PREVALENCE OF MENSTRUAL PAIN AND ASSOCIATED RISK FACTORS AMONG IRANIAN WOMEN

by

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ABSTRACT

Objective: Dysmenorrhea is a common disorder among women. The aim of this study was to estimate the prevalence of dysmenorrhea and to investigate the associated risk factors in Iranian women

Methods: In a cross-sectional study, 381 women in Tehran, Iran completed a questionnaire regarding dysmenorrhea. Descriptive statistics, spearman rho correlation, and ordinal regression model were used to present the results. The response rate was 72%.

Results: The prevalence of no, mild, moderate, and severe menstrual pain was 9.8%, 40.9%, 27.5%, and 21.7% respectively. The mean age at menarche was 12.3 years. Age, socioeconomic status, fruit and vegetable intake, fatty diet, stress level, and family history of dysmenorrhea were all associated with menstrual pain. There was no association between BMI, parity, smoking, and physical activity with dysmenorrhea.

Conclusion: menstrual pain is a common complaint in Iranian women. By identifying modifiable risk factors, recommendations could be made to reduce dysmenorrhea.

Keywords: Menstruation; Dysmenorrhea; Risk factor; Iran; Reproductive health;

To my beloved uncle, Majid Tavallaee (1948-2007), a courageous man who lived every day of his life with goals and dreams and never gave up his hope and optimism until the last day of his battle against melanoma.

Without you I would never learn to dream my dreams with open eyes and make them come true.

You made me live as though heaven is on earth.

Rest in Peace

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: REPRODUCTIVE SYSTEM

Introduction

This paper aims to investigate the prevalence of menstrual pain and associated risk factors in Iranian women. A quick review on women's reproductive system seems to be essential to help better understand the concepts and terms.

Anatomy

Female reproductive system

The female reproductive system consists of the following organs: Ovaries, fallopian tubes, uterus, vagina, and vulva. In some references, mammary glands are also considered parts of female reproductive system (Scourge et al, 2008, chap.38).

Ovaries: paired bilateral organs located on either side of the uterus against the lateral wall of pelvic. The major role of ovaries is producing hormones and release eggs (ovum).

Fallopian tubes: tubular structures lined by a ciliated mucosa that carry the eggs from ovary to uterus.

Uterus: a hollow fibromuscular organ located in pelvic cavity between the bladder and rectum. It consists of two parts: the body and cervix. The inner layer of uterus is called endometrium. The superficial layer of endometrium goes under

cyclic changes during menstrual periods. The cervix is the lower part of the uterus which leads to vagina through a canal.

Vagina: elastic muscular canal located between the cervix and vulva.

Vulva: external genitalia in female body.

Reproductive endocrinology

Normal reproductive function needs specific quantitative and chronological regulation of the hormones. The organs that produce reproductive hormones are hypothalamus, pituitary, and ovaries.

Hypothalamus: a small region located at the base of the brain which supplies many important neurotransmitters in reproductive function such as Gonadotropin-Releasing Hormone (GnRH).

Pituitary: a very small gland located below hypothalamus consists of two lobes. The anterior lobe synthesizes and secrets important endocrine hormones such as Follicle Stimulating Hormone (FHS) and Luteinizing Hormone (LH). These hormones are called gonadotropins.

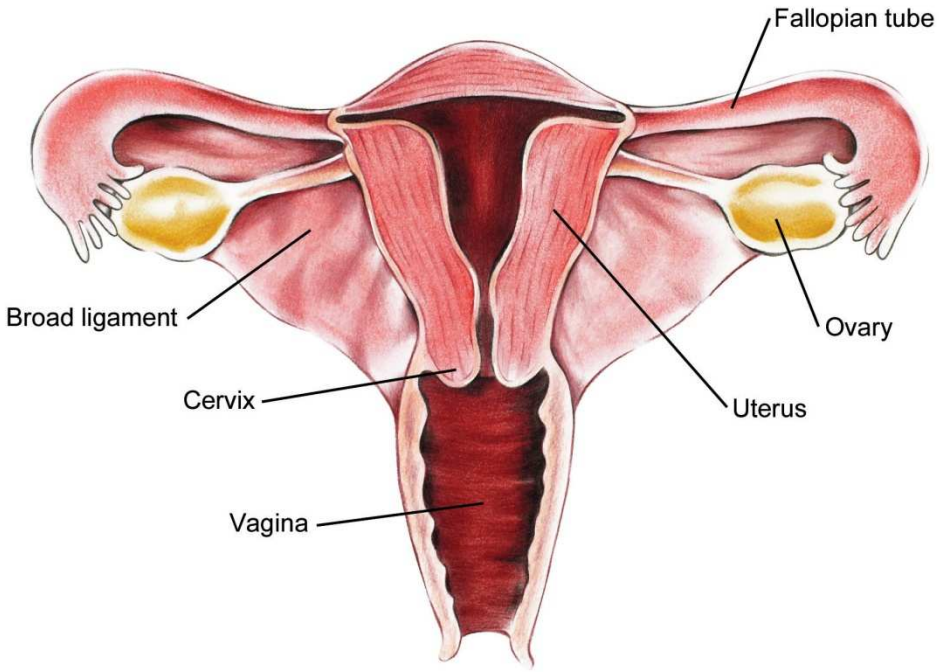
Ovaries: organs responsible for producing hormones such as progesterone, estrogen, and testosterone.

Role of hormones

GnRH stimulates FSH and LH from anterior pituitary that stimulate estrogen and progesterone production in ovaries. These processes are controlled by the size and frequency of GnRH pulses, as well as by feedback

from androgens and estrogens. The role of gonadotropins will be discussed further.

Figure 1-1 Anatomy of female reproductive system



Source: http://www.cs.nsw.gov.au/cancer/sgog/assets/UterusDia.jpg

Physiology

The menstrual cycle

There are three phases in menstrual cycle of women of reproductive age: follicular phase, ovulation, and luteal phase. The first day of bleeding is called day one of the cycle. The follicular phase which is also called the proliferative phase is approximately from day one to fourteen. During the follicular phase, FSH secretion is slightly elevated which stimulates the growth of ovarian follicles.

However, only one follicle becomes dominant during a cycle and it produces estrogen. Estrogen enters the blood stream and stimulates the cells of the uterus to reproduce. Therefore the endometrium becomes thicker during this phase. Progesterone remains low during this phase. The estrogen level reaches its highest level around the day fourteen. This leads to a peak secretion of LH. The high level of LH causes the dominant follicle to burst and release ova. This phase is identified as ovulation. The luteal phase also known as secretary phase starts after the ovulation. During this period, the ruptured follicle develops to corpus luteum due to the high level of LH. The corpus luteum is responsible for the secretion of progesterone, which increases the endometrial blood supply and makes the uterus ready to receive the fertilized egg. If fertilization of the egg does not occur, the corpus luteum degenerates and the level of estrogen and progesterone drops. This leads to the next menstrual bleeding.

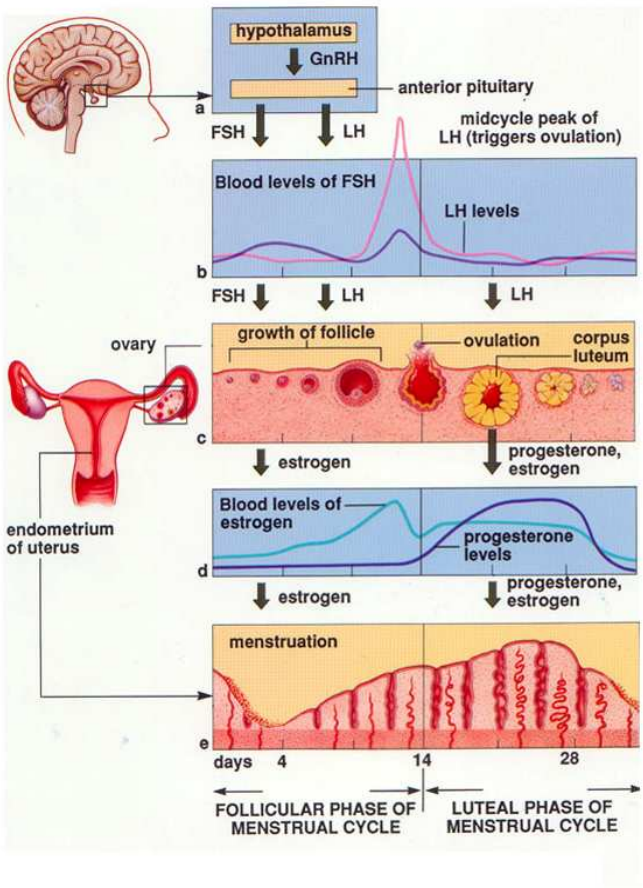
Menstruation

Definition and pathophysiology

The first menstrual period in females is called menarche. The age at menarche varies among women. Genetic and environmental factors both influence the age at menarche which has been reported between 12 to13 years of age (Chumlea et al, 2003). However, the average age at menarche has declined during the last century (McDowell, Brody, Hughes, 2007) .The average length of menstrual cycles is 29.1 ± 3.5 days (Creinin, Keverline, Meyn, 2004). According to Michell (2001), cycles between 21 to 35 days are considered normal. Polymenorrhea is the medical term for cycles with intervals of 21 days or

less and oligomenorrhea is the medical term for those last more than 35. The average length of bleeding is 5.2±1 days (Creinin et al, 2004). Average of total blood flow is between 25 and 80 milliliter per period. The clinical definition of menorrhagia is a blood loss of greater than 80 mL or one lasting longer than 7 days (Prentice, 1999). An abnormally light or short menstrual period is called hypomenorrhea while amenorrhea is the absence of menstrual pain in women in their reproductive age.

Figure 1-2: Hormone levels during menstrual cycle



Source: http://www.soc.ucsb.edu/sexinfo/images/05-07-Menstrual.jpg

Dysmenorrhea

Dysmenorrhea is defined as severe frequent pain during menstruation. There are two broad categories of dysmenorrhea: primary and secondary.

Primary dysmenorrhea: defined as frequent, cramping pain in the lower abdomen occurring with menses in the absence of specific pelvic pathology. It usually begins after the establishment of ovulatory cycles. The exact pathophysiology of primary dysmenorrhea is still unknown. However, the following strong theories have been suggested:

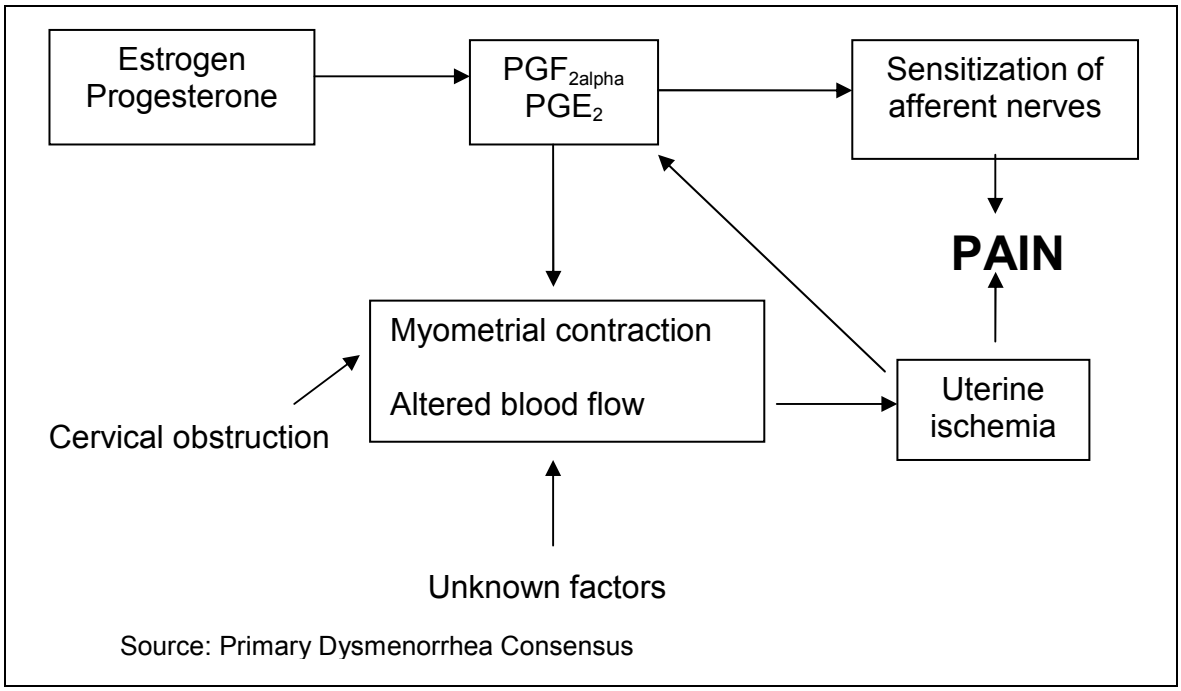
1. Role of prostaglandins: prostaglandins are hormone like substances derived from a chemical called arachidonic acid. As menstruation begins, the disintegrating endometrial cells release PGF_{2alpha} that stimulates myometrial contractions, ischemia and sensitization of nerve endings. Chan and Hill (1978) showed that women who had higher levels of PGF_{2alpha} in their menstrual fluid tended to have more severe dysmenorrhea. Furthermore, the prostaglandin level is higher over the first two days of menses when symptoms peak. Other studies have shown that non-steroidal anti-inflammatory drugs which inhibit prostaglandin production, suppressed menstrual pain.
2. Role of Leukotrienes: leukotrienes are synthesized in the cell from arachidonic acid and have been proposed to increase the sensitivity of pain fibers in the uterus. Studies showed that women with primary dysmenorrhea had significant amounts of leukotrienes in their

endometrium that did not respond to treatment with prostaglandin antagonists (Demers et al, 1984).

3. Role of Vasopressin: Vasopressin is a hormone secreted from posterior pituitary that may be involved in myometrial hypersensitivity, reduced uterine blood flow, and pain in primary dysmenorrhea (Akerlund et al, 1979).

4. Genetic factors: Wu et al (2000) investigated the association of the cytochrome P450 2D6 (CYP2D6) and glutathione S-transferase Mu (GSTM1) polymorphisms with dysmenorrhea and concluded that women with variant genotypes in both CYP2D6 and GSTM1 had the highest risk of dysmenorrhea. The results of this study suggested evidence of genetic susceptibility to dysmenorrhea.

Figure 1-3: Pathophysiology of primary dysmenorrheal



Source: Primary Dysmenorrhea Consensus

Secondary dysmenorrhea: defined as menstrual pelvic pain due to an underlying disease such as endometriosis, adenomyosis, uterine myomas, endometrial polyps, ovarian cysts, pelvic infection, and cervical stenosis.

Prevalence

Dysmenorrhea is the most common gynecological complaint (Harel, 2006). Various studies have been conducted on menstrual pain and the prevalence of dysmenorrhea has been reported from 43% to 90% among different populations (Wang et al, 2004). Dysmenorrhea is also the most recurrent reason for women to miss school or work (Harel, 2006).

Risk Factors

Several studies have been done on dysmenorrhea and influencing factors worldwide and the results vary. Some researchers showed that older people experienced less pain during menstruation (Andersch, 1982; Taperi, 1982, Sundell, 1990; Alicia, 2004). Various studies showed that parity was a protective factor for dysmenorrhea (Alicia, 2004; NG, 1992; Sundell, 1990) while other researchers found no association between child bearing and dysmenorrhea (Pullon, 1988; Messing, 1993). Harlow (1996) and Balbi (2000) showed that women who had had an early menarche age, experienced more pain during menstruation. Alicia (2004) found no association between the age at menarche and dysmenorrhea. The identification of behavioral risk factors could be important as they could be modified during the life period. Researchers studied the influence of diet on menstrual pain and suggested that a low fat vegetarian

diet was associated with less menstrual pain (Barnanrd et al, 2000). Some studies showed that smokers experienced more menstrual pain compared with non smokers (Harlow, 1996; sundell, 1990; Parazzini, 1994). In contrast, one study showed that smokers tended to experience less pain (Anderche, 1982). Parazzini (1994) showed that alcohol consumption had no association with menstrual pain. Some studies showed that more physically active women tended to have less pain during menstruation (Hightower, 1998). Researchers showed that mental health was associated with menstrual pain. Alonso (2001) explained that women who had more anxiety and were more depressed experienced more pain over their menstrual periods. Risk factors will be discussed further in chapter two of this paper.

Diagnosis

A typical history of pelvic pain during menstruation can suggest primary dysmenorrhea. However, physicians should perform a precise physical and paraclinical examination to eliminate other possible causes of pain such as secondary dysmenorrhea and other pelvic abnormalities to diagnose dysmenorrhea. A physician should get a complete menstrual, gynecological, psychological, familial and dietary history of the patient. Abdominal, vaginal and rectal examination is necessary. Lab tests such as pregnancy test, infection screening, Pap smear, urine analysis, and complete blood cells may be needed. Imaging studies such as ultrasonography is helpful to find any possible anatomical disorder. Rarely surgical intervention such as laparoscopy is needed to diagnose endometriosis.

Treatment

Non-medical treatments

Information on the effectiveness of such methods remains uncertain and controversial. However, some people prefer to use this method rather than medical treatments. Interventions such as regular exercise, topical heat, smoking cessation, salt restriction, dietary/herbal supplements and some alternative treatments (e.g. acupuncture, yoga, and meditation) have been demonstrated effective methods to reduce dysmenorrhea (Fugh-Berman & Kronenberg, 2003).

Medical treatments

1) Non steroidal anti-inflammatory drugs (NSAIDS) such as Aspirin, Ibuprofen, and Naproxen suppress prostaglandins and also act against inflammatory factors. There is a risk of excess bleeding and peptic ulceration following the use of this group of drugs.

2) COX-2 Inhibitors are similar to NSAIDS which have fewer side effects on gastrointestinal system.

3) Acetaminophen may be effective due to lessen the amount of gonadotropin and estradiol levels (Cramer et al, 1998).

4) Hormonal treatments

a. Oral contraceptives: The proposed mechanism of action is reduced prostaglandin release during menstruation.

b. Progestin: works primarily by suppressing ovulation (Hatcher et al, 1998).

c. Mirena: an intrauterine device that has a local effect on the endometrium, which becomes atrophic and inactive (Critchleyet al, 1998).

Surgical treatments

1) Laparoscopy: diagnosis of endometriosis and removing it.
2) Hysterectomy: permanently remove the uterine. It is a good choice for women who undergo unbearable pains and have completed their family.
3) Nerves destruction techniques: blocking the pain-conducting nerve fibers leading from the uterus.

CHAPTER 2: A QUANTITATIVE STUDY ON MENSTRUAL PAIN AND ASSOCIATED RISK FACTORS AMONG IRANIAN WOMEN

Introduction

Menstrual pain (Dysmenorrhea) is one of the most common complaints of women and is the most common gynecological problem worldwide (Kennedy, 1997; Harel, 2006). Kaunitz (2000) cited the U.S. National Health Interview Study which indicated that 2.5 million female US residents in their reproductive age, experienced menstrual symptoms resulting in visits to health care providers, missed school/work, or bed rest. Andersch and Milson (1982) reported that 72% of Swedish women suffered from dysmenorrhea. Another study conducted in Naples, reported 85% of women experienced menstrual pain (Balbi et al, 2000). According to the latest studies, 10% of females experienced an absence from work for 1 to 3 days per month because of menstrual pain and were not capable to carry out their normal daily activities (Jarret et al, 1995; Pedron et al, 1998). It has been also revealed that menstrual pain is the most important cause of student absence from school (Drank et al, 1995; Nafstad et al, 1995).

There is evidence that there are some modifiable risk factors for menstrual pain. However, there are some differences in the results of studies. Certain types of diets such as low fat vegetarian seemed to decrease the intensity of pain during menstruation according to one study (Barnard et al, 2000). There was a positive association between caffeine consumption and intensity of menstrual pain (Deligeoroglou, 2000). Golomb et al (1998) indicated that exercise might lead to reduction of menstrual pain. Wang and colleagues (2004) showed a significant positive association between pain and stress.

The prevalence of dysmenorrhea was estimated to be 71% in Iranian women in a previous study (Poureslami et al, 2002). In the same study, 15% of women mentioned menstrual pains had influenced their daily life activities and led to absence from school or work between one to seven days a month (Poureslami et al, 2002).

Finding the modifiable risk factors can help us make recommendations to alleviate dysmenorrhea. By addressing this issue, we may have major impact on the quality of life for a significant number of people and may reduce the burden of work absence as well as modify the cost of treatment for women suffering from menstrual pain each month. Not many studies have been done regarding the prevalence of menstrual pain in Iranian women. The aim of this study was to estimate the prevalence of dysmenorrhea in Iranian population and investigate the possible risk factors for menstrual pain. Results of this study could be further used to propose appropriate preventive methods and low cost interventions to alleviate menstrual pain.

Methods

Study design/Data collection: In a cross sectional study, participants were asked to fill out a survey questionnaire by mail. The data collection was performed in Tehran, Iran from June to August 2007.

Population: by using a stratified random sampling method, 381 females (0.01% of female population in Tehran) were selected from 22 different districts in Tehran (Table 3-1; Table 3-2). Postal codes, provided by the statistical centre of Iran, were used to target the study population.

Questionnaire: Each envelope sent to participants contained a page explaining the research objectives, the 35-item questionnaire, a pre paid returning envelope and a consent form. The questionnaire included data regarding demographic information, life style habits, psychological status, menstruation characteristics, and overall medical and drug history. Participants were asked to report their menstruation characteristics based on their experience over the last 12 months. The first day of bleeding considered the first day of the cycle. Duration of bleeding was defined by the first day of the appearance of any spots until the complete spotlessness. Social economic status was based on family annual income while families with the annual income of 3 million Tomans or less were categorized as low socioeconomic status. Participants were asked to report their weekly frequency of certain food intake. Physical activity was measured using a semantic scale in which participants were asked to rate their physical activity from non active to very active.

Validation: The severity of dysmenorrhea was assessed by a scoring system reported by Anderch and Milson (1982) as below:

No pain: painless menstrual periods

Mild pain: Sometimes or always, experience low cramps, which are uncomfortable but never interfered with daily tasks

Moderate pain: Sometimes or always, experience very painful menstrual cramps

Severe pain: Sometimes or always, cut back on activities in addition to experiencing painful menstrual cramps.

Response rate: In the first run, 211 women (55%) returned the questionnaire. Since all the returned questionnaires were anonymous, I sent a reminder to all participants four weeks after sending the first questionnaire. I thanked all the participants who sent back the questionnaires and reminded others to complete the survey. I got 310 (81%) of questionnaires back by the end.

Exclusion criteria: Questionnaires with more than 10% of unanswered questions were considered incomplete and were excluded (40 questionnaires). Four of the participants had never menstruated and were excluded. Participants who reported being diagnosed with secondary dysmenorrhea were excluded as well. Consequently, data included 276 participants in total, which made the ultimate response rate 72%.

Statistical analysis: Statistical analysis was performed by SPSS16 (Chicago, IL) software. Spearman's correlation coefficients were used to examine the possible associations of severity of dysmenorrhea with study variables. Adjustment for potential confounders of the associations between variables and pain level was accomplished by using ordinal regression (Polytomous Universal Models (PLUMS)).

Ethics: This study was approved by Simon Fraser University office of research ethics and Iran's national research ethics committee.

Results

Table 2-1 depicts the characteristics of the study population. The age of participants ranged from 16 to 56. Of the study population, 73.7% were between 25 to 35 years of age (Mean ± SD = 29.5 ± 6). The educational level of the group was uniform and high: 92% had at least a bachelor degree. Among participants, 55.1% were either married or lived with partners while 40.2% had never been married and 4.8% were divorced, widowed or separated from partners. Among the study population, 85.1% had no biological child. Considering the monthly income, 88.8% of the study population had an average or above average socioeconomic status. Body Mass Index (BMI) ranged from 14 to 37 (Mean ±SD = 21.6 ± 3). Of the study population, 70.7% had the BMI between 18.5 and 24.9. There were 33 underweight women (12%) with BMI of less than 18 and 31(11.2%) overweight among participants (25 ≤ BMI <30). Six women (2.2%) were obese with the BMI of over 30. Results of this study showed that 73.6% of women had never smoked, 6.9% were former smokers, and 19.6% were current smokers. Of the study population, 47% reported drinking at least one serving of alcohol each week. Among participants, 48.9% reported themselves inactive, very low or low active while 33.7% were moderately active and 17.4% were highly or extremely active. Of study population,18.1% reported experiencing none or very low stress in their lives while 36.6% reported themselves a bit stressed and 45.2% were quite a bit or extremely stressed. Of participants,

37.7% never or rarely felt depressed while being depressed most of the time or always was reported by 12.3% of the study population.

Table 2-1: Characteristics of the study population

	n (%)		n (%)
Age		**Marital Status**	
Less than 24	37 (13.4)	Single	111 (40.2)
25-30	162 (58.7)	Married	111 (40.2)
31-34	36 (13)	With Partner	41 (14.9)
35-45	27 (9.8)	Divorced	9 (3.3)
More than 45	14 (5.1)	Separated	3 (1.1)
		Widowed	1 (0.4)
Education		**Biological Children**	
Less than High School Diploma	0 (0)	None	235 (85.1)
High School Diploma	3 (1.1)	One	20 (7.2)
Some College	19 (6.9)	Two	14 (5.1)
Bachelor degree	201 (72.8)	Three	5 (1.8)
Masters degree or higher	53 (19.2)	Four or more	2 (0.7)
Ethnicity		**Socioeconomic status**	
Fars	159 (57.6)	Very Low	5 (1.8)
Azeri	77 (27.9)	Less than Average	26 (9.4)
Gilak/Mazandaranian	17 (6.2)	Average	124 (44.9)
Kurd	4 (1.4)	More than Average	112 (40.6)
Other Iranian	19 (6.9)	Very High	9 (3.3)
BMI		**Sleep (Hours/Day)**	
< 18.5	33 (12)	< 6	25 (9.1)
18.5- 24.9	195 (70.7)	6 ≤ Hours < 8	184 (66.7)
25- 29.9	31 (11.2)	8 ≤ Hours < 12	66 (23.9)
> 30	6 (2.2)	> 12	1 (0.4)
Smoking Status		**Physical Activity**	
Never Smoked	203 (73.6)	Inactive	18 (6.5)
Former Smoker	19 (6.9)	Very Low active	48 (17.4)
Occasionally	19 (6.9)	Low Active	69 (25)
< 5 cigarettes a day	15 (5.4)	Moderately active	93 (33.7)
5 < cigarettes a day < 10	14 (5.1)	Highly active	39 (14.1)
10 > cigarettes a day	6 (2.2)	Extremely active	9 (3.3)
Alcohol (Servings/ Week)		**Stress Level**	
None	146 (52.9)	No Stress at all	5 (1.8)
Less than Three	92 (33.3)	Not very stressed	45 (16.3)
Three to Seven	31 (11.2)	A bit stressed	101 (36.6)
More than Seven	7 (2.5)	Quite a bit stressed	89 (32.2)
		Extremely stressed	36 (13)
Coffee (Cups/ Day)		**Feeling Depressed**	
None or less than one	84 (30.4)	Never	11 (4)
1 ≤ Cups < 3	140 (50.7)	Rarely	93 (33.7)
3 ≤ Cups < 5	46 (16.7)	Sometimes	138 (50)
≥ 5	6 (2.2)	Most of the time	31 (11.2)
		Always	3 (1.1)

Table 2-2: Characteristics of menstruation in study population

	n (%)		n (%)
Age at Menarche		**Pain level**	
Less than 10	6 (2.2)	None	27 (9.8)
10-11	40 (14.5)	Mild	113 (40.9)
12-13	157 (56.9)	Moderate	76 (27.5)
14-15	57 (20.7)	Severe	60 (21.7)
16 or more	9 (3.3)		
Regularity of periods		**Duration of each pain episode**	
Always	122 (44.2)	No pain	27 (9.8)
Most of the time regular	115 (41.7)	< 30 Minutes	44 (15.9)
Usually Irregular	25 (9.1)	30 Minutes < Duration ≤ one hour	51 (18.5)
Always Irregular	14 (5.1)	One hour < Duration < 2 hours	51 (18.5)
		> Two hours	66 (23.9)
Period Intervals		Pain all the time	37 (13.4)
< 21 days	12 (4.3)		
21-35 days	228 (82.6)	**Family History of Menstrual pain**	
> 35 days	15 (5.8)	No	59 (27.6)
		Yes (Both Mom and Sister)	114 (41.3)
Duration of bleeding per period		Yes (Mom or Sister)	41 (14.9)
≤ 3 Days	25 (9.1)	Don't know	62 (22.4)
4-7 Days	227 (82.2)		
> 7	24 (8.7)	**Using Contraception**	
		No	146 (52.9)
Number of Pads/Tampons per day		Yes	130 (47.1)
< 3	57 (20.7)	Pills/Patches	49 (17.8)
3-5	152 (55.1)	Barrier	75 (27.1)
6-7	50 (18.1)	IUD	3 (1.1)
> 7	17 (6.2)	Permanent methods	3 (1.1)
Work/ School absence due to pain		**Using medication for pain**	
Yes	113 (40.9)	No	50 (18.1)
No	163 (59.1)	Yes	226 (81.9)
		Pain relievers	206 (74.6)
Sexually Active		Hormones	10 (3.6)
Yes	196 (71)	Topical patches	2 (0.7)
No	80 (29)	Traditional Methods	11 (4)
		Surgery	3 (1.1)

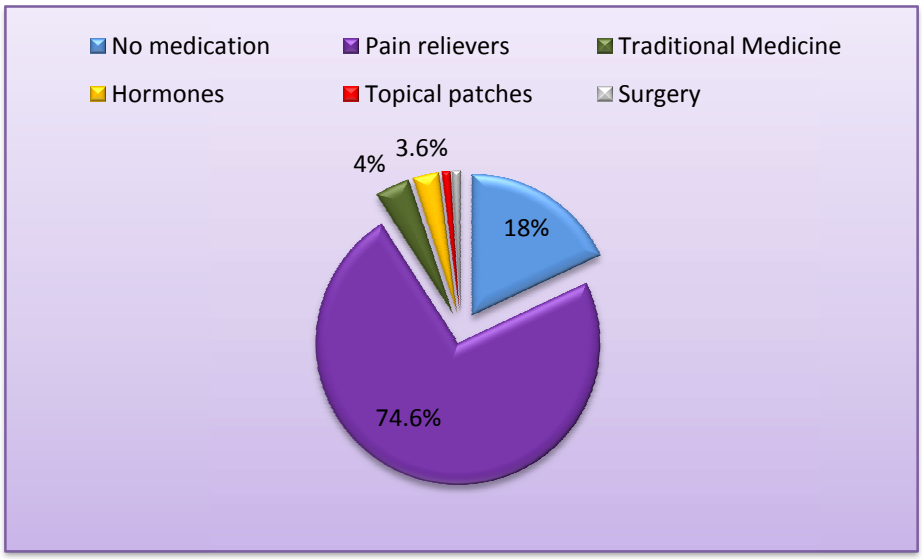
Table 2-2 shows the menstrual characteristics of the study population. The mean age at menarche was 12.3 years (SD= 0.7). Of the study population, 85.9% usually experienced regular periods while 5.1% of them always had irregular periods. The intervals of periods were between 21 and 35 days in 82.6% of the population while 4.3% experienced polymenorrhea (intervals less than 21 days) and 5.8% experienced oligomenorrhea (intervals more than 35 days).

Considering the bleeding duration of each period, 82.2% of the study population experienced bleeding from four to seven days each month while 9.1% had hypomenorrhea (bleeding less than three days) and 8.7% had hypermonorrhea (bleeding for more than seven days in each period).

The prevalence of no, mild, moderate, and severe menstrual pain was 9.8%, 40.9%, 27.5%, and 21.7% respectively. Family history of menstrual pain was seen in 27.6% of women. Of the population, 71% were sexually active and among those 66% used contraception. Barriers were mostly used method of contraception followed by pills/patches and IUD.

Figure 2-1 shows the distribution of pain relief strategies used by participants. To alleviate menstrual pain, 81.9% of the population reported using medication. Pain relievers were mostly used (74.6%). Traditional methods were used by 4% while 3.6% used hormones of any kind.

Figure 2-1: Distribution of pain relief strategies used by participants



Pain level

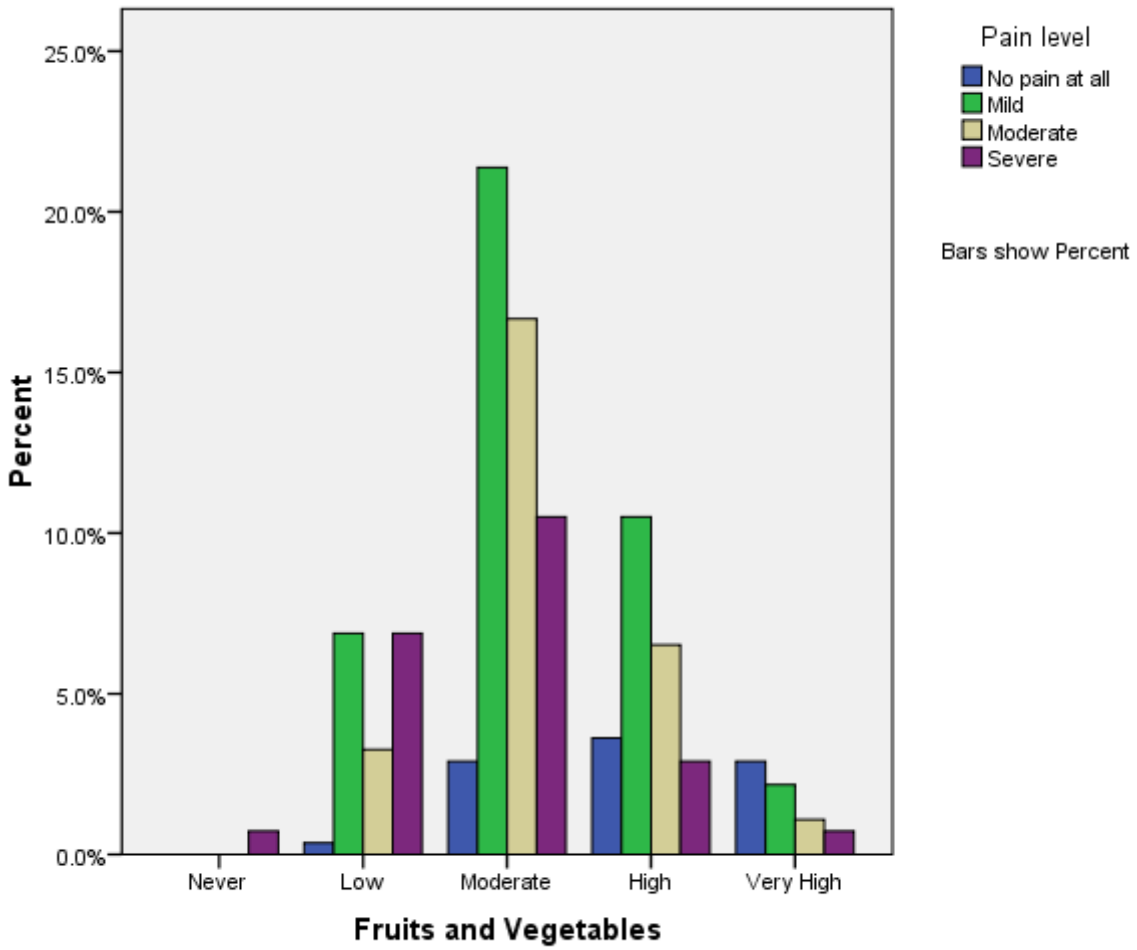
Among people who experienced severe menstrual pain, 85% were below the age of 30 and only 5% of participants with severe pain were above 35 years of age. Using spearman rho correlation method, there was a significant negative association between age and pain level (r= - 0.22, $p< 0.01$). There was no significant association between menstrual pain and education or socioeconomic status, and marital status in this study. Sexual activity was not associated with pain level. There was no association between BMI and pain level in this study population.

Using a bivariate correlation method, people who tended to drink alcohol, experienced less pain in this study (r= - 0.18, $p<0.01$). Among those with no pain, 62.9% and among those with mild pain, 53.1% reported drinking at least one serving of alcohol each week. In contrast, 66.7% of women with severe pain were non drinkers. There was no association between smoking and caffeine consumption with the severity of pain in this study.

Among participants, 66.6% who had no pain over their periods had a high consumption of fruits and vegetables in their normal diets while 83.3% of women who experienced severe pain had a low intake of fruits and vegetables. There was a strong inverse association between pain level and fruit and vegetable consumption using spearman's rho correlation (r= - 0.27, $p<0.01$). Figure 2-2 shows the association between fruits and vegetables and pain level. All women who experienced no pain and 92% of those who had mild menstrual pain had a moderate or low intake of fats and oil on their daily basis. Women who tended to

have a low fat diet, experienced less pain during their menstrual periods (r=0.14, *p*= 0.01). There was no association between level of pain and intake amount of dairy, meats, grains, and sweets in this study.

Figure 2-2: Association of fruits and vegetable consumption and pain level

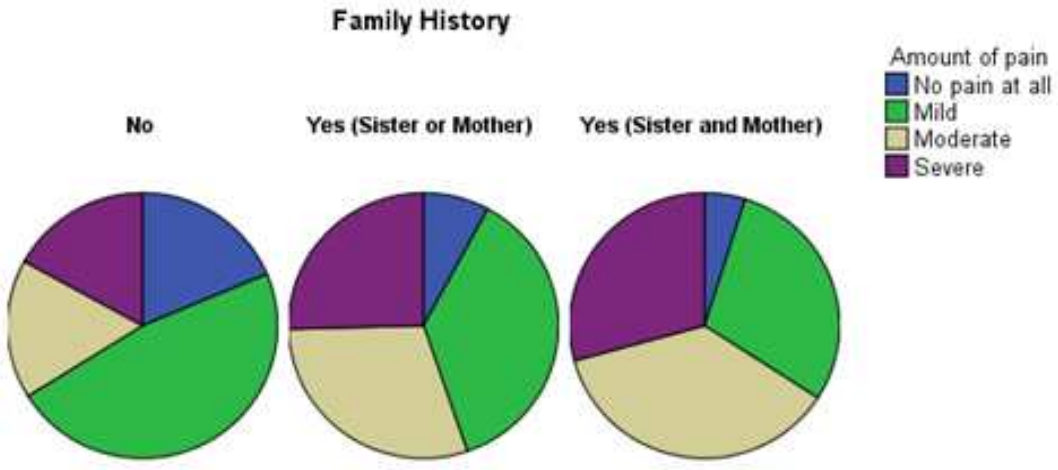


Among women who had severe menstrual pain, 83.4% had moderate or low activity. Physical activity level and menstrual pain were negatively associated in this study using a bivariate correlation model (r=- 0.12, *p= 0.03*).

There was no significant association between the amount of sleep and menstrual pain in this study.

Stress level was positively associated with menstrual pain using spearman's rho correlation (r= 0.16, *p<0.01*). Of women who experienced severe pain, 58.3% reported themselves quite a bit or extremely stressed. There was also a positive association between depression and pain level (r= 0.13, *p= 0.02*).

Figure 2-3: Association between family history of dysmenorrhea and pain level



There was a strong association between family history of dysmenorrhea and pain experienced by study population (r= 0.22, *p<0.01*). Among women who reported no dysmenorrhea in their mothers or sisters, 84.1% had no or mild pain during menstruation while 80.4% of women with severe pain reported

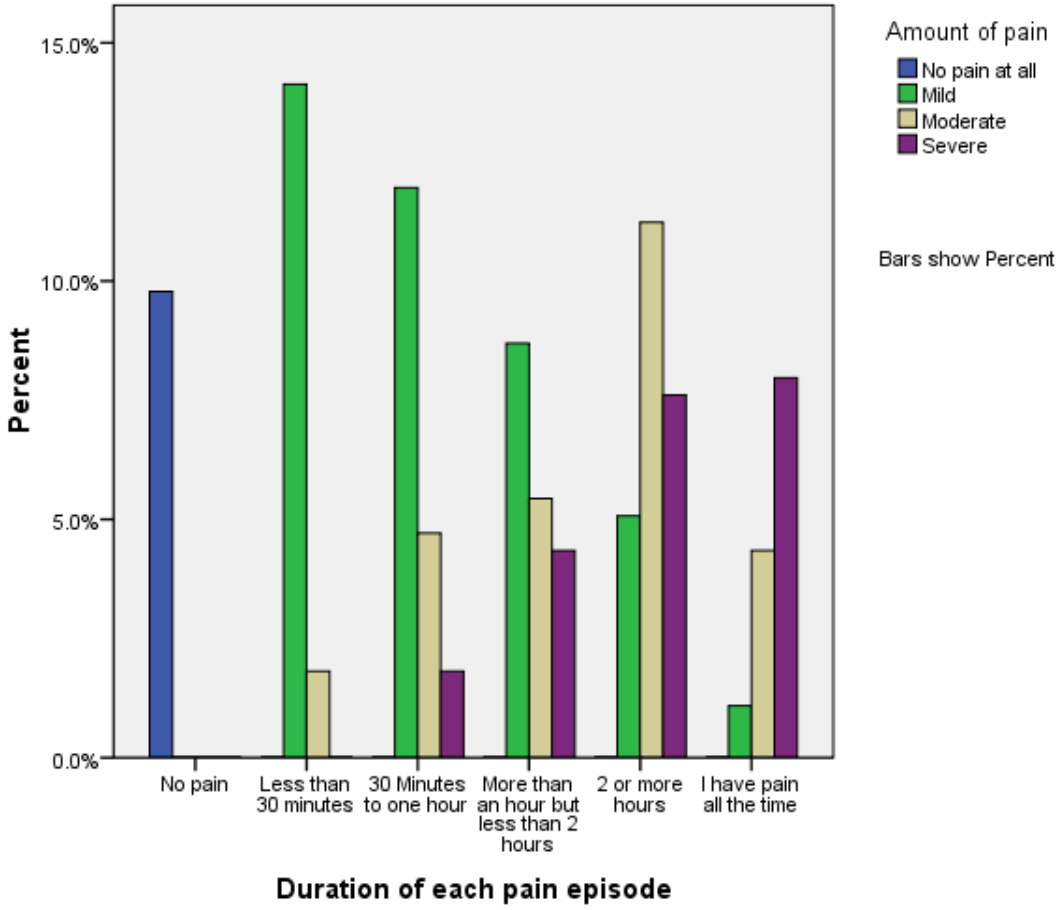
dysmenorrhea in one of their close family members. There was no significant association between age at menarche, period intervals, and regularity of periods with pain level in this study population.

Women who had a longer bleeding duration over each period, tended to experience more pain (r=0.18, $p= 0.02$). Of the study population, 8.7% experienced bleeding for more than seven days on each period among which 66.6% had moderate to severe pain.

Hypermenorrhea (heavy period) was associated with severe pain (r=0.16, $p<0.01$). Of women who had no pain during their menstruation, 96.3% had a very light blood loss while 76.5% of women who had extremely heavy periods experienced severe menstrual pain as well.

Finally women who had severe dysmenorrhea, experienced longer pain episodes (r=0.69, $p<0.01$). Among women who experienced severe pain, 71.7% reported having pain for more than two hours without using any pain killer while 91.7% had at least one hour pain episode. In contrast, 63.7% of people with mild pain, reported suffering from dysmenorrhea for less than an hour. Figure 2-4 demonstrates the association between pain level and duration of each pain episode.

Figure 2-4: Association between pain level and duration of each pain episode



Bleeding duration:

There was a meaningful association between duration of bleeding on each period and heaviness of bleeding. Women who had longer periods experienced heavier ones as well (r=0.16, *p<0.01).* There was a significant negative association between alcohol consumption and duration of bleeding (r= - 0.17, *p<0.01).* Physical activity was negatively associated with duration of bleeding (r= - 0.16, *p<0.01).* People with family history of dysmenorrhea tended to have longer bleeding duration (r= 0.19, *p<0.01).*

Pain episode duration:

Of women who experienced pain all the time during their periods, 81.1% were 30 years old or younger. Among women who had pain episodes of two hours or more, 74.3% were below the age of 30. There was a significant negative association between age and duration of each pain episodes (r= - 0.13, *p= 0.02*).

Among women who had pain episodes of two hours or more, 75% had moderate to low intake of dairy products, 40.7% had a high or very high carbohydrate diets, and 58.2% had a moderate to high fat diet on daily basis. Using spearman rho correlation model, there was a significant negative association between duration of pain episodes and intake of dairy products (r= - 0.24, *p< 0.01*). There was a significant positive association between amount of fat intake and duration of each pain episodes (r= 0.15, *p= 0.01*).

Of participants who had pain episodes of two hours or more, 86.4% reported themselves stressed in daily basis. Stress level tended to be associated with longer pain episodes in women (r=0.23, *p< 0.01*).

Only 17.5% of people with longer pain episodes had no family history of pain. Women with no family history of pain tended to have shorter pain duration in our study (r=0.25, *p< 0.01*). Women who had heavier periods, experienced longer pain episodes (r=0.16, *p< 0.01)*

Heaviness of bleeding:

Of people who used six pads/tampons or more per day, 76.1% were nulliparous. There was a significant association between nulliparity and heaviness of bleeding (r= 0.15, *p= 0.01*). Of women who used three or less

pads/tampons each day, 94.5% had the BMI of 25 or less while 88.2% of participants who used three to five pads/tampons a day were normal or underweight. There was a significant association between BMI and heaviness of bleeding (r=0.15, *p= 0.01*).

Regularity of periods:

Participants who had a high fat diet tended to have more irregular periods compared with those having a low fat diet (r=0.15, *p= 0.01*).

Of the study population, 71% were sexually active. Participants who were sexually active had more regular periods compared with those who did not have sexual relationships (r=0.16, *p<0.01*). Among women who were sexually active, 87.7% reported always or usually having regular periods.

Period intervals:

There was no significant association between independent variables with polymenorrhea and oligomenorrhea in this study. Table 2-3 shows the results of Spearman's rho correlation model for variables.

Table 2-3 shows the results of spearman correlation coefficient that demonstrate the bivariate association between our variables.

Table 2-3: Results of Spearman's rho correlation between variables

	Correlation Coefficient Approx. Sig					
	Amount of pain	Period Intervals	Regularity	Bleeding Duration	Heaviness	Pain episode Duration
Amount of Pain	1 .					
Period Intervals	-0.04 0.49	1 .				
Regularity	0.10 0.09	0.36 **<0.01**	1 .			
Bleeding duration	0.18 **0.02**	0.1 0.1	0.15 **0.01**	1 .		
Heaviness	0.16 **<0.01**	-0.08 0.19	0.02 0.66	0.16 **<0.01**	1 .	
Pain episode Duration	0.69 **<0.01**	0.02 0.68	0.10 0.09	0.09 0.1	0.16 **<0.01**	1 .
Age at Menarche	-0.04 0.44	-0.08 0.15	-0.01 0.84	-0.21 0.72	-0.04 0.50	0.03 0.59
Age	-0.22 **<0.01**	-0.01 0.79	-0.05 0.37	0.03 0.56	0.07 0.21	-0.13 **0.02**
Biological Children	-0.07 0.22	0.01 0.81	-0.01 0.81	0.04 0.44	0.15 **0.01**	-0.01 0.77
Socioeconomic status	0.07 0.21	0.008 0.9	-0.08 0.18	0.05 0.36	0.01 0.74	0.03 0.53
BMI	-0.06 0.2	-0.02 0.68	0.02 0.73	0.03 0.6	0.15 **0.01**	-0.06 0.3
Fruits and vegetables	-0.27 **<0.01**	0.00 0.99	-0.07 0.22	-0.1 0.07	-0.24 <0.01	0.04 0.5
Milk products	-0.03 0.55	-0.04 0.42	0.02 0.62	-0.03 0.51	0.02 0.64	-0.24 **<0.01**
Meat and alternatives	0.10 0.71	0.05 0.34	0.10 0.08	0.10 0.09	-0.01 0.77	0.07 0.21
Grains	0.09 0.13	-0.04 0.51	0.08 0.14	0.04 0.5	-0.17 0.77	-0.04 0.5
Fats and oils	0.14 **0.01**	0.05 0.39	0.15 **0.01**	-0.04 0.94	-0.06 0.29	0.15 **0.01**
Sweets and chocolates	0.00 0.88	0.04 0.47	0.07 0.24	0.02 0.72	-0.03 0.56	0.05 0.33
Caffeine	0.07 0.20	0.11 0.06	0.02 0.71	0.08 0.18	0.1 0.09	0.04 0.49
Alcohol	-0.18 **<0.01**	0.07 0.20	-0.09 0.11	-0.17 **<0.01**	-0.03 0.56	-0.11 0.06
Smoking	-0.16 **<0.01**	-0.01 0.78	0.004 0.9	0.04 0.94	-0.002 0.97	-0.06 0.25
Physical Activity	-0.12 **0.03**	-0.07 0.25	-0.04 0.45	-0.16 **<0.01**	0.01 0.81	0.12 0.06
Sleep	0.07 0.23	0.12 0.04	0.07 0.22	-0.04 0.47	-0.09 0.11	0.02 0.67
Stress	0.16 **<0.01**	-0.01 0.75	0.07 0.2	0.05 0.37	0.009 0.87	0.23 **<0.01**
Depression	0.13 **0.02**	-0.08 0.16	0.08 0.15	0.058 0.33	0.045 0.46	0.18 0.6
Family history	0.22 **<0.01**	0.02 0.68	0.06 0.37	0.19 **<0.01**	0.11 0.08	0.25 **<0.01**
Sexual activity	0.06 0.31	-0.05 0.40	0.16 **< 0.01**	0.006 0.92	-0.08 0.17	0.01 0.79

Ordinal regression:

Results of the ordinal regression showed that there was a significant positive association between age and pain level (OR=0.94, 95% CI 0.91-0.97). This association remained significant after controlling for possible confounders (OR=0.9, 95% CI 0.8-0.9). Older women experienced less pain in their menstrual cycles. People with average or higher socioeconomic status significantly experienced less pain compared with people with low socioeconomic status (OR= 0.1, 95% CI 0.03-0.8). After controlling for confounders, this negative association remained significant at all levels.

Women who had high fruit and vegetable intake experienced less pain during their menstruation. This association remained significant after controlling for other variables. There was also a significant association between fats and oil consumption and pain level. People who had a high fat diet were 3.8 times more likely to experience pain compared with those with low fat diet. However, this association did not remain significant after controlling for other variables.

Participants who had one to seven servings of alcohol per week, experienced less pain compared with those who were non-drinkers. This association remained significant for women who had three to seven servings of alcohol each week after controlling for other variables.

Women who felt depressed all the time were 13.3 times more likely to experience pain compared with those who were not depressed at all.

Women who had heavy periods were 4.6 times more likely to experience menstrual pain. There was also a significant association between pain level and

duration of each pain episode among participants. This association remained significant after controlling for other variables. Women with family history of menstrual pain were 3.5 times more likely to experience menstrual pain compared with those with no family history (95% CI 1.6-7.3).

Table 2-4: Association between pain level and selected variables using ordinal regression

Variable	Unadjusted OR (95% CI)	*P-Value*	Adjusted OR (95% CI)*	*P-Value*
Age	0.94 (0.91-0.97)	< 0.01¨	0.9 (0.8-0.9)	<0.01”
SES				
Very low	.	.	.	.
Less than average	0.1 (0.03-1.2)	0.07	0.03 (0-0.6)	0.02”
Average	0.1 (0.03-0.8)	0.03”	0.03 (0-0.5)	0.01”
More than Average	0.2 (0.04-1.3)	0.1	0.04 (0-0.8)	0.03”
Very high	0.3 (0.04-2.4)	0.2	0.04 (0-1.45)	0.07
Biological children				
None	.	.	.	.
One	0.5 (0.2-1.2)	0.1	0.3 (0.1-1.3)	0.1
Two	1 (0.3-2.6)	0.9	1.9 (0.3-9.4)	0.4
Three	1.2 (0.2-6.3)	0.7	2.8 (0.1-43)	0.4
Four or more	0.3 (0.02-4.1)	0.3	2.9 (0.1-88)	0.5
BMI	0.9 (0.8-1.02)	0.1	0.9 (0.8-1.07)	0.5
Fruits & vegetables				
Never or low	.	.	.	.
Moderate	0.4 (0.2-0.8)	<0.01¨	0.5 (0.2-1.09)	0.09
High	0.2 (0.1-0.4)	<0.01¨	0.3 (0.1-0.7)	<0.01”
Very high	0.08 (0.03-0.2)	0.01¨	0.1 (0.04-0.4)	<0.01”
Milk & products				
Never or low	.	.	.	.
Moderate	1.3 (0.7-2.2)	0.3	1.3 (0.7-2.3)	0.3
High	0.6 (0.3-1.1)	0.1	0.6 (0.3-1.3)	0.2
Very high	2.1 (0.7-6.7)	0.1	2.3 (0.6-8.2)	0.1
Meat & alternatives				
Never or low	.	.	.	.
Moderate	1.4 (0.7-2.7)	0.2	1.1 (0.4-2.9)	0.7
High	2.2 (0.9-5)	0.06	1.7 (0.5-5.1)	0.3
Very high	0.8 (0.1-7.7)	0.9	1.4 (0.07-26.5)	0.8

Table 2-4 (continued):

Variable	Unadjusted OR (95% CI)	*P-Value*	Adjusted OR (95% CI)*	*P-Value*
Grains				
Never or low	.	.	.	.
Moderate	0.9 (0.4-1.8)	0.8	1.1 (0.4-3)	0.7
High	1.4 (0.7-2.8)	0.3	1.5 (0.5-4)	0.3
Very high	1.1 (0.2-5.5)	0.8	0.2 (0-14)	0.5
Fats and Oils				
Never or low	.	.	.	.
Moderate	1.5 (0.9-2.4)	0.06	1.3 (0.8-2.1)	0.2
High	3.8 (1.6-9.3)	< 0.01”	2.1(0.8-5.5)	0.1
Sweets & Chocolate				
Never	.	.	.	.
Low	0.8 (0.2-3.2)	0.7	1.1 (0.2-4.8)	0.8
Moderate	0.9 (0.2-3.7)	0.9	1.4 (0.3-6.1)	0.6
High	0.7 (0.1-3)	0.6	0.7 (0.1-3.3)	0.7
Very high	1.5 (0.3-8.1)	0.5	1.5 (0.2-8.3)	0.6
Caffeine (cups/d)				
<1	.	.	.	.
1-3	1.3 (0.8-2.1)	0.2	1.4 (0.7-3)	0.2
3-5	1.6 (0.8-3.1)	0.1	1.4 (0.5-3.5)	0.4
>5	0.9 (0.2-4.2)	0.9	0.4 (0.06-4.1)	0.5
Alcohol (Servings/w)				
None	.	.	.	.
<3	0.5 (0.3-0.8)	0.01”	0.6 (0.3-1.3)	0.2
3-7	0.3 (0.1-0.7)	<0.01”	0.1 (0.05-0.6)	0.01”
>7	0.8 (0.2-3.5)	0.8	1.2 (0.1-7.7)	0.8
Smoking				
Never smoked	.	.	.	.
Former smoker	0.4 (0.1-1.02)	0.06	0.3 (0.09-1.03)	0.06
Occasionally	0.4 (0.2-1.1)	0.1	0.4 (0.1-1.6)	0.2
At least one a day	0.3 (0.1-0.8)	0.02”	0.4 (0.09-1.9)	0.2
5-10 cigarettes a day	0.5 (0.2-1.5)	0.2	0.6 (0.1-3.2)	0.6
>10 a day	1.3 (0.3-5.9)	0.6	2.9 (0.1-47)	0.4
Physical activity				
Inactive	.	.	.	.
Very Low Active	0.8 (0.3-2.3)	0.7	0.6 (0.1-2.4)	0.5
Low Active	0.7 (0.2-1.8)	0.4	1.03 (0.3-3.5)	0.9
Moderately Active	0.4 (0.1-1.1)	0.1	0.6 (0.2-2.1)	0.4
Highly Active	0.6 (0.2-1.8)	0.4	1.1 (0.3-4.3)	0.8
Extremely Active	0.2 (0.06-1.1)	0.08	0.5 (0.06-4.7)	0.5
Sleep (hr/Day)				
4-8	.	.	.	.
8-12	0.6 (0.3-1.08)	0.09	0.9 (0.2-3.1)	0.5
>12	0.8 (0.3-1.8)	0.6	0.8 (0.3-1.7)	0.9
Sexual activity				
Yes	.	.	.	.
No	1.2 (0.7-2)	0.3	2.4 (0.3-4)	0.8

Table 2-4 (continued):

Variable	Unadjusted OR (95% CI)	*P-Value*	Adjusted OR (95% CI)*	*P-Value*
Stress				
Not very stressed	.	.	.	.
A bit stressed	1 (0.5-1.8)	0.9	0.9 (0.3-2.5)	0.9
Quite a bit stressed	1.8 (0.9-3.4)	0.06	1.1 (0.4-3.1)	0.7
Extremely stressed	3.3 (1.5-7.5)	<0.01”	1.1 (0.3-4.02)	0.8
Depressed				
Never	.	.	.	.
Rarely	3.45 (1-11)	0.03”	3.1 (0.6-15)	0.1
Sometimes	4.2 (1.3-13)	0.01”	3.7 (0.7-18)	0.1
Most of the times	9.1 (2.5-33.4)	<0.01”	13.3 (2-86)	< 0.01”
Age at menarche				
<10	1.6 (0.2-10.7)	0.6	0.4 (0.03-5.7)	0.5
10-11	2.9 (0.8-11)	0.1	1.2 (0.1-10)	0.8
12-13	1.1 (0.3-4)	0.8	0.32 (0.04-2.5)	0.2
14-15	1.8 (0.5-6.7)	0.4	0.5 (0.06-4.6)	0.5
>16	.	.	.	.
Regularity of Periods				
Always regular	.	.	.	.
Usually regular	1.6 (1.04-2.6)	0.03”	1.7 (0.8-3.4)	0.1
Usually irregular	1.1 (0.5-2.6)	0.6	0.3 (0.1-1.1)	0.09
Always irregular	1.9 (0.8-4.7)	0.1	1.1 (0.2-5.2)	0.8
Period intervals				
<21	1.8(0.5-7.1)	0.4	10.8 (0.9-128)	0.06
21-35	1.6 (0.6-4)	0.3	5.1 (0.8-31)	0.07
>35	.	.	.	.
Duration of bleeding				
≤3	.	.	.	.
4-7	2.3 (1.07-5)	0.03”	1.7 (0.6-5.1)	0.2
≥7	3.7 (1.3-10)	0.01”	1.2 (0.2-5.5)	0.7
Pads/day				
<3	.	.	.	.
3-5	1.1 (0.6-1.9)	0.6	1.06 (0.4-2.4)	0.8
6-7	1.6 (0.8-3.3)	0.1	2.1 (0.7-6)	0.1
>7	5.2 (1.8-14.8)	<0.01”	4.6 (1.07-20)	0.04”
Duration of pain episode				
< 30 min	.	.	.	.
30min- an hour	3.97 (1.4-11.1)	< 0.01”	4 (0.7-22)	0.1
1-2 hours	9.4 (3.4-26)	< 0.01”	15 (3-74)	<0.01”
>2 hours	22 (8.1-59)	< 0.01”	47 (9.7-130)	<0.01”
All the time	71 (23-222)	< 0.01”	198 (49-300)	<0.01”
Family history				
Yes	2.6 (1.5-4.7)	<0.01¨	3.5 (1.6-7.3)	< 0.01”
No	.	.		

* Adjusted for age, SES, BMI, diet, physical activity, smoking, alcohol, stress, depression, family history, and sexual activity

“ Significant level

. Reference category

Pain episode duration:

Younger women tended to have longer pain episodes after controlling for other variables (OR=0.9, 95% CI 0.90-0.98). Participants who had a high fat diet were 3.7 times more likely to experience longer pain episodes compared with women with low fat diet. This association remained significant after controlling for potential confounders. Highly stressed women experienced longer pain duration compared with those with a low level of stress (OR=4, 95% CI 1.5-10). Finally, women with family history of menstrual pain were more likely to experience longer pain episodes during menstruation (OR=1.8, 95% CI 1.02-3.4).

Table 2-5: Association between duration of pain episode and selected variables using ordinal regression

Variable	Unadjusted OR (95% CI)	*P-Value*	Adjusted OR (95% CI)*	*P-Value*
Age	0.95 (0.92-0.98)	< 0.01"	0.9 (0.90-0.98)	0.01"
Milk & products				
Never or Low	.	.	.	.
Moderate	0.6 (0.3-1.08)	0.09	0.6 (0.3-1.3)	0.2
High	0.3 (0.1-0.7)	<0.01"	0.6 (0.2-1.3)	0.2
Very high	1.5 (0.4-4.5)	0.4	2.5(0.6-10)	0.1
Fats and Oils				
Never or low	.	.	.	.
Moderate	1.07 (0.6-1.7)	0.7	0.9 (0.5-1.6)	0.9
High	2.9 (1.2-7.1)	0.01"	3.7 (1.2-11.4)	0.01"
Stress				
Not very stressed	.	.	.	.
A bit stressed	1.03 (0.5-2)	0.9	1.2 (0.5-2.8)	0.5
Quite a bit stressed	1.3 (0.7-2.7)	0.3	1.8 (0.8-4.1)	0.1
Extremely stressed	4.4 (1.9-10.2)	<0.01"	4 (1.5-10.7)	<0.01"
Family history				
Yes	2.2 (1.2-4.05)	<0.01"	1.8 (1.02-3.4)	0.04"
No	.	.	.	.

* Adjusted for age, SES, BMI, diet, physical activity, smoking, alcohol, stress, depression, family history, and sexual activity

" Significant level

. Reference category

Bleeding duration:

Participants who experienced heavy periods also experienced longer bleeding duration. An interesting result was that people who were extremely active were less likely to have long bleeding duration compared with non-active people (OR= 0.1, 95% CI 0.02-0.9). Women who had three to seven servings of alcohol each week experienced less pain compared with non-drinkers (OR=0.3, 95% CI 0.09-0.95). In contrast heavy drinkers experienced more bleeding duration compared with non-drinkers (OR= 1.8, 95% CI 1.2-12).

Table 2-6: Association between duration of bleeding and selected variables using ordinal regression

Variable	Unadjusted OR (95% CI)	*P-Value*	Adjusted OR (95% CI)*	*P-Value*
Pads/day				
<3	.	.	.	.
3-5	1.9 (0.8-4.3)	0.1	2.3 (0.8-6.2)	0.09
6-7	2.6 (0.9-7.2)	0.06	3.4 (1.03-11.6)	0.04”
>7	7.6 (2-28)	<0.01”	9.06 (2.05-40)	<0.01”
Physical activity				
Inactive	.	.	.	.
Very Low Active	1.3 (0.3-5.6)	0.6	1.5 (0.3-7)	0.5
Low Active	0.6 (0.1-2.7)	0.6	0.7 (0.1-3.2)	0.6
Moderately Active	0.6 (0.1-2.6)	0.5	1.3 (0.3-5.6)	0.6
Highly Active	0.3 (0.08-1.5)	0.1	0.3 (0.06-1.4)	0.1
Extremely Active	0.1 (0.01-0.7)	0.02”	0.1 (0.02-0.9)	0.05”
Alcohol (Servings/w)				
None	.	.	.	.
<3	0.4 (0.2-0.9)	0.03”	0.8 (0.3-1.8)	0.6
3-7	0.2 (0.09-0.6)	<0.01”	0.3 (0.09-0.95)	0.05”
>7	1.2 (1.08-5.1)	0.6	1.8 (1.2-12)	0.05”
Family history				
Yes	2.3 (1.05-5)	0.03”	2.02 (0.8-4.6)	0.09
No	.	.	.	.

* Adjusted for age, SES, BMI, diet, physical activity, smoking, alcohol, stress, depression, family history, and sexual activity

“ Significant level

. Reference category

Discussion

This study estimated the prevalence of dysmenorrhea and recognized risk factors for menstrual cramps, as well as risk factors associated with the severity and duration of a pain event, duration and heaviness of bleeding on each period, and regularity of menstruation in a cohort of Iranian women.

Menstrual pain is a common complaint. Of this study population, 49.2% experienced moderate to severe menstrual pain while only 9.8% reported having no pain at all during menstruation. Of participants, 21.7% reported having severe pain which is twice the prevalence reported in a similar study (Harlow, 1996). This study was consistent with previous studies and showed that menstrual pain is a common gynecological problem among women especially in young population.

One important finding was the association between fruits and vegetables intake and pain level. Women, who had a high consumption of fruits and vegetables on daily basis, experienced less menstrual pain. A lower consumption of fruit, fish and eggs was found to be associated with severe menstrual pain in previous studies (Nagata et al, 2005; Balbi et al, 2000). Adlercreutz (1990) showed that vegetarians had higher levels of serum sex-hormone binding globulin (SHBG). Vegetarians tend to have lower BMIs which is correlated with higher levels of SHBG. It has also been shown that a low fat diet is associated with a lower estrogen level in women (Prantice et al, 1990). A high fiber diet can also lead to higher elimination of estrogen through feces (Adlercreutz, 1990). Elevated SHBG or decreased estrogen may lead to less stimulation of the

endometrium and reduced the proliferation of endometrium and therefore a lower level of prostaglandins. There is evidence that fruits and vegetables have high content of omega-3 fatty acids which compete with the fatty acid omega 6 to produce prostaglandins and leukotrienes. Prostaglandins made from omega 3 fatty acids have a decreased power and this can reduce the myometrial contractions (Balbi et al, 2000). Another possible explanation for this association is that fruits and vegetables are sources of magnesium and calcium. The lack of which, may lead to menstrual pain. Calcium plays a key role in stabilization of muscular cells. Reduction of calcium may lead to spasm and contraction (Balbi et al, 2000).

Younger women experienced more pain compared with women of older age. This result is consistent with other studies (Pullon et al, 1988; Balbi et al, 2000). This association remained significant after controlling for confounders in this study. However, it remained uncertain whether younger age alone is contributed to the occurrence of dysmenorrhea. Other factors such as parity and the use of contraception may interfere with any assessment of this association. The results of this study also revealed that younger women experienced longer pain episodes.

Stress level was associated with the duration of pain episode. This is consistent with the results of the study conducted by Wang and colleagues (2004) and two others (Christiani et al, 1995; Gordley, 2000). They explained this association by linking stress with the cascade of neuroendocrine responses. Stress can also cause impaired follicular development by restraining the release

of FSH and LH. This impairment can probably lead to progesterone release which affects the synthesis of prostaglandins. It has also been shown that stress release hormones such as adrenaline and cortisol have an effect on prostaglandin synthesis which can lead to myometrial contraction (Wadhwa et al, 1996; Casey et al, 1985).

Women with a family history of menstrual pain were more likely to experience dysmenorrhea. This finding suggests the evidence of genetic susceptibility to dysmenorrhea. Wu et al (2000) investigated the association of the cytochrome P450 2D6 (CYP2D6) and glutathione S-transferase Mu (GSTM1) polymorphisms with dysmenorrhea and concluded that women with variant genotypes in both CYP2D6 and GSTM1 had the highest risk of dysmenorrhea. However this association could be due to the similar living patterns and behaviors in families.

There was no association between being overweight and the occurrence of menstrual cramps. This was consistent with the results of some previous studies (Sundell et al, 1990; Pullon et al, 1988). However, Harlow and Park (1996) demonstrated a strong positive relationship between high BMI and dysmenorrhea. Obese women tend to have higher estrogen levels (Olson et al, 2006). It has also been shown that people with higher BMI have higher levels of prostaglandin (Martinez et al, 1999). Both high estrogen and high prostaglandin are probable mechanisms of dysmenorrhea. Only 2.2% of this study population were obese which could be a reason that the association did not reach a level of statistical significant.

Physical activity was not associated with pain level in this study consistent to the results of some other studies (Harlow et al, 1996; Sundell et al, 1990; Pullon et al, 1988). Hightower et al (1998) showed that physical activity lowered the intensity of menstrual pain in women. Martinez and colleagues (1999) suggested that physical activity could lead to lower level of prostaglandin which could be a reason for women experiencing less pain. Choi et al (1995) showed women who regularly exercised (more than 3 times per week) had less physical symptoms during menstruation in comparison with inactive women. In contrast, another study showed that vigorous exercise was associated with 30% increase in menstrual pain in a group of cohort nurses (Metheny et al, 1989). Golomb and colleagues (1998) mentioned different theories to address the negative association between menstrual pain and physical activity. Exercise induced stress could cause the imbalance in the hypothalamic-pituitary-ovarian axis which reduces menstrual symptoms. Some other studies suggested the release of beta endorphins after exercise which relieves pain (Bonen, 1984). Enhanced metabolism and better pelvic blood flow due to exercise have also been suggested to alleviate pain (Izzo & Labriola, 1991).

Some studies have shown that smokers experienced more menstrual pain rather than non smokers (Harlow, 1996; Sundell, 1990; Parazzini, 1994). In contrast, one study showed that smokers tended to experience less pain (Anderche, 1982). Smoking is known to cause vasoconstriction which reduces endometrial blood flow and can lead to menstrual pain. It has also been suggested that smokers tended to have longer periods (Parazzini, 1994) which

has been associated with menstrual cramps. There was no significant association between smoking and dysmenorrhea in this study. 73.6% of the study population were non smokers and 6% were former smokers. However among those with severe pain, smokers tended to have longer pain episodes. This could also be explained by psychological differences between smokers and non-smokers.

Balbi and colleagues (2000) showed that non alcohol drinkers experienced less menstrual pain. Some other previous studies showed that people who drank alcohol in moderate, tended to have more severe pain compared with those who did not drink alcohol at all. But women who drank more than seven servings of alcohol per week had less painful menstruation (Parazzini et al, 1994). In our dataset, women who drank alcohol in moderate, experienced significantly less pain compared with non drinkers, but there was no significant association at other levels of alcohol consumption.

Participants with higher socioeconomic status experienced less pain. This is in contrast with the result of another study (Klein & Litt, 1981). There was no significant association between parity and menstrual pain in this study which is consistent with previous studies (Pullon, 1988; Messing, 1993). However, Juang and colleagues (2006) showed the parity is a protective factor for dysmenorrhea. They also showed that women who had natural child birth experienced less menstrual pain rather than those who had a cesarean section. No evidence was found in the literature to explain this. However, theories such as a lower amount of prostaglandins after delivery and pelvic floor injuries which may lead to

decreasing the output of neurosensory innervations from the uterus to the pain center in the brainstem have been suggested. Another explanation could be the disappearance of uterine adrenergic nerves after pregnancy and reduction of uterine noradrenalines in the last trimester of pregnancy.

Despite its strengths, several limitations of this study should be considered. It may be difficult to measure pain and compare it among people since pain experience is an individual perception. Menstruation is a sensitive subject and participants may be unwilling to share their experiences. I tried to avoid this by keeping participants anonymous. The response rate of the study was 72% which was good enough but still could affect the results. Previous studies showed that evaluating participant's diet, physical activity, stress level, and etc was usually quite hard especially with a limited number of questions. Thus, continuing this research with a wider quantity and range of data is suggested to verify these associations. Recall bias could be a concern of this study. However, Munster et al. (1992) documented that the magnitude of recall bias was rather small with respect to the menstrual cycle pattern in the immediately preceding year, a condition that was similar to my study. The association of menstrual pain and family history could be a reflection of recall bias as well. People who have pain may be more likely to notice, remember or ask their family members about their experiences. There was a positive association between stress level, depression and pain. However, it is possible that pain itself lead to more stress and depression among women. Although women with potential causes of secondary dysmenorrheal were excluded from

study sample, it was not possible to discriminate between primary and secondary dysmenorrhea in this study population. Some individuals with dysmenorrhea might have endometriosis or other conditions that are not detectable on routine examination. Nonetheless, the prevalence of diseases such as endometriosis is quite low in the society and so this should not interfere with results of this study. This study sample was very homogeneous with respect to education, race and socio-economic status, which limited cultural confounding factors, but also limited the external validity of the results.

In conclusion, menstrual pain is a common complaint in Iranian women. By identifying the modifiable risk factors, health workers can make recommendations to reduce menstrual pain. Menstrual pain is more prevalent in younger women. Perhaps, they could be considered the target group of diagnosis and treatment of this issue. A low fat vegetarian diet is associated with less pain in women. Promoting healthy lifestyles could be effective in preventing and reducing menstrual pain. Further quantitative research and clinical trials on modifiable risk factors are recommended.

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CHAPTER 3: APPENDICES

Figure 3-1: Distribution of population in Tehran's districts

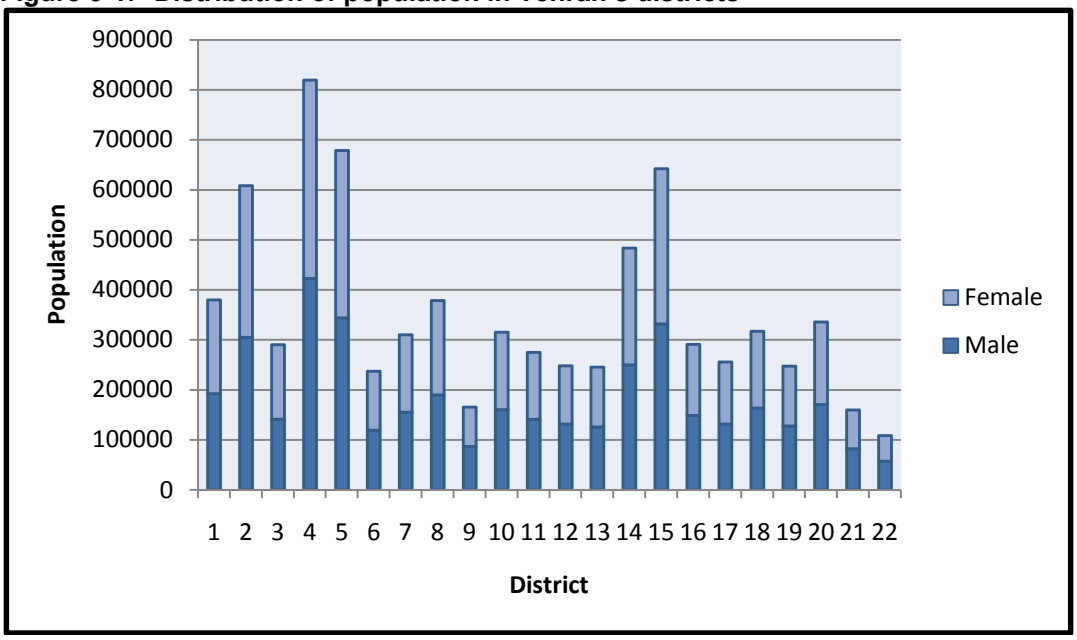

Figure 3-2: Number of questionnaires sent to different districts residents

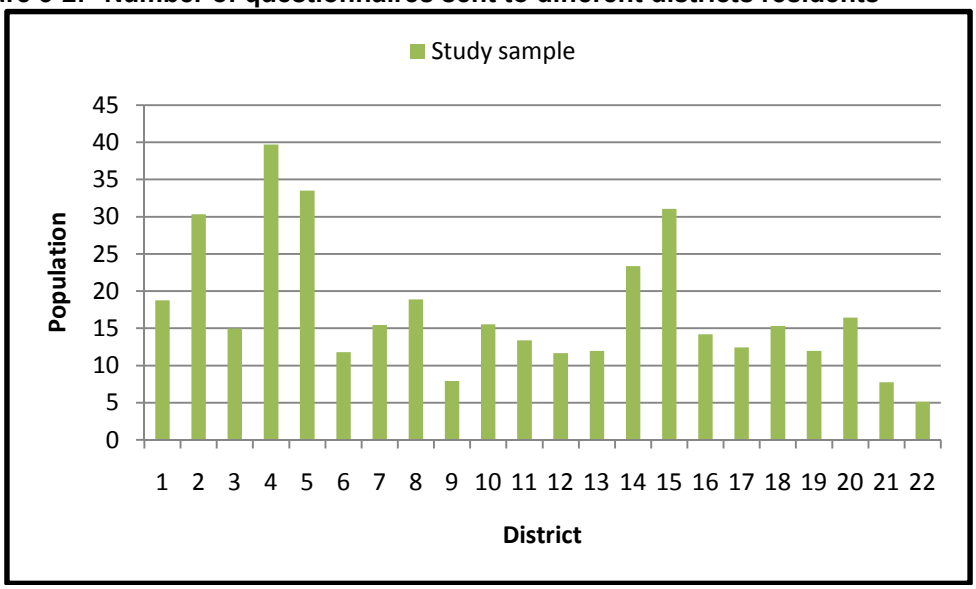

Table 3-1: Age and pain level among participants

		Pain level				
Age		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
< 24	Count	1	18	8	10	37
	% within age	2.7	48.6	21.6	27	100
	% within pain level	3.7	15.9	10.5	16.7	13.4
	% of total	0.4	6.5	2.9	3.6	13.4
25-30	Count	16	58	47	41	162
	% within age	9.9	35.8	29	25.3	100
	% within pain level	59.3	51.3	61.8	68.3	58.7
	% of total	5.8	21	17	14.9	58.7
31-34	Count	5	15	10	6	36
	% within age	13.9	41.7	27.8	16.7	100
	% within pain level	18.5	13.3	13.2	10	13
	% of total	1.8	5.4	3.6	2.2	13
35-45	Count	3	14	8	2	27
	% within age	11.1	51.9	29.6	7.4	100
	% within pain level	11.1	12.4	10.5	3.3	9.8
	% of total	1.1	5.1	2.9	0.7	9.8
> 45	Count	2	8	3	1	14
	% within age	14.3	57.1	21.4	7.1	100
	% within pain level	7.4	7.1	3.9	1.7	5.1
	% of total	0.7	2.9	1.1	0.4	5.1
Total	Count	27	113	76	60	276
	% within age	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-2: Socioeconomic status and pain level among participants

		Pain level				
SES		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
Very Low	Count	0	1	1	3	5
	% within SES	0	20	20	60	100
	% within pain level	0	0.9	1.3	5	1.8
	% of total	0	0.4	0.4	1.1	1.8
< Average	Count	3	12	5	6	26
	% within SES	11.5	46.2	19.2	23.1	100
	% within pain level	11.1	10.6	6.6	10	9.4
	% of total	1.1	4.3	1.8	2.2	9.4
Average	Count	18	48	38	20	124
	% within SES	14.5	38.7	30.6	16.1	100
	% within pain level	66.7	42.5	50	33.3	44.9
	% of total	6.5	17.4	13.8	7.2	44.9
> Average	Count	4	51	28	29	112
	% within SES	3.6	45.5	25	25.9	100
	% within pain level	14.8	45.1	36.8	48.3	40.6
	% of total	1.4	18.5	10.1	10.5	40.6
Very High	Count	2	1	4	2	9
	% within SES	22.2	11.1	44.4	22.2	100
	% within pain level	7.4	0.9	5.3	3.3	3.3
	% of total	0.7	0.4	1.4	0.7	3.3
Total	Count	27	113	76	60	276
	% within SES	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-3: BMI and pain level among participants

		Pain level				
BMI		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
< 18.5	Count	1	14	5	13	33
	% within BMI	3	42.4	15.2	39.4	100
	% within pain level	4	12.7	6.8	23.2	12.5
	% of total	0.4	5.3	1.9	4.9	12.5
18.5- 24.9	Count	21	77	61	36	195
	% within BMI	10.8	39.5	31.3	18.5	100
	% within pain level	84	70	82.4	64.3	73.6
	% of total	7.9	29.1	23	13.6	73.6
25-30	Count	2	15	8	6	31
	% within BMI	6.5	48.4	25.8	19.4	100
	% within pain level	8	13.6	10.8	10.7	11.7
	% of total	0.8	5.7	3	2.3	11.7
>30	Count	1	4	0	1	6
	% within BMI	16.7	66.7	0	16.7	100
	% within pain level	4	3.6	0	1.8	2.3
	% of total	0.4	1.5	0	0.4	2.3
Total	Count	25	110	74	56	265
	% within BMI	9.4	41.5	27.9	21.1	100
	% within pain level	100	100	100	100	100
	% of total	9.4	41.5	27.9	21.1	100

Table 3-4: Alcohol consumption and pain level among participants

Alcohol (Servings/Week)		Pain level				
		No Pain	Mild	Moderate	Severe	Total
None	Count	10	53	43	40	146
	% within Alcohol	6.8	36.3	29.5	27.4	100
	% within pain level	37	46.9	56.6	66.7	52.9
	% of total	3.6	19.2	15.6	14.5	52.9
1 ≤ Servings ≤ 3	Count	11	41	25	15	92
	% within Alcohol	12	44.6	27.2	16.3	100
	% within pain level	40.7	36.3	32.9	25	33.3
	% of total	4	14.9	9.1	5.4	33.3
3-7	Count	5	17	6	3	31
	% within Alcohol	16.1	54.8	19.4	9.7	100
	% within pain level	18.5	15	7.9	5	11.2
	% of total	1.8	6.2	2.2%	1.1	11.2
> 7	Count	1	2	2	2	7
	% within Alcohol	14.3	28.6	28.6	28.6	100
	% within pain level	3.7	1.8	2.6	3.3	2.5
	% of total	0.4	0.7	0.7	0.7	2.5
Total	Count	27	113	76	60	276
	% within Alcohol	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-5: Smoking status and pain level among participants

Smoking (Cigarettes/ day)		Pain level				
		No Pain	Mild	Moderate	Severe	Total
Never smoked	Count	13	82	58	50	203
	% within Smoking	6.4	40.4	28.6	24.6	100
	% within pain level	48.1	72.6	76.3	83.3	73.6
	% of total	4.7	29.7	21	18.1	73.6
Former Smoker	Count	4	9	5	1	19
	% within Smoking	21.1	47.4	26.3	5.3	100
	% within pain level	14.8	8	6.6	1.7	6.9
	% of total	1.4	3.3	1.8	0.4	6.9
Occasionally	Count	4	7	5	3	19
	% within Smoking	21.1	36.8	26.3	15.8	100
	% within pain level	14.8	6.2	6.6	5	6.9
	% of total	1.4	2.5	1.8	1.1	6.9
< 5	Count	3	8	2	2	15
	% within Smoking	20	53.3	13.3	13.3	100
	% within pain level	11.1	7.1	2.6	3.3	5.4
	% of total	1.1	2.9	0.7	0.7	5.4
> 5 but < 10	Count	2	6	4	2	14
	% within Smoking	14.3	42.9	28.6	14.3	100
	% within pain level	7.4	5.3	5.3	3.3	5.1
	% of total	0.7	2.2	1.4	0.7	5.1
	% of total	2	6	4	2	14
> 10	Count	1	1	2	2	6
	% within Smoking	16.7	16.7	33.3	33.3	100
	% within pain level	3.7	0.9	2.6	3.3	2.2
	% of total	0.4	0.4	0.7	0.7	2.2
Total	Count	27	113	76	60	276
	% within Smoking	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-6: Coffee consumption and pain level among participants

		Pain level				
Coffee (Cups/Day)		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
0 or less than one	Count	8	40	21	15	84
	% within Coffee	9.5	47.6	25	17.9	100
	% within pain level	29.6	35.4	27.6	25	30.4
	% of total	2.9	14.5	7.6	5.4	30.4
1 ≤ Cups < 3	Count	14	56	36	34	140
	% within Coffee	10	40	25.7	24.3	100
	% within pain level	51.9	49.6	47.4	56.7	50.7
	% of total	5.1	20.3	13	12.3	50.7
3 ≤ Cups < 5	Count	3	16	18	9	46
	% within Coffee	6.5	34.8	39.1	19.6	100
	% within pain level	11.1	14.2	23.7	15	16.7
	% of total	1.1	5.8	6.5	3.3	16.7
≥ 5	Count	2	1	1	2	6
	% within Coffee	33.3	16.7	16.7	33.3	100
	% within pain level	7.4	0.9	1.3	3.3	2.2
	% of total	0.7	0.4	0.4	0.7	2.2
Total	Count	27	113	76	60	276
	% within Coffee	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-7: Physical activity and pain level among participants

		Pain level				
Physical Activity		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
Inactive	Count	0	6	9	3	18
	% within activity	0	33.3	50	16.7	100
	% within pain level	0	5.3	11.8	5	6.5
	% of total	0	2.2	3.3	1.1	6.5
Very Low active	Count	3	17	16	12	48
	% within activity	6.2	35.4	33.3	25	100
	% within pain level	11.1	15	21.1	20	17.4
	% of total	1.1	6.2	5.8	4.3	17.4
Low Active	Count	7	26	17	19	69
	% within activity	10.1	37.7	24.6	27.5	100
	% within pain level	25.9	23	22.4	31.7	25
	% of total	2.5	9.4	6.2	6.9	25
Moderately Active	Count	10	47	20	16	93
	% within activity	10.8	50.5	21.5	17.2	100
	% within pain level	37	41.6	26.3	26.7	33.7
	% of total	3.6	17	7.2	5.8	33.7
Highly Active	Count	6	11	13	9	39
	% within activity	15.4	28.2	33.3	23.1	100
	% within pain level	22.2	9.7	17.1	15	14.1
	% of total	2.2	4	4.7	3.3	14.1
Extremely Active	Count	1	6	1	1	9
	% within activity	11.1	66.7	11.1	11.1	100
	% within pain level	3.7	5.3	1.3	1.7	3.3
	% of total	0.4	2.2	0.4	0.4	3.3
Total	Count	27	113	76	60	276
	% within activity	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Figure 3-3: Association between fats and oils intake and pain level in study population

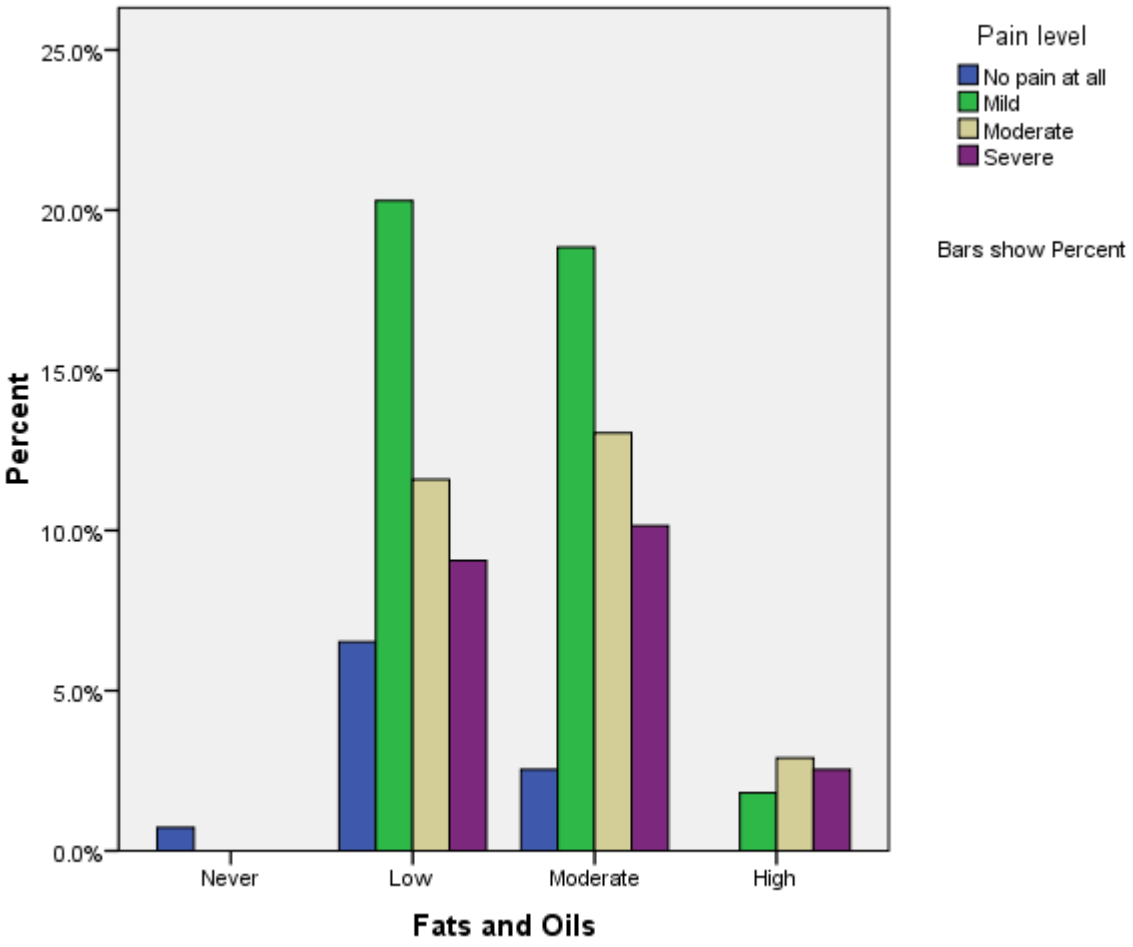

Table 3-8: Sleep and pain level among participants

		Pain level				
Sleep (Hours/Day)		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
< 6	Count	2	10	8	5	25
	% within Sleep	8	40	32	20	100
	% within pain level	7.4	8.8	10.5	8.3	9.1
	% of total	0.7	3.6	2.9	1.8	9.1
6 ≤ Hours < 8	Count	20	77	53	34	184
	% within Sleep	10.9	41.8	28.8	18.5	100
	% within pain level	74.1	68.1	69.7	56.7	66.7
	% of total	7.2	27.9	19.2	12.3	66.7
8 ≤ Hours < 12	Count	5	26	14	21	66
	% within Sleep	7.6	39.4	21.2	31.8	100
	% within pain level	18.5	23	18.4	35	23.9
	% of total	1.8	9.4	5.1	7.6	23.9
> 12	Count	0	0	1	0	1
	% within Sleep	0	0	100	0	100
	% within pain level	0	0	1.3	0	0.4
	% of total	0	0	0.4	0	0.4
Total	Count	27	113	76	60	276
	% within Sleep	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-9: Stress and pain level among participants

		Pain level				
Stress Level		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
No stress at all	Count	1	1	2	1	5
	% within stress level	20	20	40	20	100
	% within pain level	3.7	0.9	2.6	1.7	1.8
	% of total	0.4	0.4	0.7	0.4	1.8
Not very stressed	Count	8	17	11	9	45
	% within stress level	17.8	37.8	24.4	20	100
	% within pain level	29.6	15	14.5	15	16.3
	% of total	2.9	6.2	4	3.3	16.3
A bit stressed	Count	12	47	27	15	101
	% within stress level	11.9	46.5	26.7	14.9	100
	% within pain level	44.4	41.6	35.5	25	36.6
	% of total	4.3	17	9.8	5.4	36.6
Quite a bit stressed	Count	4	37	25	23	89
	% within stress level	4.5	41.6	28.1	25.8	100
	% within pain level	14.8	32.7	32.9	38.3	32.2
	% of total	1.4	13.4	9.1	8.3	32.2
Extremely stressed	Count	2	11	11	12	36
	% within stress level	5.6	30.6	30.6	33.3	100
	% within pain level	7.4	9.7	14.5	20	13
	% of total	0.7	4	4	4.3	13
Total	Count	27	113	76	60	276
	% within stress level	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Table 3-10: Depression and pain level among participants

		Pain level				
Depressed		**No Pain**	**Mild**	**Moderate**	**Severe**	**Total**
Never	Count	4	4	2	1	11
	% within depressed	36.4	36.4	18.2	9.1	100
	% within pain level	14.8	3.5	2.6	1.7	4
	% of total	1.4	1.4	0.7	0.4	4
Rarely	Count	5	47	25	16	93
	% within depressed	5.4	50.5	26.9	17.2	100
	% within pain level	18.5	41.6	32.9	26.7	33.7
	% of total	1.8	17	9.1	5.8	33.7
Sometimes	Count	17	48	42	31	138
	% within depressed	12.3	34.8	30.4	22.5	100
	% within pain level	63	42.5	55.3	51.7	50
	% of total	6.2	17.4	15.2	11.2	50
Most of the times	Count	1	14	7	12	34
	% within depressed	2.9	41.2	20.6	35.3	100
	% within pain level	3.7	12.4	9.2	20	12.3
	% of total	0.4	5.1	2.5	4.3	12.3
Total	Count	27	113	76	60	276
	% within depressed	9.8	40.9	27.5	21.7	100
	% within pain level	100	100	100	100	100
	% of total	9.8	40.9	27.5	21.7	100

Figure 3-4: Association between pain level and age at menarche

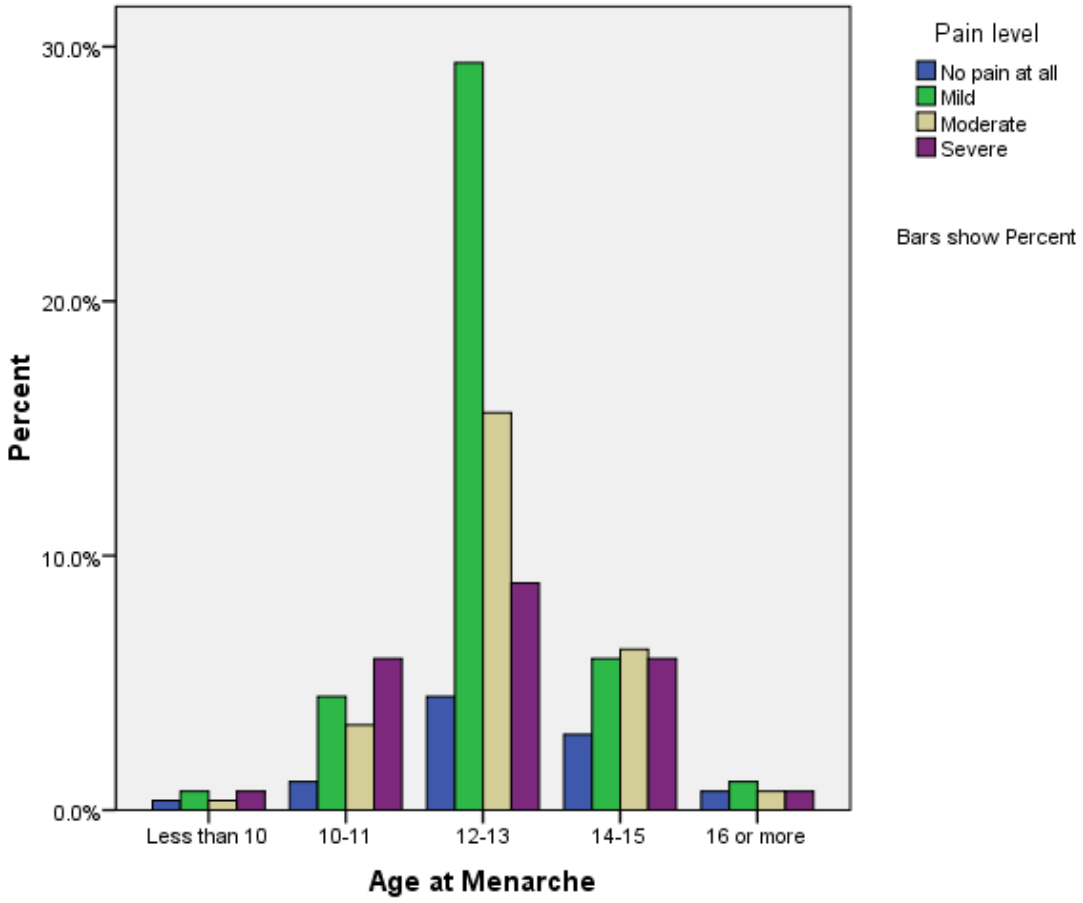

Figure 3-5: Association between regularity of periods and pain level

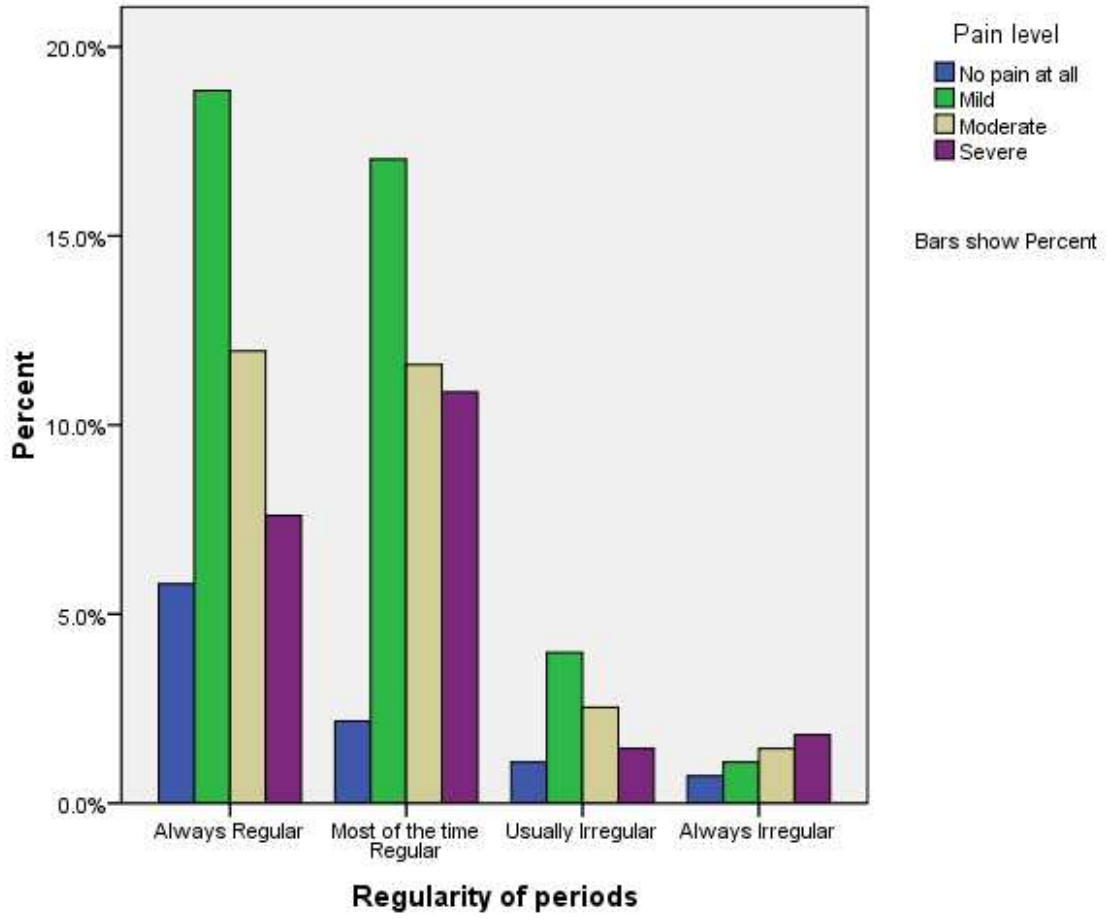

Figure 3-6: Association between pain level and duration of each pain episode

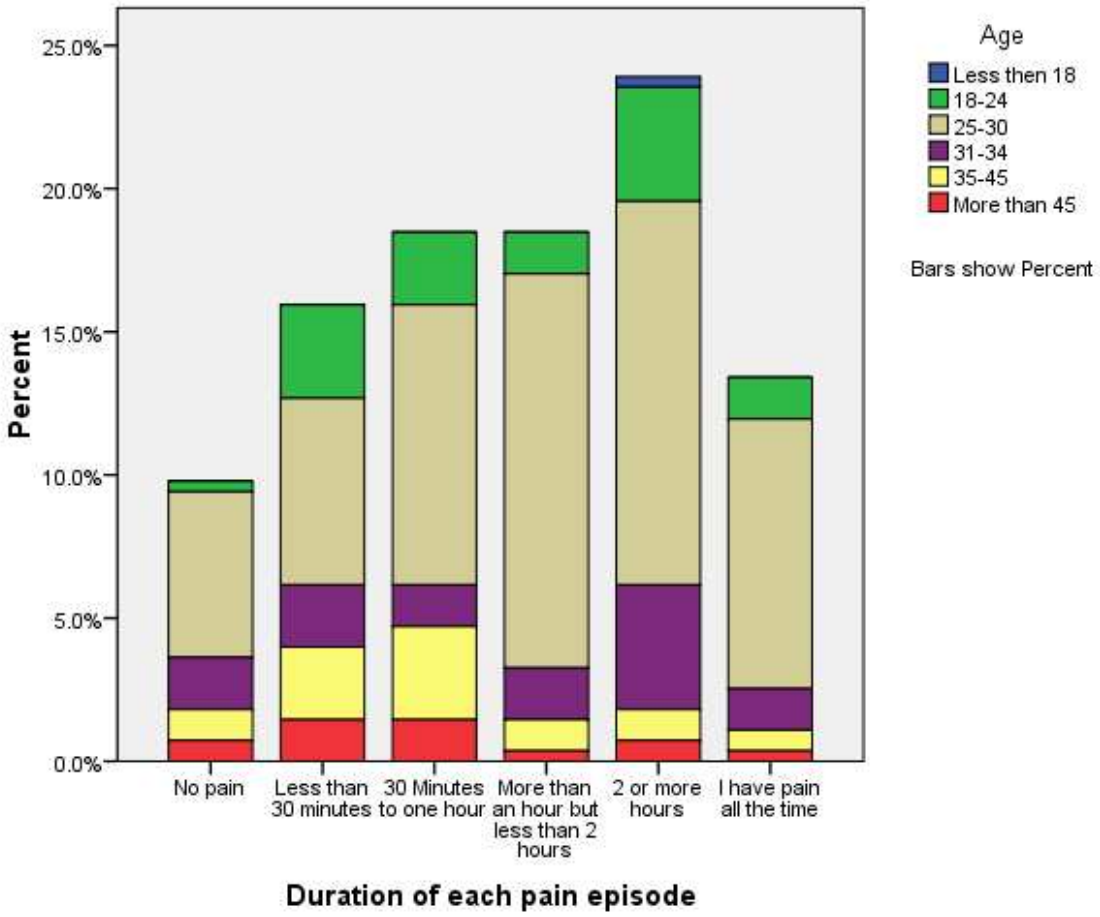

Figure 3-7: Association between duration of each pain episode and dairy intake

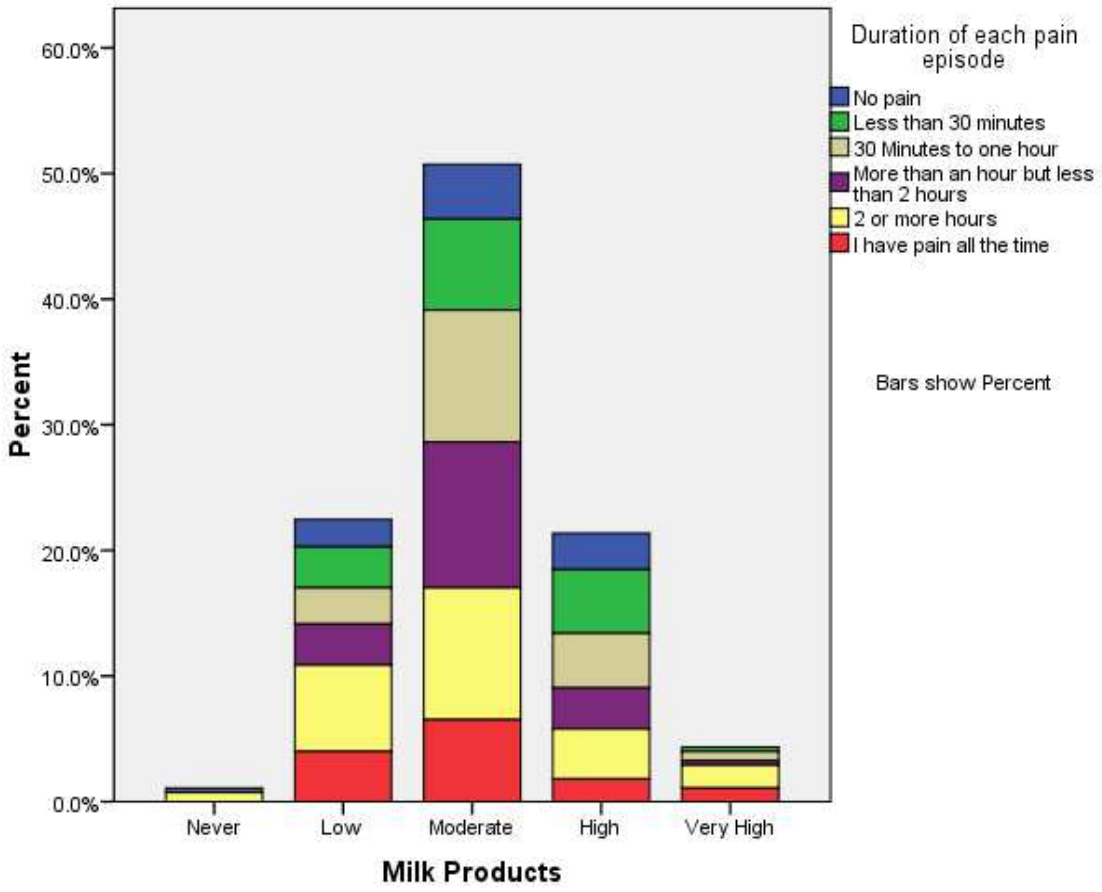

Figure 3-8: Association between duration of pain episodes and grains intake

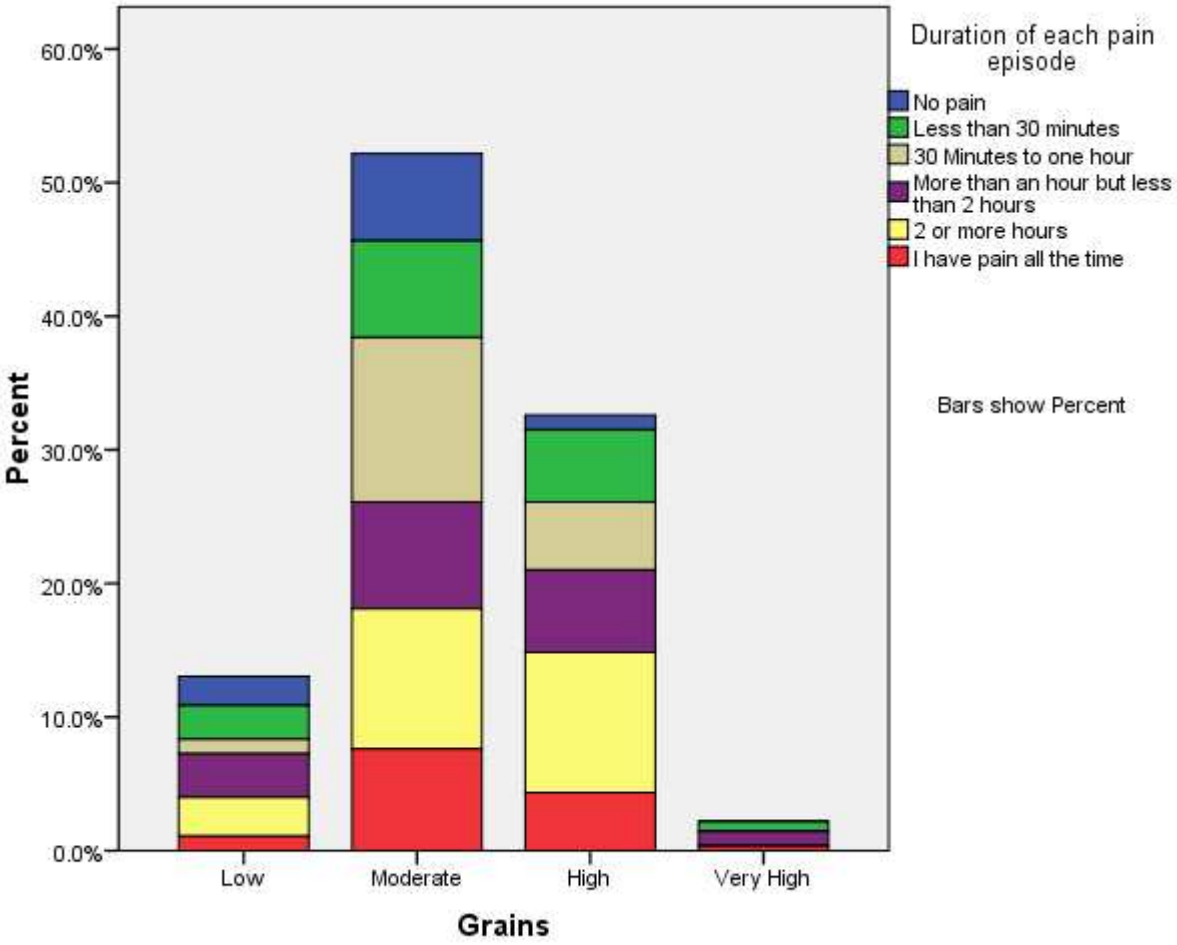

Figure 3-9: Association between duration of each pain episode and high fat diet

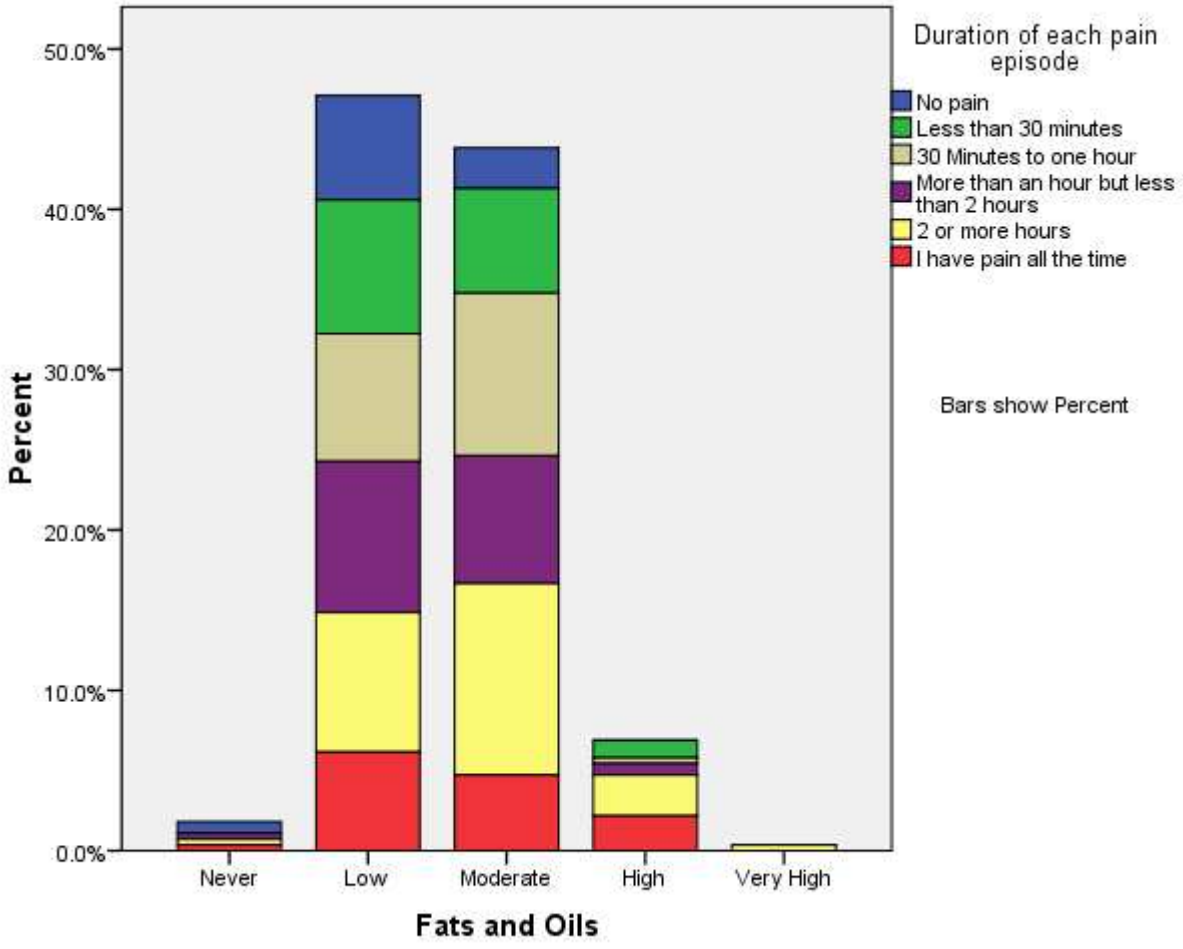

Figure 3-10: Association between duration of each pain episode and physical activity

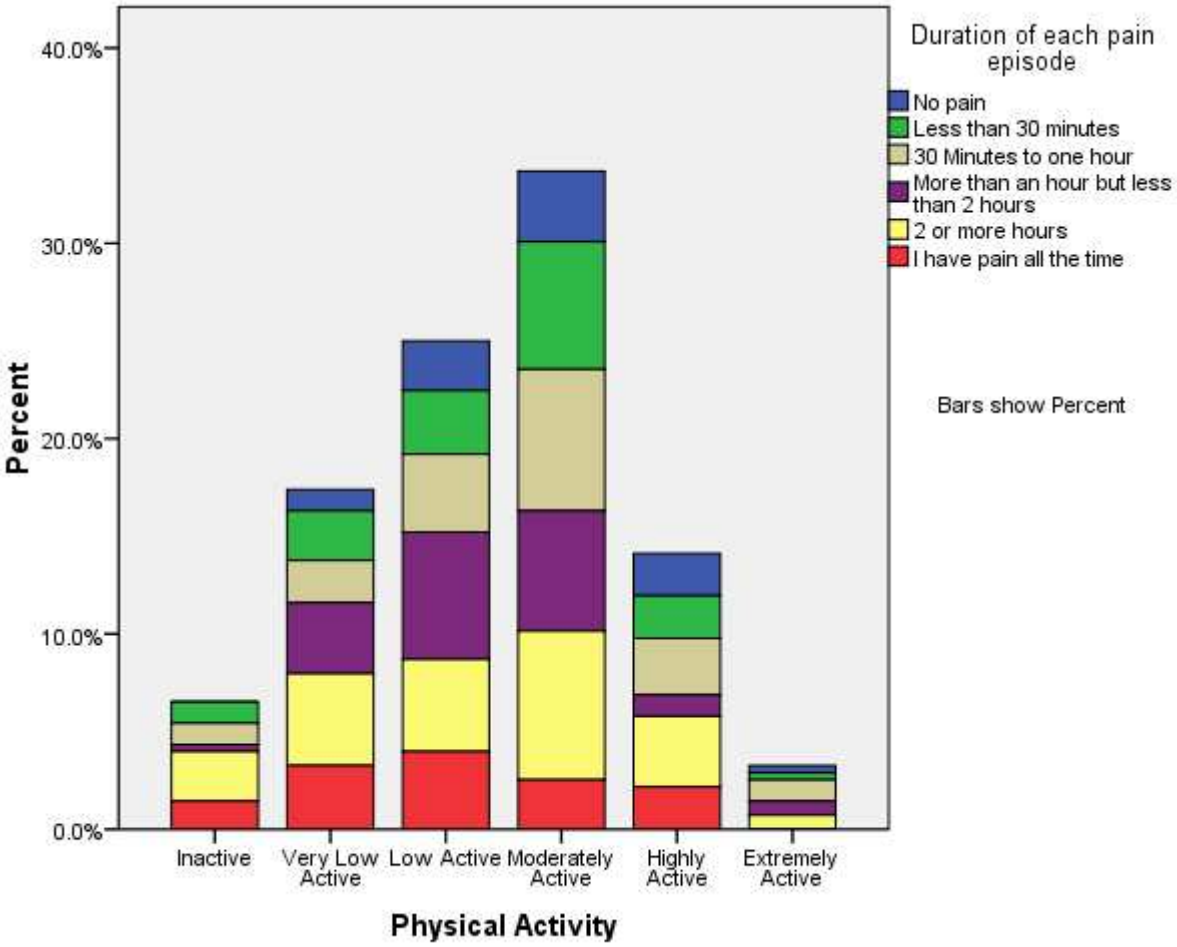

Figure 3-11: Association between duration of pain episodes and depression

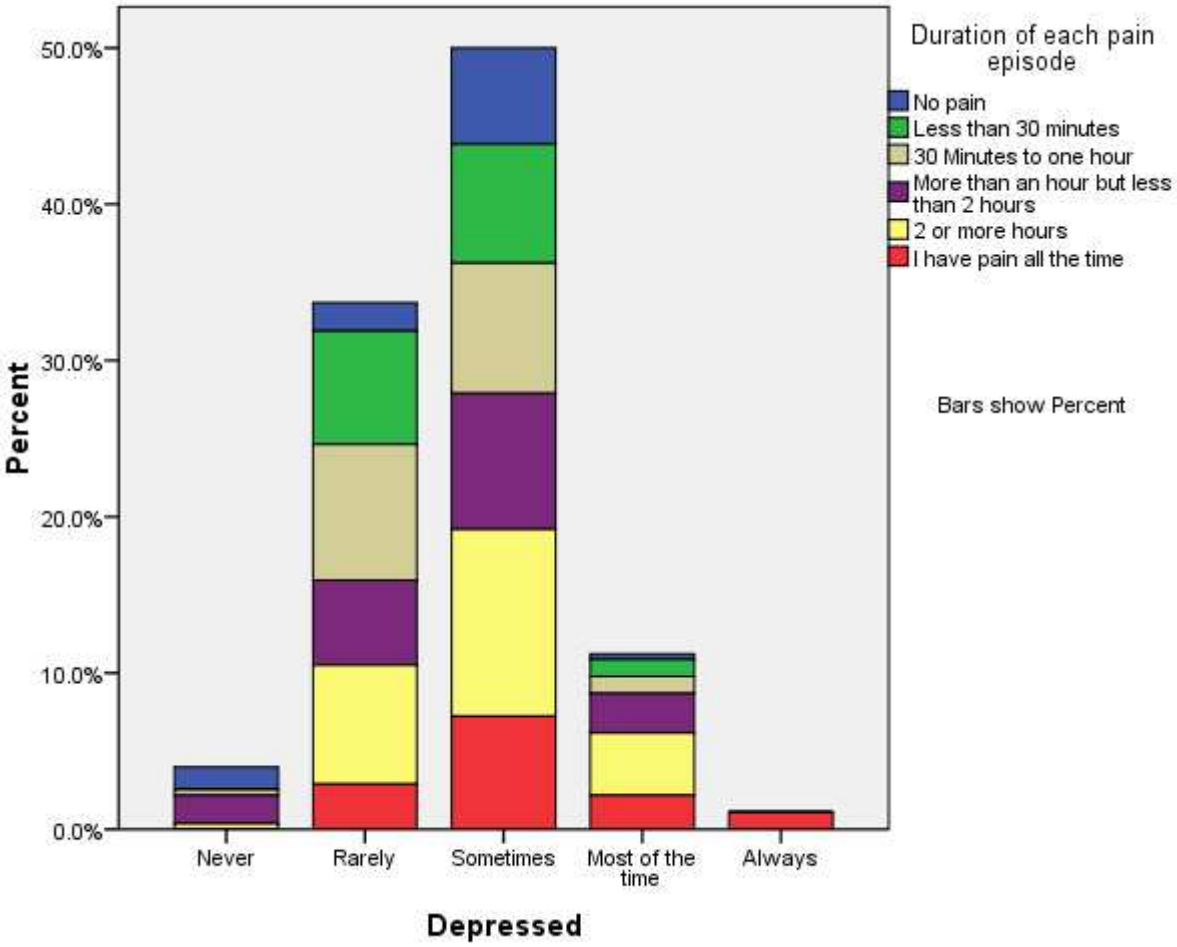

Figure 3-12: Association between duration of bleeding and alcohol consumption

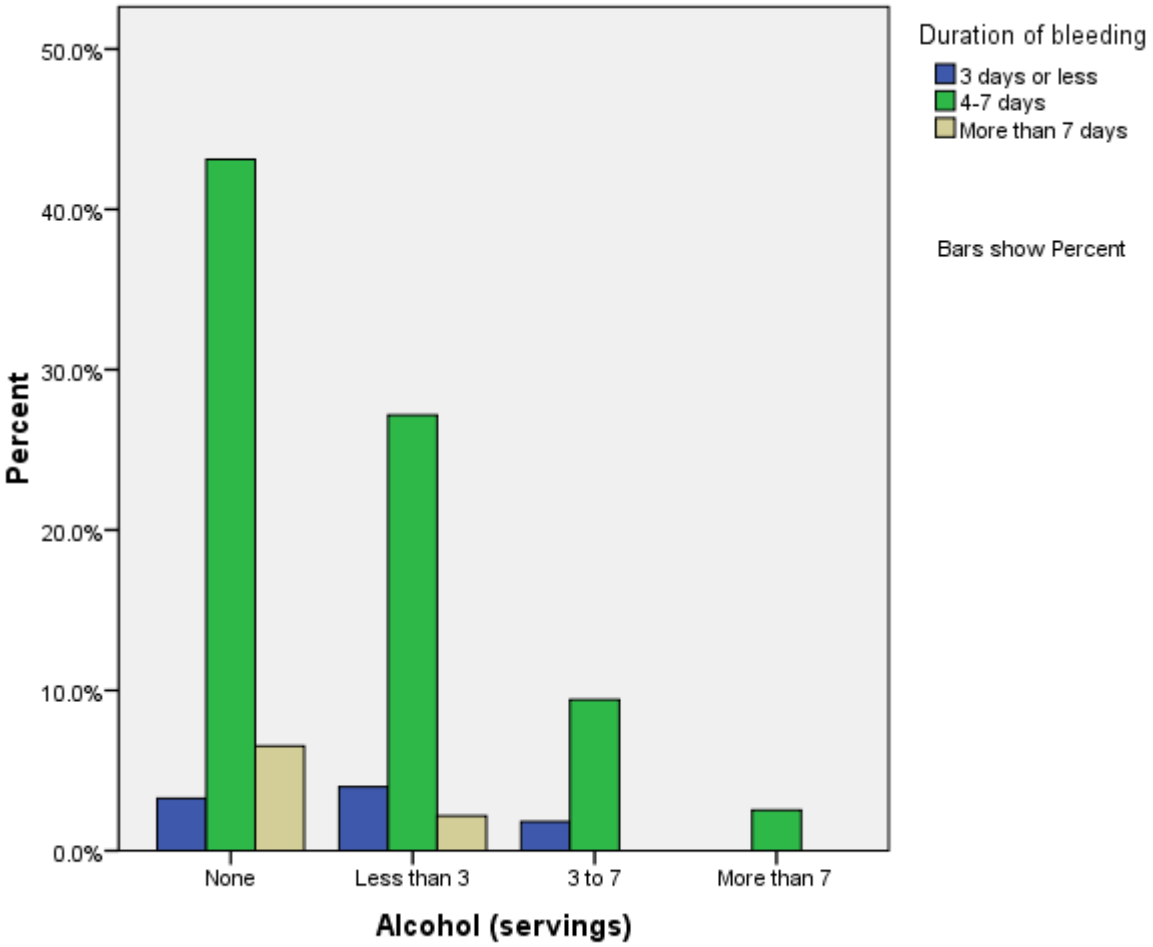

Figure 3-13: Association between duration of bleeding and physical activity

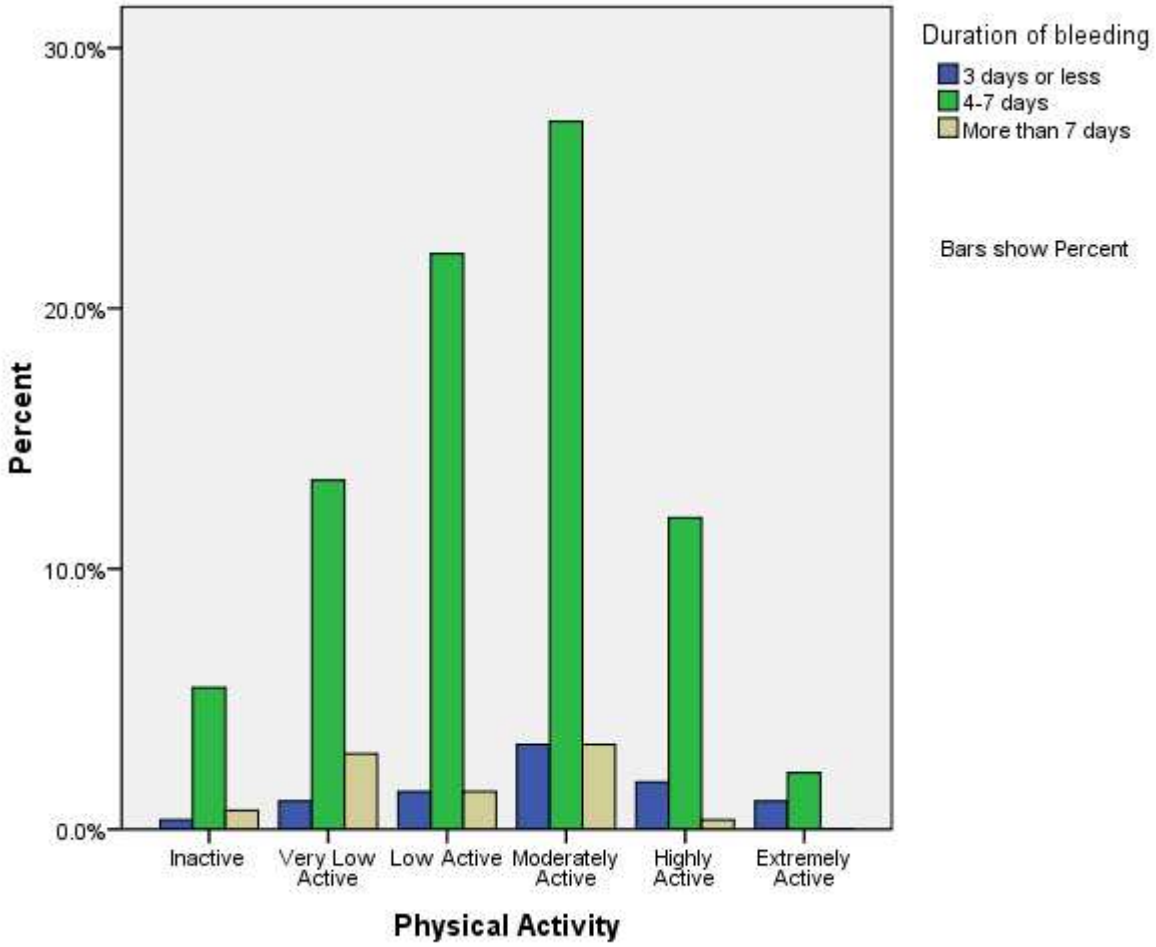

Figure 3-14: Association of duration of bleeding and family history of menstrual pain

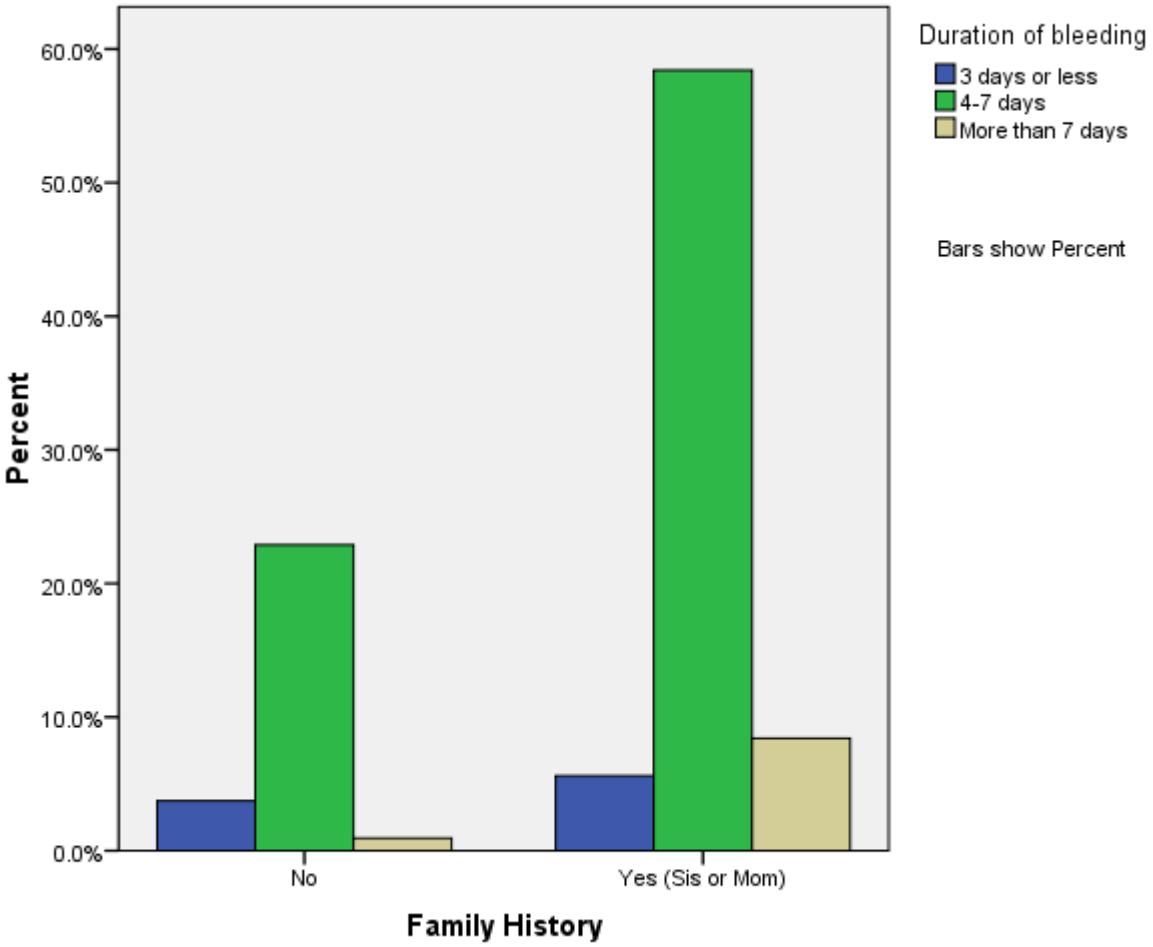

Figure 3-15: Association between BMI and heaviness of periods

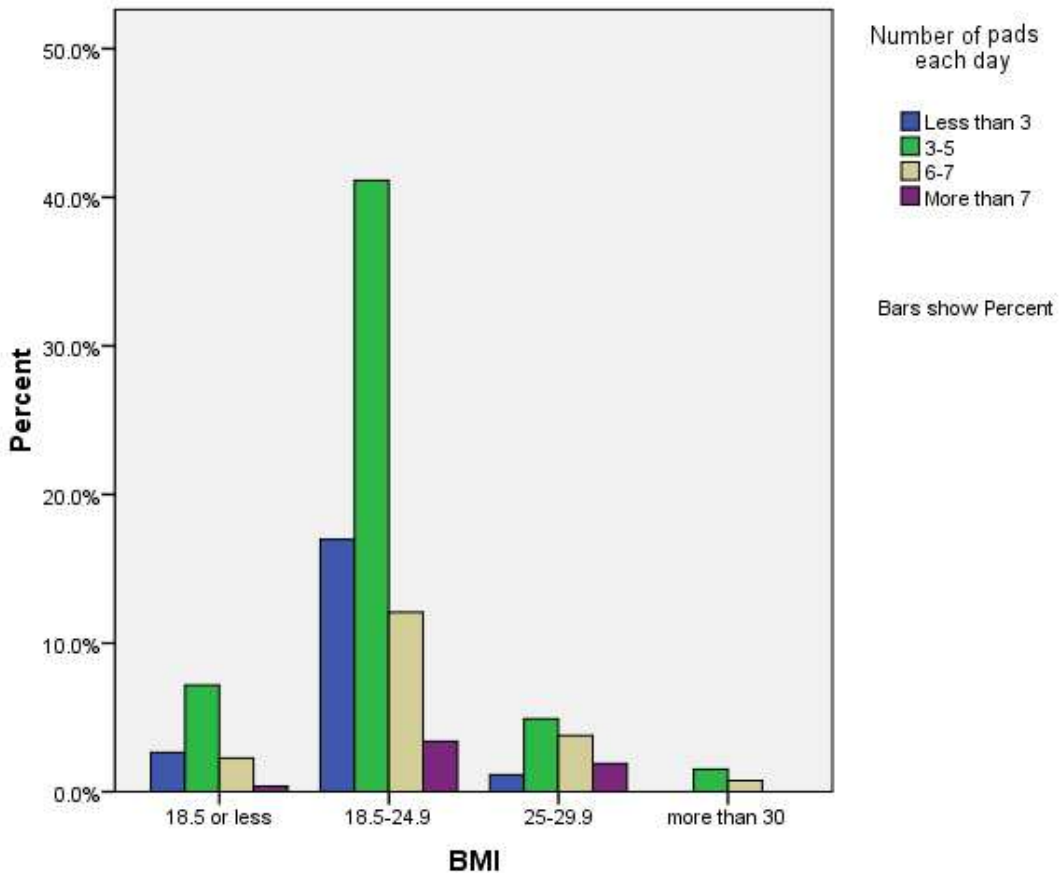

Figure 3-16: Association between sexual activity and regularity of periods