# Sports Nutrition Supplement Use: Comparison between a USA and a Palestinian community

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**Abstract**

*This study was undertaken to examine nutritional supplement consumption and to compare results between study participants from fitness centers in Eastern Massachusetts, USA, and in the West Bank, Palestine. Participants (n=355) completed surveys detailing their exercise habits, nutritional supplement use, reasons for use, and any experienced side effects. Whey protein, vitamins and minerals, branched chain amino acids, and creatine were most commonly consumed. Independent samples t-tests revealed significantly higher supplement use in male participants and in those who believed supplement use improved exercise performance.Independent samples t-tests didn't reveal significant differences in total supplement use by location (West Bank or USA), level of education, or whether they'd taken a nutrition course. There were significant differences between location and frequency of use of whey protein, branched-chain amino acids, multivitamin/minerals and weight loss products. West Bank participants used more whey protein and BCAA than USA participants. Participants from the West Bank were less likely to use multivitamin/mineral supplements and weight loss products than USA participants. Most commonly reported side effects were headaches, palpitations, and diarrhea. Nutritionists, trainers, coaches, and health educators may use this data to educate their clients about risks associated with consumption of supplements that are largely unregulated.*

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## Introduction

Dietary modifications (e.g. eating extra carbohydrate for prolonged exercise, consuming additional protein for muscle repair) are an important adjunct to athletic performance. Even though food provides the essential macro and micronutrients the body needs, many athletes are drawn to supplements above and beyond additional carbohydrate or protein. Known as "ergogenic aids," dietary supplements designed for sports competition are generally untested and unregulated by the US Food and Drug Administration (FDA). The Dietary Supplement

Health and Education Act (DSHEA) of 1994 (Public Law 103-417; 103rd Congress), defined a "dietary supplement" as: a product intended to supplement the diet that contains one or more of the following dietary ingredients: a) a vitamin; b) a mineral; c) an herb or other botanical; d) an amino acid; e) a dietary substance for use by man to supplement the diet by increasing the total dietary intake; or f) a concentrate, metabolite, constituent, extract, or combination of any ingredient described in clause (a), (b), (c), (d), or (e) ("Office of dietary supplements - dietary supplement health and education act of 1994," 1994).

Professional athletes are subject to restrictions imposed by the National and International Agencies of Anti-Doping for prevention and fighting against doping (taking illegal substances to improve sports performance). Anabolic steroids, stimulants, diuretics, narcotic analgesics and cannabinoids, peptide hormones, glucocorticoids, and beta-blockers are all banned (World anti-doping association, n.d.). To comply with the World Anti-Doping Agency's Prohibited List, athletes sometimes try herbal remedies or plant extracts, since the use of these is not restricted.

On January 19, 2016, the Public Broadcasting Service show, FRONTLINE along with the New York Times and the Canadian Broadcasting Corporation released an investigative report, "Supplements and Safety." The report revealed that over half of Americans take dietary supplements daily. The top selling dietary supplements in the USA are Vitamin C, Vitamin D, Vitamin E, and fish oil. More startling reports in this program included the death of a major league baseball player after taking ephedra. (Ephedra comes from the herb, ma huang, and is often used for weight loss and as an energy booster, but has been linked to heart attack and stroke). They also reported that in 2013 in Hawaii, an outbreak of liver problems overran the state's only transplant center. The liver damage was linked to "oxy-elite," a fitness supplement (US Food and Drug Administration 2014). At the Children's Hospital of Philadelphia, a group of pharmacists challenged supplement manufacturers to provide proof that their products actually contained what was stated on the label. Only 21% met the required standards. It was also reported that federal prosecutors and regulators have taken legal action against over 100 supplement companies, either for unsupported claims or for mislabeling their products. Approximately 85,000 supplements are available on the US market in a given year. The dietary supplement industry has a powerful lobbying presence in the US Capitol. (Public Broadcasting System, 2016)

Studies from various countries on use of dietary supplements have shown mixed outcomes. Doina (2014) in her study in Constanţa, Romania examined competitive, professional, and amateur athletes who use pharmaceutical drugs and nutritional supplements to increase power, strength, and muscular hypertrophy, and to treat muscle pain and injuries. Study participants reported using fewer pharmaceutical drugs and more nutritional supplements, despite relatively low awareness of the side effects of these supplements. Though anti-inflammatory drugs and physical therapy were available to them for muscle pain and injury, many reported using alternative remedies such as herbal extracts (combinations of mint, eucalyptus, ginseng, salvia, juniper, rosemary, lemongrass, camphor, St. John's Wort), and nutritional supplements including magnesium, calcium and potassium - minerals that are directly involved in nerve impulse transmission and muscle contraction. Other popular products used for joint pain and inflammation included omega 3 fatty acids, glucosamine and chondroitin sulfate.

Aina and Oluwayemisi (2014) studied use of supplements in college students at a university in Lagos, Nigeria. The majority (87%) used supplements, while 50% felt that supplement use should be encouraged. Only half reported their supplement use to their physicians. Only 14% reported knowledge about supplement side effects. The most popular supplement they used was vitamin C.

Parnell, Wiens, and Erdman (2015) examined relationships among dietary supplements and reasons athletes used them. Participants were 567 Canadian athletes who engaged in athletic training for 5 hours or more per

week. Vitamin and mineral supplements were associated with general health, while use of BCAAs, glutamine, and protein powder were reportedly used for boosting immunity and enhancing general health.

El Khoury and Antoine-Jonville (2012)assessed the prevalence of nutritional supplement consumption and the potential influencing factors among people exercising in gyms in Beirut Lebanon. In this cross-sectional study, 512 exercisers, aged between 20 and 50 years, were randomly selected from gyms. The nutritional supplement consumption was reported among 36.3% (95% confidence interval 32.2–40.5) of participants, with a weak presence of medical supervision.

Tawfiket al. (2016)investigated supplement consumption as well as perspectives of young Egyptian athletes. Three hundred and fifty eight adolescent athletes (aged 13–18 years old) recruited from 4 sport clubs and 2 fitness centers in Greater Cairo governorate completed questionnaires. The prevalence of sport supplement consumption was (48.9%, n = 175), predominantly from sport drinks (66.9%) and creatine (54.3%). Coaches were the partcipants' primary source of sport nutrition information.

Borrione et al. (2012) evaluated consumption of plant-derived nutritional supplements among a group of trained athletes. Using plasma biochemical markers and hormonal profiles they found increased plasma levels of progesterone and estrogen in 65% of their investigated athletes, highlighting that habitual consumption of these supplements is associated with hormonal alterations that could potentially lead to health complications.

Abe, Hein, & Gregory PJ (2015) completed a review of two websites - FDA MedWatch and Health Canada - to identify regulatory alerts regarding dietary supplements from January 1, 2005, through December 31, 2013. Of the 1560 dietary supplement alerts, 83% were identified through Health Canada, and 18% through FDA MedWatch. Though country of origin was not provided in the alerts, the United States was the most common place, followed by China and Canada. Most supplements associated with the alerts were purchased online, through retail stores, or from mail order services. Intended use for these supplements included: sexual enhancement, weight loss, bodybuilding or athletic performance, general health, and energy boosting. Most common reasons for issuance of regulatory alerts were: pharmaceutical product contaminant, heavy metal contaminant, an ingredient shown to cause harm, a bacterial contaminant, packaging problems, a production plant or manufacturer that did not meet good manufacturing practices, and fungal or other contaminants. For some, there was more than one reason for a regulatory alert.

Other researchers have found chemical toxins in popular supplements. Gabriels, Lambert, Smith, Wiesner, and Hiss (2015) found melamine contamination in 47% of 138 nutritional supplements bought from various shops, pharmacies, outlets, suppliers, manufacturers and distributors, and directly from consumers. All were bought in South Africa, but some were imported from other countries. Melamine is composed of multi-amine. As a source of non-protein nitrogen, it falsely increases the claimed protein content of some products, and is a food adulterant/contaminant. Sometimes it ends up in food via carry over from the illegal use of melamine in animal feed. Melamine has been identified as a nephrotoxin in both animals and humans (Dalal& Goldfarb, 2011).

Hedegaard, Rokkjaer, and Sloth (2013) in their research, found arsenic contamination in some dietary supplements purchased in Denmark (herbs, other botanicals and algae – all advertised as having health benefits). Contaminated supplements originated in Asia, Europe, and the USA. Since herbs are natural products, grown in the ground, they may absorb elements such as arsenic from the water, soil they are grown in, or from pesticides and fertilizer. The results demonstrated that consumption of certain dietary supplements could contribute significantly to the dietary exposure to inorganic arsenic at levels close to the toxicological limits established by the European Food Safety Authority (EFSA).

In the United States, the FDA regulates labeling for nutritional products. If a manufacturer wants to make a claim about a supplement, the manufacturer must have substantiation that the claim is truthful and must submit a notification with the text of the claim to FDA no later than 30 days after marketing the dietary supplement with the specific claim. Those claims are limited to "general structure-function." General claims, such as "contains nutrients that enhance bone health," or "contributes to heart health" can be made, but sellers can't assert that a product prevents or treats disease. The FDA has the authority to stop the manufacturer from advertising if a claim is considered impermissible. The DSHEA holds supplement manufacturers to industry standards for retaining product quality. The Federal Trade Commission has jurisdiction over supplement advertising: Manufacturers must report truthfully what the supplements contain and must back up with scientific proof any claims they make. Also the Dietary Supplement and Nonprescription Drug Consumer Protection Act of 2006 requires "adverse event reporting," meaning that the FDA must notify the public about any adverse incidents (e.g. rapid pulse, high blood pressure, gastrointestinal distress), related to a product once it is on the market (US Food and Drug Administration, 2013, June 14).

In Palestine, there is no independent regulatory agency for food and drugs like the US FDA. Instead, the Palestinian Ministry of Health has a drug registration department that regulates drugs, herbs, and food supplements. The Ministry of Health - Nutrition Department, which captures 60% of sport supplements in the market, registers sport nutritional supplements. About 40% of these products are illegally marketed (e.g. via internet shopping, or products coming in from Israel). Food labeling for sport supplements is the responsibility of Palestinian Standard Institute.

In the US, sports nutrition supplement sales are expected to double over the next 10 years. Reports in Nutrition Business Journal include an estimated $38.8 billion in nutritional supplement sales in 2015. When broken down by category, 14% were from sports supplements, 31% vitamins, 7% minerals, 12% meal supplements, 18% herbs and botanicals, and 18% "specialty/other." Use by females has steadily risen. US Army personnel increasingly report using dietary supplements to increase physical and mental strength (Supplement business report 2016).

Given the data from these studies, there is reason for the general public to be concerned with the quality of products they've purchased, as well as the potential health threats associated with their use. The aims of this study were to: 1) find out why people use nutritional supplements 2) gain more knowledge about the most commonly used supplements and any side effects that the users experienced and 3) compare and contrast the results between study participants in a West Bank, Palestine community and one in Eastern Massachusetts, USA.

**Methodology**

Study participants (n= 355) were randomly selected from fitness centers and sports clubs, in two locations – one in several cities and towns in Eastern Massachusetts, USA and the other in several cities and towns in the West Bank, Palestine. A survey, (adapted from: Massad, S.J., Donohue, R, Hodge, J.J., & Shier, N.W. 2004) was administered to assess the extent to which selected participants use supplements, their primary reasons for use, and their awareness of potential health risks. They were also asked to describe the type of exercise they did during a typical week, how much money they typically spent per week on supplements, what factors influenced their use, and whether they had experienced any side effects.

Statistical Package for the Social Sciences (SPSS) version 24 was used to compute data. Independent samples t-tests were used to compute whether there were significant differences in number of different supplements used based on: participant sex, participants' belief in whether supplement use improved their exercise performance, and participants' awareness of specific health risks associated with supplements they used. Independent

samples t-tests were also used to examine whether there were significant differences in total number of different supplements used based on participants' location (US or West Bank), level of education, or whether they had taken a nutrition course.

Chi-square tests of independence were performed to examine the relationship between participant location (West Bank or USA) and how frequently creatine, ginseng or herbs, supplements designed for weight loss, whey protein, branch-chain amino acids, and multivitamins and mineral were used. A chi-square test of independence was performed to examine the relationship between participant location (West Bank or USA) and belief that exercise performance is improved due to supplement use.

The relationship between money spent each week on supplements and different supplements used was investigated using Spearman's rank-order correlation. The relationship between frequency of fitness facility use each week and number of different supplements used was investigated using Spearman's rank-order correlation. The relationship between number of different supplements used and number of side effects experienced was investigated using Person product-moment correlation coefficient.

Subjective data on factors that influenced use of supplements, amount of money spent on them, awareness of side effects, types of supplements used, and adverse consequences due to supplement use were tabulated and used for further analysis and discussion.

**Results**

Of the 355 participants that completed the surveys, 175 (49%) were in the Eastern Massachusetts, USA community and 180 (51%) were in the West Bank, Palestine; 240 (68%) were male, 115 (32%) were female. The mean age was 25.6, standard deviation (SD) was 10.4, and median age was 22. Two hundred and nine (59%) had taken at least one college-level-nutrition course; 146 (41%) had not. Of those who reported regular supplement use (n=263; 74%), 174 (66%) felt that nutritional supplement use improved their athletic performance; 89 (34%) did not. Thirty three percent of the supplement users reported that they were aware of the risks. Fifty-three (15%) reported spending more than $10 per week on supplements, while the remaining 302 participants (85%)reported spending $10 or less per week.

Eighty-three participants (23%) had a high school education, 174 (49%) were currently college students, 74 (21%) had completed Bachelor's degree, 17 (5%) had completed a Master's degree, and 7 (2%) had completed a Doctoral degree. Seventy-four (21%) reported using their fitness facility daily, 122 (34%) went 5-6 times a week, 98 (28%) went 3-4 times a week, 36 (10%) went once or twice a week, and 25 (7%) went less than once a week. Fifteen percent of participants reported palpitations and diarrhea from using supplements, while 12% reported headaches, and 10% reported experiencing high blood pressure, dehydration, cramps, and nausea.

Independent samples t-tests revealed significant differences in the number of different supplements used based on: 1) participant sex (Males ($M$ = 6.93, $SD$ = 5.81), Females ($M$ = 4.81, $SD$ = 5.30), $t$ (204.1) = 3.26, $p$ = .001, two tailed) - males used significantly more supplements than females, 2) participants' belief that supplement use improved their exercise performance (Yes ($M$ =8.98, $SD$ =4.99), No ($M$ =5.19, $SD$ =6.19), $t$(260) =5.33, $p$< 0.001, two tailed) - those who had faith in supplements improving their performance used more supplements, and 3) participants' awareness of specific health risks associated with supplements they use (Yes ($M$ =9.31, $SD$ =6.45), No ($M$ =6.36, $SD$ =4.62), $t$(205.7) =4.19, $p$<0 .001, two tailed) – those who reported awareness of side effects still had more supplement consumption. Independent samples t-tests did not reveal significant differences in total supplement use based on participants' location (West Bank or USA), level of education, or whether they had taken a nutrition course.

There was no evidence of a relationship between location and frequency of use of creatine, ginseng, or herbs. There were significant relationships between location and frequency of use of whey protein ($X^2$ (4, N = 330) = 11.07, p <0.05), branched-chain amino acids ($X^2$ (4, N = 329) =22.57, p <0.001) and multivitamin/minerals ($X^2$ (4, N = 333) =25.26, p <0.001). Adjusted residuals revealed that West Bank participants were more likely to use whey protein and branched-chain amino acids weekly to daily than participants from the USA. In contrast, participants from the West Bank were less likely to report weekly to daily use of multivitamin/minerals, and weight loss products than participants from the USA.

The relationship between participant location (West Bank or USA) and belief that exercise performance improved due to supplement use was significant, $X^2$ (1, N = 263) =58.02, p < 0.001. Ninety two percent of West Bank participants compared to 47% of USA participants believed that supplements improved exercise performance.

Spearman's rank-order correlation showed a positive correlation of medium strength between the amount of money spent each week on supplements and different supplements used, which was statistically significant ($r_s$ (264) = .46, $p$<0.001. (See figure 1).Spearman's rank-order correlation showed a weak negative correlation between the frequency of fitness facility use each week and number of different supplements used, which was statistically significant ($r_s$ (334) = -.23, $p$<0.001). (See figure 2).Person product-moment correlation coefficient showed a weak negative correlation between the between number of different supplements used and number of side effects experienced, which was statistically significant ($r$ = .-.13, $n$ =334, p <0.05). More supplement use was associated with fewer side effects.

**FIGURE I: RELATIONSHIP BETWEEN MONEY SPENT EACH WEEK ON SUPPLEMENTS AND NUMBER OF DIFFERENT SUPPLEMENTS USED**

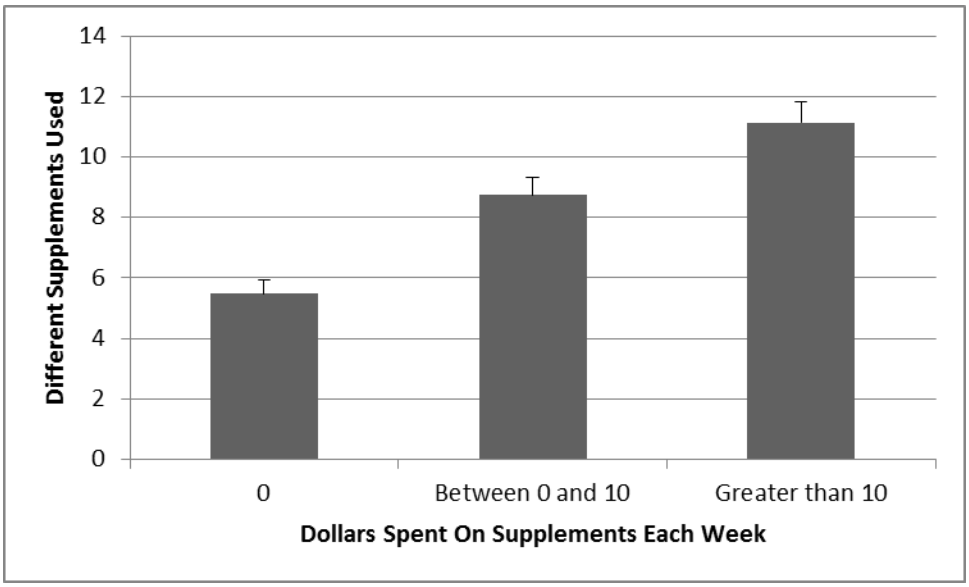
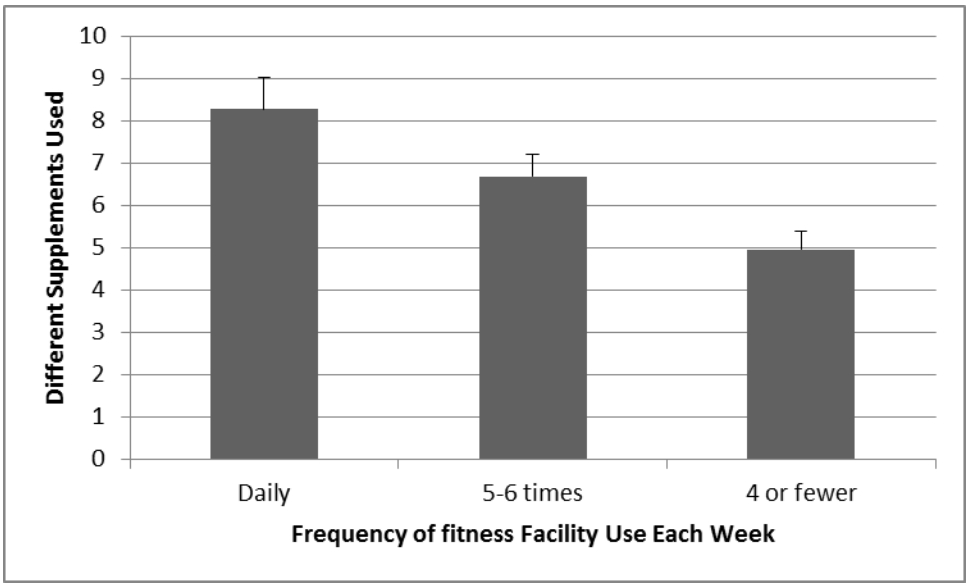


**FIGURE 2: RELATIONSHIP BETWEEN FREQUENCY OF FITNESS FACILITY USE EACH WEEK AND NUMBER OF DIFFERENT SUPPLEMENTS USED**




Close to half of the participants reported using whey protein and vitamin and mineral supplements, while close to1/3 reported using branched chain amino acids and creatine, and fewer than ¼ reported using ginseng and herbs, and weight loss products. The total number of participants who reported weekly to daily use of the various supplements and the total number and percent from each location (US or West Bank) is presented in table 1.

**Table 1 Frequency of supplement use**

| **Supplement** | **Number and total percent reporting weekly to daily use (N=356)** | **US (N=175)** | **W. Bank (N=181)** |
|---|---|---|---|
| Whey Protein | 166 (47.0%) | 68 (39%) | 98 (56%) |
| Branched-chain amino acids | 107(30%) | 39(19%) | 68 (37%) |

| | | | |
|---|---|---|---|
| Creatine | 92 (26%) | 37 (22%) | 55 (30%) |
| Vitamins and minerals | 154 (43%) | 91(52%) | 61 (33%) |
| Ginseng/herbs | 52 (15%) | 20 (11%) | 32 (18%) |
| Weight loss products | 36 (10%) | 28 (16%) | 8 (4%) |

The most common reasons given for supplement use were 1) trainer or coach recommended it, 2) friend recommended it, and 3) started using it after seeing an advertisement. Results are tabulated in table 2.

**Table 2. Primary Reasons for Supplement Use**

| **Reason** | **Frequency** |
|---|---|
| Trainer or coach recommended it | 72 |
| A friend recommended it | 52 |
| Started using it after seeing an advertisement | 31 |
| To improve general health | 22 |
| To improve body building/weight lifting exercises | 20 |
| Immune system boost | 20 |
| Other: | |

| | |
|---|---|
| Decided to use them after doing my own research/reading | 11 |
| To ensure adequate vitamin and mineral intake | 11 |
| Dr. recommended it | 9 |
| Recommended by naturopath, nutritionist, homeopath or chiropractor | 3 |
| Parents recommended | 3 |
| I wanted to get bigger | 2 |
| I'm a beast | 1 |
| Pregnancy | 1 |
| Herbal medicine as religious practice | 1 |
| Take B1-2 and a multivitamin because | 1 |
| I'm vegan | 1 |
| Training for a half marathon whilevegan, didn't feel as if I was getting enough protein | 1 |
| | 1 |

The most common locations where supplements were typically purchased were through a health club, another type of store, or via the Internet. Results are presented table 3.

**Table 3. Locations from which Supplements Are Typically Purchased**

| **Location** | **Frequency (Total)** | **US** | **West Bank** |
|---|---|---|---|
| My health club | 55 | 7 | 48 |
| At a pharmacy | 45 | 37 | 8 |
| At another type of store | 78 | 50 | 28 |
| Through the Internet | 60 | 32 | 28 |
| Mail order catalogue | 5 | 3 | 2 |

The most common reported reasons for not using supplements were: 1) I don't know enough about them, 2) I don't think that they are effective, 3) I believe that they have harmful side effects, or 4) They are too expensive. Results are summarized in table 4.

**Table 4. Reasons for not using supplements**

| **Reason** | **Frequency** |
|---|---|
| I don't know enough about them | 53 |
| I don't think that they are effective | 29 |
| I believe that they have harmful side effects | 34 |
| They are too expensive | 45 |

Other:

| | |
|---|---|
| I do not need them | 5 |
| They are not regulated | 4 |
| Not necessary for someone who is moderately active | 3 |
| I haven't been working out as consistently as I had in the past so I haven’t been bothered to buy supplements like I used to | 1 |
| Used whey protein in college as a varsity athlete and found that it didn't feel right in my system and was hard to digest. | 1 |
| Workout for stress relief and for active lifestyle-don’t feel need for supplements to achieve my goals. | 1 |
| General inconvenience | 1 |
| I don't care for them | 1 |
| Can get all the nutrition needed by eating a balanced diet, not so insecure that I feel the need to supplement | 1 |
| I feel that I eat correctly | 1 |
| Not enough information on side effects | |

A list of less commonly used additional supplements used, such as omega 3 fatty acids and vegan protein supplements is in table 5.

**Table 5. Other supplements used**

| Supplement | Frequency |
|---|---|
| Fish Oil/ Omega-3 fatty acids | 8 |
| Vegan protein powder | 6 |
| C4 Extreme pre workout formula | 3 |
| Coenzyme Q-10 | 3 |
| Calcium and Vitamin D | 3 |
| Glutamine | 2 |
| Egg protein | 1 |
| Jack3d pre-workout formula | 2 |
| Trimethylglycine (TMG) | 1 |
| Protein Bars | 2 |
| Raspberry Ketones | 2 |
| Gingko Biloba | 1 |
| Glucosamine | 1 |
| Non soy protein powder with leucine | 1 |
| L Carnitine | 1 |

| | |
|---|---|
| Occuvite | 1 |
| Probiotocs | 1 |
| Turmeric pills 1/day; milk thistle 1/day | 1 |
| Probiotics | 1 |
| Pre workout Cellular C4 Daily | 1 |
| Casein protein | 1 |
| Boost | 1 |
| Post workout recovery by ProGym | 1 |
| Protein powder mix: amino acids plus creatine | 1 |
| Athlean X | 1 |

**Discussion:**

In this sample, the most popular supplements used were whey protein and multivitamins – both are generally safe in low to moderate doses. Excess protein (more than double the Recommended Dietary Allowance or RDA), including that coming from whey protein supplements can lead to dehydration, urinary calcium loss, and weight gain (Bray et al, 2012). Those with cow's milk allergies should avoid whey.

Vitamins and minerals are toxic to the liver in high doses – generally doses that exceed 5 to 10 times the RDA. High doses of minerals and fat-soluble vitamins pose a greater risk than water-soluble vitamins. Vitamin D has been widely promoted as a way to improve calcium retention and bone health. Yet in the recent years, studies on the effect of intravenous administration of large doses vitamin D given annually or monthly resulted in an actual significant increase in the number of falls and fractures in elderly patients (Gallagher, 2016).

Excessive doses of vitamin C or zinc can lead to gastrointestinal distress, including diarrhea, and stomach cramps (Sego, 2011). Excessive doses of selenium could potentially cause hair loss, gastrointestinal distress, fatigue, and mild nerve damage. Excessive doses of vitamin B-6 can cause temporary neuropathy that can be reversed if the dosage is discontinued. High doses of vitamin C also blunt blood sugar test results, since the chemical structure of vitamin C (ascorbic acid) is very similar to that of glucose (Bahr & Wilson, 2015).

Close to1/3 (30%) of participants reported using branched chain amino acids (BCAA), which are often promoted to boost protein synthesis during and after heavy exercise. BCAAs include isoleucine, leucine, and

valine. BCAA are catabolized in the skeletal muscle and enhance protein synthesis (Ra et al, 2013). They compete with and limit the amino acid tryptophan into the brain, hence, are often associated with increased mental alertness and reducing fatigue. Side effects may include nausea.

Twenty nine percent reported regular use of creatine. Higher intensity, shorter duration exercises in which the body relies on the Adenosine Triphosphate Phosphocreatine (ATP-PC) system for fuel are more demanding of creatine – phosphocreatine is involved in resynthesizing ATP when it splits into ADP and inorganic phosphate. Even though not typically recommended by Nutritionists, creatine supplements are sometimes used for exercises involving bodybuilding or weight lifting. Weight gain is the most common side effect (Kreider et al, 2010).

Only 8 participants reported using Omega-3fattyacids. This is sometimes used by athletes due to the associated reduction of inflammatory indices, and possibly promotion of exercise performance. The main concern associated with excess intake is that it may increase the risk of hemorrhaging due to the decreased platelet aggregation associated with high doses (Detopoulou&Papamikos, 2014).

Not surprisingly more males than females reported using supplements. Advertisements for products that are purported to increase muscle mass are primarily aimed at men. Awareness of health risks associated with supplement use was not especially high. Only one third of the total participants reported being aware of health risks associated with their use. Interestingly, more supplement use was associated with fewer side effects. It's possible that those who experienced side effects used fewer supplements than those who didn't experience many side effects.

Even though some of the reported side effects from supplement use (high blood pressure, rapid pulse, headaches, gastrointestinal distress, and nausea) may not be life threatening, there is enough evidence to be concerned about potentially more serious dangers. This is underscored by the findings of melamine and arsenic contamination in some supplements (Hedegaard, Rokkjaer, and Sloth, 2013 and Gabriels, Lambert, Smith, Wiesner, and Hiss, 2015).

Our findings on why athletes chose to use supplements were consistent with Parnell, Wiens, and Erdman (2015) and Abe, Hein, & Gregory PJ (2015). In all 3 investigations, those who were surveyed reported using supplements for general health, bodybuilding, energy-boosting, immunity, or weight loss. Like the Doina (2014) study, participants in this study reported relatively low awareness of supplement risks and side effects.

## Conclusion

Even though the study participants did not report especially high incidence of adverse side effects from supplement use, there was enough evidence that the participants who exercise regularly put some faith in supplement use to improve their performance. The main difference in supplement use between West Bank participants and those in the US was that in the US there was greater use of vitamins and minerals and weight loss products. This may be due to more widespread availability in the US. Study participants in the US put more faith in supplement use and spent a little more money each week, than those in the West Bank. This may also be attributed to more advertising and availability of supplements.

Recommendation: Nutritionists, Dietitians, and other health professionals who work with athletes should stress to supplement users to choose wisely, heed warnings, avoid very high doses, follow directions on labels, research the purity and quality, and stay abreast of any reported adverse effects by periodically checking websites and regulatory warnings. Both the US Food and Drug Administration and the Consumer Lab regularly

post, via Internet sites, safety alerts, advisories, information about recalls, and current warnings on dietary supplements.

**References**

Abe AM, Hein DJ, & Gregory PJ (2015). Regulatory alerts for dietary supplements in Canada and the United States, 2005-13. *American Journal of Health System Pharmacy: AJHP official journal of Health System Pharmacists, 72*(11), 966–971. doi:10.2146/ajhp140574

Aina, B., &Ojedokun, O. (2014). Knowledge and use of dietary supplements by students of College of Medicine, University of Lagos, Idi-Araba, Lagos, Nigeria. *Journal of Basic and Clinical Pharmacy*, *5*(2), 34. Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA373207657&asid=71d7b457919a7b2bee613a6df5a2ad50

Bahr, R. L., & Wilson, D. C. (2014).The impact of high-dose vitamin C on blood glucose testing in 18F-FDG PET imaging.*Journal of Nuclear Medicine Technology*, *43*(1), 70–71. doi:10.2967/jnmt.114.140335

Bray, G. A., Smith, S. R., de Jonge, L., Xie, H., Rood, J., Martin, C. K.& Redman, L. M. (2012). Effect of dietary protein content on weight gain, energy expenditure, and body composition during overeating.*JAMA*, *307*(1), 47. doi:10.1001/jama.2011.1918

Detopoulou, P., &Papamikos, V. (2014). Gastrointestinal Bleeding after High Intake of Omega-3 Fatty Acids, Cortisone and Antibiotic Therapy: A Case Study. *International Journal of Sport Nutrition and Exercise Metabolism*,*24*(3), 253-257. doi:10.1123/ijsnem.2013-0204

Dalal, R. P., & Goldfarb, D. S. (2011).Melamine-related kidney stones and renal toxicity.*Nature Reviews Nephrology*, *7*(5), 267+. Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA255494822&asid=0e5b51919fb865ae8e2aebaa726bdf8f

Doina, M. (2014).The demand for pharmaceutical products used by athletes to treat muscular and articular afflictions--a farmacoeconomic study.*Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health.*

Eliason, M. J., Eichner, A., Cancio, A., Bestervelt, L., Adams, B. D., &Deuster, P. A. (2012). Case reports: Death of active duty soldiers following ingestion of dietary supplements containing 1, 3-Dimethylamylamine (DMAA). *Military Medicine*, *177*(12), 1455–1459. doi:10.7205/milmed-d-12-00265

El Khoury. D and Antoine-Jonville.S (2012).Intake of Nutritional Supplements among People Exercising in Gyms in Beirut City. Journal of Nutrition and Metabolism Volume 2012, Article ID 703490, 12 pages doi:10.1155/2012/703490

Gabriels, G., Lambert, M., Smith, P., Wiesner, L., & Hiss, D. (2015). Melamine contamination in nutritional supplements - Is it an alarm bell for the general consumer, athletes, and 'Weekend Warriors'? *Nutrition Journal*, *14*(1). Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA459624157&asid=a0a4f2cc553c579a469e9cf9b7391697

Gallagher, J.C. (2016). Vitamin D and falls - The dosage conundrum.*Nature Reviews: Endocrinology 12* (11), 680-684.

Hedegaard, R. V., Rokkjaer, I., & Sloth, J. J. (2013). Total and inorganic arsenic in dietary supplements based on herbs, other botanicals and algae--a possible contributor to inorganic arsenic exposure. *Analytical and Bioanalytical Chemistry*, *405*(13), 4429+. Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA338217456&asid=579a4736c752104426a89a1ba143409d

Kreider, R. B., Wilborn, C. D., Taylor, L., Campbell, B., Almada, A. L., Collins, R., Antonio, J. (2010). ISSN exercise & sport nutrition review: research & recommendations. *Journal of the International Society of Sports Nutrition*, *7*, 7. Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA223691539&asid=7a2ef1bd21f99d62d0099a663ab894c5

Massad, S.J., Donohue, R, Hodge, J.J., & Shier, N.W. 2004): Nutritional supplements and college athletes: An up-to-date assessment tool. *Journal for the International Council of Health, Physical Education, Recreation, Sport, and Dance, XL(3):25-28)*

Office of dietary supplements - dietary supplement health and education act of 1994. (1994, October 25). Retrieved December 28, 2016, from Office of Dietary Supplements, https://ods.od.nih.gov/About/DSHEA_Wording.aspx#sec3

Parnell, J. A., Wiens, K., & Erdman, K. A. (2015).Evaluation of congruence among dietary supplement use and motivation for supplementation in young, Canadian athletes.*Journal of the International Society of Sports Nutrition*, *12*(48). Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA451670496&asid=ce2cfc3242b147040e0513a2591b0e5f

Public Broadcasting System (2016, June 9) Supplements and Safety. Retrieved December 1, 2016 from http://www.pbs.org/wgbh/frontline/announcement/jan-19-frontline-and-the-new-york-times-investigate-supplements-and-safety/

Ra, S.-G., Miyazaki, T., Ishikura, K., Nagayama, H., Komine, S., Nakata, Y.,&Ohmori, H. (2013). Combined effect of branched-chain amino acids and taurine supplementation on delayed onset muscle soreness and muscle damage in high-intensity eccentric exercise.*Journal of the International Society of Sports Nutrition*, *10*, 51. Retrieved from http://libraries.state.ma.us/login?gwurl=http://go.galegroup.com.fscproxy.framingham.edu/ps/i.do?p=HRCA&sw=w&u=fst&v=2.1&it=r&id=GALE%7CA349125402&asid=3d11e24d048c7d07f0b8d03926470bdf

Sego, S. (2011). Alternative meds update: what you should know about the herbs and supplements patients use .*Clinical Advisor,* 138-138.

Supplement business report 2016. *Nutrition Business Journal* 6/1/2016 ID: NUT15043592. Retrieved December 28, 2016 from http://www.marketresearch.com/Nutrition-Business-Journal-v2520/Supplement-Business-10145498.

Tawfik S, El Koofy N, Moawad EMI (2016) Patterns of Nutrition and Dietary Supplements Use in Young Egyptian Athletes: A Community-Based Cross-Sectional Survey. PLoS ONE 11(8): e0161252. doi:10.1371/journal.pone.0161252

US Food and Drug Administration (2014, July 1) FDA Investigation Summary: Acute Hepatitis Illnesses Linked to Certain OxyElite Pro Products. Retrieved December 28, 2016 fromhttp://www.fda.gov/food/recallsoutbreaksemergencies/outbreaks/ucm370849.htm.

US Food and Drug Administration. (2013, June 14). Dietary supplement and nonprescription drug consumer protection act. Retrieved December 28, 2016, from http://www.fda.gov/RegulatoryInformation/Legislation/SignificantAmendmentstotheFDCAct/ucm148035.htm

World anti-doping association (n.d.). National anti-doping organizations (NADO) Retrieved December 28, 2016 from https://www.wada-ama.org/en/national-anti-doping-organizations-nado