Individual and Worksite Environmental Factors Associated with Habitual Beverage Consumption among Overweight and Obese Adults

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ABSTRACT

The number of overweight adults has risen to two-thirds of the population [1], thus increases in energy intake, particularly from beverages are of great concern [2]. Sugar-sweetened beverage (SSB) intake has increased by 222 calories in recent decades [3], which contributes a significant source of added sugars to the American diet [4]. It has been reported that water consumers have a lower overall energy intake (~194 kcals) as compared to non-consumers of water [2] therefore substituting water for SSBs may facilitate weight loss and weight management [5]. Evidence also indicates that diet quality follows a socioeconomic gradient [6], and that the environment has a powerful influence on beverage consumption [7]. Thus, modifying the food environment could be a promising strategy for promoting healthier beverage consumption behavior. A large portion of the US population spends their day at a worksite [8] making the worksite a viable setting for implementing environmental approaches to promote effective behavior change. At this time, it is unclear if a reduction of SSB intake would be a viable dietary weight management intervention strategy. Therefore, our purpose was to determine if water, SSB intake, SSB energy, total beverage intake, and total beverage energy varies with individual and environmental factors among overweight and obese employees from 28 worksites involved in a randomized controlled weight management trial. These findings may contribute to the development of tailored weight management programs aimed to improve beverage consumption patterns.

1. Flegal KM, Carroll MD, Ogden CL, Curtin LR: Prevalence and trends in obesity among US adults, 1999-2008. *JAMA : the journal of the American Medical Association* 2010, 303:235-241.
2. Popkin BM, Barclay DV, Nielsen SJ: Water and food consumption patterns of U.S. adults from 1999 to 2001. *Obesity research* 2005, 13:2146-2152.
3. Duffey KJ, Popkin BM: Shifts in patterns and consumption of beverages between 1965 and 2002. *Obesity* 2007, 15:2739-2747.
4. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Rosett J: Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation* 2009, 120:1011-1020.
5. Dennis EA, Flack KD, Davy BM: Beverage consumption and adult weight management: A review. *Eating behaviors* 2009, 10:237-246.
6. Darmon N, Drewnowski A: Does social class predict diet quality? *The American journal of clinical nutrition* 2008, 87:1107-1117.

7. Lowe MR, Tappe KA, Butryn ML, Annunziato RA, Coletta MC, Ochner CN, Rolls BJ: An intervention study targeting energy and nutrient intake in worksite cafeterias. *Eating behaviors* 2010, 11:144-151.
8. U.S. Department of Health and Human Services: The Surgeon General's Vision for a Healthy and Fit Nation. *Rockville, MD: US Department of Health and Human Services, Office of Surgeon General* January 2010.

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Chapter 1: Introduction

Obesity has increased at an alarming rate over the past three decades [1, 2]. The combined prevalence of overweight and obesity in adults encompasses approximately two-thirds of the United States population [3]. Overweight and obesity are generally defined using body mass index (BMI), calculated as weight in kilograms divided by height in meters squared. For adults, overweight and obesity are generally defined as a BMI of 25 to 29.9 and a BMI of 30.0 or higher, respectively [4]. The adult BMI distribution has experienced a large rightward shift over time paralleling the prevalence of obesity [5, 6].

Although the prevalence of obesity does not appear to be continuing at the same rate most notably in women [2, 3]; overweight and obesity continues to be a leading public health concern [7]. Furthermore, evidence suggests obesity rates may continue to increase causing inevitable health and societal consequences [8]. Obesity is a well-known risk factor for numerous comorbidities [5] and is responsible for more health care expenditure than any other medical condition [7]. Considering obesity has become the second leading preventable cause of disease and death in the United States [9], various health modifications to combat its high prevalence are essential in order to prevent future challenges associated with the current epidemic.

Novel evidence suggests, concomitant with the increases in overweight and obesity, consumption of added sugars has increased by approximately 19%; totaling an approximated 431 additional calories to the American diet from added sugars alone [10].

Soft drinks and other sugar-sweetened beverages (SSBs) are considered the largest source of added sugars [10]. Thus, consumption of SSBs has been identified as a prime contributor to the overweight and obesity epidemic [11]. In addition to being a primary source of added sugars, soft drinks are the chief contributor of energy intake in the US diet [12]. It is well established that there has been a substantial increase in total energy intake in the United States over time. It is estimated that approximately 50% of the increase in daily caloric intake results from consumption of SSBs [13]. Accordingly, energy intake from SSBs has increased by 222 calories in recent decades [13].

Although beverages satisfy thirst [14], meal energy intake is not downwardly adjusted when caloric beverages are consumed; thus producing a net increase in total energy intake [15]. The mechansim for the weak satiety response demonstrated by beverages is unclear but is supported by several observations. First, beverages are consumed at a faster rate and are rapidly emptied from the stomach relative to solid foods [16]. Second, fewer satiety signals are activated via beverage consumption given beverages are largely comprised of carbohydrates [17]. Lastly, solid versus liquid influences are recognized when considering appetite-related hormonal responses [18]. Thus, more attention has recently been focused on beverage consumption as a dietary weight management intervention strategy.

In general, adults consuming high-energy intake from SSBs consume less healthy diets [13]. In contrast, energy intake is approximately nine percent lower in adults that consume water as compared to non-water consumers [19]. Consequently, efforts to guide healthier beverage consumption have been set forth by The Beverage Guidance Panel [20]. The Panel recommends that consumption of beverages containing minimal or ideally no calories should take precedence over beverages with high-caloric value. Drinking water is ranked as the preferred beverage to fulfill daily beverage needs and maintain adequate hydration. Additionally, pre-meal water consumption was demonstrated to acutely reduce meal energy intake among overweight and obese adults [21]. Accordingly, the Surgeon General's Vision for a Healthy Fit Nation 2010 and the Dietary Guidelines for Americans 2010 recognized the need to control beverage energy and set forth recommendations. The Surgeon General suggested to reduce consumption of beverages with added sugars and promoted increased water consumption and availability [22]. The Dietary Guidelines acknowledged consumers of SSBs generally have higher body weights, thus recommended SSBs should only be consumed when nutrient needs have been met and without exceeding daily calorie limits [23]. Therefore, in accordance with the current guidelines, encouraging increased water consumption and replacing caloric beverages with water may facilitate weight management.

The association of obesity with gender, ethnicity, and socioeconomic status are considered multifaceted and dynamic [9]. Evidence suggests a strong social patterning of overweight and obesity with those from a lower socio-economic status, specifically among women and racial minorities [24]. Repeated epidemiologic data reveals the notion that diet quality follows a socioeconomic gradient [25]. Energy-dense diets contributing fewer nutrients are generally associated with lower socioeconomic status. Energy density is the amount of energy in a particular weight of food (kJ/g). Foods with a low energy density provide less satiety as compared to foods with a high energy density meaning for the same energy a more satiating portion can be consumed when energy density is low [26]. Conversely, greater affluence demonstrates a positive relationship with a diet quality and is associated with lower energy dense diets. Education and household income demonstrate a negative association when compared to dietary energy density [27]. While both education and income can be used to predict diet quality, education has been regarded as the strongest predictor [27].

Additionally, socioeconomic status has been linked to added sugar intake [28] and SSB consumption [29]. Although added sugar intake is independently associated with race, household income, and educational status; groups representing low income and educational status are especially vulnerable to consuming diets with elevated added sugars [28]. Considering consumption of added sugars, including SSBs, is excessive in the US [10]; targeting low education and income populations may have important implications for addressing the obesity epidemic and could serve as an integral component of weight management.

Changes in the built environment [7] along with aforementioned socioeconomic factors [24] have contributed in a progressive increase in the average BMI. As a result, adulthood BMI may have less to do with one's age as compared to changes in social, environmental, and cultural conditions that significantly influence energy intake [30]. Explanations for the current obesity patterns can be linked to obesogenic (ie, increased food availability, high energy dense food supply, decreased need for physical activity) environments and societal trends, which encourage overeating and reduced physical activity [31]. Accordingly, it has recently been suggested that social-environmental factors may contribute a greater responsibility to the obesity epidemic as compared to individual characteristics [32]. Efforts to improve behavioral factors through health education directed at the individual and group level have yet to demonstrate much success [33]. Therefore, population-based interventions working to improve the social environment may lead to improved health and to eventual decreases in the prevalence of obesity [3].

Critical opportunities for environmental settings to target interventions can occur in multiple settings including the home, childcare centers, school systems, work places, and the community [22]. A significant portion of the 140 million men and women who are employed in the United States spend a substantial amount of time each week at their worksite [22]. Thus, interventions tailored to worksites are capable of reaching a significant portion of the population [34]. Research has demonstrated health promotion interventions in the workplace can be cost effective and well worth the implementation expense [35]. Worksites augment social support and may be seen as an effective strategy to support people's effort to reach and maintain a healthy weight [22]. To our knowledge, a worksite-based investigation of beverage consumption has not been conducted. Therefore, the primary purpose of this investigation was to determine if SSB and total beverage intake varies with individual and environmental factors among overweight and obese employees from 28 worksites involved in a randomized controlled weight management trial. Examining beverage consumption patterns of working adults may aid the development of effective tailored worksite weight management programs.

References

1. Flegal KM, Carroll MD, Ogden CL, Johnson CL: Prevalence and trends in obesity among US adults, 1999-2000. *JAMA : the journal of the American Medical Association* 2002, 288:1723-1727.
2. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM: Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA : the journal of the American Medical Association* 2006, 295:1549-1555.
3. Flegal KM, Carroll MD, Ogden CL, Curtin LR: Prevalence and trends in obesity among US adults, 1999-2008. *JAMA : the journal of the American Medical Association* 2010, 303:235-241.
4. World Health Organization: Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. 854:1-452 1995.
5. Flegal KM: Epidemiologic aspects of overweight and obesity in the United States. *Physiology & behavior* 2005, 86:599-602.
6. Popkin BM: Does global obesity represent a global public health challenge? *The American journal of clinical nutrition* 2011, 93:232-233.
7. Hensrud DD, Klein S: Extreme obesity: a new medical crisis in the United States. *Mayo Clinic proceedings Mayo Clinic* 2006, 81:S5-10.
8. Wang Y, Beydoun MA, Liang L, Caballero B, Kumanyika SK: Will all Americans become overweight or obese? estimating the progression and cost of the US obesity epidemic. *Obesity* 2008, 16:2323-2330.

9. Wang Y, Beydoun MA: The obesity epidemic in the United States--gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiologic reviews* 2007, 29:6-28.

10. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Rosett J: Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation* 2009, 120:1011-1020.

11. Malik VS, Schulze MB, Hu FB: Intake of sugar-sweetened beverages and weight gain: a systematic review. *The American journal of clinical nutrition* 2006, 84:274-288.

12. Block G: Foods contributing to energy intake in the US: data from NHANES III and NHANES 1999-2000. *Journal of Food Composition and Analysis*, 2004 439-447.

13. Duffey KJ, Popkin BM: Shifts in patterns and consumption of beverages between 1965 and 2002. *Obesity* 2007, 15:2739-2747.

14. Almiron-Roig ED, A: Hunger, thirst and energy intakes following consumption of caloric beverages. *Physiol Behav* 2003.

15. DellaValle DM, Roe LS, Rolls BJ: Does the consumption of caloric and non-caloric beverages with a meal affect energy intake? *Appetite* 2005, 44:187-193.

16. Kissileff HR: Effects of physical state (liquid-solid) of foods on food intake: procedural and substantive contributions. *The American journal of clinical nutrition* 1985, 42:956-965.

17. Wolf A, Bray GA, Popkin BM: A short history of beverages and how our body treats them. *Obesity reviews : an official journal of the International Association for the Study of Obesity* 2008, 9:151-164.

18. Tieken SM, Leidy HJ, Stull AJ, Mattes RD, Schuster RA, Campbell WW: Effects of solid versus liquid meal-replacement products of similar energy content on hunger, satiety, and appetite-regulating hormones in older adults. *Hormone and metabolic research = Hormon- und Stoffwechselforschung = Hormones et metabolisme* 2007, 39:389-394.

19. Popkin BM, Barclay DV, Nielsen SJ: Water and food consumption patterns of U.S. adults from 1999 to 2001. *Obesity research* 2005, 13:2146-2152.

20. Popkin BM, Armstrong LE, Bray GM, Caballero B, Frei B, Willett WC: A new proposed guidance system for beverage consumption in the United States. *The American journal of clinical nutrition* 2006, 83:529-542.

21. Dennis EA, Flack KD, Davy BM: Beverage consumption and adult weight management: A review. *Eating behaviors* 2009, 10:237-246.

22. U.S. Department of Health and Human Services: The Surgeon General's Vision for a Healthy and Fit Nation. *Rockville, MD: US Department of Health and Human Services, Office of Surgeon General* January 2010.

23. U.S. Department of Agriculture and U.S. Department of Health and Human Services: Dietary Guidelines for Americans, 2010. *7th Edition, Washington, DC: US Government Printing Office* December 2010.

24. Clarke P, O'Malley PM, Johnston LD, Schulenberg JE: Social disparities in BMI trajectories across adulthood by gender, race/ethnicity and lifetime socio-economic position: 1986-2004. *International journal of epidemiology* 2009, 38:499-509.

25. Darmon N, Drewnowski A: Does social class predict diet quality? *The American journal of clinical nutrition* 2008, 87:1107-1117.

26. Rolls BJ: Plenary Lecture 1: Dietary strategies for the prevention and treatment of obesity. *The Proceedings of the Nutrition Society* 2010, 69:70-79.

27. Monsivais P, Drewnowski A: Lower-energy-density diets are associated with higher monetary costs per kilocalorie and are consumed by women of higher socioeconomic status. *Journal of the American Dietetic Association* 2009, 109:814-822.

28. Thompson FE, McNeel TS, Dowling EC, Midthune D, Morrissette M, Zeruto CA: Interrelationships of added sugars intake, socioeconomic status, and race/ethnicity in adults in the United States: National Health Interview Survey, 2005. *Journal of the American Dietetic Association* 2009, 109:1376-1383.

29. Rehm CD, Matte TD, Van Wye G, Young C, Frieden TR: Demographic and behavioral factors associated with daily sugar-sweetened soda consumption in New York City adults. *Journal of urban health : bulletin of the New York Academy of Medicine* 2008, 85:375-385.

30. Feng J, Glass TA, Curriero FC, Stewart WF, Schwartz BS: The built environment and obesity: a systematic review of the epidemiologic evidence. *Health & place* 2010, 16:175-190.

31. Hill JO: Understanding and addressing the epidemic of obesity: an energy balance perspective. *Endocrine reviews* 2006, 27:750-761.

32. Zhang Q, Wang Y: Trends in the association between obesity and socioeconomic status in U.S. adults: 1971 to 2000. *Obesity research* 2004, 12:1622-1632.

33. Brown T, Kelly S, Summerbell C: Prevention of obesity: a review of interventions. *Obesity reviews : an official journal of the International Association for the Study of Obesity* 2007, 8 Suppl 1:127-130.

34. Estabrooks PA, Glasgow RE: Worksite interventions. In: Baum A, Newman S, Weinman J, West R, McManus C, editors. *Cambridge Handbook of Psychology, Health and Medicine.* 2 ed. Cambridge UK: Cambridge University Press 2005, 264-8

35. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, Johnson DB, Buchanan LR, Archer WR, Chattopadhyay S, Kalra GP, Katz DL: The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review. *American journal of preventive medicine* 2009, 37:340-357.

Chapter 2:

Individual and Worksite Environmental Factors Associated with Habitual Beverage Consumption among Overweight and Obese Adults

Abstract

Obesity is a major health problem with the combined prevalence of overweight and obesity encompassing two-thirds of the adult population. Rises in added sugar namely from sugar-sweetened beverages (SSB), have been identified as a prime contributor to the overweight and obesity epidemic. Thus, replacing SSBs with water may facilitate weight management. Evidence suggests environmental influence and socioeconomic factors have contributed to the rise in obesity prevalence. The worksite is an example of an environmental setting, which may influence individual's dietary behaviors. Therefore, the primary purpose of this investigation was to determine if SSB and total beverage intake varies with individual and environmental factors among overweight and obese employees from 28 small-to medium-sized worksites. Data was collected as part of baseline assessments for an ongoing weight management intervention trial. Participants (n=1,758; 75% female; age 46$\pm$0.3yrs; BMI: 33.2$\pm$0.2 kg/m^2) underwent height and weight assessment and completed a brief, self-administered beverage intake questionnaire (BEVQ). Demographic information and worksite descriptive characteristics (CHEW) were evaluated. All individual-level variables were self-reported with the exception of body weight. Surveys were available via paper and pencil or in a web-based format. Most participants were white (~76% of sample) with some college education or a college degree (~85% of sample). Decreased consumption of SSBs was found in females, Caucasians, and higher educational and income level participants. Mean water intake (~28 fl oz) was well below the recommended Dietary Reference Intake (DRI) across the entire sample. Increased water availability was associated with significant decreases in SSB intake and energy. Overall, findings suggest that decreased water availability within the worksite may encourage SSB consumption specifically among vulnerable populations (ie, low income, low educational level). Worksite environmental interventions and policy changes may be necessary in order to increase availability of healthy beverages. Importantly, reduction of SSB consumption and increased water intake could be a cost effective and easily administered dietary strategy for worksite-based weight management interventions.

Keywords: sugar-sweetened beverage, environment, worksite, water availability, weight management

Introduction

Obesity constitutes a major public health concern, due to the high prevalence of obesity in the United States (US) [1]. Yet, efforts to reduce the obesity prevalence have not clearly determined effective long-term weight management strategies. Some attention has been directed at examining the dietary habits of Americans which may be targeted to reverse the dramatic increase in overweight and obesity. Americans of all age groups are consuming a greater amount of daily total calories [2], and a significant portion of the increase in total caloric (energy) intake is derived from energy-dense snacks along with the rise in consumption of energy-containing beverages [3]. In addition, approximately one-fourth of total energy intake comes from food groups that contain large quantities of sugar and fat [3].

Energy-containing (ie, caloric) beverages contribute significantly to overall energy intake in the US diet [4]. Accordingly, energy-containing soft drinks are the primary contributor of the top ten food items that contribute to energy consumption in the US diet [3]. Consumption of sugar-sweetened beverages (SSB) has been identified as a potentially significant contributor to unhealthy weight status [4]. It has been reported that nearly 50% of people ages four and older consume at least one caloric soft drink each day. The combination of soft drinks and other SSB contributes to about nine percent of total calories, 18% of carbohydrates, and 49% percent of added sugar intake [5]. Excessive consumption of sugars has been associated with adverse health conditions such as greater energy intake, higher body weight, and lower intake of essential nutrients [6].

Therefore, consumption of SSBs has been suggested as an important dietary contributor to weight gain and obesity development [7].

Although beverages satisfy thirst they do not promote satiety, thus consumption of energy-containing beverage leads to increases in overall energy intake [8, 9]. Calorically sweetened beverages account for approximately fifty percent of the overall increase in daily energy intake in recent decades (~150-300 kcal) [10]. Considering the increase in consumption of SSB parallels the increase in obesity prevalence, examining current beverage consumption patterns may be an important step in developing effective dietary strategies to better manage body weight.

Adults consuming greater amounts of energy-containing beverages consume less healthy diets [7] and are more likely to consume energy-dense snacks as compared to water consumers [11]. Water drinkers generally maintain healthier dietary habits (consume ~200 kcals less/day) [11] thus, water consumption habits may be used to identify those who consume healthier diets. Attention is now being focused on water's role in weight management. Water consumed prior to a meal reduces hunger and increases satiety ratings, which ultimately generates a decrease in meal energy intake in middle-aged and older overweight and obese adults [12]. Furthermore, evidence suggests increasing daily water consumption prior to meal energy facilitates long-term weight loss among this population [13]. This effect may be made possible due to water's ability to acutely reduce meal energy intake and total energy intake over time. Ultimately, replacement of energy-containing beverages with water may be an effective dietary weight management strategy.

Diet quality is generally associated with affluence and socioeconomic standing [14]. Individual factors such as educational status and income level are associated with obesity and emphasize the importance of socioeconomic influence on weight status [14]. It is difficult to determine the independent influence of socioeconomic factors on lifestyle and health status, as educational level may be a better predictor of energy density and diet quality as compared to other sociodemographic factors [15]. Body Mass Index (BMI) and the prevalence of obesity are associated with educational level among men and women [16]. Educational level has been associated with overall diet quality in US adults as well as those in other countries [17]. Adults with lower education levels are more likely to be physically inactive, eat less healthful diets, and be overweight or obese [14]. Furthermore, it has been suggested that groups with low income and education are particularly vulnerable to consuming diets with high added sugars [18]. The influence of these individual-level factors on dietary behaviors should be investigated, in order to effectively tailor weight management approaches to the needs of a particular population.

More recently, the focus on obesity prevention and treatment has broadened from the individual level to include environmental factors that promote obesity. The obesity epidemic has been linked to environmental and societal trends that encourage sedentariness and overeating [19]. The environmental changes associated with encouraging obesity have been termed the 'obesogenic environment' [20]. The causal relationship between the obesogenic environment and individual behaviors is being explored in order to provide an overview of the wider environmental determinants of individual dietary habits [21]. For example, the rise in food availability and accessibility coupled with an increase in sedentariness appears to be a prime driver of the obesity epidemic [22].

Our current food supply largely consists of foods that are energy-dense and high in fat and sugar. Soft drinks and other SSBs are the primary source of added sugars in the American diet [6] while soft drinks are also considered the top energy contributor in the American diet [3]. Accordingly, the American Heart Association has recommended minimizing intake from SSB to half of an individual's appropriate discretionary calorie allowance to achieve and maintain a healthy weight and decrease cardiovascular risk [6]. The current 'obesogenic' environment appears to promote positive energy balance. As environmental influences become stronger people may be unable to biologically oppose the environmental factors which lead to undesired weight gain [20]. Ultimately, it may be necessary to address environmental influences affecting positive energy balance to promote and maintain adherence to dietary recommendations.

Environmental approaches to modifying health behaviors could include a variety of settings, including schools, healthcare systems, and communities. A large portion (ie, ~33%) of the US population spends their day at a worksite [23]. Thus, the work site may be a viable setting for implementing environmental approaches to promote effective behavior change. Worksite interventions can reach large numbers of adults and are feasible settings for reaching the working population; worksite-based interventions may also augment social support and facilitate adherence to weight management programs [23]. The food environment within a worksite can have significant effects on food choice [24], therefore; engaging an environmental perspective may be necessary to promote effective and sustainable worksite-based health interventions.

At this time, it is unclear if a reduction in SSB intake would be a viable dietary weight management intervention target for vulnerable populations. A population approach would include environmental change ultimately supporting healthy behaviors. To our knowledge, no studies have explored the relationship between individual and worksite environmental factors associated with beverage consumption. Therefore, our purpose was to determine if water intake, SSB intake, SSB energy, total beverage intake, and total beverage energy varies with individual and environmental factors among overweight and obese employees from 28 worksites involved in a randomized controlled weight management trial. These findings may be used to inform the development of tailored worksite weight management programs targeting improvements in beverage consumption patterns.

Materials and Methods

Data was collected as part of baseline assessments conducted at twenty-eight small (<300 employees) to medium (<1000 employees) sized worksites enrolled in an ongoing weight management intervention trial. Participants completed a brief, self-administered beverage intake questionnaire (BEVQ) [25], and a brief health survey, which included information on demographic factors such as race, ethnicity, education, income, and occupation. Height and weight were also assessed. All individual-level measures were self-reported and with the exception of body weight. The survey was available via paper and pencil or in a web-based format, and presented to employees as part of a study to assess workplace health promotion efforts. Data from the brief health survey was used to predict the proportion of the employee population that would be eligible for the future weight management intervention trial, which would include only individuals classified as overweight (BMI≥25 kg/m^2) or obese (BMI≥30 kg/m^2) [26].

Height and weight were measured to calculate BMI (kg/m^2). Weight was obtained objectively using a digital scale (WB-110A, Tanita, Tokyo) without shoes. Educational level was categorized as follows: some high school or high school diploma (E1), some college (E2), college graduate (E3), or post graduate education (E4). Total household income was categorized as follows: less than $29,000 (I1), $30,000 to $49,999 (I2), 50,000-$99,999 (I3) and $100,000 or more (I4). Environmental factors were measured using an observational method assessment by trained evaluators, using the Checklist of Health Promotion Environments at Worksites (CHEW) [27]. The checklist provides observations concerning worksite descriptive characteristics. For this investigation, the CHEW was used to assess the following worksite environmental characteristics: number of soft drink vending machines, number of slots of soft drinks per vending machine, number of water coolers, and the number of water fountains.

Individuals eligible to participate in the weight management intervention trial were invited to complete the BEVQ. The BEVQ is a rapid (<5 minutes), valid, and reliable quantitative self-administered tool, with a reading grade level of 6.9 [28]. The BEVQ assesses habitual beverage intake, including total beverage consumption (fl oz, kcal) and specific beverage categories including SSB and water across nineteen beverage categories. Total beverage energy and grams of each beverage is determined via multiplying the fluid ounce total per day by the beverage energy and grams per fluid ounce of each beverage category. SSB consumption was calculated based on reported consumption of the following beverage categories: sweetened juice beverage/drink, soft drinks, regular sweetened tea, coffee with cream and/or sugar, mixed alcoholic drinks, meal replacement shakes/protein drinks and energy drinks.

Total beverage and SSB consumption was evaluated across individual factors (BMI, gender, race, education, and income level) and worksite environmental factors (number of vending machines, number of soft drink slots, number of water coolers, number of water fountains, worksite size). The number of water fountains and available soft drink slots were standardized per employees at each worksite in attempt to provide a relative measurement when comparing characteristics across worksites which varied in size. For the purpose of this investigation the number of water fountains and water coolers was referred to as “water availability.”

Statistical Analysis

Statistical analyses were performed using SPSS statistical analysis software (SPSS Inc v. 12.0 for Windows, Chicago IL). Analyses included descriptive statistics, one-way ANOVA with Student-Newman-Keuls post-hoc analyses, independent t-tests, and multi-level linear mixed models. Data are expressed as mean $\pm$ SEM.

To assess independent predictors of beverage consumption a three-level hierarchical model was constructed for five different dependent variable outcomes. The five dependent variables consisted of water intake (fluid ounces), total beverage intake (fluid ounces), total beverage energy (kcals), SSB intake (fluid ounces), and SSB energy (kcals). The first model (intercepts only model) identified independent worksite predictors for each outcome of interest and was used as a measure of comparison for the subsequent models. The second model assessed independent demographic predictors for each outcome of interest. The demographic predictors included BMI, gender, race, education, and income level. The third model added worksite environmental predictors, which included the number of soft drink slots standardized per person, water availability (presence or absence of water cooler(s) and the number of water fountains standardized per person), and worksite size classified as small or medium. All p values presented are two-tailed, and a p value <0.05 was considered statistically significant.

Results

Descriptive Characteristics

Participants (n=1758; 75% female) aged 46±0.3 years were enrolled in the study; demographic characteristics are presented in Table 1. Most participants were white (~76% of sample), with some college education or a college degree (~85% of sample). Mean BMI (33.2±0.2 kg/m^2) was in the obese range, which is not unexpected considering the focus of the larger trial. A significant portion of the participants (~38%) reported an annual household income below $49,999.

No significant differences between BMI and beverage consumption variables were found, possibly due to the population consisting of only overweight and obese individuals. Mean daily water consumption and total SSB energy were significantly lower ($p<0.05$) in white participants (Water: 27±1 fl oz; SSB energy: 187±6 kcals) as compared to other races (Water: 29±1fl oz; SSB energy: 215±12 kcals). Additionally, total mean fluid ounce beverage consumption was significantly greater ($p<0.001$) in white individuals (69±1 fl oz) as compared to other races (62±1fl oz). Thus, white individuals in this sample consume less SSB energy but maintain a greater habitual total beverage intake (fl oz). Male participants consumed significantly more ($p<0.001$) total fluid ounces and total beverage energy as compared to females (Male: 75±2 fl oz, 459±18 kcals; Female: 64±1 fl oz, 333±8 kcals). Additionally, male participants consumed significantly greater ($p<0.01$) total SSB fluid ounces and total SSB beverage energy as compared to females (Male: 19±1 fl oz, 224±11 kcals; Female: 16±1 fl oz, 184±6 kcals). Mean daily water consumption did not differ by gender.

Total water consumption, as presented in Table 2, did not differ by educational level. Conversely, total beverage energy and total beverage intake were significantly higher among individuals in the lowest educational level (E1: 25% greater kcals than average, 4% greater fl oz than average). Mean daily SSB consumption and SSB energy intake were significantly different across educational levels. Individuals classified in the two lower educational levels reported higher total SSB energy (E1: 43% greater than average; E2: 6% greater than average) than individuals in the two higher educational levels (E3: 13% less than average, E4: 38% less than average). Mean daily SSB consumption varied across all educational levels with each category reporting a significantly larger total consumption as compared to educational level below the respective level.

Total water consumption across household income categories was not different (see Table 3). However, total beverage energy was significantly different across income categories with the two lowest incomes reporting significantly greater beverage energy (I1: 24% greater than average; I2: 10% greater than average) as compared to the two higher income categories (I3: 5% less than average; I4: 11% less than average). However, total beverage intake did not significantly differ by income category. Mean daily SSB consumption and SSB energy were significantly different in the two lower household income levels (I1: 27% greater kcals than average, 24% greater fl oz than average; I2: 18% greater kcals than average, 18% greater fl oz than average) as compared to the two higher income categories (I3: 8% less kcals than average, 31% less fl oz than average I4:

31% less kcals than average, 31% less fl oz than average). However, the two lower household income levels did not differ whereas the two higher income levels did demonstrate a significant difference.

These results indicate both low education and income level are associated with increased beverage energy. Education level was an important determinant of beverage consumption with the exception of water; the lowest education level was associated with significantly higher SSB consumption and total beverage energy as compared to other educational levels. Beverages such as soft drinks, fruit juice, milk, sweetened tea and coffee, and alcohol contributed a significant proportion to total beverage energy. Mean water intake in this sample (28+1 fl. oz) was well below the recommended Dietary Reference Intake (DRI) of 11-15 cps/d (91-125 fl oz) and Adequate Intake (AI) of 9-13 cps/d (72-104 fl oz) [29].

Characteristics of the twenty-eight small to medium-sized worksites enrolled in the study are presented in Table 4. Sixteen worksites were classified as small (< 300 employees) and twelve were classified as medium-sized worksites (300-612 employees). On average, small worksites had approximately 184 fewer workers as compared to medium sized worksites. Once water fountains and total number of soft drinks were standardized per employee, there was not a significant difference between small and medium worksite beverage availability.

Table 5 presents mean beverage consumption and beverage energy within individual worksites and across all worksites. Employees at small worksites were found to have significantly greater ($p=0.001$) total beverage fluid ounces and total beverage energy as compared to those at medium-sized worksites. Additionally, employees at small worksites consumed significantly greater ($p<0.001$) habitual daily SSB energy. No significant differences between total SSB fluid ounce consumption and total water consumption were found based on worksite size.

Multi-level Model Results

Water

Race was the only individual predictor of water consumption at the individual level. The second model including individual demographic predictors was significantly better than one in which only the worksite predictors were included X^2 (8, N=1691)=675.01, $p<0.001$. Whites were considered to consume less water within the population investigated ($p<0.05$). The full model as a whole was significantly better than one in which only the individual predictors were included, X^2 (4, N=1691)=10.354, $p<0.05$. Thus, predictors as a group improved the model beyond that produced by considering variability in individuals and worksites. Environmental factors played a greater role in water consumption as the only significant determinant of water consumption in the final model was water fountain availability; increased water fountain availability at worksites was associated with increased total fluid ounce water intake by worksite employees ($p<0.01$).

Total Beverage Intake (fluid ounces)

Gender, race, and BMI were predictors of total beverage intake using the individual level model. The second model including individual demographic predictors was significantly better than one in which only the worksite predictors were included, X^2 (8, N=1702)=802.06, p<0.001. Females consumed less total fluid ounces than males (p<0.001). Additionally, whites consumed more total fluid ounces as compared to other racial groups (p<0.001), and a higher BMI was associated with greater total beverage intake (p<0.001). The full model as a whole was significantly better than one in which only the individual predictors were included, X^2 (4, N=1702)=14.29, <p<0.01. Thus, predictors as a group improved the model beyond that produced by considering variability in individuals and worksites. Addition of worksite environmental variables resulted in gender, race, BMI, and water fountain availability being significant predictors of total beverage intake. Males, white individuals, and those with greater BMI consumed greater total fluid ounces (p<0.001). Additionally, decreased water fountain availability at worksites was associated with greater total beverage fluid ounce intake by worksite employees (p<0.01).

Total Beverage Energy (kcals)

Gender, education, and income were predictors of total beverage energy using the individual level model. The second model including individual demographic predictors was significantly better than one in which only the worksite predictors were included, X^2 (8, N=1702)=1537.62, p<0.001. Females consumed less total beverage energy than males (p<0.001). Additionally, less educated individuals and those with lower household incomes consumed greater total beverage energy ($p<0.001$). The model including environmental factors did not differ significantly from the individual level predictors however; the model including environmental factors remained significant as compared to the model in which only the worksite intercepts were included, X^2 (12, N=1702)=1539.72, $p<0.001$. Addition of environmental factors did not alter results mentioned previously pertaining to the individual predictors of beverage energy.

Sugar-sweetened Beverage Intake (fluid ounces)

Gender, education, income, and BMI were significant predictors of SSB intake in the individual level model. The second model including individual demographic predictors was significantly better than one in which only the worksite predictors were included, X^2 (8, N=1702)=741.98, $p<0.001$. Females consumed less total SSB fluid ounces than males ($p<0.001$), and education and household income demonstrated an inverse relationship in which lower education and income resulted in greater SSB consumption ($p<0.001$). Additionally, BMI had a positive relationship with total SSB intake ($p<0.01$). The full model as a whole was significantly better than one in which only the individual predictors were included, X^2 (4, N=1702)=11.26, $p<0.05$. Thus, predictors as a group improved the model beyond that produced by considering variability in individuals and worksites. Addition of worksite environmental factors resulted in gender, education, income, BMI, and water cooler availability being significant predictors of employee's habitual SSB beverage intake. Results were concurrent with the individual level model with the exception that water coolers demonstrated an inverse relationship with SSB consumption; decreased water availability at worksites was associated with higher habitual consumption of SSB by worksite employees ($p<0.05$).

Sugar-sweetened Beverage Energy (kcals)

Gender, education, income, and BMI were significant predictors of SSB beverage energy using the individual level model. The second model including individual demographic predictors was significantly better than one in which only the worksite predictors were included, X^2 (8, N=170)=1118.88, $p<0.001$. Females consumed less SSB energy than men ($p<0.001$). Education ($p<0.001$) and household income ($p<0.01$) demonstrated an inverse relationship in which lower education and income resulted in greater SSB energy intake. Additionally, BMI had a positive relationship with SSB energy ($p<0.01$). The full model as a whole was significantly better than one in which only the individual predictors were included, X^2 (4, N=1700)=11.73, $p<0.05$. Thus, predictors as a group improved the model beyond that produced by considering variability in individuals and worksites. Addition of environmental factors resulted in gender, education, income, BMI, and water cooler availability being significant predictors of SSB energy. Results paralleled the individual level model with the exception that water coolers demonstrated an inverse relationship with SSB consumption. Decreased water availability contributed to an increased consumption of SSB energy ($p<0.05$).

Discussion

Overall, these findings suggest decreased water availability within the worksite may encourage greater habitual consumption of energy-containing beverages by overweight and obese employees, specifically among vulnerable populations (ie, low income, low educational level). Water consumption was more dependent on environmental predictors of beverage consumption as compared to individual factors, thus suggesting a need for increased water availability within the worksite. The worksite environment is a greater predictor of water consumption yet the lack of water availability is disproportionately affecting overweight and obese employees with low socioeconomic status. Accordingly, individuals with lower educational status and household income are at increased risk for consuming greater energy-containing beverages and SSB, which could adversely impact health and weight status.

Beverages are contributing significantly to total daily energy intake (~359 kcals/day) with over half of the energy resulting from SSB consumption (~195 kcals/day). Excess calories from SSB consumption are much less desirable than nutrient dense foods [7], and are suggested to play an additive role in increasing total energy consumption during a meal [8]. Individuals may overlook beverage energy, thus attention toward interventions aimed to reduce beverage energy should be considered.

Within this population of overweight and obese employees, decreased worksite water availability contributed to greater consumption of total SSB intake and energy along with greater total beverage fluid ounce intake. Results suggest employees are selecting energy-containing beverages and are consuming greater total fluid ounces while drinking these high energy beverages. This could be a direct result of the bottle size available to consumers. Although decreased water availability corresponded to increased SSB energy, it did not correlate with overall beverage energy. This finding is not unexpected considering water consumers have been found to consume substantial amounts of milk and 100% fruit juice [11] which contribute to total beverage energy but not SSB energy. Additionally, it is possible that SSB are an alternative beverage to water within worksites by vulnerable consumers, whereas total beverage energy may stem from beverage intake regardless of water availability outside of the worksite (ie, glass of milk with dinner at home).

Interventions aimed at reducing availability of SSB and increasing water availability may be a viable strategy to reduce overweight and obesity within worksites. In addition, policies aimed at altering the price of soda within the workplace may be an effective strategy considering an increase in price is generally associated with a significant decrease in daily energy intake [30]. Thus price manipulations of SSB may encourage employees to consume more water, if it is made available and easily accessible. Furthermore, policy changes aimed at increasing water availability via installing additional water fountains and water coolers within the worksite should be considered. For example, an intervention focused on increased water consumption of elementary school children was found to be effective in decreasing the risk of overweight in schools with increased water fountain availability [31]. Process evaluation results determined the intervention to be sustainable and feasible in the school setting. While policy changes will not entirely solve the obesity epidemic, they may reduce energy intake and aid in significant weight loss when considering the collective population.

Strengths of this investigation include a large sample size and detailed information on beverage consumption using a validated tool. This investigation acknowledges several limitations. First, the population consisted of overweight and obese adults; therefore beverage patterns were not compared to those of normal weight status and may not apply to the general population. Furthermore, the population predominately consisted of Caucasian females, which may limit translation of the results to larger scale populations. In addition, no information was provided on caffeine's role in beverage selection. Lastly, beverage consumption results were self-reported. In general, self-reported data is subject to recording error, making it possible the reported beverage consumption may not accurately portray habitual beverage consumption within the population. For example, daily water consumption at a water fountain may have been quantified incorrectly. Although limitations exist, results suggest the need for future investigations aimed at determining the effect of beverage consumption changes and weight-related outcomes of worksite-based environmental changes.

Although multicomponent interventions (ie, changes aimed at the individual and environmental level) may be necessary to control overweight and obesity among adults in worksite settings, increasing water availability may encourage employers to consume more water and maintain healthier habitual beverage habits. Our findings, when considered in the context of other literature, suggest dietary interventions could target increased water availability within the worksite. Future studies are warranted to determine if reducing beverage energy intake and increasing water consumption could be an effective dietary strategy for worksite-based weight management interventions.

Table 1: Participant Characteristics of Overweight and Obese Employees Among 28 Worksites:

Variable	Frequency (n)	Percent (%)
Sex		
Male	434	24.7
Female	1324	75.3
Race		
White	1327	75.6
Other	428	24.3
Education		
(E1) High School or Less	277	15.7
(E2) Some College	585	33.3
(E3) College Graduate	608	34.6
(E4) Post Graduate Education	289	16.4
Income		
(I1) $<15,000-29,999	239	13.8
(I2) $30,000-49,999	421	24.3
(I3) $50,000-99,999	687	39.6
(I4) $100,000 or more	386	22.3

Variable	Mean	Range
Age, yrs	46.6 ± 0.3	20-86
BMI, kg/m^2	33.2 ± 0.2	21.3-68.7

Table 2: Habitual Daily Beverage Consumption Across Education[1] Levels Among Overweight and Obese Employees within 28 Small-to Medium-Sized Worksites:

Variable	Mean $\pm$ SEM	Range
Water Intake, fl oz	**28±1**	**0-60**
E1	27±1	
E2	28±1	
E3	28±1	
E4	27±1	
Total Beverage Energy, kcal	**358±8**	**0-3727**
E1	449±25[A]	
E2	369±13	
E3	344±12	
E4	319±15	
Total Beverage Intake, fl oz	**67±1**	**0-264**
E1	70±2[A]	
E2	67±1	
E3	68±1	
E4	63±2	
Total Sweetened Beverage Energy, kcal	**194±5**	**0-1690**
E1	277±18[B]	
E2	205±9[A]	
E3	172±8	
E4	141±11	
Total Sweetened Beverage Intake, fl oz	**17±1**	**0-120**
E1	24±1[C]	
E2	18±1[B]	
E3	15±1[A]	
E4	12±1	

[1] **E1, High School or Less; E2, Some College; E3, College Graduate; E4, Post College Education**

[A] **Significantly different from all other education categories, P<0.05.**

[B] **Significantly different from all other education categories including [A].**

[c] **Significantly different from all other education categories including [A,B]**

Table 3: Habitual Daily Beverage Consumption Across Income[1] Categories Among Overweight and Obese Employees within 28 Small-to Medium-Sized Worksites:

Variable	Mean ± SEM	Range
Water Intake, fl oz	**28±1**	**0-60**
I1	28±1	
I2	28±1	
I3	28±1	
I4	28±1	
Total Beverage Energy, kcal	**358±8**	**0-3727**
I1	443±26[B]	
I2	394±17[A]	
I3	340±11	
I4	323±15	
Total Beverage Intake, fl oz	**67±1**	**0-264**
I1	68±2	
I2	67±2	
I3	67±1	
I4	67±1	
Total Sweetened Beverage Energy, kcal	**194±5**	**0-1690**
I1	247±18[B]	
I2	228±12[B]	
I3	180±8[A]	
I4	148±5	
Total Sweetened Beverage Intake, fl oz	**17±1**	**0-120**
I1	21±1[B]	
I2	20±1[B]	
I3	16±1[A]	
I4	13±1	

[1] I1, <$29,999; I2, $ 30,000-$49,999; I3, $50,000-$99,999; I4, >$100,000
[A] Significantly different from all other income categories, P<0.05.
[B] Significantly different from all other income categories including [A].
[c] Significantly different from all other income categories including [A,B]

Table 4: Descriptive Characteristics of 28 Small-to Medium-Sized Worksites

Worksite	Number of Employees	Number of Water Fountains (Water Fountains/ Employee)	Number of Water Coolers Coolers	Number of Soft Drink Vending Machines	Total Number of Soft Drink Slots (Slots/Employee)
			Small		
Worksite 1	100	2 (0.02)	0	0	0
Worksite 2	189	14 (0.07)	1	2	11(0.6)
Worksite 3	197	4 (0.02)	0	3	20(0.1)
Worksite 4	206	8 (0.03)	0	2	9(0.4)
Worksite 5	217	5 (0.02)	0	4	56(0.3)
Worksite 6	219	4 (0.02)	1	2	10(0.5)
Worksite 7	230	0	0	2	36(0.2)
Worksite 8	238	3 (0.01)	0	4	91(0.4)
Worksite 9	243	5 (0.02)	2	3	37(0.2)
Worksite 10	246	1 (0.004)	4	2	15(0.06)
Worksite 11	253	6 (0.02)	0	2	8(0.03)
Worksite 12	255	20 (0.08)	3	5	32(0.1)
Worksite 13	276	3 (0.01)	3	0	0
Worksite 14	289	9 (0.03)	0	6	36(0.1)
Worksite 15	291	12 (0.04)	7	2	11(0.04)
Worksite 16	297	4 (0.01)	24	3	46(0.2)
Mean	240	6(2)	3	3	26(0.1)
			Medium		
Worksite 17	301	5 (0.02)	0	0	0
Worksite 18	310	32 (0.1)	0	4	15(0.5)
Worksite 19	315	9 (0.03)	0	2	15(0.5)
Worksite 20	350	6 (0.02)	0	2	8(0.2)
Worksite 21	350	25 (0.07)	2	6	43(0.1)
Worksite 22	353	5 (0.01)	14	2	34(0.1)
Worksite 23	380	6 (0.02)	15	3	39(0.1)
Worksite 24	435	10 (0.02)	4	2	6(0.01)
Worksite 25	462	23 (0.05)	8	6	24(0.05)
Worksite 26	477	0	8	3	39(0.1)
Worksite 27	589	9 (0.02)	0	5	8 (0.01)
Worksite 28	612	14 (0.02)	5	4	103(0.2)
Mean	424	11(3)	4	3	28(0.06)
Overall Mean	325	8(3)	4	3	27(0.1)

Table 5: Habitual Daily Beverage Consumption Among Overweight and Obese Employees Across 28 Small-to Medium-Sized Worksites

Worksite	Total Beverage (fl oz)	Total Beverage (Kcals)	Sugar Sweetened Beverage (fl oz)	Sugar Sweetened Beverage (Kcals)	Water (fl oz)
Small					
Worksite 1	67± 5	335± 41	14± 2	142± 23	24±3
Worksite 2	70± 5	457± 41	24± 3	267± 32	24±2
Worksite 3	69± 4	390± 56	19± 3	218± 40	25±3
Worksite 4	67± 5	433±88	20± 3	209± 29	29±3
Worksite 5	72± 3	380± 38	19± 2	215± 26	31±2
Worksite 6	61± 3	307± 26	15± 2	169± 22	28±2
Worksite 7	65± 4	466± 52	19± 2	241± 32	29±2
Worksite 8	67± 4	273± 36	13± 2	153± 24	32±3
Worksite 9	72± 4	341±44	19± 3	216± 38	30±3
Worksite 10	65± 3	307± 25	15± 2	167± 18	30±2
Worksite 11	70± 4	375± 38	15± 2	164± 25	25±2
Worksite 12	65± 6	339± 48	18± 3	19 ± 33	26±4
Worksite 13	66± 4	425± 52	18± 3	231± 34	30±2
Worksite 14	77± 4	454± 38	21± 3	251± 31	29±2
Worksite 15	69± 3	395± 38	22± 3	249± 31	28±2
Worksite 16	71± 4	351± 30	20± 2	231± 31	27±2
Mean	68± 1	380± 11	18± 1	211± 8	28±1
Medium					
Worksite 17	69± 4	329± 33	11±1	118± 17	34±3
Worksite 18	58± 4	296± 36	13±2	143± 24	23±2
Worksite 19	63± 3	332± 27	13±1	152± 19	28±2
Worksite 20	60± 3	274± 21	14±1	147± 16	27±2
Worksite 21	69± 4	398± 48	18±3	203± 29	25±2
Worksite 22	81± 6	522± 55	25±3	294± 33	25±2
Worksite 23	72± 4	353± 35	20±3	224± 31	31±3
Worksite 24	59± 3	317± 30	11±2	129± 16	24±2
Worksite 25	59± 3	291± 32	13±2	132± 23	24±2
Worksite 26	62± 4	339± 40	19±3	219± 35	28±2
Worksite 27	67± 2	287± 22	15±1	164± 17	30±2
Worksite 28	73± 4	300± 31	15±2	156± 21	27±2
Mean	66± 1	332± 10	15± 1	173± 7	27±1
Total Mean	67± 1	358± 8	17±1	194± 5	28

References

1. Flegal KM, Carroll MD, Ogden CL, Curtin LR: Prevalence and trends in obesity among US adults, 1999-2008. *JAMA : the journal of the American Medical Association* 2010, 303:235-241.
2. Nielsen SJ, Siega-Riz AM, Popkin BM: Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obesity research* 2002, 10:370-378.
3. Block G: Foods contributing to energy intake in the US: data from NHANES III and NHANES 1999-2000. *Journal of Food Composition and Analysis* 439-447 2004.
4. Nielsen SJ, Popkin BM: Changes in beverage intake between 1977 and 2001. *American journal of preventive medicine* 2004, 27:205-210.
5. Murphy DA: The scientific basis of recent US guidance on sugar intake. *Am J Clin Nutr* 2003.
6. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Rosett J: Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation* 2009, 120:1011-1020.
7. Duffey KJ, Popkin BM: Shifts in patterns and consumption of beverages between 1965 and 2002. *Obesity* 2007, 15:2739-2747.
8. DellaValle DM, Roe LS, Rolls BJ: Does the consumption of caloric and non-caloric beverages with a meal affect energy intake? *Appetite* 2005, 44:187-193.

9. Dennis EA, Flack KD, Davy BM: Beverage consumption and adult weight management: A review. *Eating behaviors* 2009, 10:237-246.

10. Popkin BM, Armstrong LE, Bray GM, Caballero B, Frei B, Willett WC: A new proposed guidance system for beverage consumption in the United States. *The American journal of clinical nutrition* 2006, 83:529-542.

11. Popkin BM, Barclay DV, Nielsen SJ: Water and food consumption patterns of U.S. adults from 1999 to 2001. *Obesity research* 2005, 13:2146-2152.

12. Davy BM, Dennis EA, Dengo AL, Wilson KL, Davy KP: Water consumption reduces energy intake at a breakfast meal in obese older adults. *Journal of the American Dietetic Association* 2008, 108:1236-1239.

13. Dennis EA, Dengo AL, Comber DL, Flack KD, Savla J, Davy KP, Davy BM: Water consumption increases weight loss during a hypocaloric diet intervention in middle-aged and older adults. *Obesity* 2010, 18:300-307.

14. Darmon N, Drewnowski A: Does social class predict diet quality? *The American journal of clinical nutrition* 2008, 87:1107-1117.

15. Monsivais P, Drewnowski A: Lower-energy-density diets are associated with higher monetary costs per kilocalorie and are consumed by women of higher socioeconomic status. *Journal of the American Dietetic Association* 2009, 109:814-822.

16. Groth MV, Fagt S, Stockmarr A, Matthiessen J, Biltoft-Jensen A: Dimensions of socioeconomic position related to body mass index and obesity among Danish women and men. *Scandinavian journal of public health* 2009, 37:418-426.

17. Satheannoppakao W, Aekplakorn W, Pradipasen M: Fruit and vegetable consumption and its recommended intake associated with sociodemographic factors: Thailand National Health Examination Survey III. *Public health nutrition* 2009, 12:2192-2198.

18. Thompson FE, McNeel TS, Dowling EC, Midthune D, Morrissette M, Zeruto CA: Interrelationships of added sugars intake, socioeconomic status, and race/ethnicity in adults in the United States: National Health Interview Survey, 2005. *Journal of the American Dietetic Association* 2009, 109:1376-1383.

19. Delormier T, Frohlich KL, Potvin L: Food and eating as social practice--understanding eating patterns as social phenomena and implications for public health. *Sociology of health & illness* 2009, 31:215-228.

20. Hill JO: Understanding and addressing the epidemic of obesity: an energy balance perspective. *Endocrine reviews* 2006, 27:750-761.

21. Elinder LS, Jansson M: Obesogenic environments--aspects on measurement and indicators. *Public health nutrition* 2009, 12:307-315.

22. Feng J, Glass TA, Curriero FC, Stewart WF, Schwartz BS: The built environment and obesity: a systematic review of the epidemiologic evidence. *Health & place* 2010, 16:175-190.

23. U.S. Department of Health and Human Services. *The Surgeon General's Vision for a Healthy and Fit Nation.* Rockville, MD: *U.S. Department of Health and Human Services, Office of Surgeon General* 2010.

24. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, Johnson DB, Buchanan LR, Archer WR, Chattopadhyay S, Kalra GP, Katz DL: The

effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review. *American journal of preventive medicine* 2009, 37:340-357.

25. Hedrick VE, Comber DL, Estabrooks PA, Savla J, Davy BM: The beverage intake questionnaire: determining initial validity and reliability. *Journal of the American Dietetic Association* 2010, 110:1227-1232.

26. Expert Panel on the Identification Evaluation, and Treatment of Overweight in Adults: Clinical Guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: executive summary, 1998

27. Oldenburg B, Sallis J, Harris D, Owen N: Checklist of Health Promotion Environments at worksites (CHEW): Development and Measurement Characteristics. *American Journal of Health Promotion* 2002; 16(5):288-99.

28. Hedrick VE CD, Flack KD, Estabrooks P, Nsiah-Kumi PA, Ortmeier S, Savla J, and Davy BM: Development of a Brief Questionnaire to Assess Habitual Beverage Intake: Sugar-Sweetened Beverages and Total Beverage Energy Intake, *In Review*.

29. Panel on Dietary Reference Intakes for Electrolytes and Water. Institute of Medicine. The Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Dietary Reference Intakes for Water P, Sodium Chloride, and Sulfate. National Academy Press 2004,146-147.

30. Duffey KJ, Gordon-Larsen P, Shikany JM, Guilkey D, Jacobs DR, Jr., Popkin BM: Food price and diet and health outcomes: 20 years of the CARDIA Study. *Archives of internal medicine* 2010, 170:420-426.

31. Muckelbauer R, Libuda L, Clausen K, Kersting M: A simple dietary intervention in the school setting decreased incidence of overweight in children. *Obesity Facts* 2009, 2(5): 282-5.

Chapter 3: Conclusions and Future Directions

Obesity prevalence has increased steadily over the past three decades. At the individual level, obesity is a biological response to sustained positive energy balance resulting from dietary and physical activity lifestyle choices [1]. It has been suggested that the built environment affects energy balance by presenting opportunities or barriers of adherence to dietary recommendations, which may encourage patterns of overeating and little physical activity [2]. The proportion of calories from beverages has increased over this time period as well [3], whereas daily consumption of water has remained stable [4]. Workplaces are an example of environmental setting in which individuals may access energy-dense foods and beverages [5]. Therefore, this investigation examined beverage consumption patterns within 28 small-to medium-sized worksites among overweight and obese employees. Findings suggest the need for increased water availability to reduce overall beverage energy and in particular, SSB energy, within the working population.

It is estimated that calorie intake from beverages has increased by approximately 278 kcals, or 135%, since 1977 [6]. Sweetened beverages are increasing in portion size, and milk intake is being replaced by SSB. Importantly, Americans are consuming excess calories from beverages with minimal nutritional value [6]. The population investigated for the purpose of this study was fairly representative of usual beverage patterns observed in NHANES data regarding water and SSB consumption. Total U.S. beverage energy significantly contributes (>400 kcal) to overall daily energy intake [3]. Beverage energy consumption was similar (358 kcals/day) in this investigation, to that observed with large population-based surveys. However, mean daily water consumption (~28 fl oz) was significantly below reported U.S. daily consumption (~45 fl oz) [7].

Beverage energy has been suggested to play an additive role in total energy consumption during a meal [8]. Eliminating beverage energy from the population investigated in this study could facilitate in a one-pound decrease in weight over a ten-day period. The prevalence of increased SSB consumption with decreased water availability emphasizes the idea that diet quality is environmentally influenced. Other demographic factors may also play influential roles in habitual beverage consumption, as vulnerable populations were at greater risk for consuming greater beverage and SSB energy. Weight loss interventions should ideally be tailored to the specific needs of a particular demographic group and the surrounding environment in order to achieve optimal results [5].

Effective weight loss interventions should be encouraged to increase water availability with a goal of decreasing beverage energy intake. Water consumption is believed to facilitate weight management and may be used to indicate health conscious consumers [9]. Currently there is not adequate evidence to support a Recommended Dietary Allowance (RDA) for water. Consequently, a Dietary Reference Intake (DRI) of 3.7 L/day (125 fl oz) for men and 2.7 L/day for women (91 fl oz) and an Adequate Intake (AI) of 3.0 L/day (104 fl oz) for men and 2.2 L/day (72 fl oz) for women is recommended [7]. Mean water consumption was below recommended intake levels across all groups. Our findings, when considered in the context of other literature, suggests that worksite-based dietary interventions could target a transition from SSB to water, and possibly reduce total energy intake and body weight over time. Ultimately, reducing beverage energy intake and increasing water consumption could be an effective dietary strategy for weight management interventions implemented within worksites.

Future interventions aimed at decreasing overweight and obesity via beverage intake may be easily administered and cost effective for the worksite population. In the workplace, obesity is considered an important driver of cost, thus employers maintain interest in interventions and policies that aim to improve employee health and reduce healthcare costs [5]. Worksite informational and educational programs may be effective to a limited extent because they facilitate voluntary adaptions of behavior. Worksite environmental policy changes may be necessary in order to target the entire population and enhance availability of healthy beverages. Although little data exists to recommend beverage taxing, evidence suggests taxing selective foods is associated with significant declines in overall daily energy intake [10]. Likewise, it may be beneficial to manipulate beverage price in order to steer employees away from SSB consumption within the worksite, specifically for vulnerable populations. However, beverage taxing remains controversial considering price manipulations may adversely affect low-income populations. Individuals with low income and education are more susceptible to low-cost energy-dense foods along with greater added sugar consumption [11]. Policies aimed at increasing water availability may act to offset the disproportionate SSB consumption patters seen within the population as a result of lower socioeconomic and/or educational status.

With overweight and obesity affecting nearly two-thirds of the American population [12] it is necessary to investigate strategies to reduce the prevalence. Social variation may be a significant causal determinant of diet quality and weight gain as results suggests most vulnerable subgroups in the investigated population disproportionally suffer from environmental influences. Investigating diet quality and its association to a socioeconomic gradient and environmental influences should be considered in future investigations in order to promote feasible weight loss recommendations. Public education regarding the consumption of caloric beverages may be an effective and simple weight loss strategy considering nearly 30% of Americans are consuming more than a quarter of their daily calories from beverages [4]. More importantly, unless the environment is altered to promote healthy living, the prevalence of overweight and obesity will likely continue to grow considering consumers will maintain unhealthy lifestyle choices [13]. Therefore, the most significant finding within this population is the opportunities for environmental policy and change to foster healthy dietary beverage consumption by increasing water availability. Gaining more information on current beverage trends and environmental influences within the working population could further promote the overarching goal of developing worksite-based weight management interventions, which could target replacing energy-containing beverages with increased water consumption.

References

1. Feng J, Glass TA, Curriero FC, Stewart WF, Schwartz BS: The built environment and obesity: a systematic review of the epidemiologic evidence. *Health & place* 2010, 16:175-190.
2. Delormier T, Frohlich KL, Potvin L: Food and eating as social practice--understanding eating patterns as social phenomena and implications for public health. *Sociology of health & illness* 2009, 31:215-228.
3. Duffey KJ, Popkin BM: Adults with healthier dietary patterns have healthier beverage patterns. *The Journal of nutrition* 2006, 136:2901-2907.
4. Duffey KJ, Popkin BM: Shifts in patterns and consumption of beverages between 1965 and 2002. *Obesity* 2007, 15:2739-2747.
5. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, Johnson DB, Buchanan LR, Archer WR, Chattopadhyay S, Kalra GP, Katz DL: The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review. *American journal of preventive medicine* 2009, 37:340-357.
6. Nielsen SJ, Popkin BM: Changes in beverage intake between 1977 and 2001. *American journal of preventive medicine* 2004, 27:205-210.
7. Panel on Dietary Reference Intakes for Electrolytes and Water. Institute of Medicine. The Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Dietary Reference Intakes for Water P, Sodium Chloride, and Sulfate. National Academy Press; Washington, DC: 2004. pp. 146-147.

8. DellaValle DM, Roe LS, Rolls BJ: Does the consumption of caloric and non-caloric beverages with a meal affect energy intake? *Appetite* 2005, 44:187-193.

9. Popkin BM, Barclay DV, Nielsen SJ: Water and food consumption patterns of U.S. adults from 1999 to 2001. *Obesity research* 2005, 13:2146-2152.

10. Duffey KJ, Gordon-Larsen P, Shikany JM, Guilkey D, Jacobs DR, Jr., Popkin BM: Food price and diet and health outcomes: 20 years of the CARDIA Study. *Archives of internal medicine* 2010, 170:420-426.

11. Drewnowski A: The cost of US foods as related to their nutritive value. *The American journal of clinical nutrition* 2010, 92:1181-1188.

12. Flegal KM, Carroll MD, Ogden CL, Curtin LR: Prevalence and trends in obesity among US adults, 1999-2008. *JAMA : the journal of the American Medical Association* 2010, 303:235-241.

13. Kim S, Popkin BM: Commentary: understanding the epidemiology of overweight and obesity--a real global public health concern. *International journal of epidemiology* 2006, 35:60-67; discussion 81-62.

Appendix A: Beverage Intake Questionnaire (BEVQ)

Beverage Questionnaire

Instructions:
In the past month, please indicate your response for each beverage type by marking an "X" in the bubble for "how often" and "how much each time"
1) Indicate how often you drank the following beverages, for example, you drank 5 glasses of water per week, therefore mark 4-6 times per week
2) Indicate the approximate amount of beverage you drank each time, for example, you drank 1 cup of water 2 times per day, therefore mark 1 cup under "how much each time"

Subject ID ____________

Date ____________

	HOW OFTEN (MARK ONE)							**HOW MUCH EACH TIME (MARK ONE)**				
Type of Beverage	**Never or less than 1 time per week (go to next beverage)**	**1 time per week**	**2-3 times per week**	**4-6 times per week**	**1 time per day**	**2+ times per day**	**3+ times per day**	**Less than 6 fl oz (3/4 cup)**	**8 fl oz (1 cup)**	**12 fl oz (1 1/2 cups)**	**16 fl oz (2 cups)**	**More than 20 fl oz (2 1/2 cups)**
Water	O	O	O	O	O	O	O	O	O	O	O	O
100% Fruit Juice	O	O	O	O	O	O	O	O	O	O	O	O
Sweetened Juice Beverage/Drink (fruit ades, lemonade, punch, Sunny Delight)	O	O	O	O	O	O	O	O	O	O	O	O
100% Vegetable Juice (V8, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
Whole Milk	O	O	O	O	O	O	O	O	O	O	O	O
Reduced Fat Milk (2%)	O	O	O	O	O	O	O	O	O	O	O	O
Low Fat/Fat Free Milk (Skim, 1%, Buttermilk, Soymilk)	O	O	O	O	O	O	O	O	O	O	O	O
Soft Drinks, Regular	O	O	O	O	O	O	O	O	O	O	O	O
Diet Soft Drinks/Artificially Sweetened Drinks (Crystal Light)	O	O	O	O	O	O	O	O	O	O	O	O
Sweetened Tea	O	O	O	O	O	O	O	O	O	O	O	O
Coffee, with cream and/or sugar (includes non-dairy creamer)	O	O	O	O	O	O	O	O	O	O	O	O
Tea or Coffee, black, with/without artifical sweetener (no cream or sugar)	O	O	O	O	O	O	O	O	O	O	O	O
Non-alcoholic or Light Beer	O	O	O	O	O	O	O	O	O	O	O	O
Beer, Ales, Wine Coolers	O	O	O	O	O	O	O	O	O	O	O	O
Hard Liquor (shots, rum, tequila, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
Mixed Alcoholic Drinks (daiquiris, margaritas, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
Wine (red or white)	O	O	O	O	O	O	O	O	O	O	O	O
Meal Replacement Shakes/Protein Drinks (Slimfast, shakes, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
Energy Drinks (Red Bull, Rockstar, Full Throttle, etc.)	O	O	O	O	O	O	O	O	O	O	O	O
Other (list):	O	O	O	O	O	O	O	O	O	O	O	O
Other (list):	O	O	O	O	O	O	O	O	O	O	O	O

Appendix B: Checklist of Health Promotion Environments at Worksites (CHEW)

General Building Characteristics:

Worksite: ____
Building/Address: ______________________________________
Date: __________ Time: __________ Observer: ___________________

BUILDING ASSESSMENT

Number of buildings at the worksite No. = _______
Number of floors No. = _______
Worksite is on how many floors? No. = ________

Freestanding or connected to other buildings? 1. Freestanding 2. Connected

Is worksite all or part of building? 1. All 2. Part

Bike Friendliness:

Number of bicycles seen stored inside building:
Tally: ______________________________ Total No. = ______

Number of bike rack spaces on grounds
Tally: ______________________________ Total No. = ______

Number of bikes parked outside
Tally: ______________________________ Total No. = ______

Number of bike lockers
Tally: ______________________________ Total No. = ______

Other lock up facilities for bikes (tick if yes) ☐

Changing Rooms and Showers:

Number of male changing rooms
Tally: ______________________________ Total No. = ______

Number of female changing rooms
Tally: ______________________________ Total No. = ______

Number of unisex changing rooms
Tally: ______________________________ Total No. = ______

Number of male showers

Tally: ___________________________________ Total No. = ______

Number of female showers
Tally: ___________________________________ Total No. = ______

Number of unisex showers
Tally: ___________________________________ Total No. = ______

Information Environment

Number of bulletin boards at the worksite
Tally: ___________________________________ Total No. = ______

Physical Activity:

Number of signs or posters generally encouraging physical activity (other than related to stairs)
Tally: ___________________________________ Total No. = ______

Number of notices about onsite exercise classes
Tally: ___________________________________ Total No. = ______

Number of notices about offsite physical activity/sports sponsored by the specific worksite
Tally: ___________________________________ Total No. = ______

Number of notices about offsite physical activity/sports sponsored by other organizations (this can include the parent company)
Tally: ___________________________________ Total No. = ______

Number of other notices about physical activity/sports
Tally: ___________________________________ Total No. = ______

Nutrition:

Number of signs/posters encouraging dietary fat reduction or promoting programs
Tally: ___________________________________ Total No. = ______

Number of signs/posters encouraging more fruits and vegetables or promoting programs
Tally: ___________________________________ Total No. = ______

Number of notices on bulletin board about dietary information other than the above
Tally: ___________________________________ Total No. = ______

Number of notices on bulletin board about weight loss or healthy weight maintenance
Tally: ___________________________________ Total No. = ______

Smoking:

Number of entrances to building
Tally: ___________________________________ Total No. = ______

Number of signs about smoking restrictions on or around entrance doors
Tally: ___________________________________ Total No. = ______

Number of notices on bulletin board about smoking cessation programs or smoking policies
Tally: ___________________________________ Total No. = ______

Number of signs/posters about smoking
Tally: ___________________________________ Total No. = ______

Alcohol:

Number of signs/posters about responsible drinking
Tally: ___________________________________ Total No. = ______

Number of notices on bulletin boards about responsible drinking or alcohol policies
Tally: ___________________________________ Total No. = ______

Health Promotion:

Number of bulletin boards dedicated to health promotion
Tally: ___________________________________ Total No. = ______

Number of postings related to combination of diet, physical activity, smoking, or alcohol
Tally: ___________________________________ Total No. = ______

Elevator Checklist

(tick if yes or present)	Entrance 1	Entrance 2	Entrance 3
Elevator (or sign) visible from major employee entrance	☐	☐	☐
Sign encouraging use of stairs at elevators	☐	☐	☐

Total number of elevators Total No. = _______

Stair Use Facilitation

(tick if yes or present)	Stairwell Number #1	#2	#3	#4	#5	#6	#7	#8
Staircase not enclosed in stairwell	☐	☐	☐	☐	☐	☐	☐	☐
Able to see stairs from entrance	☐	☐	☐	☐	☐	☐	☐	☐
Carpeted	☐	☐	☐	☐	☐	☐	☐	☐
Painted/decorated/finished walls	☐	☐	☐	☐	☐	☐	☐	☐
Utilities not visible in stairwell (eg. gas pipes, elec wires)	☐	☐	☐	☐	☐	☐	☐	☐
Door is ajar on most or all floors	☐	☐	☐	☐	☐	☐	☐	☐
Door is unlocked on most floors	☐	☐	☐	☐	☐	☐	☐	☐
Door marked "stairs" (not just exit)	☐	☐	☐	☐	☐	☐	☐	☐
No warnings or cautions on door	☐	☐	☐	☐	☐	☐	☐	☐
Floor number labeled inside of stairway	☐	☐	☐	☐	☐	☐	☐	☐
No restricted exit (locked from inside)	☐	☐	☐	☐	☐	☐	☐	☐
Signs encouraging use of stairs	☐	☐	☐	☐	☐	☐	☐	☐

Access to Exercise Equipment

	Workout Room 1	Workout Room 2
In worksite	☐	☐
In grounds	☐	☐
Area for aerobics/ dance/other activities	1. No area 2. Part time 3. Permanent	1. No area 2. Part time 3. Permanent
Size of workout area:	____ft X ____ft	____ft X ____ft
Treadmills	No. = ________	No. = ________
Ellipticals	No. = ________	No. = ________
Bikes	No. = ________	No. = ________
Rowing Machines	No. = ________	No. = ________
Stepper Machines	No. = ________	No. = ________
Free Weights	No. = ________	No. = ________
Resistance Equipment	No. = ________	No. = ________
Other Machines	No. = ________	No. = ________
TV in workout area	☐	☐
Music in workout area	☐	☐

Sedentary Entertainment Equipment
(circle if present)

	In worksite or on grounds?	
Table Tennis Tables	1. Worksite	2. Grounds
Billiard Tables	1. Worksite	2. Grounds
Sauna	1. Worksite	2. Grounds
Spa	1. Worksite	2. Grounds
TV Lounge	1. Worksite	2. Grounds

Food Choice Environment

Canteen

Canteen 1

In worksite or on grounds? 1. Worksite 2. Grounds

(For the following tick if present)
Fresh fruit ☐
Green salads ☐
Lowfat milk or yogurt ☐

Number of other low/reduced fat items on menu or on notices No. = ______
Number of NHF ticks displayed or other labeling of low fat items No. = ______
Number of items with easily visible nutrition information signs (fat grams, cals) No. = ______
Number of signs/prompts to choose low fat items No. = ______
Number of signs/prompts to choose fruits and vegetables No. = ______

Canteen 2

In worksite or on grounds? 1. Worksite 2. Grounds

(For the following tick if present)
Fresh fruit ☐
Green salads ☐
Low fat milk or yogurt ☐

Number of other low/reduced fat items on menu or notices No. = ______
Number of NHF ticks displayed or other labeling of low fat items No. = ______
Number of items with easily visible nutrition information signs (fat grams, cals) No. = ______
Number of signs/prompts to choose low fat items No. = ______
Number of signs/prompts to choose fruits and vegetables No. = ______

Water Coolers

Number of water coolers: ________________
Number of water fountains: ______________

Vending Machines

	#1	#2	#3	#4	#5	#6
In worksite	☐	☐	☐	☐	☐	☐
On grounds	☐	☐	☐	☐	☐	☐
Type of machine:						
Please tick if snack machine	☐	☐	☐	☐	☐	☐
Please tick if soft drink machine	☐	☐	☐	☐	☐	☐
Please tick if hot drink machine	☐	☐	☐	☐	☐	☐
(Please write NA if not applicable)						
Total number of items that machine holds	☐	☐	☐	☐	☐	☐
Number of slots with low fat/sugar snacks	☐	☐	☐	☐	☐	☐
Number of slots with fresh fruit	☐	☐	☐	☐	☐	☐
Number of slots with fresh green salads	☐	☐	☐	☐	☐	☐
Number of slots with items with heart tick	☐	☐	☐	☐	☐	☐
Number of slots with fruit juice or mineral water (can be mineral water with some fruit juice)	☐	☐	☐	☐	☐	☐
Number of slots with diet soft drink	☐	☐	☐	☐	☐	☐
Number of slots with coffee/tea with no milk and no sugar	☐	☐	☐	☐	☐	☐
Please tick if there is an option for using lowfat milk for coffee/tea	☐	☐	☐	☐	☐	☐
Please tick if there is a sign encouraging selection of lowfat items	☐	☐	☐	☐	☐	☐

Lunch Room Assessment

Lunch Room 1

In worksite or on grounds? 1. Worksite 2. Grounds

(For the following tick if present)

Microwave ☐

Other oven or toaster ☐

Fridge ☐

Seating in or near food preparation area ☐

Lunch Room 2

In worksite or on grounds? 1. Worksite 2. Grounds

(For the following tick if present)
Microwave ☐
Other oven or toaster ☐
Fridge ☐
Seating in or near food preparation area ☐

Smoking Environment

Number of cigarette vending machines in the building
Tally: ___________________________________ Total No. = ______

Number of cigarette disposal units on the grounds (at entrances ect.)
Tally: ___________________________________ Total No. = ______

Alcohol Environment

Is there an observed area where alcohol is served? (tick if yes) ☐

Parking Assessment

Number of signs in parking lot encouraging drivers to park farther No. = ______

Grounds Assessment

Are grounds exclusive for target worksite or shared? 1. Exclusive 2. Shared

(For the following tick if present)
Volleyball court ☐
Basketball goal ☐
Walking path on or adjacent to grounds ☐
Open space/grassy area large enough for physical activity ☐

Size of open space/grassy areas _____ft X _____ft

Other outdoor fitness or sport facilities (tick if yes) ☐
Please specify:____
____

Things not included from original:

- asking about signs for low fat and fruits and veggies under Canteen since this was already in the information environment
- neighborhood assessment, this is beyond the scope of this study
- the interview