensive support services such as biokineticists, physiotherapists, sports dietitians and attract fewer personal trainers. Four gymnasiums located in Johannesburg (CBD, suburbs of Glenanda, Springs and Meadowdale), belonging to a popular fitness chain, were identified. The franchise categorises its gymnasiums according to range of amenities offered and charges membership fees accordingly. Permission to conduct this study was obtained from the gym authorities.

Questionnaire[6]

A validated self-administered questionnaire that includes questions about demographic characteristics, type and frequency of DS use, reasons for DS use, main reason/s for exercising, sources of supplementation information and attitude towards DS, was adopted from the study by Mc Creanor *et al* (2017) [6] after permission was obtained from the researchers.

3.4 Statistical analysis

The research questions the paper seeks to answer are: *What are the sources of information on DS use by adult members of Johannesburg low-cost gymnasiums? What are the relationships between choices of DS used and age, gender, race and DS users' reasons for exercising?*

It was hypothesized that: *Friends, gymnasium training partners and the Internet are among DS users in Johannesburg low-cost gymnasiums' most frequently used sources of information on supplementation and health professionals are the least consulted. The choice to use DS is dependent on age, gender, level of education and socio-economic status.*

Data was entered and analysed using the Statistical Package for Social Sciences (Version 25) (SPSS Inc., Chicago, IL, USA).

Through cross-tabulation, chi-square tests and Cramer's V were used to establish association between independent variables; gender, age, education and dependant variables; reason for joining gym/reason for exercising, choice of DS. A two-way Analysis of Variance ANOVA was conducted that examined the effect of age, income, and average monthly expenditure on various factors associated with DS use such as choice of DS, exercises and attitude towards DS. Results were considered significant if the p value was < 0.05.

3.5 Results

Demographics

This study included 351 adult men and women attending four low-cost gym from the same chain in Johannesburg. Table 1 summarizes the basic characteristics of the participants of which 71.2% were male. The population was young with $\bar{x}$ = 29 years and SD = 7,16. Johannesburg is a multi-racial city and the population of this study constituted mainly blacks (67.7%), whites and others (Mixed ancestry/Indians).

Table 1: Descriptive statistics of the demographic information of participants

Demographics	Population (n)	Percentage (%)
N	351	
Dietary supplement users	186	53
Non-users	162	47
Gender		
Male	252	71.8
Female	99	28.2
Race		
Caucasians	78	22.2
Blacks	237	67.7
Indian/coloureds	36	9.8
Highest Level of Education		
University	187	54.5
Technical college	76	22.2
High school-Matric	80	23.3
	Mean ($\bar{x}$)	Standard deviation (SD)
Age	29,38	7,16
Monthly income	R10 793,35	R6 301,51
Monthly expenditure on DS	R 723,07	R 554,39
Percentage of income spent on DS per month	6.7%	

This study firstly aimed to understand the reasons for choosing a low-cost gym. Figure 1 shows that the main reason for choosing the gymnasiums was convenience for being close to either work or home (68.4%) and that it was affordable (44.7%). However only 7.7% of the

participants reported that they chose their gym because it was cheap, thereby enabling them to save money for other fitness related expenses such as gym attire and supplements.

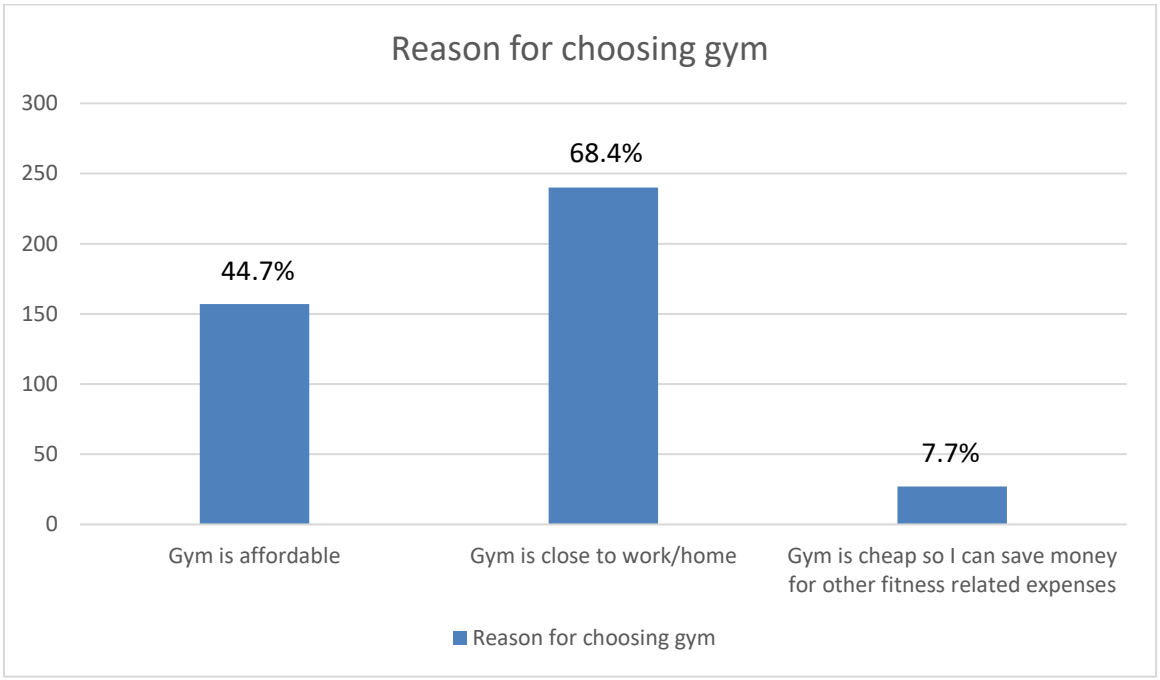

Figure 1: Reasons for gym choice

This study also aimed to investigate the reasons for supplementation use. Two tailed T-tests at 95% confidence interval were done to determine which factors contributed the most to supplementation use. Table 2 shows, however, that there was no statistically significant correlation between affordability of gym and reasons for taking DS, reasons for going to gym, attitudes towards DS, reasons for not using DS and type of DS used. Furthermore age, income and qualifications were not correlated to any of the factors.

Physical activity

More than 79% did not have personal trainers. However, use of personal trainers was higher among females with 24% compared to 18% among males. 67% of males' main reason for exercising was to build muscle mass, whereas 41.8% of females preferred exercise for weight-loss and 30.6% choosing to do aerobics compared to 19% among males.

Use of dietary supplements

DS use was reported by 53.4% of the participants with 40.3% of them having started taking DS at 18 years of age. Seven users (2%) reported that they started taking DS before the age of 12 years. Among male respondents 59% were DS users compared to 38.8% among females. A

comparison between males and females on factors associated with DS use was conducted using Chi-square tests and yielded results below:

Table 2: Factors associated with DS use-gender comparison by cross-tabulation

Variable (column %)	Male (n=252)	Female (n=99)	p-value[1]
DS use in past 12 months	59	38.8	0.001
Reason for joining gym			
Muscle gain	76.7	33	0.000
Weight-loss	25.3	41.8	0.01
Aerobics	19.7	30.6	0.02
Sports specific training	19.3	9.3	0.037
Health	70.3	70.4	0.612*
Choice of DS			
Whey protein	49.6	29.6	0.001
Conjugated Linoleic Acid (Weight-loss)	7.2	39.2	0.000
Vitamin	26.4	25.5	0.893*
Reason for using DS			
Improve gym performance	39.4	24.2	0.007
Muscle gain	37.8	22.2	0.006
Reasons for not using DS			
DS is unnecessary	27.9	46.9	0.001
Harm to health	23.9	44.9	0.000
Against my beliefs	11.6	27.6	0.000
Do not trust DS companies	19.9	32.7	0.012
Attitude towards DS			
There is a problem of DS in gyms	25.5	40.9	0.006
Will never use DS	16.7	32.6	0.007
Tempted to use performance enhancing substances	40.8	26.9	0.015

[1]*Pearson Chi-Square tests *No significant difference*

The use of DS was significantly associated with gender ($p \leq 0.05$). Males joined the gym to build mass and preferred body building DS. Females on the other hand were more involved in aerobic exercises and preferred weight loss DS.

Attitude towards DS

Table 2 above shows that males had a more positive attitude towards DS than females and indicated they were tempted to use performance enhancing substances to achieve fitness goals p=0.015. On the other hand, among non-users more females than males agreed they do not trust DS companies p=0.012 and DS use was against their beliefs p=0.000. Furthermore, more among females than males felt there was a problem with DS use in gyms p=0.006, that DS use was unnecessary p=0.001 and would never use DS p=0.007. Both males and females concurred DS information in the media was inadequate p=0.673 and that gyms need to educate members on DS use p=0.258.

Monthly expenditure on DS

Of the 53.4% DS users, the biggest proportion (24.3%) spent less than R500 on DS with 21.4% spending R500-R1500 per month. The remaining 7.7% spent more than R1500 per month on DS. With an average monthly income of R10 793.35, DS users spent an average of R723.07 on DS which constitutes 6.7% of their monthly income.

Monthly expenditure on DS amongst DS users was tested using ANOVA against the reasons for use of DS and choice of DS and a medium to strong association at $p<0.05$ was found with reasons to gain muscle, improve performance, achieve personal goals, maintain health and choice of DS. This is shown in table 3 below.

Table 3: Factors influencing expenditure on DS

Monthly expenditure on DS

Factors influencing expenditure on DS	N	Mean	Standard deviation	Effect size	p-value
Reason for DS- muscle gain	187	0.33	0.472	0.611	0.000
Reason for DS- improve gym performance	187	0.40	0.490	0.681	0.000
Reason for DS- personal goals	187	0.43	0.497	0.702	0.000
Reason for DS use- Health	187	0..28	0.449	0.522	0.000
DS type- Whey protein and creatine	186	0.278	0.324	0.827	0.000
DS type- vitamin	185	0.1892	0.278	0.542	0.000

Results of ANOVA tests. Correlation at p-value <0.05 was found to be significant

The results in table 3 above makes it possible to conclude that DS users are highly motivated to use DS and are willing to spend more on DS to achieve their health and exercise goals.

The same ANOVA tests were also conducted on age and income and at $p<0.05$ results showed no correlation. It can be concluded therefore that in our study age and income level did not influence choice of DS and reasons for using DS.

Sources of supplement information

The most common sources of information on DS used by respondents were internet (51%) and friends/fellow gym members (34%) (Figure 2). The least consulted were official sources such as scientific journals (4%), health professionals or physicians (4%) and biokineticists (3%) featuring at the bottom of the list. Sources of information used by respondents are summarized in Figure 2 below:

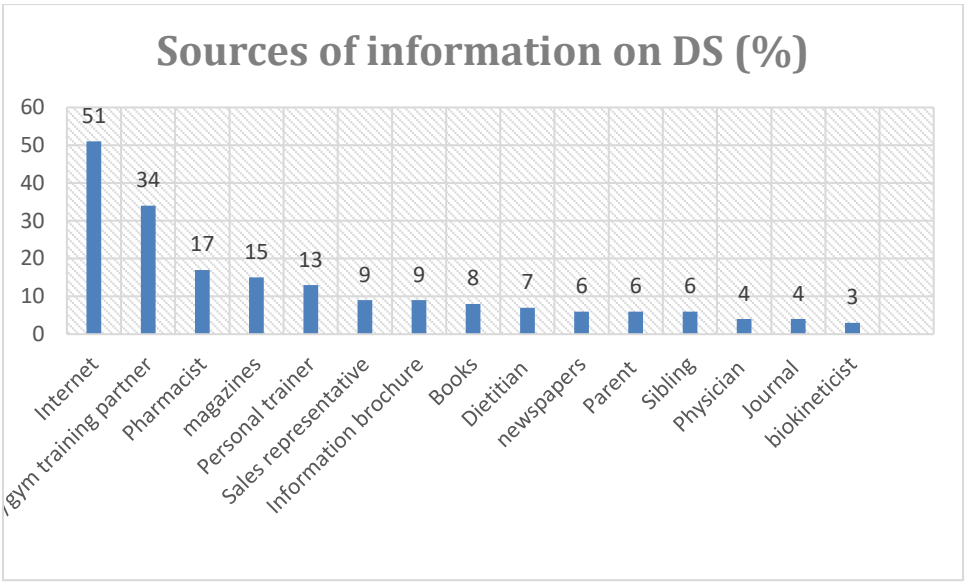

Figure 2: Common sources used to obtain information

Although 74.2% of the participants agreed that the use of DS was rising, 57.7 % reported that there was no pressure to use DS. Furthermore, despite admitting the increase in use, 57.4% of the participants acknowledged that they were unaware of any DS banned by World Anti-Doping Agency (WADA). This could be an indication of lack of information on possible risks of DS use. The data reported here appear to support the assumption that although DS use in gymnasium is prevalent members are not well-informed about DS.

3.6 Discussion

The aim of the research was to establish the use of DS among adult members in Johannesburg low-cost gymnasiums and to investigate the factors influencing DS use. The study also viewed the expenditure on supplements. Discrepancies in reported prevalence rates of DS could be explained by the different types of gymnasiums included in past studies and varied characteristics of participants [14]. To the researchers' knowledge there are only two studies conducted so far on dietary supplements use in South African gyms with population in both studies being predominantly Caucasians. Therefore, our research specifically targeted low-cost gyms with greater composition of Black people (67.7%) which is different from studies by Mc Creanor et al in Johannesburg North [15] and by Senekal et al in Cape Town gyms [16] where research population was predominantly Caucasians.

Affordability of gym membership could have contributed to the greater number of non-Caucasians in our study which concurs with a study by Zhang that membership price was the

most important factor why people join a gym with convenience being the second most important factor[17]. The importance of gym convenience [17] is also confirmed in our study where participants indicated the main reason for choosing their gym was because it is closer to work/home.

Also in the low-cost gyms studied in this research, the majority of the respondents (79.9%) did not have personal trainers compared to those in the higher cost gyms where more than half of the participants (50.1%) [15] used personal trainers. A possible explanation for this is affordability which could explain why on average each of the four low-cost gyms we studied had a single personal trainer. It also accounts for the absence of biokineticists, physiotherapists and possibly dietitians that can be found at upmarket gymnasiums. The unavailability of dietitians in low-cost gymnasiums puts members at risk of misinformation from readily available but unreliable sources such as internet and friends as observed in our study.

Our research established a high prevalence of DS use amongst participants (53.4%), compared to the non-users. This is similar to the findings by Lacerda [18] where gyms located in North Eastern Brazil reported 64.7% DS use and 63.8% in India's Kurukshetra and Haryana gyms [9]. The main reason for using DS in our study was to gain muscle mass and improve gym performance. In relation to this, body building DS creatine and whey protein were the most consumed supplements. Findings by Elkhoury in Beirut gyms concur that the main reason for DS use was muscle gain (47.3%) with performance supplements (protein 39.8%, amino acids 34.9%) being the most commonly used [14]. In our study, however, at correlation of $p<0.05$, gender, reason of using DS and reason for joining gym influenced the choice of DS. Males preferred body building DS, such as creatine and whey protein, with main reason for joining gym being muscle mass gain. More females than males opted to do health-related exercises such as aerobic exercises with DS users amongst them opting for weight loss supplements such as Conjugated linoleic acid (CLA). On the contrary, in gymnasiums in Johannesburg North, more females (57%) were interested in exercising to gain muscle [15], possibly suggesting a trend in bodybuilding among females [19].

Similar to Larceda [18], the current research did not find any correlation between DS use and age which contradicts findings by Elkhoury[(9)]. Elkhoury observed that the desire to build muscle decreased with age in participants above 40 years who prefer health and disease preventing supplements[14]. However, the difference with Elkhoury's study could possibly be explained by

the age inclusion criteria (population of 20-50 years) while in our study members above 45 were excluded, resulting in a younger population averaging $\bar{x}$=29.

Several studies have reported a positive correlation between income and dietary supplement use with more DS consumption among higher income groups [20-22]. This could possibly suggest that the more disposable income an individual has the more likely they will use DS. However, in our study a positive correlation against expenditure and reasons for DS use seems to suggest regardless of economic status, DS users have strong health and fitness motives making them willing to spend on DS.

There seems to be a trend of overly trusting in the safety of DS [23]. In our study this attitude was especially observed among male DS users who indicated a willingness to use performance enhancing substances. Such strong positive attitude towards DS is however problematic in that it may lead to use of illegal substances and doping [24, 25]. However similar to findings in our study, gymnasium members agree that DS information in the media is inadequate and there is a need for educational programs on DS in gyms [6]. Dietary supplement users admitting lack of adequate knowledge is an encouraging attitude for success of awareness campaigns on safe DS use.

Similar to many studies [9, 14, 15], worryingly, DS users preferred to get supplementation information from 'uncertain sources' such as friends and media [14]. Furthermore health professionals were the least consulted which concurs with study by Malik where as little as 0.8% of the participants got information from health professionals whereas 34.5% got DS advice from friends and 'gym fellows'[9]. This could explain why DS consumers lack knowledge of possible risks of DS use as shown in our study where many respondents (51.8% male and 71.7% female) were unaware of the DS banned by World Anti-Doping Agency (WADA). This makes it necessary for dietitians to be present in fitness clubs, most of which are selling DS products in an 'uncontrolled way'[26].

Most DS efficacy has not been scientifically proven [27]. DS users are therefore at risk of economic harm which occurs when a consumer needlessly purchases a product with no noticeable benefits [28]. Lower income groups in South Africa spend about half of their income (45.5-57.1%) on food [29, 30] which would make an additional 6.7% expenditure on DS observed in our study unwarranted. Furthermore, although wealthier households spend more on DS, it is

low-income households that bear the heaviest financial burden in terms of proportion of household income [31].

3.7 Conclusion

Gymnasiums are large consumers of DS with users more likely to be male. Use of DS in low-cost gymnasiums, similar to other gymnasiums studied in the past, depends on gender and exercise goals. Also, it is a health concern that many DS users are unaware of possible risks associated with DS use and continue depending on unreliable sources for information on DS use. There is definite need for gymnasiums to have dietitians available to advise members on safe and effective DS use. Our study revealed a greater proportion of Black people in low-cost gymnasiums. A suggestion for future studies would be to target community gyms that are predominantly black with a view of contrasting findings with studies of upmarket gyms where membership is predominantly Caucasian. Such a study could give an insight into whether ethnicity influences DS use and provide an even wider understanding of how widespread DS use is in South Africa.

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CHAPTER 4

ARTICLE 2

Attitudes and beliefs of adult members at low-cost gymnasiums in Johannesburg regarding Dietary Supplement use

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Prepared for submission to: African Journal for Physical Activity and Health Science

4.1 Abstract

Our study aimed to gain a deeper understanding of the attitudes behind the use of Dietary Supplements (DS) particularly among members of recently emerging low-cost gyms in Johannesburg whose demographic characteristics may be different from previously studied gyms located in low-density suburbs. Participants were drawn from four, multi-purpose gymnasiums in Johannesburg belonging to a popular fitness chain seeking to expand into middle- and lower-income areas. The gymnasiums, compared to branches in low density suburbs, were categorised as low-cost owing to their lower membership costs, excluded services such as biokinetics, physiotherapy and massage therapy. The gymnasiums also excluded costly maintenance features such as swimming pools, saunas and steam rooms. We conducted three focus group discussions as the qualitative part of an explanatory, sequential mixed-method study. In total, 18 participants, 38.6% male, 61.2% female volunteered. There were 55.6% DS users and 44.3% were non-users. The average age of the participants was 27. Focus group discussions transcriptions were coded using ATLAS.ti^{TM} and thematic analysis was done to identify *a priori* and emergent themes. DS users believed DS use's benefits outweigh risks and that DS were effective in maintaining health, weight loss, muscle gain, improve strength and mental focus. Participants concurred that DS use achieved results faster.

Preferred sources of information were the Internet, fellow gymnasium members and personal trainers. Some participants believed they spent less on DS compared to normal food diet. **Conclusion:** Members of low-cost gymnasiums are not adequately informed on regulatory frameworks, risks and efficacy of DS. They need guidance on which sources are reliable for advice on DS use.

Key words: Dietary supplements, eKasi, attitude, gymnasiums

4.2 Introduction

Dietary supplements (DS) used world-wide are increasing at a rate of 6.8% annually, and the global DS business is estimated to be worth more than $100 billion annually (Binns, Lee, & Lee, 2018). It is reported that in South Africa, 46% of the population are taking at least one supplement daily to boost health (Jennings, 2017). However, many researches concur that most DS have no proven health benefits (Wheatley & Spink, 2013; Starr, 2015). Furthermore, there are reported risks associated with DS intake that may be harmful with long term use (Timcheh-Hariri, Balali-Mood, Aryan, Sadeghi, & Riahi-Zanjani, 2012; Eichner, 2014; Or, Kim, Simms, & Austin, 2019).

DS is classified by the South African Medicines Control Council (MCC) as health supplements defined as substances, extracts or mixtures of substances that may supplement a diet, have a nutritional physiological effect and are sold in pharmaceutical dosage forms not usually associated with food (Medicines Control Council, 2015). According to MCC, health supplements may include vitamins, minerals, amino acids, animal extracts, products and derivatives.

Literature found that the major predictor for the decision to use supplements was attitude (Conner, Kirk, Cade, & Barrett, 2003; Jasamai, Islahudin, & Samsuddin, 2017). These attitudes may explain why DS users are willing to spend money on supplements despite the possibility of adverse effects and lack of scientifically proven efficacy. A large proportion of people exercising regularly in gyms are DS users, and they are often insufficiently informed about all aspects of DS including the indications, contra-indications, dosages, and potential side effects (Jairoun et al., 2020).

The most commonly used DS among athletes and people exercising in gyms are protein, multivitamin/multi-mineral supplements (MVM), sports bars, caffeine and fat burners

(Abdelbaky, Althubaiti, Aloufi, Almalki, & Aljohani, 2020; Gabriels, Coopoo, & Mc Creanor, 2020; Ruano & Teixeira, 2020). Users believe that DS could help them build muscle, enhance performance (strength and endurance), lose weight, maintain health or improve mental alertness (Sharif, Mohammed, Mohammed, & Sharif, 2018; Ruano & Teixeira, 2020; Aljaloud et al., 2020). Appetite suppressants and protein DS have also been used for body image enhancement (Brennan, Lalonde, & Bain, 2010).

Numerous studies have recommended interventions, such as regulating DS and awareness campaigns to ensure safe, effective and informed DS use. However, there is a need for a deeper understanding of personal factors fundamental to people's dietary habits (Glasauer, 2014), as DS use has also been reported to vary depending on geographic location (Bianco et al., 2011; Rozga, Stern, Stanhope, Havel, & Kazaks, 2013). Therefore, local studies adding to the information for development of effective interventions and policy indicators, are valuable.

This study seeks to answer questions on attitudes motivating use of DS with regards to perceptions of safety, rationale for use, and source of information regarding DS among members of low-cost gyms in order to plan more targeted interventions.

4.3 Methodology

Design and participants

This project followed an explanatory, sequential mixed-method design. The researchers gained insight into the attitudes and beliefs of DS users, for instance, that protein and creatine supplements were commonly used in a selected low-cost gymnasium context and consumed by individuals seeking to increase muscle mass and exercise performance. Furthermore, DS users are neither aware of possible risks of DS use nor are they aware of DS regulatory challenges and shortfalls. Also, members of low-cost gymnasiums prefer to get information from uncertain sources such as friends and the Internet. It is from the quantitative survey data collection and analysis that such themes were identified. These themes were then used as probing questions during the focus group discussions (Figure 1 illustrates the process).

Three focus group discussions (FGDs) were conducted which included in total of eighteen (18) volunteers, regardless of gender. Each group comprised six (n=6) participants each and data saturation was determined when no new themes emerged (Given, 2015; Saunders et al., 2018).

A pilot study was not conducted as participants were familiar with the topic after participation in the quantitative survey, from which the themes for the FDGs were developed. However, to ensure that the questions were clearly understood, the researchers allowed participants time during the FGD to seek clarity, and questions were rephrased if needed (Breen, 2006).

The qualitative data from the FGD were written as notes taken by the scribe and audio recordings from the discussions. All audio recordings were transcribed. A thematic analysis of the FGDs (notes and transcriptions) was done by using ATLAS.ti™ through which primary and secondary concepts/themes were identified along with additional information (i.e., non-verbal communication) to provide detailed information on what was observed and why it is important and/or relevant.

Constant comparative analysis was used to determine data saturation. This method involves checking whether themes from one group also emerged in other groups, which allows researchers to assess saturation across multiple focus groups within the same study (Onwuegbuzie, Dickinson, Leech, & Zoran, 2009).

Ethical clearance

Ethical clearance was obtained from the Human Research Ethics Committee (HREC), Faculty of Health Sciences at the North-West University: NWU ethics number: NWU-00451-19-S1.

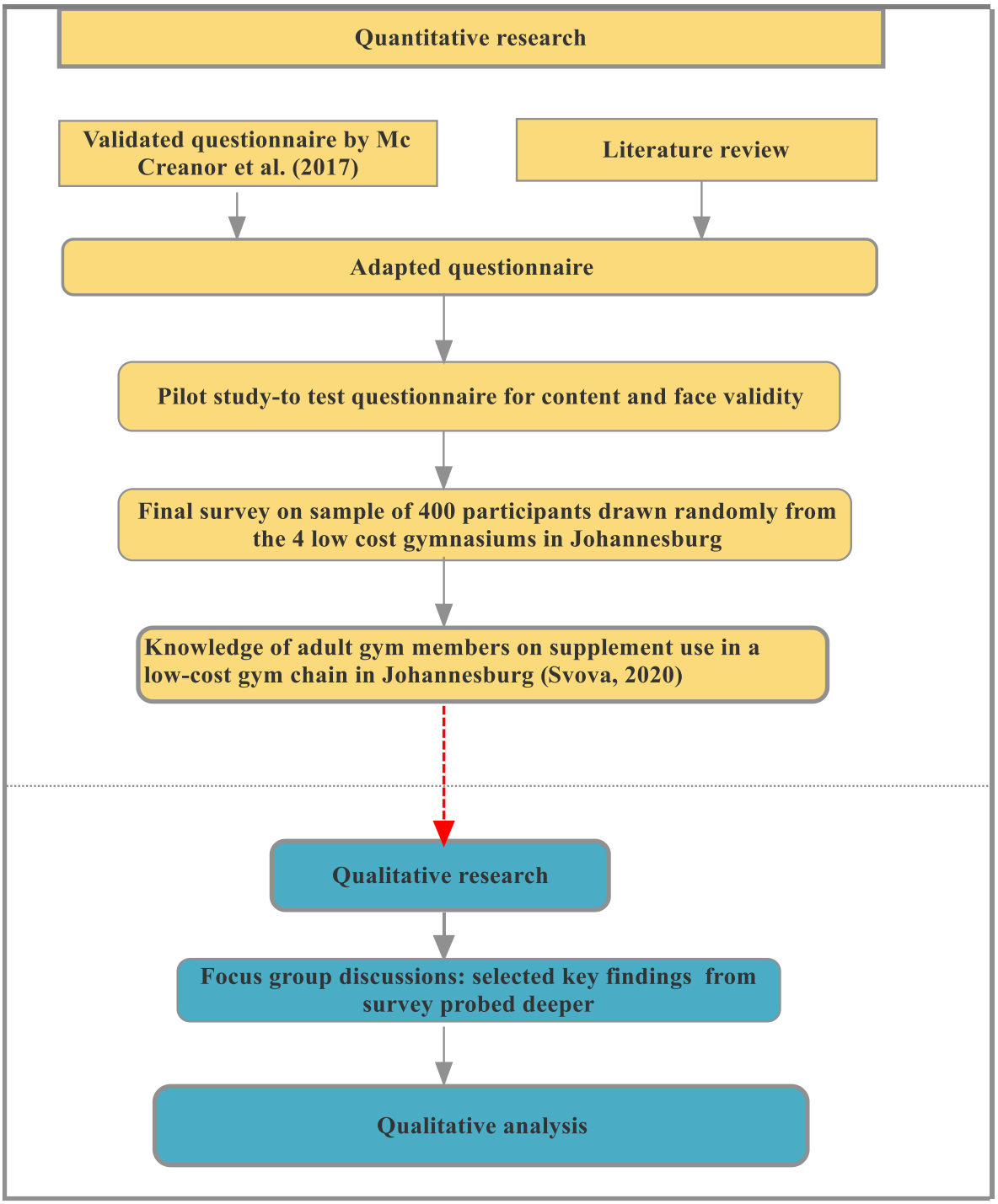

Figure 1: Explanatory sequential mixed method design

4.4 Results and discussion

The question schedule for the FGDs is shown below:

Table 1: FGDs interview schedule

Theme	**Question**
Definition of DS	What comes to mind when you think of dietary supplements? ***Probes:*** What is your understanding of dietary supplements?
Reasons for taking or not taking supplements	In your opinion, what do you think is the purpose of dietary supplements?
Perceived benefits of dietary supplements/self-efficacy	What would you say are the benefits of dietary supplements?
Perceived risks of dietary supplements	What would you say are the risks of using dietary supplements?
Uses of supplements in relation to normal diet i.e., food	What would you say is the difference in nutritional value between normal food and dietary supplements? ***Probes:*** Which do you trust more? Why? Which would you consider as having the highest quality when it comes to nutrition and why?
Perceived change in quality of food over time	What do you think of the nutritional value of food over the years ie from the way its farmed to manufacturing? ***Probes:*** Would you say organic food is healthier? Are functional foods a better option? Are synthetic foods better and worth paying more for?
Source of information on dietary supplements.	Who would you trust for advice on use of supplements? ***Probes:*** What do you think of the of the following as sources of information on dietary supplements?

Six *a priori* themes were identified before FGDs were done and two new themes emerged during the course of discussions as highlighted below.

4.5 Results

The results of the FGDs are summarised in Table 2 and Figure 2 below:

Table 2: Focus group themes and code count

Priori themes developed from findings by Svova (2020)			
Themes	**Sub-themes**	**Number of codes**	**N (total)**
Positive and negative attitude towards DS use	Benefits of DS use?	20	53 codes
	Risks of DS use?	33	
Sources of information on DS use	Non-professionals	17	19 codes
	Health professionals	2	
Positive and negative attitudes towards normal food	Natural food quality is good	6	13 codes
	Disadvantages of natural food	7	
Regulation of DS use	Government regulations	2	4 codes
Inadvertent doping from DS contamination	Awareness of World Anti-doping Agency (WADA)	2	
Expenditure on DS	DS are cheaper and more accessible than organic foods.	2	

N=frequency of codes in each theme

Table 2 shows that the most discussed topic (highest number of codes) was that of risks and benefits of DS use. Participants, however, often compared and contrasted DS use and normal food intake, resulting in the two themes being inter-connected as shown in Figure 2.

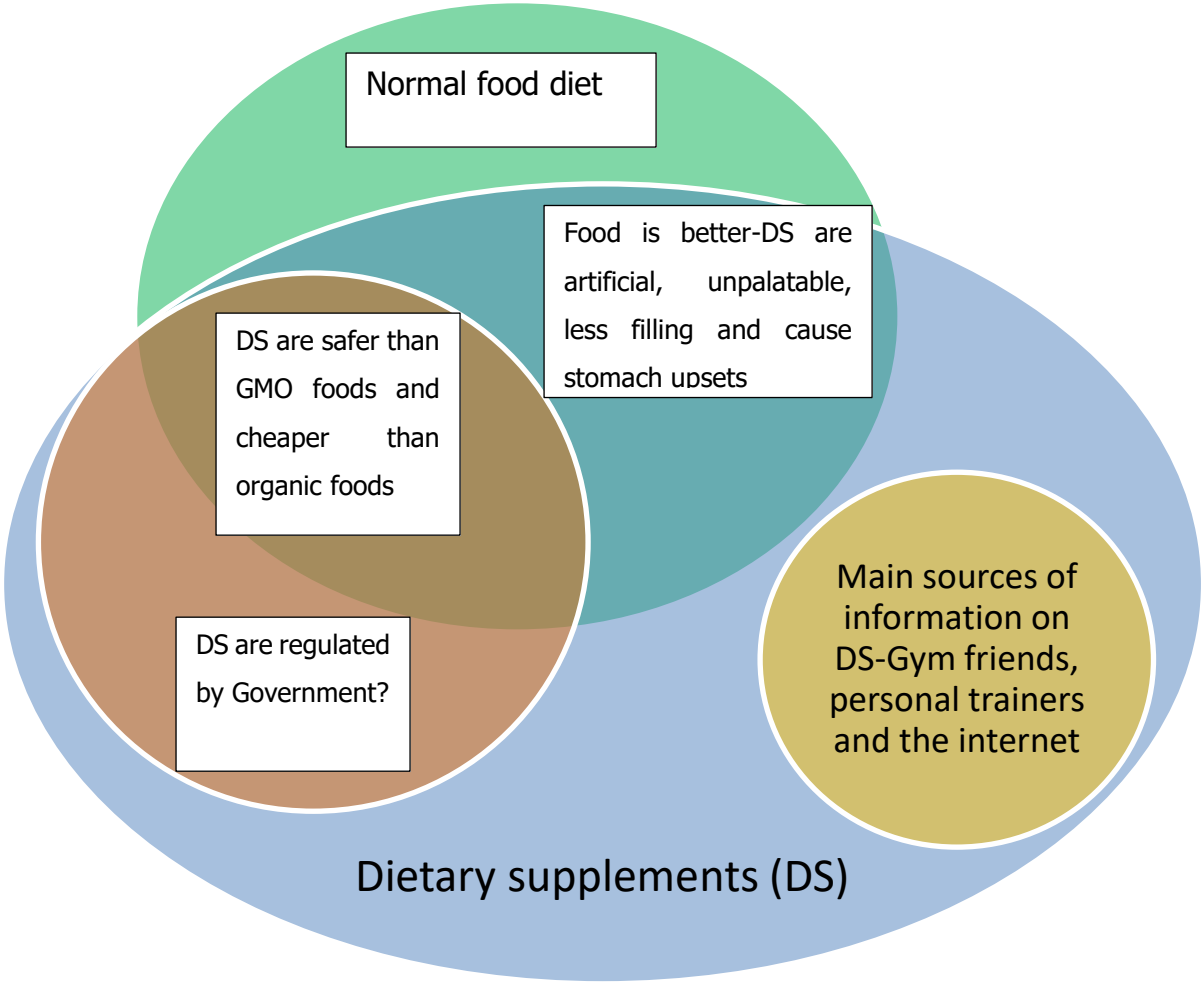

Figure 2: Focus group themes and their inter-connections

Benefits/risks associated with DS

Benefits of DS

Participants who spoke in favour of DS suggested that there could be some nutrients lacking in their diets and that DS can provide for those degraded during strenuous exercises. Furthermore, those preferring DS over food gave reasons that DS were convenient as they are easy to prepare and have nutritional ingredients measured and labelled, enabling the user to control quantities consumed. Dietary Supplement users among the participants believed any risks DS may pose are outweighed by benefits. Furthermore, some users believed it was reasonable to spend money on performance-enhancing substances that guaranteed results including illicit drugs such as anabolic steroids.

Risks

Only one participant, an athlete, indicated the possible risk of contamination of DS with substances considered illegal by the World Ant-Doping Agency (WADA). Most of the participants, however, suggested DS are only risky if the DS user has an underlying health condition. Diabetes and heart disease were repeatedly cited as conditions that can be worsened by taking certain DS.

Sources of advice on DS

The Internet, fellow gym members and personal trainers were the most preferred sources of DS information. Participants strongly believed that advice from a fellow gym member was the best as they would be speaking from experience and that one could easily see the results they were achieving. There was general, high regard for personal trainers whom the participants believed were knowledgeable about nutrition. The Internet was also preferred as it was easily accessible, for example, by using smartphones.

Regulation of DS

There was consensus among the participants that products sold in reputable shops had been approved by government. However, there was confusion as to whom the regulatory authority for DS was with the sports minister and health minister being put forward as possible responsible authorities. Only athletes among the participants were aware of WADA and the risk of doping posed by some DS containing banned substances.

Emergent themes

It emerged in the FGDs that DS consumption was motivated by the belief that food nowadays has lost nutritional value owing to genetic modification. Furthermore, participants felt that organic foods were not a good alternative as they were too expensive and inaccessible to poorer communities such as the townships (also known as eKasi in South Africa).

Another new finding made in the current study was that some participants in the FGDs believed that DS would work out cheaper than normal food as users cut costs of getting a nutrition analysis from a dietician by simply following nutrition guidelines on the DS labels.

4.6 Discussion

Benefits/risks associated with DS

In this study, there was consensus among FGD participants that protein supplements cause people to build muscle mass (hypertrophy). In the FGDs, the statements below reflect this common view about protein supplements:

"I don't really know much about supplements but what comes to my mind about supplements is pills or things that people take to make themselves buff."

"Remember if your genes are a problem you fighting against them so that means you need to have a source where you can get those calories that means dietary supplements but if you want to maintain that skinny body just carry on with your normal food."

Protein supplements are widely consumed in gymnasiums by people seeking to build muscle mass but literature is not conclusive on the efficacy of protein supplements, particularly compared to normal dietary protein intake (Kårlund et al., 2019). On the contrary, protein supplement users are cautioned against possible risks of excessive protein intake such as hyperaminoacidemia, hyperammonemia and hyperinsulinemia (Bhatnagar, 2020), with lifestyle/recreational sports people being at greater risk (Kårlund et al., 2019).

When probed if they thought they would not get results without DS, some participants suggested DS help in achieving results faster.

"I think it depends with what a person feels let's say you want to gain weight are you willing to take the long journey of eating healthy or you want to take a short cut way of using dietary supplements."

Our results are supported by researchers indicating DS consumers believe supplements to be capable of immediate results pertaining to health and fitness goals (Goston & Correia, 2010). Apart from having high regard for protein supplements, it was clear that participants in the FGDs have the perception that their normal dietary food intake was inadequate, arguing that DS is necessary as food is no longer nutritious owing to genetic engineering of agricultural products, favouring mass production over quality.

"I sometimes feel I don't get enough nutrients from just eating right. So I have to take supplements to add more nutrients in my body."

"I think about DS is that, considering the food we eat like pap, meat they might not have all the elements we need for our body but when you buy the dietary supplements they have all the elements we need from A up to Z."

"I think the benefits of supplements is that if you lack a certain protein in your body or a certain thing that you can't to produce much more, I think it helps you to supply that in your body."

"I completely agree that we don't really get everything from what we eat so we have to take some supplements and it is also possible to have a whole balanced diet."

Similar attitudes that normal dietary food intake was not sufficient were noticed among students taking vitamin supplements in a study by Brown (2010). These views are also reflected widely in literature as nutrient deficiencies are reported to be the main reason why people are using DS (Egan, Hodgkins, Shepherd, Timotijevic, & Raats, 2011; Pajor, Oenema, Eggers, & de Vries, 2017).

Another reason cited by participants in our study in support of DS, is that they are a convenient meal replacement that is easy to prepare and have measured and labelled nutritional ingredients assisting users to control quantities consumed.

"I need to take let's say 40 grams of proteins per day; the two shakes I will drink in the morning and the evening I'm sorted on that issue of proteins and I know by the end of a week I have reached quarter or half of my goal but with taking steak I need to go to a dietitian first to tell me the amount of protein in the steak."

"I don't have like a diet sheet so if I'm about to cook let's say two eggs I won't be sure of the amount of proteins I will get but if I have protein shake I know the amount of proteins I will get in a day. Definitely with a shake I am sure of the quantity."

***"**I go for DS because when I make my protein shake I'm sure about the protein in it rather than with normal food where you might not even know the quantity of protein in the food."*

In a study by Moberg (2017) convenience was one important factor for deciding to use sports supplements among the respondents who felt DS were a quick and easy, practical nutrition

solution packaged with measured portion sizes. Past studies have reported use of DS as a meal replacement by college students and people frequenting gyms (El Khoury & Antoine-Jonville, 2012; Lieberman et al., 2015).

Similarly, Maughan et al. (2018) observed that dietary supplements, amongst other reasons, are used as a convenient source of energy and nutrients by athletes especially during exercise sessions. This implies that among athletes and young adults exercising in gyms, DS in their ready-measured form, save them time from cooking and pondering the nutrient content as would happen with normal food.

Although admitting DS were not as palatable and filling as food, several participants argued DS benefits outweigh risks.

*"70-30% in favour of benefits if you like you are committed to using the DS you might go for the benefits. Especially if you are educated about using them." (**Participant meant DS have 70% benefits and 30% risks)***

Similar findings by Druker and Gesser-Edelsburg (2017) were that among gymnasium members, DS were safe with any risk associated with DS being "expressed as possible but not certain". In the present study, a low-risk perception of DS was also noted in the FGDs where more than half of the thirty-three (33) codes on DS risks were either about excessive use or underlying health conditions. It can be argued, therefore, that participants in the present study presumed DS to be inherently safe and only harmful when wrongly used.

"Anything that you take too much or abuse will have side effects even if you take medication it will also provide side effects that will be too much."

"When it comes to supplements if it's not used correctly in right procedures it will provide some side effects like heart failure and cholesterol problems."

"The side effects that I know depend on the individual because we don't tolerate between the same. Some people can experience heart palpitations from the kidney depending on the individual."

"Not all people use supplements because of heart problems."

"Maybe you suffering from diabetes or maybe there is something in your body that is gonna make you feel bad, I believe when it comes to supplements make sure that you are healthy if I take this, is it gonna make me feel in a certain way. I also believe that everyone suffer with different things."

Similar to our results, a study of Dutch adults found that both DS users and non-users concurred that DS use was safe and only harmful to individuals taking excessive doses or having certain medical conditions (Pajor et al., 2017).

However, DS still pose risks in various other ways because some DS in their nature and composition may be contaminated or toxic (Binns, Lee, & Lee, 2018b; Mathews, 2018; Costa et al., 2019). In fact, in studies finding toxicity of herbal food supplements used for weight loss, some victims neither had underlying conditions nor were there reports of excessive use (Max H. Pittler & Ernst, 2004; M. H. Pittler, Schmidt, & Ernst, 2005). It can be argued, therefore, that DS still pose risks to healthy populations.

DS as gateway to illegal substances

Dietary supplement use has been strongly associated with use of illegal substances such as anabolic steroids (Barkoukis, Lazuras, Lucidi, & Tsorbatzoudis, 2015; Mathews, 2018). In our study, some participants suggested that they would use any substance, including illegal substances such as steroids, which could achieve results despite the side effects.

"You use a supplement for let's say one month if it goes well for you and you see results even though it gives you bad side effects, you will still go for it."

"If you got R300 and I give you Creatine or Dianabol what will you take?...I will go for Dianabol."

Dianabol is a common anabolic androgenic steroid taken by some body builders in gymnasiums (Khwaja, Srivastava, Deshmukh, & Chaudhry, 2018). In one study, it was observed that DS users are 3.5 times more likely to take illegal performance-enhancing drugs compared to non-supplement users and all participants using illicit appearance- and performance-enhancing drugs reported using DS prior to using the illicit drugs (Hildebrandt, Harty, & Langenbucher, 2012).

Expenditure on DS

Some participants in our study believed that DS are sold with nutritional content on the labels, thereby, cutting costs associated with visiting a dietitian.

"To buy the ready prepared shake is cheaper because with the normal food you have to go and consult with the dietitian and you will pay him first for example the shake cost R300 and to see the dietitian cost R250 plus he will also tell you the type of food to buy which will also add up on the money you pay him therefore at the end of the day, the money spent on the normal food processes will be higher than the cost for the protein shake."

However, any spending on a product of which benefits are uncertain, such as the case with DS, is questionable especially among lower income groups. Svova (2020) report that members of low-cost gymnasiums on an average monthly income of R10 793.35 spent 6.7% of that income on DS. Therefore, the cost-benefit ratio will make expenditure on DS unreasonably costly as it "represents an enormous health related expenditure of unsubstantiated value" (Quinones, Winsor, Patino, & Hoffmann, 2013). Sekhampu and Niyimbanira (2013) suggest that a low-income, average South African township family spends 45.5 % of their monthly budget on food and, therefore, an additional nutritional expense of 6.7% on DS becomes an unjustifiable expense.

Participants were adamant that DS were cost effective, arguing that DS had a superior nutritional value than normal food.

"Dietary supplements for example whey isolate is protein in its purest form. 1 (one) scoop of protein vs a kilogram of steak."

When probed about what they thought about the nutritional value of food, participants in the current study pointed out that mass produced foods were less nutritious. They argued further that organic foods had higher nutritional value but are not accessible especially in low-income areas such as townships (eKasi).

"Free range and organic foods are difficult to get. For example, for people staying in eKasi."

However, scientific evidence is largely lacking support in terms of the benefits of most DS, for example, one study strongly cautioned consumers to "stop wasting money on vitamin and mineral supplements" (Guallar, Stranges, Mulrow, Appel, & Miller, 2013). Consumers' view

that DS were value for money could be influenced by the media (the Internet, television, magazines, newspapers) where DS are marketed as effective even though they have little or no beneficial effect on health (Temple, 2013; Lim, Chock, & Golan, 2020). In our study, we investigated the sources of information and found that the Internet was one of the major sources participants relied on.

Sources of information on dietary supplements

The Internet

Participants suggested that information on DS was readily available on the Internet.

"I'm kind of a person who will read about it from the Google."

"I think it's more to do with the media, magazines and televisions because they advertise about supplements clearly stating that you have to eat this and that to become like that."

"..take your phone and go to the internet and Google, search why the brand is like that and how will this benefits me this will last me like 30 days so everything comes into consideration take 5 to 10 minutes to understand the DS. Consider the value or what is inside of the product."

The reliance on the Internet as a source of information among populations ranging from athletes to people exercising in gymnasiums has been reported in numerous studies world-wide (Mc Creanor, Coopoo, & Gabriels, 2017; Baltazar-Martins et al., 2019; Ruano & Teixeira, 2020).

Fellow gym members and personal trainers were also preferred sources of DS information. Participants strongly believed that the advice from other gym members was useful as they would be speaking from experience and that one could easily see the results they were achieving.

"I will just ask someone who has experience, someone whom I will say I want to look like this person who has been taking the product before."

Past studies support that friends are among the most preferred sources of supplement information with DS users; learning about DS from what they see and hear from people they associate with (Brown, 2010; Senekal et al., 2019).

"I will ask someone in the gym. I don't trust the pharmacies because they want to push the product for profit. It's a business."

"I trust asking someone at gym more because I can see their results. Compared to the internet where if there are pictures, they may be photo shopped."

"I have my friend who used supplements to lose weight and it benefited her so in my opinion I think you can use them both to gain and lose weight."

However, reviewed studies on weight-loss DS provide no evidence beyond a reasonable doubt that any specific DS is effective for reducing body weight (Onakpoya, 2012). Rather, DS toxicity has been mainly associated with weight-loss products (Egras, Hamilton, Lenz, & Monaghan, 2010; Ansari & Omar, 2017).

The next preferred source would be personal trainers.

"A personal trainer just gives you like a diet on a daily basis and tells what to eat, also the exercises…..to achieve your goal."

"I believe a personal trainer because he already studied about certain things."

In literature, it is clear that there is a general high regard for personal trainers whom the participants believed were knowledgeable about nutrition. Personal trainers are the most accessible to exercising individuals seeking advice on physical training and basic nutrition (Kiss, Pfeiffer, Popp, Oláh, & Lakner, 2020). Most personal trainers possess "body capital", which refers to bodies widely recognised as perfect on social platforms, which trainers reportedly use as their business cards (Hutson, 2013; De Lyon, Neville, & Armour, 2017). De Lyon et al. (2017) argue that the trainer's body capital is often taken to reflect professional competence and authority about health, the basis on which clients trust their advice.

However, most personal trainers are not trained in nutrition and often rely on information from Google and community media (Barnes, Desbrow, & Ball, 2016; Feldvari, Balog, & Tanacković, 2019; McKean, Mitchell, O'Connor, Prvan, & Slater, 2019). Kiss et al. (2020) observe that in Hungary, the regulation of the trainer qualification system is rather liberal/loose resulting in them offering services outside their qualifications and core competencies. In SA, the recent proposal to introduce a fitness regulatory authority to look into the conduct of gyms and fitness professionals should be lauded. Kiss et al. (2020) suggest the need for trainers'

duties to be clearly defined and encourage fitness trainers to either work with dietitians or upgrade qualifications to include nutrition.

The low-risk perception among DS users does not only result from inadequate sources of information but also the misconception and false sense of security that government regulates DS.

Regulation of DS

In the current study, there was consensus among the participants that products sold in reputable shops had been approved by government. Participants were however uncertain as to which ministry between Sports and health was directly responsible for DS regulation.

"I think the Minister of Health needs to make sure that everything that goes to the stores meets the requirements. And that everything that we buy is good for us."

"Sports Minister."

In the US, the FDA does not approve DS efficacy and safety claims before supplements are sold (Schneider, 2019). However, US consumers seem to believe that DS are regulated by the FDA in the same way as medical drugs are where products are rigorously checked before being sold. In a sample of 185 graduates, 75% mistakenly believed that the FDA was responsible for certifying the safety and efficacy of DS prior to reaching the market whereas 50% trusted the content of DS to be analysed by the FDA (Dodge, Litt, & Kaufman, 2011; Starr, 2015). Such erroneous assumptions are problematic in that the consumer believes that a credible government agent is involved in checking DS and are less likely to scrutinize the products before using them. Furthermore, consumers are less likely to question the manufacturing and marketing practices of DS and those reading labels will believe the information to be authentic. Participants in our study pointed out that they follow instructions on DS labels.

"There are also instructions that guides you on how to use the DS and what happens if you overdose."

However, labelling discrepancies have been reported in past studies, for example, catchy but misleading phrases such as "clinically tested" on some DS labels give consumers a false sense of security (Quinones et al., 2013; Starr, 2015). Some DS marketers are taking advantage of loose regulation by providing consumers with deceiving information.

In the South African context, regulation of DS is yet to take effect with the South African Health Products Regulatory Authority (SAHPRA) only being recently established with suggestions that DS may be regulated as complimentary medicine.

4.7 Conclusion

Misconceptions about the efficacy of protein DS, the low-risk perception of DS and the lack of knowledge about DS regulation reported in our study were reported in past studies to be commonly associated with inadequate sources of information used by DS users. Members of low-cost gyms like other populations are not well-informed on DS efficacy, possible risks associated with use and the regulatory framework. Furthermore, the fact that participants prefer non-scientific sources of information such as media and friends put them at risk of misinformation. Also, of concern is participants' trust in personal trainers for nutrition, advice which may be problematic considering that several studies report that most trainers and coaches are not qualified in nutrition. Awareness campaigns in gymnasiums should also focus on misconceptions about DS and educate DS users on reliable websites and health professionals regarding safety and efficacy of DS. This information may help curb irrational spending and consumption of DS.

Acknowledgements: Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s). We acknowledge the assistance of Professor Yoga Coopoo from the University of Johannesburg for initial guidance and for the use of a validated questionnaire in the quantitative part of this research; Emília Margit Pajor of Maastricht University (Netherlands) on FGD question format; Professor Suria Ellis of the North-West University for statistical consultation; Ms Noloyiso Matiwane for facilitating in FGD interviews; and Natasha Ravyse for the editing.

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CHAPTER 5

SUMMARY, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1 Introduction

Dietary supplement use is increasing exponentially (Datta & Vitolins, 2016:1) in recent years despite the lack of regulatory oversight and in the face of growing safety concerns. The gym population is fast becoming the major market for DS (El Khoury & Antoine-Jonville, 2012:2) with consumers in these places taking DS with the hope of altering body composition, increase exercise performance and maintain health (Goston & Correia, 2010:606; Senekal et al., 2019:6).

People exercising in gyms seek advice on DS mainly from unreliable and uncertain sources such as the Internet and gym friends (Jawadi et al., 2017:2; Mc Creanor et al., 2017:2). This is a cause for concern as literature reports that there is no scientific evidence to prove that most DS are effective and that there are possible risks associated with some DS (Starr, 2015:1). The fitness industry has grown extensively seeking to accommodate diverse populations (Addolorato et al., 2020:2). This has led to the establishment of gyms in a previously overlooked no-frills market (low-cost, simplicity, style) and the 'high-end' market (quality, fineness, distinction) (Pedragosa & Correia, 2009; Sacavém & Correia, 2009) areas resulting in the gym population characteristics such as socio-economic profiles, also changing. The current study, therefore, chose a targeted approach of investigating factors driving DS consumption among members in low-cost gymnasiums.

5.2 Summary

It is against this background discussed in the introduction above, that the following research questions were posed: What are the ***attitudes*** *on DS use among adult members of Johannesburg low-cost gymnasiums? What are the* ***effects*** *of attitudes on DS spending by adult members of Johannesburg low-cost gymnasiums? What are the* ***sources of information*** *on DS use by adult members of Johannesburg low-cost gymnasiums? What are the relationships between choices of DS used and age, gender, and DS users' reasons for exercising?* The objectives to answer the questions were set as:

- *to determine attitudes on DS use among adult members of Johannesburg low-cost gymnasiums;*
- *to determine the effects of attitudes mentioned above of adult members of Johannesburg low-cost gymnasiums on DS spending;*
- *to determine the sources of information on DS use by adult members of Johannesburg low-cost gymnasiums; and*
- *to determine the prevalence of DS use in low-cost Johannesburg gyms and*
- *to establish among adult members of Johannesburg low-cost gymnasiums, the relationships between choices of DS used and DS users' age, gender, and reasons for exercising.*

The current dissertation is in article format according to the guidelines of the North-West University and was approved by the research committee. Chapter 1 provided an overview of the problem statement, objectives, hypotheses and structure of the dissertation.

Chapter 2 presented a literature review on dietary supplements. Insight that protein DS are the most consumed DS in the gyms was gained (Ruano & Teixeira, 2020:3). Also, DS consumption was reported to vary depending on age, gender and type of exercises. To some extent, amongst the general population, DS use may vary according to race (Dickinson & MacKay, 2014:2). It was reported that DS users are not well informed on the use of DS (Lacerda et al., 2015:8) and that they believe benefits of DS outweigh any possible risks. Furthermore, the most common sources of information on DS used in gyms are friends, personal trainers and the Internet (Mc Creanor et al., 2017:2).

Chapter 3 (Article 1) is presented according to the requirements of the South African Journal for Clinical Nutrition (SAJCN) and has been submitted for publication.

In this article entitled: ***Knowledge of adult gymnasium members on supplement use in a low-cost gymnasium chain in Johannesburg,*** low-cost gym members' sources of information on DS and the relationship between their choices of dietary supplements (DS) and age, gender, and DS users' reasons for exercising was investigated. The findings reflected that members of low-cost gymnasiums get information on DS mostly from unreliable, non-professional sources. An additional finding showed that gender and exercise goals influenced the choice of DS. It was also established that DS expenditure was motivated by DS users' desire to achieve fitness and health goals resulting in unrealistic proportions of income spent on DS.

Chapter 4 is presented according to the requirements of the African Journal of Physical Activity and Health Sciences (AJPHES).

In this article entitled: ***Attitudes and beliefs of adult members at low-cost gymnasiums in Johannesburg regarding Dietary Supplement use,*** the attitudes behind the use and spending on Dietary Supplements (DS) among members of low-cost gymnasiums was explored. Dietary Supplement users were found to have a low-risk perception of DS use and that DS were risky to people who had underlying medical conditions making them susceptible to adverse effects of the DS. Furthermore, among participants arguing DS use is worth the risk, some expressed willingness to use illegal substances such as anabolic androgenic steroids. This was noted as being evidence that DS use could be a gateway to the use of illegal substances and doping. A further finding exposed that DS users believed they spent less on DS than they would do on normal food.

5.3 Conclusion

The conclusions of the study are derived from the results presented in chapters 3 and 4, respectively and are in accordance with the objectives and hypotheses stated in Chapter 1.

5.3.1 Hypothesis 1

Dietary Supplement users in Johannesburg low-cost gymnasiums, in order to achieve their goals, display a positive attitude towards supplement use.

Dietary Supplement users believed that DS were effective in achieving results faster. Protein DS were specifically singled out in the FGDs as necessary for mass gaining, particularly for naturally thin people seeking to build muscle. Participants were in consensus that the benefits of DS outweigh any risks that may be associated with DS use.

Hypothesis 1 is, therefore, accepted.

5.3.2 Hypothesis 2

There is a positive correlation between attitudes of DS users in Johannesburg low-cost gymnasiums and the amount of money they spend on DS.

Amongst DS users, a strong correlation of $p<0.05$ was found between dietary expenditure and reasons for using DS to gain muscle, improve performance, achieve personal goals and

maintain health. This was also reflected in the FGDs where some DS users argued that in order to achieve their goals, they would use DS and even illegal substances, such as steroids, regardless of the side effects. Furthermore, only 7.7% among DS users spent over R1500 per month on DS. However, the average monthly expenditure on DS for the participants was R723.07, which constitutes 6.7% of their average monthly income. This shows that although having limited financial resources, by proportion to their average income, DS users still spent a considerable portion of their income on DS.

Hypothesis 2 is, therefore, accepted.

5.3.3 Hypothesis 3

Friends, gymnasium training partners and the Internet are among DS users in Johannesburg low cost gymnasiums' most frequently used sources of information on supplementation whereas health professionals are the least consulted sources.

The most preferred source of information on DS were the Internet (51%) and friends/fellow gym members (34%). In the FGDs, the Internet was preferred for being easily accessible whereas fellow gym members and personal trainers were perceived as knowledgeable about DS and had "body capital" as proof that the DS are effective. The least consulted were official sources such as scientific journals (4%), physicians (4%) and biokineticists (3%).

Hypothesis 3 is, therefore, accepted.

5.3.4 Hypothesis 4

There is widespread use of DS among members of low-cost gymnasiums in Johannesburg.

There were more than fifty-three percent (53.4%) users in the gyms of which most users were male.

Hypothesis 4 is therefore accepted.

5.3.5 Hypothesis 5

The choice to use DS is dependent on age, gender, level of education, socio-economic status and ethnicity.

The use of DS was significantly associated with gender ($p \leq 0.05$). Whereas more (59%) male respondents were DS users whereas fewer (38.8%) females used DS. Also, 37.8% of males reported the use of DS in order to gain muscle mass compared to 22.2% of females. Furthermore 39.4% of males took DS to improve gym performance compared to 24.2% among females. Age, level of education and income were not significantly associated with DS use.

Hypothesis 4 is, therefore, partially accepted.

5.4 Limitations and recommendations

This study had some limitations, which should be noted when results are being interpreted. The first limitation is that the studied population involved gyms belonging to one fitness chain, which may limit generalisability of the findings. Future research should include gyms belonging to various franchises fitting the description of low-cost and draw a random sample of which gyms to involve. Another limitation was including unequal proportions of DS users and non-users in one focus group. Although in theory it may provide for an open-minded discussion, however, in this study, the DS users being more than non-users seemed to dominate the discussions with non-users contributing less. Future studies may consider separate FGDs for DS users and non-users or convenience sampling to ensure each group is equally represented. Findings of the current study support the notion that consumers are not absolutely free in their choices as long as full information on the safety of DS is unavailable, and as long as consumers have limited means to evaluate the truthfulness of safety and efficacy of DS use. It is thus suggested that awareness campaigns in gymnasiums, focusing on misconceptions about DS and educating DS users on reliable websites and health professionals regarding safety and efficacy of DS, are initialised. This information may help curb irrational spending and consumption of DS. The researcher strongly urges the newly appointed South African Health Products Regulatory Authority (SAHPRA) to ensure the above-mentioned DS common in gyms be strictly regulated for both safety and efficacy. This will help low-cost gymnasiums considering that by virtue of their cost-saving drive, are likely to struggle to get regular services of a dietitian.

5.5 Future research

Important observations from this study contributing to existing research are that DS use is spreading to lower-income groups with the establishment of low-cost gymnasiums in previously overlooked residential areas. Generalised and uninformed DS use observed in this

study, will result in a disproportionate financial burden among lower-income populations. There were also indications that race may influence how people perceive and use DS. Having discovered a greater proportion of black people attending low-cost gymnasiums future research could investigate the extent to which race/ethnicity influences DS use. A suggestion would be to target township gymnasiums in for example, Soweto and Thembisa, attended by mostly black people to see if gymnasium culture is different, and what attitudes they may have towards DS, compared to findings in upmarket gyms where membership is predominantly Caucasian.

Also, it might be interesting to discover how supplement stores and gyms perceive DS, particularly those commonly used in gyms. Findings of such studies can be compared to the perceptions of DS users.

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APPENDIXES

APPENDIX A: QUESTIONNAIRE

Questionnaire

The following survey has been adopted from an existing research survey created by

Mc Creanor *et al.* (2017): Attitudes towards nutritional supplements use amongst adult gymnasium users in Johannesburg north.

Citation:

Mc Creanor, X., Coopoo, Y. & Gabriels, G. (2017). Attitudes towards nutritional supplement use amongst adult gymnasium users in Johannesburg North. *South African Journal of Sports Medicine*, 29(1):1-5.

Thank you for your participation in this research study. Your time is greatly appreciated.All responses are strictly anonymous and no identifying information is asked for or required. Please be reminded that you are free to withdraw from this survey at any given time.

SECTION 1: BACKGROUND INFORMATION

The following questions will ask background information about you.

1.1 What is your age? _____ Years old

1.2 Please specify your gender

Male	
Female	

1.3 What is the highest level of education you completed?

University or college or equivalent	
Intermediate between secondary level and university (e.g technical training)	
Secondary school Grade 12	

1.4 Why did you choose your current gym?

It is more affordable	
It is closer to where I work/live	
It's cheap and I can save money to be able to buy other things that enhance my training experience	
Other (please specify)	

1.5 From what ethnic group are you?

Caucasian (White)	
African (Black)	
Indian, coloured or other	

1.6 What is your monthly income range?

Below R5000	
R5000-R10 000	
R10 000-R15 000	
R15 000-R20 000	
Above R20 000	

SECTION 2: GENERAL INFORMATION

2.1 Read the questions carefully and answer suitably

2.1.1 Do you feel that the uses of dietary supplements in gymnasiums are rising?

Yes	
No	

2.1.2 Do you believe there is pressure placed on gymnasium users to use dietary supplements?

Yes	
No	

2.1.3 Are you aware of any supplements that are prohibited by the World Anti-Doping Agency?

Yes	
No	

2.2 Do you receive information on the use of dietary supplements from any of the following sources?

Pharmacist	
Personal trainer	
Journals	
Friend/Training partner	
Dietician	
Physician	
Biokineticist	
Sibling	
Parent	
Information brochures	
Representative from a supplement company	
Magazines	
Newspapers	
Books	
Internet	
I have not received any information	

Other (Please specify)	

2.3 Kindly rate the degree to which you agree or disagree with the following gymnasium related statement-My reasons going to the gymnasium.

1=Mainly, 2=Sometimes, 3=Never (Please circle one number)

Muscle gain	1	2	3
Weight loss	1	2	3
Swimming	1	2	3
Body conditioning	1	2	3
Aerobic exercise	1	2	3
Sport specific training	1	2	3
Spiritual motive	1	2	3
Staying healthy	1	2	3
Cross-fit training	1	2	3
Other (Please specify)			

2.4 Do you make use of or have you ever used a personal trainer?

Yes	
No	

SECTION 3: USE OF SUPPLEMENTS

3.1 In the past year (12 months), have you used dietary supplements?

Yes----Proceed to question 3.2	
No-----Proceed to question 3.6	

3.2 When did you begin using dietary supplements?

10-12 years old-Primary school level	
13-18 years old-High school level	
Over 18 years old-When I joined the gymnasium	

3.3 What are your reasons for using dietary supplements?

	YES	NO
Assists me in coping with the stresses of muscle gains in the gymnasium.		
Helps to improve the way I perform in the gymnasium.		
Helps to reduce food craving in order to decrease my body weight.		
I feel pressured by my peers.		
Help me reach my personal goals		
To be healthy		
Other(specify)_____		

3.5 On average, how much do you spend on dietary supplements per month?

R0.00-R500	
R500-R1000	
R1000-R1500	
R1500-R2000	
R2000-R2500	
R2500-R3000	
More than R3000	

3.6 If you DO NOT USE dietary supplements, what are the main MOTIVATING FACTORS?

	YES	NO
I don't think it is necessary to take them.		
I am afraid of what they may do to my health.		
It goes against what I believe.		
I don't know what type of dietary supplements I must use.		
I don't trust the companies that make the dietary supplements.		
I cannot afford the supplements.		
I am concerned about getting addicted to them.		
I am afraid of getting fake products.		
Other (please specify)_____		

SECTION 4: USE OF DIETARY SUPPLEMENTS

4.1 What dietary supplements do you use regularly?

	YES	NO
Creatine supplements (e.g Creatine monohydrate)		
Protein supplements(e.g Whey protein)		
Carbohydrate supplements (e.g Energade, Powerade)		
CLA (Conjugated Linoleic Acid) Weight loss supplements		
Phedra-cut Thermogenic Aid		
Branch Chained Amino Acids (BCAA)		
L-Glutamine		
Fish oil (e.g Omega 3-tablets)		
Caffeine (e.g Redbull, Guarana)		
Vitamins (A,B,B12,C and E)		
Other (please specify)_____		

4.2 Do you read the nutritional value, benefits and side effects on the labels before you use the supplements? (Please select the most appropriate answer)

Always-My health must come first.	
Sometimes-It is safe to use if I buy from the pharmacy.	
Never-I trust the manufacturing company that supplies my supplements	
Other (Please specify)_____	

SECTION 5: ATTITUDES TOWARDS SUPPLEMENTS IN GYMNAIUMS

Kindly rate the degree to which you agree or disagree with the following sport related statements.
1=Strongly agree, 2=Agree, 3=Disagree, 4=Strongly disagree (Please circle one number.)

(5.1) There is a problem of dietary supplement use in my gymnasium.	1	2	3	4
(5.2) Gymnasiums should offer educational programmes for gymnasium users on the use of dietary supplements.	1	2	3	4
(5.3) There are too many gymnasium users using dietary supplements to enhance their performance in my gymnasium.	1	2	3	4
(5.4) The use of dietary supplements by gymnasium users has not been reported enough in the media.	1	2	3	4
(5.5) The use of performance enhancing substances and dietary supplements has risen in the last five years.	1	2	3	4
(5.6) I would never consider the use of dietary supplements.	1	2	3	4
(5.7) I am sometimes tempted to use performance enhancing supplements.	1	2	3	4
(5.8) Many of my friends think it is acceptable to use dietary supplements.	1	2	3	4
(5.9) If I don't take supplements, I will not be able to succeed because everyone else takes supplements.	1	2	3	4
(5.10) I think it is always wrong to use dietary supplements for gym purposes.	1	2	3	4
(5.11) I think gymnasium participants who want to reach their goals have to use dietary supplements.	1	2	3	4
(5.12) I don't think it is fair to use dietary supplements.	1	2	3	4

SECTION 6: SUGGESTIONS TO HELP ADDRESS THE PROBLEM OF EXCESSIVE USE OF DIETARY SUPPLEMENTS.

If you believe that the excessive use of dietary supplements in gymnasiums is a problem, can you suggest some ways to help solve the problem?

_____
_____
_____
_____
_____
_____
_____
_____
_____

Debriefing Statement

Thank you very much for your participation in this survey; your time is greatly appreciated. If you would like to contact the survey author for any additional information, Amos H. Svova (Phone: 0782085035, email: asvova659@gmail.com)

APPENDIX B: FOCUS GROUP QUESTION SCHEDULE

A. Sample questions for focus group discussions with possible themes

1. **Theme:** Definition of Dietary supplements**. Question**: What comes to mind when you think of dietary supplements?

Probes: What is your understanding of dietary supplements?

2. **Theme:** Reasons for taking or not taking supplements**. Question:** In your opinion, what do you think is the purpose of dietary supplements?

Now I would like to talk about the benefits of dietary supplements:

3. Theme: Perceived benefits of dietary supplements/self-efficacy**. Question:** What would you say are the benefits of dietary supplements?

4. Theme: Perceived risks of dietary supplements. **Question:** What would you say are the risks of using dietary supplements?

5. Theme: Benefits and risks/self-efficacy continued. **Question:** Considering the risks and benefits that may be associated with dietary supplements, in your opinion, which one outweighs the other?

6. Theme: Uses of supplements in relation to normal diet ie food. **Question:** What would you say is the difference in nutritional value between normal food and dietary supplements?

Probes:

- Which do you trust more? Why?
- Which would you consider as having the highest quality when it comes to nutrition and why?

7. Theme: Perceived change in quality of food over time. In your opinion, what do you think of the nutritional value of food over the years ie from the way its farmed to manufacturing?

Probes: Would you say organic food is healthier? Are functional foods a better option? Are synthetic foods better and worth paying more for?

8. Theme: Trusted source of information on dietary supplements. Who would you trust for advice on use of supplements?

Probe: what do you think of the of the following as sources of information on dietary supplements;

Pharmacist

Personal trainer

Journals

Friend/Training partner

Dietician

Physician

Biokineticist

Sibling

Parent

Information brochures

Representative from a supplement company

Magazines

Newspapers

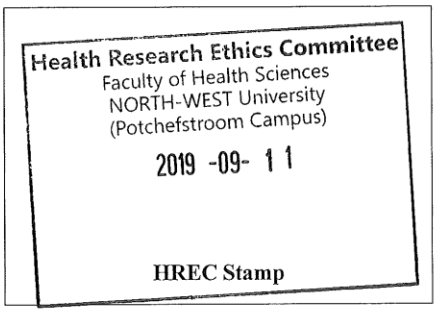
Books

Internet

Questions to be used in the study focus group discussions were drawn from focus group schedule and emergent themes in study by Pajor et al. 2017. Questions were also constructed from themes in the current study survey requiring further exploration to give deeper understanding of attitudes towards dietary supplements.

APPENDIX C: INFORMED CONSENT FOR QUANTITATIVE SURVEY

Private Bag X1290, Potchefstroom
South Africa 2520
Tel: +2718299-1111/2222
Fax: +2718299-4910
Web: http://www.nwu.ac.za



INFORMED CONSENT DOCUMENTATION FOR ADULT GYMNASIUM MEMBERS IN JOHANNESBURG COMPLETING SURVEY ON DIETARY SUPPLEMENTS.

TITLE OF THE RESEARCH STUDY: Attitudes, choice and expenditure on dietary supplements among adult members at low cost gymnasiums in Johannesburg.

ETHICS REFERENCE NUMBERS: NWU-00451-19-S1
PRINCIPAL INVESTIGATOR: Professor SM Hanekom
POST GRADUATE STUDENT: Amos Hatityi Svova
ADDRESS: 14 Carrowood village 9 Olympus street Florida North
CONTACT NUMBER: 0782085035

You are being invited to take part in a research study that forms part of a post-graduate dissertation (MSc in Sport Sciences). Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is entirely voluntary and you

APPENDIX D: INFORMED CONSENT FOR FOCUS GROUP DISCUSSION

NWU®
NORTH-WEST UNIVERSITY
NOORDWES-UNIVERSITEIT
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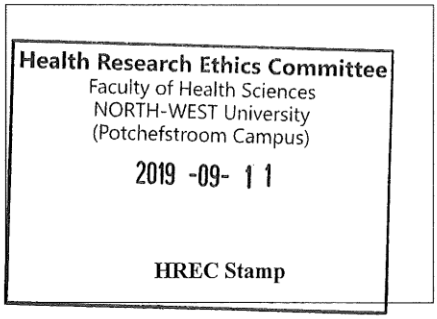
Private Bag X1290, Potchefstroom
South Africa 2520
Tel: +2718 299-1111/2222
Fax: +2718 299-4910
Web: http://www.nwu.ac.za



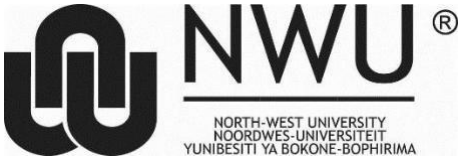
INFORMED CONSENT DOCUMENTATION FOR ADULT GYMNASIUM MEMBERS IN JOHANNESBURG PARTICIPATING IN FOCUS GROUP DISCUSSION ON DIETARY SUPPLEMENTS

TITLE OF THE RESEARCH STUDY: Attitudes, choice and expenditure on dietary supplements among adult members at low cost gymnasiums in Johannesburg.

ETHICS REFERENCE NUMBERS: NWU-00451-19-S1
PRINCIPAL INVESTIGATOR: Professor Hanekom
POST GRADUATE STUDENT: Amos Hatityi Svova
ADDRESS: 14 Carrowood village 9 Olympus street Florida North
CONTACT NUMBER: 0782085035

You are being invited to take part in a **research study** that forms part of a post-graduate dissertation (MSc in Sport Sciences). Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand.

APPENDIX E: ETHICS CLEARENCE



Private Bag X1290, Potchefstroom
South Africa 2520

Tel: 086 016 9698
Web: http://www.nwu.ac.za/

North-West University Health Research Ethics Committee (NWU-HREC)

Tel: 018 299-1206

Email: Ethics-HRECApply@nwu.ac.za (for human studies)

11 September 2019

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the North-West University Health Research Ethics Committee (NWU-HREC) on 13/06/2019, the NWU-HREC hereby approves your study as indicated below. This implies that the NWU-HREC grants its permission that, provided the general and specific conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Attitudes, choices and expenditure on dietary supplements among adult members at low cost commercial gymnasiums in Johannesburg Central Business District Principal Investigator/Study Supervisor/Researcher: Dr C Botha-Ravyse

Student: AH Svova-27926303

Ethics number:

N	W	U	-	0	0	4	5	1	-	1	9	-	A	1
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type: Single

Commencement date: **11/09/2019** **Risk:** **Minimal**

Expiry date: 30/09/2020

Approval of the study is provided for a year, after which continuation of the study is dependent on receipt and review of a three/six-monthly/annual monitoring report and the concomitant issuing of a letter of continuation. A monitoring report is due at the end of September annually until completion.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The principal investigator/study supervisor/researcher must report in the prescribed format to the NWU-HREC:*
  - *Annually on the monitoring of the study, whereby a letter of continuation will be provided annually, and upon completion of the study; and*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the principal investigator/study supervisor/researcher must apply for approval of these amendments at the NWU-HREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *Annually a number of studies may be randomly selected for active monitoring.*
- *The date of approval indicates the first date that the study may be started.*

9.1.5.4.2 Ethics Approval Letter of Study

In the interest of ethical responsibility, the NWU-HREC reserves the right to:

- *request access to any information or data at any time during the course or after completion of the study;*
- *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
- *withdraw or postpone approval if:*
  - *any unethical principles or practices of the study are revealed or suspected;*
  - *it becomes apparent that any relevant information was withheld from the NWU-HREC or that information has been false or misrepresented;*
  - *submission of the annual monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and/or*
  - *new institutional rules, national legislation or international conventions deem it necessary.*

- *NWU-HREC can be contacted for further information via Ethics-HRECApply@nwu.ac.za or 018 299 1206*

Special in process conditions of the research for approval (if applicable):

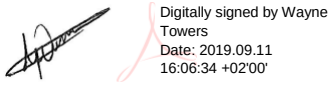
a. Please submit the interview schedule for the focus group discussion for review and approval by the NWU-HREC before it is implemented in the study.

As the study progresses the aforementioned conditions should be submitted to Ethics-HRECProcess@nwu.ac.za with a cover letter with a specific subject title indicating “Outstanding documents for approval: NWU-XXXXX-XX-XX.” The letter should include the title of the approved study, the names of the researchers involved, that the documents are being submitted as part of the conditions of the approval set by the NWU-HREC, the nature of the document i.e. which condition is being fulfilled and any further explanation to clarify the submission.

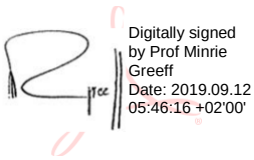
The *e-mail*, to which you attach the documents that you send, should have a *specific subject line* indicating the nature of the submission e.g. “Outstanding documents for approval: NWU-XXXXX-XX-XX”. The e-mail should indicate the nature of the document being sent. This submission will be handled via the expedited process.

The NWU-HREC would like to remain at your service and wishes you well with your study. Please do not hesitate to contact the NWU-HREC for any further enquiries or requests for assistance.

Yours sincerely,



Prof Wayne Towers
Chairperson NWU-HREC



Prof Minrie Greeff
Head of the Faculty of Health Sciences Ethics Office

Current details:(23239522) G:\My Drive\9. Research and Postgraduate Education\9.1.5.4 Templates\9.1.5.4.2_NWU-HREC_EAL.docm
20 August 2019

File Reference: 9.1.5.4.2

APPENDIX F: PERMISSION FROM GYMNASIUMS AUTHORITIES

07 May 2019

Dear Amos H. Svova,

Permission to conduct study

Please note that we are happy for you to conduct your research at **Planet Fitness Just gyms in Johannesburg: Newtown, Glenanda, Meadowdale, Springs** branches, a research entitled: ***Attitudes, choice and expenditure on dietary supplements among adult members at Johannesburg low cost public gymnasiums***, in accordance with the criteria you have submitted.

Please contact me should you require any further assistance.

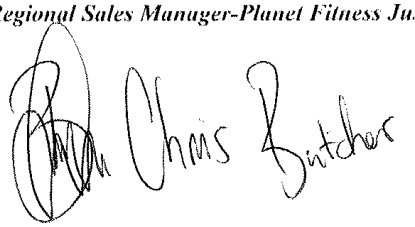
Kind regards

Maartin Du Toit (maartin.dutoit@planetfitness.co.za cell number: 083 630 7792)

Regional Operations Manager-Planet Fitness

Chris Butcher (chris.butcher@planetfitness.co.za cell number: 0664884112)

Regional Sales Manager-Planet Fitness Just Gyms



APPENDIX G: JOURNAL REQUIREMENTS FOR ARTICLE 1(SAJCN)

Author Instructions

S Afr J Clin Nutr 2010;23(4)

Author instructions

All manuscripts and correspondence to be submitted electronically to: www.sajcn.co.za

Copyright

Material submitted for publication in the South African Journal of Clinical Nutrition (SAJCN) is accepted provided it has not been published elsewhere. Copyright forms will be sent with acknowledgement of receipt and the SAJCN reserves copyright of the material published. The SAJCN does not hold itself responsible for statements made by the authors.

Authorship

All named authors must give consent to publication. Authorship should be based only on substantial contribution to: (i) conception, design, analysis and interpretation of data; (ii) drafting the article or revising it critically for important intellectual content; (iii) final approval of the version to be published. All three of these conditions must be met (Uniform requirements for manuscripts submitted to biomedical journals; www.icmje.org/index.html).

Manuscripts

Short items are more likely to appeal to our readers and therefore to be accepted for publication. *Manuscript should not exceed 4000 words in total all contents inclusive.*

Original articles of 4 000 words or less, with up to 6 tables or illustrations, should normally report observations or research of relevance to the field of nutrition. References should preferably be limited to no more than 25.

Short reports or scientific letters, which include case reports, side effects of nutrient supplements/drugs and brief or negative research findings should be 1000 words or less, with 1 table or illustration and no more than 6 references.

Editorials, Opinions, Issues in the field of nutrition. should be about 1000 words and

are welcome, but unless invited, will be subjected to the SAJCN peer review process.

Review articles are rarely accepted unless invited.

Letters to the editor, if intended for the correspondence column, should be marked 'for publication', signed by all authors and presented in triple spacing. Letters should be no longer than 400 words with only one illustration or table.

Obituaries should not exceed 400 words and may be accompanied by a photograph.

Manuscript preparation

• Please submit your manuscript electronically at www.sajcn.co.za. (Register as an author, log in and follow the 5 steps to upload your manuscript.)

• Please submit the manuscript as a MS Windows Word document.

• Please have your manuscript edited by a language expert or colleague proficient in English prior to submission. Articles must be in UK English.

• All manuscripts must include an abstract (50-250 words).

• Research articles should have a structured abstract not exceeding 250 words (50 for short reports) comprising: Objectives, Design, Setting, Subjects, Outcome measures, Results and Conclusions.

• Refer to articles in recent issues for guidance on the presentation of headings and subheadings.

• Abbreviations should be spelt out when first used in the text and thereafter used consistently.

• Scientific measurements should be expressed in SI units except: blood pressure should be given in mmHg and haemoglobin values in g/dl.

If in doubt, refer to www.icmje.org/index.html

Illustrations

1. All illustrations must be submitted electronically. High resolution (300dpi) .jpg or .tiff files are preferred.

2. Figures consist of all material that cannot be set in type, such as photographs and line drawings.

3. Tables and legends for illustrations should appear on separate sheets and should be clearly identified.

4. Line drawings should be arranged to conserve vertical space. Note that reduction to 80 mm for a single column or 170 mm for double columns should not render lettering illegible. Explanations should be included in the legend and not on the figure itself.

5. Figure numbers should be clearly marked on the back of prints and the top of illustrations should be indicated.

6. If any tables or illustrations submitted have been published elsewhere, written consent to republication should be obtained by the author from the copyright holder and the author(s).

7. A limited number of illustrations are free at the discretion of the editor. Colour illustrations are encouraged but are charged to the author.

References

References should be inserted in the text as superior numbers and should be listed at the end of the article in numerical and not in alphabetical order.

Authors are responsible for verification of references from the original sources.

References should be set out in the Vancouver style and approved abbreviations of journal titles used; consult the List of Journals in Index Medicus for these details.

Names and initials of all authors should be given unless there are more than six, in which case the first three names should be given followed by et al. First and last page numbers should be given.

Journal references should appear thus:

1. Price NC. Importance of asking about glaucoma. BMJ 1983; 286: 349-350. Book references should be set out as follows:

1. Jeffcoate N. Principles of Gynaecology. 4th ed. London: Butterworth, 1975: 96-101.

2. Weinstein L, Swartz MN. Pathogenic properties of invading microorganisms. In: Sodeman WA jun, Sodeman WA, eds. Pathologic Physiology: Mechanisms of Disease. Philadelphia: WB Saunders, 1974: 457-472.

Manuscripts accepted but not yet published can be included as references followed by (in press).

Unpublished observations and personal communications may be cited in the text, but not in the reference list.

APPENDIX H: JOURNAL REQUIREMENTS FOR ARTICLE 2 (AJPHES)

Author Guidelines

Original manuscript and all correspondence should be addressed to the Editor-In-Chief:

Professor A.L. Toriola
Department of Sport, Rehabilitation and Dental Sciences, Tshwane University of Technology
P. Bag X680, Pretoria 0001,
Republic of South Africa
Tel: +27 12 3825806
Fax: +27 12 3825801
E-mail: abel.toriola2015@gmail.com

Articles should be submitted electronically, i.e. via e-mail attachment. However, the corresponding author should ensure that such articles are virus free. AJPHES reviewing process normally takes 4-6 weeks and authors will be advised about the decision on submitted manuscripts within 60 days. In order to ensure anonymity during the reviewing process authors are requested to avoid self-referencing or keep it to the barest minimum.

PREPARATION OF MANUSCRIPT

Manuscripts should be type written in fluent English (using 12-point Times New Roman font and 1½ line-spacing) on one side of whiteA4-sized paper justified fully with 3cm margin on all sides. In preparing manuscripts, MS-Word, Office 2007 for Windows should be used. Length of manuscripts should not normally exceed 12 printed pages (including tables, figures, references, etc.). For articles exceeding 12 typed pages US$ 10.0 is charged per every extra page. Authors will be requested to pay a publication fee to defray the very high cost of publication. The pages of manuscripts must be numbered sequentially beginning with the title page. The presentation format should be consistent with the guidelines in the publication format of the American Psychological Association (APA) (6th edition).

Title page:

The title page of the manuscript should contain the following information:
Concise and informative title.
Author(s') name(s) with first and middle initials. Authors' highest qualifications and main area of research specialisation should be provided.
Author(s') institutional addresses, including telephone and fax numbers.
Corresponding author's contact details, including e-mail address.
A short running title of not more than 6 words.

Abstract

An abstract of 200-250 words is required with up to a maximum of 5 keywords provided below the abstract. Abstract must be typed on a separate page using single line spacing, with the purpose of the study, methods, major results and conclusions concisely presented. Abbreviations should either be defined or excluded.

Text

Text should carry the following designated headings also using single line spacing: Introduction, materials and methods, results, discussion, acknowledgement, references and appendices (if appropriate).

Introduction

The introduction should start on a new page and in addition to comprehensively giving the background of the study it should clearly state the problem and purpose of the study. Authors should cite relevant references to support the basis of the study. A concise but informative and critical literature review is required.

Methods
This section should provide sufficient and relevant information regarding study participants, ethics/informed consent, instrumentation, research design, validity and reliability estimates, data collection procedures, statistical methods and data analysis techniques used. Qualitative research techniques are also acceptable.

Results
Findings should be presented precisely and clearly. Tables and figures must be presented separately or at the end of the manuscript and their appropriate locations in the text indicated. The results section should not contain materials that are appropriate for presentation under the discussion section. Formulas, units and quantities should be expressed in the *systeme internationale (SI) units*. Colour printing of figures and tables is expensive and could be done upon request at authors' expense.

Discussion
The discussion section should reflect only important aspects of the study and its major conclusions. Information presented in the results section should not be repeated under the discussion. Relevant references should be cited in order to justify the findings of the study. Overall, the discussion should be critical and tactfully written.

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For chapter references in a book: Adams, L.L. & Neveling, I.A. (2004). Body fat characteristics of sumo wrestlers. In J.K. Manny & F.O. Boyd (Eds.), *Advances in Kinanthropometry* (pp. 21-29). Johannesburg, South Africa: The Publishers Company Ltd.

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DECLARATION OF LANGUAGE EDITING

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THE WRITER'S FIX

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