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Predictors of Caffeine Consumption among Young Women

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Abstract: Designing a meaningful nutritional educational massages and introducing a real changes in food behaviors need to address predictors determining consumption. In the subject of caffeine teratogenic effects on the health of women at childbearing age, important factors such as the women's knowledge, attitude and practices which may influence the level of caffeine consumption need to be investigated. This study involved 112 Saudi non-pregnant young women with main age of 26 ± 1.85 years whom were reported as heavy coffee and soda drinkers. All study participants consume more than 100mg/day of caffeine with a mean range of 258 ± 156 - 305 ± 204 mg/day. Soft drinks provide the highest amount of caffeine, 401 ± 113 - 540 ± 60 mg, for around 56-81% of the studied group. The caffeine consumption data were gathered and calculated using the 24-hour recalls and the beverage-frequency methods. The results indicated that the two methods were significantly correlated (Pearson r = 076, P ~ 0.01). An attitude concerning the difficulty associated with limiting coffee consumption was the strongest predictor of caffeine consumption but a weak positive correlation between caffeine consumption and other attitude related to caffeine use during pregnancy. No correlation between caffeine consumption and knowledge about caffeine and a negative association existed between knowledge about caffeine and attitude toward use of caffeine during pregnancy. No relationship between knowledge about caffeine and attitude toward the importance of dietary awareness.

Key words: Caffeine, young women, coffee, soda, Saudi Arabia

Introduction

Caffeine is a substance that belongs to a group of compounds called methylxanthines which is currently the most popular drug available to humans and found in nonprescription drugs like pain relievers, diet pills, cold and allergy medicines and diuretics. It is naturally found in the leaves, seeds and fruits of over 60 different plants and a constituent of coffee, tea, some soft drinks, chocolate and coffee-flavored products such as yogurt, ice cream, hot cocoa, candies, cakes, cookies and muffins. The amount of caffeine in foods and beverages varies widely due to differences in food and beverage preparations. In general, brewed coffee contains the highest amounts of caffeine, with an average of 137 milligrams (mg) per 8-ounce cup. Instant coffee contains about 76 mg per 8-ounce cup. A 12-ounce can of caffeinated soda contains about 37 mg. Chocolate generally contains low amounts of caffeine. (See table below for more specific values) (Bunker and Williams, 1979).

Millions of people consume caffeine and for most, it has become a part of their daily diet. In the United States alone, four out of every five Americans consume caffeine each day in some form or another (Monroe, 1998). Many people consume caffeine to help them stay awake since it is absorbed in the body very rapidly and within 30-60 minutes of consumption, the level of caffeine in the bloodstream reach a high point and takes the body approximately three hours to get rid of half the amount of caffeine consumed. It is established that caffeine affects the human body in a number of ways. It stimulates cardiac muscles, relaxes smooth muscles, stimulates the central nervous system, acts as a diuretic, initiates the secretion of gastric acid and also increases the concentrations of plasma glucose and free fatty acids (Zeman, 1991).

Considering the amount that is consumed on a daily basis, the effect of caffeine on health becomes an important subject.

Areas of concern are the physiological effects of caffeine on the body, its impact on pregnancy and the role it plays in bone density. Women of childbearing age are a logical target audience for messages about potential teratogenic effects of caffeine. During the first trimester of pregnancy, however, the half-life of caffeine increases to 5.6 hours and continues to increase to a high of 18 hours by the 35th week of pregnancy (Golding, 1995). These altered pharmacokinetics may be due to changing hormone levels during pregnancy. Changing levels and the efficacy of particular enzymes may also be involved in altered caffeine half-life (Nolen, 1988). The half-life of caffeine in newborns can be as long as 40-130 hours because of the immature metabolic pathways utilized in caffeine excretion (Nehlig and Debry, 1994).

Animal studies have shown an increased incidence of birth defects when caffeine is administered to rodents in a large bolus, usually 250 mg or more. Such high caffeine doses are typically associated with delayed

skeletal ossification, palate malformation and missing digits. Caffeine metabolism differs in animals and humans. In rodents, 40% of caffeine is metabolized into trimethyl derivatives such as methyl xanthine; this pathway accounts for only 6% of caffeine metabolism in humans. In humans, between 72 and 80% of caffeine undergoes 3-methyl demethylation resulting in paraxanthanine formation (Nehlig and Debry, 1994). This difference makes the applicability of animal studies to humans questionable.

The Food and Drug Administration (FDA) completed a safety review of caffeine that focused on potential teratogenic effects of caffeine and advised pregnant women either to avoid or to use sparingly foods and drugs that contain caffeine (Food and Drug Administration, 1980). The March of Dimes also advised pregnant women as well as those who may become pregnant to limit their caffeine consumption to 444 milligrams (mg) per day (Guiry and Bisogni, 1986). Since these warnings, numerous studies have examined the effects of caffeine intake on fertility and pregnancy and its association with miscarriages, spontaneous abortion, stillbirth birth defects and low birth weight (Bech *et al.*, 2007; Bracken *et al.*, 2003; Signorello *et al.*, 2001; Clausson *et al.*, 2002; Olsen *et al.*, 1991; Fortier *et al.*, 1993). Some studies have found that low levels of caffeine consumption (less than 300 mg per day) probably don't increase the risk of miscarriage (Clausson *et al.*, 2002). Other studies have found that women who consume large amounts of caffeine (500 mg a day or more) may be twice as likely to miscarry as women who consume less (Klebanoff, 1999). The studies prior to the FDA statement were often thought to be fraught with methodological flaws and the latter studies were judged to be inadequate because they did not consider other lifestyle factors that could contribute to infertility or miscarriages (Nolen, 1988).

On a latest study that is unlike most past research as it looked at women in early pregnancy when most miscarriages happen and tried to account for a separate risk from genetic defects in fetuses and a possible risk from smoking. The research team found that the equivalent of one to three cups of American coffee increases the risk of miscarriage by 30 percent and that three to five cups raises the risk by 40 percent. They conclude that the ingestion of caffeine may increase the risk of an early spontaneous abortion among nonsmoking women carrying fetuses with normal karyotypes (Cnattingius, 2001).

The problem with reporting on caffeine's relationship with health has been the myriad of conflicting reports that verify and commend caffeine. Simply put, there are difficulties interpreting caffeine's effects on the human body and its health. Not only are caffeine's effects difficult to isolate from the other substances that often accompany in food and drink, but, the method of preparation, the differences between types of coffee beans, different methods of roasting and consumption can also have varying effects on human health. Further compounding this difficulty is that there exist individual differences in sensitivity to caffeine. It is difficult to hold for all variables involved, therefore it must be emphasized that the results of any study should be treated with a critical eye. Despite these cautionary words, some conclusions have been formed about caffeine in relation to human health and young women in particular. The Organization of Teratology Information Services (OTIS) recommends that pregnant and nursing women drink plenty of water, milk and juice and not substitute those fluids with caffeinated beverages and the American Academy of Pediatrics recommends that nursing women limit caffeine intake (Guiry and Bisogni, 1986). Finally, most experts agree that high caffeine intake (equal to about 3 or more cups of coffee a day) may increase the risk of miscarriage and of having a low-birth weight baby.

According to Ajzen's and Fishbein's theory of reasoned action (Ajzen and Fishbein, 1980), an individual's behavior is determined by both the individual's attitude toward behavior and by the subjective norm. A person's favorable or unfavorable feelings toward the behavior are determined by that individual's beliefs about the outcome of the behavior. Although a person may have a large number of these beliefs about outcomes of a behavior, usually only a small number of those beliefs will be salient; and these will determine the person's attitude toward the behavior. Underlying the subjective norm are the person's beliefs about what others think that individual should do about the behavior. Based on this, the Consistency theories predict that an individual will strive to achieve consistency among knowledge, attitudes and behaviors because dissonance among those characteristics creates psychological discomfort (McGuire, 1967).

In Saudi Arabia, the society has witnessed a dramatic shift in all living aspects including food habits. However, the statistics concerning the present rate of caffeine containing food products consumption in the country are absent; this rate is expected to be increasing specially among children and young adults. Young women, as a variable group, are increasingly seen as a regular consumer of coffee, chocolate, soda and similar caffeinated products. This situation required attention and raises the question of the main predictors covering the caffeine consumption among this group.

As the safety of caffeine is an issue that many nutrition educators must address and because women of childbearing age are a logical target audience for messages about potential teratogenic effects of caffeine. Educators who wish to design meaningful messages must consider the knowledge, attitudes and practices of their audiences because these characteristics or predispositions may influence how a specific audience

Table 1: Percentage of participants consuming different levels of caffeine per day

Caffeine Consumption Daily (mg)	Number (Percent) of Sample	
	24-Hour Recall Data	Frequency List Data
100-200	11 (13.4)	9 (11.0)
201-300	33 (40.3)	30 (36.6)
300-765	38 (46.3)	43 (52.4)
Total	82 (100.0)	82 (100.0)

will respond to a particular message (Gillespie and Yarbrough, 1984). And if messages are intended to modify food practices, understanding how knowledge and attitudes are related to behavior is important. For this, the knowledge, attitude and practices toward caffeine and nutrition in general were sighted and studied as predictors in influencing the women toward higher caffeine consumption.

Materials and Methods

The study was conducted among health watchers attending the privet Nutrition Medical Center in Riyadh, Saudi Arabia. A structured questioner was designed in which a larger group of Saudi young females were addressed and asked for their rate and quantity of caffeine consumption. Among the young females who participated, 112 young non-pregnant women with main age of 26±1.85 years show high caffeine consumption and were included as the sample for this study. The design, measurements and calculations followed on this study was according to those implemented by Guiry and Bisogni (Guiry and Bisogni, 1986).

To measure caffeine consumption, two methods were used to insure the adequacy of the data. A 24-hour recall method in which the participants record both the type and amount of all beverages consumed on the preceding day, a three days food pattern of consumption was, also, collected as participants asked to complete a beverage-frequency form for commonly consumed beverages. To measure knowledge, attitude and behavior variables, a self administered questionnaire was used in which that participants completed at the center. The amount of caffeine each participant consumed in a day was calculated by multiplying the number of reported servings by a concentration value for caffeine in the beverages according to estimates in the literature (Bunker and Williams, 1979). After reporting beverage consumption, participants completed a separate questionnaire that contained the knowledge and attitude instruments.

To develop the instruments to measure knowledge and attitudes toward caffeine, the procedures implemented by other researchers was followed (Guiry and Bisogni, 1986). To examine the relationships among knowledge, attitude and behavior variables, Pearson's r product-

moment correlations were calculated and multiple regressions to predict caffeine consumption using knowledge and the three attitudes as independent variables, was performed. The data were analyzed using programs from the Statistical Package for the Social Sciences (SPSS V. 11.0).

Results

The mean of caffeine consumption as calculated from the 24-hour recall form was 258±156 mg and was 305±204 mg when calculated from frequency data forms. Table 1 shows the percentage of participants who consumed various levels of caffeine as calculated from the 24- hour recall and the frequency data. All the participants reported to consume caffeine-containing beverages and more than 100mg/day of caffeine, accord to both types of dietary data. On a daily basis, 86.6-89.0% of the participants consumed more than 200mg of caffeine and 46.3 -52.4% found to consume above 300 mg caffeine when dietary data and frequency method were used respectively.

Table 2 presents the mean levels of caffeine consumed from coffee, tea, soft drinks, caffeinated beverages and the percentage of participants who consumed caffeine from each of these beverages. The mean of consumed caffeine from soft drink was the highest and the values obtained by the 24-hour recalls and the frequency were 401±113 and 540±60 respectively. Also, the two methods indicated that more participants consumed caffeine from soft drinks than from any other caffeine-containing beverages. The caffeine consumption data calculated from the 24-hour recalls and the beverage-frequency forms were significantly correlated (Pearson r = 0.76, P ~ 0.01).

The scores on the caffeine knowledge test ranged from 0 to 12. With a mean of 9.4±3.1. Over 78% of the participants knew that caffeine is a stimulant and that it is contained in over-the-counter drugs. Around 86% knew that tea contains caffeine and that it is advisable to pregnant women to limit caffeine consumption.

For the attitude toward caffeine and nutrition, the mean score was 21.2±4.3 for the attitude that "it is safe for pregnant women to consume caffeine." The mean scores were 23.2±5.2 and 20.7±7.3 on the other two attitude scales. Approximately 86% of the participants had scores below the midpoint for the attitude that "it is safe for pregnant women to consume caffeine," and about 75% had scores below the midpoint for "it is hard to limit coffee consumption." All of the participants had scores below the midpoint for the attitude that "nutrition is not important."

In regard to the relationships between caffeine consumption and knowledge and attitude variables. Table 3 presents the correlation coefficients among caffeine consumption, knowledge and attitude variables.

Table 2: Means and standard deviations for caffeine consumed from different beverages and percentage of sample consuming a given beverage

Caffeine sources Beverages (mg Caffeine/day)	24-Hour Recall Data		Frequency List Data	
	Mean±std	% of sample	Mean±std	% of sample
Coffee	211.2±5.5	28.5	179.1±19.4	37.3
Tea	60.6±3.8	30.7	78.0±9.4	51.9
Soft drinks	400.6±113.2	55.8	539.7±60.4	81.1
Caffeinated Beverages	27.2±17.0	22.8	36.8±5.1	17.4
All beverages	258.1±155.8	100	305.4±204.3	100

Table 3: Correlation coefficients among caffeine knowledge, attitude and consumption variables

Variable	Pearson "r"					
	1	2	3	4	5	6
Caffeine consumption						
24-hour recall	1.00					
frequency list	0.77***	1.00				
Caffeine Knowledge						
Knowledge score	-0.05	-0.09	1.00			
Attitudes						
Attitude 1 a	0.29*	0.26*	-0.71***	1.00		
Attitude 2 b	0.59***	0.48***	0.03	0.41 **	1.00	
Attitude 3 c	0.07	0.02	-0.04	0.38**	0.24	1.00

a.Attitude: It is safe for pregnant women to consume caffeine, b.Attitude: It is hard to limit coffee consumption, c.Attitude: Nutrition is not important

The strongest relationship among the variables was a fairly high, positive correlation between caffeine consumption and the attitude that "it is hard to limit coffee consumption." Caffeine consumption had a significant positive correlation with the attitude that "it is safe for pregnant women to consume caffeine," but the association was weak.

Knowledge had a moderately strong negative correlation with the attitude that "it is safe for pregnant women to consume caffeine," but knowledge was not significantly correlated with any other variables. The attitude that "it is safe for pregnant women to consume caffeine" was positively correlated with the other attitudes and caffeine consumption, but the relationships were weak.

The multiple regression analysis show the following prediction equation for caffeine consumption: $Y = -138.71 + 13.66 X$ where Y = caffeine consumption and X = score for the attitude, "hard to limit coffee consumption.' In this equation, attitude explained 41.7% of the variance in caffeine consumption and the standard error of r^2 was 117.4.

Discussion

In the literatures, no local or recent study was found by the author in the subject of caffeine consumption or its predictors. Furthermore, the available studies are limited, old and provided only general information about the public's knowledge and attitudes toward the potential danger of caffeine consumption by women. In the United States caffeine consumption from foods and beverages was found to range from 139 to 310 mg per day (Select Committee of GRAS Substances, 1978). In a survey for

food shoppers in USA, 60% reported reading or hearing about the hazards of caffeine and 53% considered the potential effects a serious problem. Reported awareness and evaluation of the seriousness of the problem were higher among women of childbearing age (Food and Drug Administration, 1980). Guiry and Bisogni (1986) investigated young women's knowledge, attitudes and behaviors related to caffeine consumption. Their results indicated that the attitude is a very important determinant of young women's caffeine consumption and that the greater knowledge about the safety of caffeine during pregnancy was associated with a more negative attitude toward the safety of caffeine use during pregnancy.

In this study, the participants were selected from a larger group on the bases of suspicion of high consumption of caffeine. However there were no local estimates available, the mean of daily intake of caffeine reported by the participants was considered high, as expected. The differences in values for caffeine consumed, from all sources, obtained by the 24-hour recall and frequency methods may be produced by multi-factors. One limitation of the 24-hour recall is that people may not remember all the foods and/or beverages that they consumed on the day preceding the interview (Sanjur, 1982). Also, some participants recorded only coffee or tea on the 24-hour recall form; whereas, on the beverage-frequency form they recorded soda in addition to coffee or tea. These differences resulted in a lower caffeine value on the 24-hour recall than on the beverage-frequency form. However the estimates of caffeine consumption from the two. measurements

differed, they were highly correlated which indicates that each method may be useful in producing a relative measure of caffeine consumption among individuals. The attitude that "it is hard to limit coffee consumption." was found to be positively associated with caffeine consumption and was the main predictor of caffeine consumption. On other hand, caffeine consumption was not affected by the attitude "it is safe for pregnant women to consume caffeine", the knowledge about caffeine nor by nutrition knowledge. These relationships and the inability of nutrition knowledge to predict food behavior were similar to those obtained by previous studies (Schwartz, 1975; Grotkowski and Sims, 1978).

Ajzen and Fishbein (1980) hypotheses is that when trying to predict behaviors the specificity of the variables must be considered. As given variables being less specifically in relating to the behavior, the less likely those variables to explain the behavior, so even though many variables may be related to the behavior, there maybe no relationship between them and the specific behavior. In other words, these variables may influence both the individual's beliefs about the behavior and the relative importance that the individual attaches to the subjective norm versus his or her own attitude toward the behavior. Examples of those external variables involve demographic characteristics, are personality traits and other attitudes. When applying this theory, results in this study indicated that respondents' feelings about the difficulty associated with limiting coffee consumption were strong as determinant in caffeine consumption. This indicates that the attitude "it is hard to limit coffee consumption" as the best predictor of caffeine consumption. This attitude is more specifically related to behavior of consuming caffeine-containing beverages than are the other variables. However this variable was an important predictor of caffeine consumption, it was found to account for only 43% of the variance in caffeine consumption which emphasizes the inclusion of other beliefs and models of study. The feelings regarding safety of caffeine consumption during pregnancy were not clear, so they are not important in determining caffeine consumption. The lack of clear effect may be due to that the respondents felt that the teratogenic effects of caffeine as irrelevant because they were not pregnant. The negative association between knowledge and the attitude that "it is safe for pregnant women to consume caffeine" could prove that those with more knowledge have more negative attitudes toward the safety of caffeine during pregnancy. All respondents reported negative feeling toward the attitude that "nutrition is not important:' and the model of scoring may have contributed to the lack of association that we ob-served.

This study introduces at least two implications for nutrition educators. First, their messages need to address the attitude that "it is hard to limit coffee consumption." they should explore the reasons why the audience perceives limiting coffee consumption as difficult and work on changing this perception. The abundance of the alternatives of caffeine-free beverage may influence individuals' attitudes and behaviors (Glanz, 1981). The second implication of this study is related to the knowledge about the safety of caffeine use during pregnancy which was associated with a more negative attitude toward the safety of caffeine use during pregnancy. This means that the increases of public knowledge will able educators to modify the attitude toward the safety of caffeine.

This study tried to investigate some characteristics of young women which could affect their behaviors related to caffeine consumption and their response to educational messages. It is recommended that more work need to be done in order to understand the predictors of food behaviors, to design meaningful educational messages and to introduce real changes toward healthier choices and practices.

References

Ajzen, I. and M. Fishbein, 1980. Understanding attitudes and predicting social behavior. Englewood Cliffs, Prentice-Hall, pp: 4-26.

Bech, B., C. Obel, T. Henriksen and J. Olsen, 2007. Effect of reducing caffeine intake on birth weight and length of gestation: randomized controlled trial. Br. Med. J., 334: 409-409.

Bracken, M., E. Triche, K. Belanger, K. Hellenbrand and B. Leaderer, 2003. Association of Maternal Caffeine Consumption with Decrements in Fetal Growth. Am. J. Epidemiol., 157: 456-466.

Bunker, M. and M. Williams, 1979. Caffeine content of common beverages. J. Am. Dietetic Assoc., 74: 28-32.

Clausson, B., F. Granath, A. Ekbom, A. Lundgren, A. Nordmark, L. Signorello and S. Cnattingius, 2002. Effect of caffeine exposure during pregnancy on birth weight and gestational age. Am. J. Epidemiol., 1: 429-436.

Cnattingius, S., 2001. Caffeine intake and the risk of first-trimester spontaneous abortion. New England J. Med., 341: 1839-1845.

Food and Drug Administration, 1980. Proposed rule: Soda water amendment to standard. Federal Register, 45: 6981638.

Fortier, I., S. Marcoux and L. Beaulac-Baillargeon, 1993. Relation of caffeine intake during pregnancy to intrauterine growth retardation and preterm birth. Am. J. Epidemiol., 137: 931-940.

Gillespie, A. and P. Yarbrough, 1984. A conceptual model for communicating nutrition. J. Nutr. Education, 16: 168-172.

Glanz, K., 1981. Social psychological perspectives and applications to nutrition education. J. Nutr. Education, 13 (Supp. 1): 66-69.

Golding, J., 1995. Reproduction and caffeine consumption: A literature review. Early Human Development, 43: 1-14.

Grotkowski, M. and L. Sims, 1978. Nutritional knowledge, attitudes and dietary practices of the elderly. J. Am. Dietetic Assoc., 72: 499-506.

Guiry, V. and C. Bisogni, 1986. Caffeine knowledge, attitudes and practices of young women. J. Nutr. Education, 18: 16-22.

Klebanoff, M., 1999. Maternal Serum Paraxanthine, a Caffeine Metabolite and the Risk of Spontaneous Abortion. New England J. Med., 341: 1639-1644.

McGuire, W., 1967. The current status of cognitive consistency theories. In Readings in attitude theory and measurement. New York, John Wiley and Sons, pp: 401-421.

Monroe, J., 1998. Caffeine's Hook. Current Health, 2: 5-12.

Nehlig, A. and G. Debry, 1994. Consequences on the newborn of chronic maternal consumption of coffee during gestation and lactation: a review. J. Am. Collage Nutr., 13: 6-21.

Nolen, G., 1988. The development toxicology of caffeine: Issues and reviews in teratology. New York, USA, Plenum Press, pp: 305-250.

Olsen, J., K. Overvad and G. Frische, 1991. Coffee consumption, birth weight and reproductive failures. Epidemiol., 2: 370-374.

Sanjur, D., 1982. Social and cultural perspectives in nutrition. Englewood Cliffs, NJ: Prentice-Hall, pp: 172-175.

Schwartz, N., 1975. Nutritional knowledge, attitudes and practices of high school graduates. J. Am. Dietetic Assoc., 66: 28-31.

Select Committee of GRAS Substances, 1978. Evaluation of the health aspects of caffeine as a food ingredient. SCOGS-89. Washington DC, Federation of American Societies for Experimental Biol., pp: 5-9.

Signorello, B., A. Nordmark, F. Granath, W. Blot, J. McLaughlin, G. Anneren, S. Lundgren, A. Ekbom, A. Rane and S. Cnattingius, 2001. Caffeine Metabolism and the Risk of Spontaneous Abortion of normal Karyotype Fetuses. Obstetrics and Gynaecology, 98: 1059-1066.

Zeman, F., 1991. Clinical Nutrition and Dietetics (2nd Ed.). New York, Macmillan Publishing Co., pp: 181-189.