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Research Article

Association of Beverage Consumption with Obesity in Healthy Adults

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Abstract

Background: The increased consumption of sugar-sweetened beverages (SSBs) has been found to be an important contributor of calories in the diet. Whether there is an association between the increased consumption of SSBs and the high rates of overweight and obesity is still questionable. The objective of this study was to examine the relationship of weight status and beverages consumed of adults in a residential compound in Abu Dhabi.

Methods: Forty nine out of 65 residents form Al Reef Villas in Abu Dhabi agreed to participate in the study. Initial assessments including beverages frequency questionnaire and anthropometry measurements were completed for all participants. Participants who were identified as high beverages consumers were invited to a one-month intervention aiming to limit their beverages consumption. A final assessment was completed for all high consumers of beverages at the end of the one-month intervention.

Results: 55% of the subjects were overweight or obese, and 51% had abdominal obesity. 73% consumed 100% fruit juices with no added sugar, 65% consumed soft drinks, and 60 % consumed plain milk and milk products. The majority (69%) consumed tea beverages rather than coffee beverages. There was no association between weight & beverages consumption. The mean energy percentage from beverages was 14.2 (±11.1) among all participants. 53% were considered high consumers of beverages and 47% (n = 23) were considered low consumers of beverages. The one-month intervention showed a significant decrease in % of calories from beverages and weight in the overweight & obese intervention group ($p < 0.001$ and $p < 0.05$) respectively.

Conclusion: This study highlighted major health problems in Abu Dhabi including high rates of overweight, obesity, and abdominal obesity. The one-month intervention was effective in reducing the energy percentage from beverages and weight of the overweight and obese participants, but no association was found in this sample between beverages consumption and overweight and obesity.

Keywords: beverages consumption, SSB, obesity, waist circumference, adults, Abu Dhabi

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1. Introduction

The term "Beverages" is very broad, and several subdivisions and definitions fall beneath it. Generally, beverages are any liquids or fluids that people drink. However, there are many classifications to identify beverages. One classification is to divide beverages into alcoholic and non-alcoholic beverages depending on their alcohol content. The alcoholic beverages are drinks containing ethyl alcohol and they are produced by the fermentation of yeast, sugars, and starches. Categories of alcoholic beverages include Wine, beer, and spirits. The non-alcoholic beverages can be further subdivided into carbonated (sodas and tonic water) and non-carbonated (coffee, tea, fruit juices and fruit drinks) according to their gas (CO_2) content [7]. Second classification is to divide beverages according to their nutrient density. These include nutrient-dense beverages (water), beverages with some nutritional benefits (fruit and vegetable juices, whole milk, alcohol, and sports drinks), and nutrient-poor beverages (soft drinks and juice drinks) [17]. Another classification is to divide beverages according to their caloric and sugar content. Subcategories of this include non-caloric beverages, non-calorically sweetened beverages, natural sweet beverages, and calorically (sugar) sweetened beverages [17].

Statistics of the US population showed that 63% of adults consume sugary drinks. The current per capita consumption of sugary drinks is estimated to be 203kcal/day among adults in comparison to only 50 kcal/day in 1965 [20]. In addition, calories from SSBs increased by 60 % among the US children and the percentage of children consuming SSBs increased from 79% to 91% between 1989 and 2008. Children and youth consumed about 224 calories per day from sugary beverages in 1999 to 2004. This made up about 11% of their daily calorie intake during that period of time [21].

On the other hand, a decrease in SSBs consumption among youth and adults was observed in the United States between 1999 and 2010. The SSBS consumption decreased among youth by 68 calories/day and among adults by 45 calories/day. In 2009-2010, SSBs contributed to 8% and 6.9% of daily energy intake among youth and adults, respectively. Soda and fruit drink consumption decreased between 1999 and 2010, whereas the consumption of sports and energy drinks and sweetened coffee and teas increased [12]. In the UK, beverages accounted for 21%, 14% and 18% of energy per day for children, adolescents, and adults, respectively. Also the British children, adolescents, and adults experienced important shifts in beverages' consumption since the 1990s. The most important shifts among children and adolescents are a decrease in consumption of high-fat milk with a shift towards sodas, fruit drinks, juices, and sweetened dairy. On the other hand, consumption of dairy, sweetened tea and coffee

and other energy-containing drinks decreased among adults, but alcohol and juices increased [23].

Regionally, there are limited statistics that show the consumption patterns of SSBs. However, a recent study by Basu, McKee, Galea, and Stuckler [1] studied soft drink consumption in 75 countries including the GCC. The results of it showed that soft drink consumption increased globally from 36 liters per person per year to 43.2 liters between 1997 and 2010. Furthermore, the results found that the United Arab Emirates was ranked the fifth highest country of soft drink consumption among all countries in 2010 with a consumption rate of 103.3 liters per person per year. Another study by Wen Ng et al. [24] examined the dietary patterns among Emiratis in 2009-2010. The results highlighted calories from beverages as one of the major contributors to total calories. They found that calories from beverages contributed to 8% of total calories for adult Emirati women and 14% for male Emirati children. Also the major SSBs consumption is associated with several health problems including, type 2 diabetes, metabolic syndrome, cardiovascular diseases, liver diseases, dental diseases, inadequate intake of some nutrients, and some types of cancer. The consumption of SSBs was found to have a role in the development of type 2 diabetes. SSBs contain high amounts of sugar allowing for a high glycemic load while having poor satiating properties. This affects insulin function in the body contributing to insulin resistance and β-cell dysfunction [21]. A meta-analysis by Malik et al. [14] on data from eight prospective cohort studies found that participants in the highest category of SSBs intake (most often 1–2 servings/day) had a 26% greater risk of developing type 2 diabetes than participants in the lowest category of intake (none or <1 serving/month). Similarly, a cohort study showed that women who consumed 2 to 3 SSBs per day had a 31% greater risk of developing type 2 diabetes, than women who consumed less than 1 SSB per month [2].

Another major concern in relation to SSBs is their impact on dental health especially for children. A study by Kolker et al. [13] found that African American children frequently consumed sugared drinks which were associated with the prevalence of dental caries. The results of a similar study by Warren et al. [22] done on 212 children suggested that consumption of SSBs in children up to 24 months of age is a strong and identifiable predictor of early childhood caries development. Also a related study found that high frequency of soft drink consumption and the presence of gingival plaque deposits is significantly associated with caries in low-income African-American adults [3].

The consumption of SSBs was also contributed to an inadequate intake of important nutrients including calcium, iron, folate and vitamin A by replacing milk consumption

among children [19]. A study by Rodriguez-Artalejo et al. [18] found that consumption of sweetened soft drinks was associated with a lower consumption of milk among Spanish children. Another study by Harnack, Stang, and Story [8] found that US children and adolescents in the highest soft drink consumption category consumed less milk and fruit juice compared with those in the lowest consumption category.

Furthermore, some studies have shown a positive association between SSBs consumption some types of cancers including endometrial, pancreatic, and prostate cancer. A recent study found that the risk of type I endometrial cancer was 78% higher among postmenopausal women in the highest quintile of SSBs intake compared to women with zero SSBs intake [10]. Many studies have found a strong association between SSBs and overweight and obesity. A 20-year study by Mozaffarian et al. [15] has done on 120,000 men and women and found that people who increased their sugary drink consumption by one 12 Oz. serving per day gained more weight over time than people who did not change their intake. Another recent study by Basu et al., [1] has examined 75 different countries worldwide and found that a 1% rise in soft drink consumption was associated with an additional 4.8 overweight adults per 100 and 2.3 obese adults per 100.

Moreover, a study by Tol Chan [4] has investigated the association between SSBs consumption and BMI using data from the National Health and Nutrition Examination Survey 2003-2004 and concluded that average BMI was positively associated with the consumption of sugar-sweetened fruit drinks and soft drinks but not with natural fruit juices.

The main purpose of the study is to examine weight status and percentages of calories consumed from beverages of adults in a residential compound in Abu Dhabi before and after a one-month pilot intervention to decrease beverages' consumption.

2. Methodology

2.1. Participants

In this intervention study, residents from Al Reef Villas in Abu Dhabi were chosen randomly over a two weeks period during spring 2014. The study leader was passing villas every day, except for the weekend days, in the afternoon (from 4 PM – 7 PM), explaining the purpose of the visit to the first person that opens the door, and asking if he/she and/or family members are willing to take part in the study. 65 residents were invited to participate in the study. The researcher handed out written study information along with explaining the study details orally to people who were invited. In addition,

written informed consent was obtained from each resident who decided to participate in the study.

2.2. Beverages Questionnaire

The assessment of the level of beverages consumption was completed using a beverages frequency questionnaire that was developed by the researcher. The questionnaire was in an online format, and was provided to participants using an iPad. Moreover, the participants were provided with cups reflecting the actual serving-sizes mentioned in the questionnaire along with putting images for the different sizes in the questionnaire to let them make accurate estimate about their beverage size. The serving-sizes of beverages reflect the common sizes, which are available at the local supermarkets and most people drink. The questionnaire was divided into a background section including demographic and health status as well as beverage sections: soft drinks, juices, energy/sport drinks, & milk drinks section, coffee and tea section, and alcohol section. The first section consisted of 7 demographical open-ended questions (name, gender, date of birth, E-mail, mobile number, villa number, and medical conditions), and a physical activity close-ended question providing options (basic everyday activities, 30 min. daily, 60 min. daily, 2≥ hours daily) from which participants selected the one that reflects their physical activity.

The second beverage section consisted of a table listing 12 different types of beverages (soft drinks, diet soft drinks, 100% fruit juices with no added sugar or syrup, fruit juices with added sugar or syrup, fruit drinks with added sugar or syrup, energy drinks, sport drinks, plain milk & milk products, flavored milk & milk products, milkshakes, smoothies), and including frequency options (Never, 1 time/week, 2-3 times/week, 4-6 times/week, 1 time/day, 2 times/day, 3 ≥ times/day) and size of the beverage that the participant drinks each time (180 ml, 250 ml, 360 ml, & 500 ml).

The third beverage section consisted of a similar table but including 10 different coffee and tea beverages (tea/herbal tea, tea/herbal tea with milk, American coffee, American coffee with milk, espresso/Turkish coffee, cappuccino, café latte, caramel latte, mocha, frappe/ Frappuccino), and there were additional options on sweetness of the beverage (no sugar, 1sugar bag/tsp, 2 sugar bags/tsps., 3 ≥ sugar bags/tsps., artificial sweetener) beside frequency and size of the beverage.

The fourth and final beverage section consisted of 7 standard servings of different types of alcoholic drinks (a can of regular beer, a glass of malt liquor, table wine, fortified wine, cordial/liqueur/aperitif, brandy, a shot of 80-proof spirits) and beside each drink there were also different options on how often and how many drinks each

time (1 glass, 2 glasses, 3≥ glasses) do the participant consume that alcoholic drink. This section was optional for alcohol drinkers only.

2.3. Anthropometry Measurements

The assessment of the weight status was performed using direct measurements of height and weight to calculate BMI, and waist and hip circumferences to assess fat distribution. Weight was measured in kilograms using a calibrated digital scale, and height was measured in centimeters using a Stadiometer. All participants were asked to take off shoes when weight and height were measured. Moreover, waist and hip circumferences were measured in centimeters using a standardized measuring tape. Measurements were recorded in the questionnaire by the researcher.

3. Data Analysis

3.1. Cutoff Values

Beverage Guidance Panel [17] recommends adults to consume 10% or less of their total energy requirements from beverages. This was used as cutoff that determined if the participant was considered a high or low consumer of beverages. According to the WHO, a person with a BMI greater than or equal to 25 is considered overweight, while a person with a BMI greater than or equal to 30 is considered obese. Also the American Heart Association has defined abdominal obesity as having waist circumference ≥88 cm for women and ≥102 cm for men. These were used as cutoffs to identify overweight, obese, and abdominally obese participants.

3.2. Total Energy Requirements Calculation

Calculating the Resting Metabolic Rate (RMR) first, and further multiplying it by a physical activity coefficient provided total energy requirements for each participant. The Resting Metabolic Rate (RMR) was calculated using Mifflin-St Jeor equation as it is the preferred equation for healthy people and weight management (men: RMR = (9.99 X weight) + (6.25 X height) – (4.92 X age) + 5; women: RMR = (9.99 X weight) + (6.25 X height) – (4.92 X age) – 161).

The physical activity Coefficients was obtained from the Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (2005). The participant's response in the health status section of the questionnaire was translated into physical activity coefficient as following:

Basic everyday activities ≈1

30 min. daily ≈1.11 (men)/1.12 (women)

60 min. daily ≈1.25 (men)/1.27 (women)

2 ≥ hours daily ≈1.48 (men)/1.45 (women)

After that, 10% of total energy requirements was calculated to identify the maximum recommended daily calories from beverages for each participant.

3.3. Calories from Beverages Calculation

Average calories of each size of each beverage in the questionnaire were calculated and used as scoring values to calculate the daily calories intake from beverages for each participant. Each participant had a scoring sheet in which the beverages that he/she drinks were listed and then calories were calculated by multiplying how often per day does the participant drink that beverage by the calories of the size he/she drinks. Then calories from SSBs, 100% fruit juices, and alcoholic beverages were summed together to calculate total calories from beverages per day for each participant. Calories from plain milk and milk products and from unsweetened tea and coffee were excluded from scoring calculations, as they are not part of the beverages that have been studied.

3.4. Intervention

After doing the assessment and calculation of daily calories from beverages and total energy requirements for all participants, those who were identified as high beverages consumers were invited to a one-month intervention by taking appointment and revisiting them. This visit involved a brief individualized discussion about the beverages of which he/she consumes a lot, how much calories and sugar do these beverages provide him/her daily, and the benefits of limiting their consumption.

Then, participants were asked if they are willing to follow the intervention. Those who decided to take part in the intervention were considered the experimental group, and participants who decided not to take part in the intervention were considered the control group. At the start of the intervention, general beverages recommendations were handed out to each participant in the experimental group as a traffic light in which green resembles beverages to drink plenty, orange resembles beverages to drink occasionally, and red resembles beverages to drink rarely, if at all. In addition, each participant was given an individualized daily beverage plan which he/she is recommended to follow for one month providing 10% or less of his/her total energy

Characteristic	n (%)
Gender	
Male	22 (45)
Female	27 (55)
Age	
18 – 25	8 (16)
26 – 35	17 (35)
36 – 49	21 (43)
≥ 50	3 (6)
Medical conditions	
None	43 (88)
Diabetes	4 (8)
Other	2 (4)

Table 1: Participants' demographics (n = 49).

needs. Also, participants were provided with a diary in which they were asked to tick the days that they have followed the plan to monitor their progress in the intervention. 10-15 minutes visits were conducted at the end of each week of the intervention for each participant to check his/her diary and to adjust the beverages plan if there is any discomfort.

4. Results

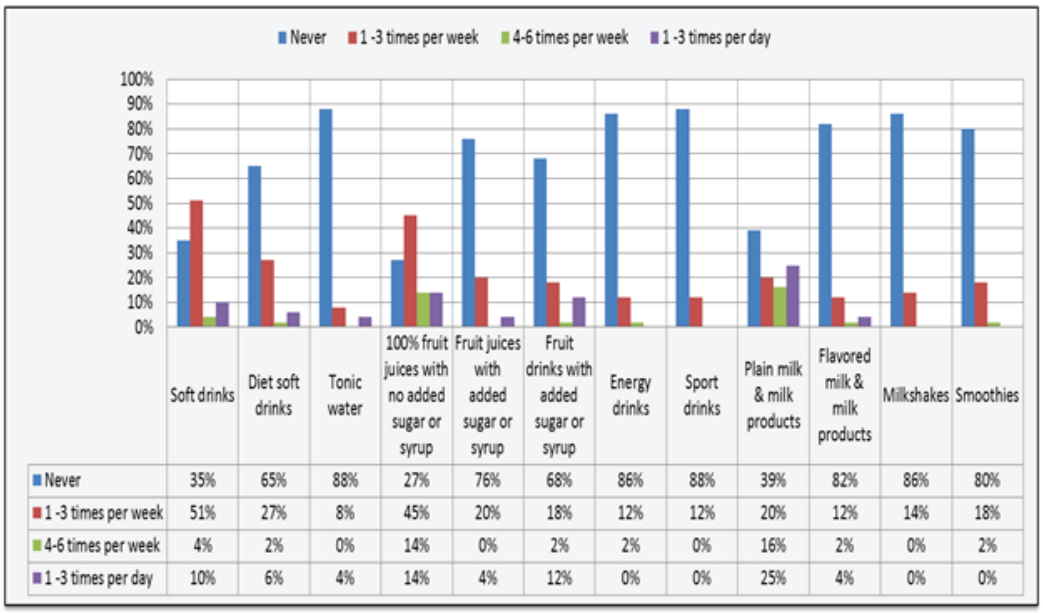
4.1. Participants

Out of 65 residents invited, 49 took part in the study. Table 1 shows the demographic characteristics of 49 residents who were included in the study.

4.2. Beverages Consumption Pattern

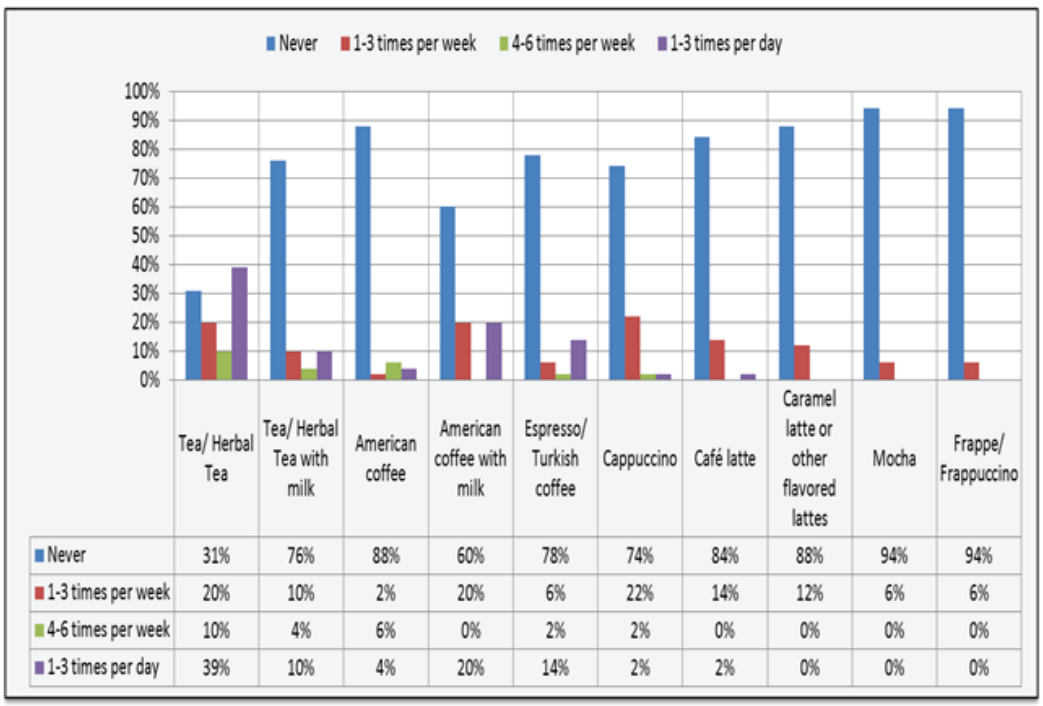
Figure 1 shows how often participants drink each type of beverages. The majority (73%) consumed 100% fruit juices with no added sugar. 65% consumed soft drinks, and 60 % consumed plain milk and milk products. Tonic water, energy drinks, sport drinks, and milkshakes are not consumed very often.

Figure 2 shows how often participants drink coffee and tea beverages. The majority (69%) consumed tea beverages rather than coffee beverages. Among all the coffee beverages, American coffee with milk was the most consumed type as 40% drinks



	Soft drinks	Diet soft drinks	Tonic water	100% fruit juices with no added sugar or syrup	Fruit juices with added sugar or syrup	Fruit drinks with added sugar or syrup	Energy drinks	Sport drinks	Plain milk & milk products	Flavored milk & milk products	Milkshakes	Smoothies
Never	35%	65%	88%	27%	76%	68%	86%	88%	39%	82%	86%	80%
1 -3 times per week	51%	27%	8%	45%	20%	18%	12%	12%	20%	12%	14%	18%
4-6 times per week	4%	2%	0%	14%	0%	2%	2%	0%	16%	2%	0%	2%
1 -3 times per day	10%	6%	4%	14%	4%	12%	0%	0%	25%	4%	0%	0%

Figure 1: Consumption frequency of different types of beverages (n = 49).



	Tea/ Herbal Tea	Tea/ Herbal Tea with milk	American coffee	American coffee with milk	Espresso/ Turkish coffee	Cappuccino	Café latte	Caramel latte or other flavored lattes	Mocha	Frappe/ Frappuccino
Never	31%	76%	88%	60%	78%	74%	84%	88%	94%	94%
1-3 times per week	20%	10%	2%	20%	6%	22%	14%	12%	6%	6%
4-6 times per week	10%	4%	6%	0%	2%	2%	0%	0%	0%	0%
1-3 times per day	39%	10%	4%	20%	14%	2%	2%	0%	0%	0%

Figure 2: Consumption frequency of coffee and tea beverages (n = 49).

it. Most of the tea and coffee consumers drink their beverage either without sugar or with 1 teaspoon of sugar; it is uncommon for tea and coffee consumers to add 2-3 teaspoons of sugar into their beverage.

55% were overweight or obese, while 45 % had normal weight. Only 29% were within the desirable levels for waist circumference. The mean energy percentage from

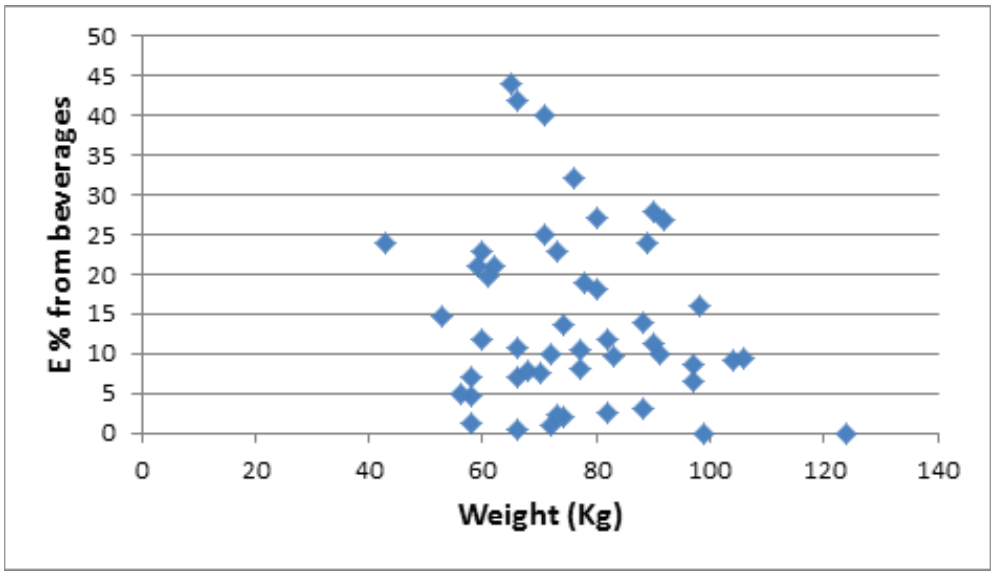


Figure 3: Weight (kg) versus energy percentage from beverages (n = 49).

	Before one-month intervention mean(SD)	After one month intervention mean (SD)	p-value
Weight	78.6 (11.3)	78.2 (11.3)	0.04
Waist Circumference	94.9 (6.7)	94.7 (6.7)	0.08
Energy % from beverages	27.1 (9.6)	12.4 (2.7)	0.0001

Table 2: Weight status and energy percentage from beverages of the overweight & obese experimental group before and after one-month intervention.

beverages was 14.2 (± 11.1) among all participants. 53% were considered high consumers of beverages and 47% (n=23) were considered low consumers of beverages. High consumers of beverages had a mean energy percentage from beverages of 22% which is four times greater than the mean percent of low consumers of beverages (5.3%).

Figure 3 shows random, nonlinear relationship between weight and beverages consumption of the 49 participants. This indicates no association between weight & beverages consumption.

Table 2 shows that the one-month intervention was effective in decreasing both the weight and energy percentage of calories from beverages in the overweight & obese experimental group.

5. Discussion

The study found that 37% were overweight and 18% were obese (55% combined). This shows that more than half of the sample falls between overweight and obesity, which reflects the UAE's high rates of overweight, and obesity. Also the results are nearly close to the results of Ng et al. [16] study (with gender differences) that showed that 66.1% of men and 60.6% of women were overweight and obese in 2013.

In addition, our study found that 51% had abdominal obesity, which is associated with a high risk for the diseases including type 2 diabetes, hypertension, dyslipidemia, cardiovascular diseases, and metabolic syndrome. According to the Health Statistics 2012 of Health Authority of Abu Dhabi (2013), the cardiovascular diseases are the first leading cause of deaths in the UAE, and the rates of people who have hypertension and high lipid values are high. Also the UAE is ranked the second highest worldwide for diabetes prevalence. Thus, it can be identified that abdominal obesity is one of the major risks to many health problems in the UAE.

The most frequently consumed beverages (on a daily basis) were plain milk and milk products, 100% fruit juices with no added sugar, and fruit drinks. This reflects that this sample does not consume SSBs on a regular basis and rather they consume them occasionally.

No association was found between weight & beverages consumption. This contradicts with Mozaffarian et al. [15], Basu et al. [1], Tol Chan [4], and Andrew Denmark [6] who all found positive association between SSBs consumption and weight gain. One attributed factor is that this study examined 100% fruit juice and alcohol along with SSBs. According to Tol Chan [4] 100% fruit juices do not associate with BMI, and the present study found that 100% fruit juices is the most consumed beverages which would have affected the results and showed no association. Another attributed factor can be the small sample size. All of the mentioned studies were done on large sample scale, which made it more applicable to identify the association.

Furthermore, the one-month intervention showed that the energy percentage from beverages reduced by 14.7% and the average weight reduced by 0.4 kg in only the overweight & obese participants and not in the normal weight participants. This indicates that the intervention was more effective in reducing energy percentage from beverages and weight for the overweight and obese participants in comparison to normal weight participants.

The reduction in energy percentage from beverages was achievable indicating that overweight and obese participants followed their beverages plan during the one-month period. However, one possible factor that might influence this result is that

overweight and obese participants, when they were asked to complete the questionnaire after the intervention, may choose what they were supposed to consume not what they actually consumed. Another factor is that time of the intervention was short which may allow the participant to follow it; however, if it was longer, they may would not manage to follow it.

In addition, the reduction in weight was quick compared to [4] who found that SSBs' reduction was associated with weight loss of 0.49 kg at 6 months and of 0.65 kg at 18 months. This indicates that possibly other factors have impacted the results. One factor is that overweight and obese participants may have a heavy meal when they were measured before the intervention, which they may did not have when they were measured after the intervention. Other factor is that maybe overweight and obese participants were encouraged to lose weight when they were told about the intervention, so they did other lifestyle/diet modifications besides beverages' reduction.

6. Limitations

Limitations of this study include the limited time of the intervention (only one month), as well as the small sample size that was not a representative sample for Al Reef residential compound. In addition, this study studied the combined effect of SSBs, 100% fruit juices, and alcohol consumption on weight status and did not examined the separated effect of each type of beverages. Furthermore, this study focused on beverages consumption in relation to weight status and did not take into account other dietary factors that impact weight status including food and eating habits.

7. Conclusion

The study highlighted major health problems in Abu Dhabi including high rates of overweight, obesity, and abdominal obesity. Plain milk and milk products, fruit juices, and fruit drinks were the most frequently consumed beverages and tea seemed more popular than coffee. The one-month intervention was effective in reducing the energy percentage from beverages and weight of the overweight and obese participants, but no association was found in this sample between beverages consumption and overweight and obesity. Further studies on larger scale of participants and time are needed to investigate the association between beverages consumption and overweight and obesity, and to examine the effectiveness of reducing beverages consumption on weight loss.

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