

**DYSMENORRHEA, MENSTRUAL PHASE, AND CHILDBIRTH PAIN:  
RESPONSIVENESS TO LABORATORY PAIN**

**DYSMENORRHEA, MENSTRUAL CYCLE PHASE, AND PREVIOUS CHILDBIRTH PAIN  
EXPERIENCE: RESPONSIVENESS TO LABORATORY PAIN**

**By**

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## ABSTRACT

The present studies were designed to investigate responsiveness of women to laboratory pain. The purpose of this investigation was manifold in that the effects of several different variables on pain perception were examined. First, the studies sought to determine whether the experience of menstrual pain, otherwise known as dysmenorrhea, had any relationship to the perception of laboratory-induced pain, namely, cold pressor pain. Second, it was asked whether menstrual phase had any relationship either on its own, or in interacting with dysmenorrhea, to pain perception. Third, based on observations from the two previous studies, it was asked whether age and/or previous experience of childbirth pain had any influence on pain perception. The first study employed a within-subjects design of young university women in order to investigate the relationship of dysmenorrhea and menstrual cycle phase to pain threshold, tolerance, and subjective pain intensity ratings. The second study employed a between-subjects design of young university women as well, in order to replicate the menstrual phase effect obtained in the first study. The third study employed a between-subjects design of older women as it dealt with the relationships of age and/or the experience of childbirth pain to the same measures of pain perception. It also dealt with defining further characteristics of dysmenorrhea as occurring in an older group of women (over 30 yrs of age).

Results from the first two studies indicated a significant increase in pain sensitivity, measured as pain threshold, from the follicular to the luteal phase of the cycle but no overall significant effects of dysmenorrhea on laboratory-induced pain. In the second study, there was a significant interaction between menstrual phase and dysmenorrhea with respect to subjective pain ratings. These results partially replicated previous findings in the literature while employing a clinically relevant method of pain induction. Results from the third study indicated that previous experience of childbirth pain, independent of age, is a significant factor in the perception of laboratory-induced pain. These latter results have never before been reported in the pain literature and thus deserve further investigation. Possible implications for an adaptation-levels model are discussed.

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## SECTION I. INTRODUCTION

### Dysmenorrhea: Types and Definitions

Dysmenorrhea is a Greek word meaning difficult monthly flow and it generally refers to painful menstruation. Symptoms typically include cramplike abdominal pains or prolonged dull aching pains often accompanied by nausea, headaches, irritability and gastrointestinal disturbances. These symptoms appear on the first day of menstruation and may last for up to 48 hrs but rarely extend beyond that.

Dysmenorrhea has been described as one of the most common gynecological complaints (Ogden, Wade, Anderson, and Davis, 1970). It is commonly observed in 52% of adult women (Ylikorkala and Dawood, 1978) and ranges from 20% to 85% in adolescent women, as reported in different studies (Lawlor & Davis, 1981; Wildholm, 1979). Severe and incapacitating dysmenorrhea occurs in 10-19% of these women (Andersch & Milsom, 1982; Lawlor & Davis, 1981; Ylikorkala and Dawood, 1978).

Dysmenorrhea may be primary or secondary. Primary dysmenorrhea occurs in the absence of pelvic anomaly whereas secondary dysmenorrhea occurs as a result of pelvic disease such as



endometriosis or inflammation caused by an infection (Edelman, Berger & Keith, 1979; Renaer, 1984; Rauh, Lukas, Shepperd, & Burket, 1985; Ylikorkala and Dawood, 1978). It is primary dysmenorrhea that has attracted a great deal of clinical and experimental interest and which constitutes the concern of this paper. Until recently, the causes of primary dysmenorrhea were not very well understood, and before the discovery of the prostaglandins (Pickles, 1957), it was variously attributed to neuroticism, negation of the feminine role and other types of psychological maladjustment.

This thesis examines dysmenorrhea from the point of view of pain research. Experimental analogues of dysmenorrheic pain are investigated in the laboratory using the cold pressor test. Studies investigating sensory factors in dysmenorrhea will receive particular emphasis in the following review since the focus of the research undertaken here is pain sensitivity in dysmenorrhea as a pain phenomenon. First, however, studies dealing with the epidemiology, assessment, etiology and treatment of dysmenorrhea will be reviewed in the following chapters.

### Epidemiology of Dysmenorrhea

Dysmenorrhea results in the loss of working hours and school days which in turn has economic consequences (Andersch & Milsom, 1982; Bergsjø, Jensen, & Zellar, 1975; Carey, 1976; Dawood, 1981; Klein, Litt, Rosenberg & Udall, 1981). It is the largest cause of

absenteeism from work or play in the USA (Sloan, 1972). Andersch and Milsom (1982) reported that 51% of the 596 women they studied had been absent from school or work due to dysmenorrhea, and 8% were absent during every menstruation. Dalton (1964) reported lowered school performance in young women during the time of dysmenorrhea.

Specific groups of women such as students (McArthur, 1975; Miller, 1930; Svennerud, 1959), teenagers and their mothers (Wildholm and Kantero, 1971), outpatients, industrial workers (Bergsjö et al., 1975), and air hostesses (Wildholm 1979) have been studied. Variability in the estimates of incidence of dysmenorrhea may be because of differences in the populations studied and assessment methods. The prevalence of dysmenorrhea in the general population has not been assessed adequately. There is only one representative sample of young 19 year-old women from the city of Gothenborg, Sweden, studied by Andersch and Milsom (1982). A 90.9% answering rate from 656 women was obtained in a mailed out questionnaire about dysmenorrhea. Severity of dysmenorrhea was assessed by a verbal multidimensional scoring system in which the pain was rated as none, mild, moderate or severe. The effects of daily activity, systemic symptoms, and use of analgesics was taken into account. A visual analogue scale was also used to measure severity of pain. As assessed by these techniques, dysmenorrhea occurred in 72.4% of the women who participated in the study. Incapacitating dysmenorrhea occurred in 15.4% of these women. Severity of dysmenorrhea was found to be

significantly correlated with menarchal age. The earlier the age during which the first menstruation occurred, the more severe the menstrual pain experienced. A significant correlation between duration of menstruation and severity of pain was also found. Daughters of dysmenorrheic mothers were more likely to experience menstrual pain than daughters whose mothers were free of symptoms. (See also Brooks-Gunn & Ruble, 1982; Paulson, 1961; Whitehead, Busch, Heller & Costa, 1986; Wildholm, 1979). This finding has important implications for the socialization of illness behavior and has also been reported for a variety of other somatic sensations (Edwards, Zeichner, Kuczmlerczyk & Baczkowski, 1985; Mikail, 1988; Turkat, 1982; Turkat & Noskin, 1983; Violin & Giurgea, 1984). Dysmenorrhea was less frequent in users of oral contraceptives, in parous women, and in smoking women, as compared with women not using oral contraceptives, nonparous women, women who had had an abortion, and non-smokers (Andersch & Milsom, 1982).

Even though the above studies differ in the populations, ages, geographical locations, ethnic backgrounds of the women, and in diagnostic criteria employed, they nevertheless provide consensus as to the high frequency of dysmenorrhea. As such this phenomenon needs adequate clinical and experimental investigation as a problem in its own right rather than as a symptom of underlying pathology.

### Types of Primary Dysmenorrhea

Dalton (1964) distinguished between spasmodic symptoms beginning at the first day of menstruation, and congestive symptoms occurring several days premenstrually. The spasmodic type refers to spasms of laborlike pain whereas the congestive type refers to dull aching pains accompanied by lethargy and depression. The latter is usually considered to be a variation or a symptom of the premenstrual syndrome (Moos, 1969). Dalton (1964) attributed these symptoms to excess and insufficiency of progesterone, respectively.

### Assessment of Dysmenorrhea

#### The Menstrual Symptom Questionnaire (MSQ)

Based on Dalton's theory, Chesney and Tasto (1975) devised the MSQ in order to distinguish empirically between the two symptom types. They performed factor-analysis on the 51 items rated by 56 women with menstrual complaints. Twelve items loaded on each of two factors corresponding to the spasmodic and congestive types. These findings were replicated in another sample of 46 women. Using the MSQ to differentiate between women suffering from the two types of dysmenorrhea, Chesney and Tasto (1975) demonstrated the beneficial effects of behavior therapy for women suffering from spasmodic dysmenorrhea. However, these results failed to be replicated by Cox and Meyer (1978), who found behavior therapy (systematic

desensitization) to be equally effective for both types of dysmenorrhea (see later section on Psychological factors). Moreover, the discriminant validity of this instrument has been criticized. Cox (1977) found that the mean MSQ scores of women reporting menstrual distress did not differ from those of symptom-free women. Bloom, Shelton, and Michaels (1978) administered a battery of personality tests to 24 dysmenorrheic women differentiated in terms of the MSQ, and found that the spasmodic group was only more impulsive than the congestive group.

Webster, Martin, Uchalic and Gannon (1979) criticized Chesney and Tasto's (1975) sample as being too small for factor-analysis. When these investigators used the same technique with a sample of 275 women they failed to support Chesney and Tasto's findings. Whereas Chesney and Tasto (1975) obtained 12 items loading on each factor, Webster et al. (1979) found only 10 of the 12 spasmodic items and 4 of the 12 congestive items. Moreover, scores obtained in the two factors were positively correlated ( $r = 0.56$ ), thus indicating that the two types of symptoms are experienced together and are not mutually exclusive. Thus, Webster et al. (1979) consider typology of dysmenorrhea in terms of spasmodic and congestive symptoms as an "invalid construct".

The above findings question Dalton's original theory on the distinction of dysmenorrhea types and render the MSQ an invalid instrument in making this distinction. Cox (1977) and MacMahon (1977,

as cited in Cox & Meyer, 1978) demonstrated that congestive and spasmodic symptoms occur on a continuum and that women can have both or either one at different menstrual periods. Cox and Meyer (1978) consider this dichotomy as "artificially forced".

### Measures of the Severity of Dysmenorrhea

The pain associated with dysmenorrhea is difficult to measure because it is frequently accompanied by nausea, diarrhea, hot flashes, and vomiting and the woman's reaction to such unpleasant events. Pain judgment might be influenced by her reaction to all of these symptoms. Several attempts have been made to view dysmenorrheic pain as a multidimensional phenomenon. The following section reviews the various diagnostic instruments commonly employed in clinical and experimental studies of dysmenorrhea.

#### Symptom Severity Scale (SSS)

This scale consists of 15 items rated from 1 (symptom not present) to 5 (very severely). It was adapted from Mullen (1971, as cited in Chesney & Tasto, 1975) and used by Chesney and Tasto (1975) to evaluate the effect of muscle relaxation in the treatment of dysmenorrhea. It has also been used by Goolkasian (1983) to differentiate between dysmenorrheic and nondysmenorrheic women in a study of pain sensitivity to radiant heat stimuli. Simple rating scales such as this have been criticized in that they treat pain as a

single sensory quality varying only along the intensity dimension (Agnew and Merskey, 1976).

#### Retrospective Symptom Scale (RSS)

This scale was developed by Cox and Meyer (1978) to tap physical and emotional dysmenorrheic symptoms, and pain behavior indices such as medication usage, and invalid hours (disability hours) due to last menstruation. Eighteen symptoms are rated for frequency and severity. RSS has demonstrated test-retest reliability in a study of 83 women. It also demonstrated concurrent, construct, and content validity on the three independent parameters of menstrual distress. Moreover, RSS frequency ratings correlated highly ( $r = 0.96$ ) with severity ratings. Cox and Meyer (1978) suggest that research on dysmenorrhea should utilize this instrument instead of the single 5-point scale.

#### The card-sort method of pain assessment

This instrument was devised by Reading and Newton (1978). It is also based on the view of pain as a multidimensional phenomenon allowing assessment of sensory, affective, and evaluative dimensions. The test consists of sorting out cards on each of which are two words describing pain, one above the other. The subject's task is to sort out the cards according to whether the top or bottom word on each card most clearly resembles her pain. A score from 1 to 4 measures

intensity of a range of pain qualities. This test was found to be reliable when it was administered 213 times over an 18 month period to Caucasian women with pelvic pain attending Obstetrics and Gynecology clinics in England. Also, it was found to be highly valid in terms of internal structure and its relationship to other pain indices such as analgesic requirements. However, this instrument is not frequently encountered in the dysmenorrhea or other pain research literature.

#### Multidimensional Scoring System (MSS)

On this scoring system, pain is rated as none, mild, moderate or severe, and its effects on daily activity, systemic symptoms, and use of analgesics is taken into account (Andersch and Milsom, 1982). Severe dysmenorrhea which inhibits daily activity and is unimproved by medication is considered as the borderline between primary and secondary dysmenorrhea. In such cases, pelvic examination is required in order to determine if the patient suffers from endometriosis or other pelvic pathology (Goldstein, deCholnoky, Emans and Leventhal, 1980).

#### Visual Analog Scale (VAS)

Severity of dysmenorrhea is also measured by the VAS. This technique involves the use of a 10 cm line on a sheet of paper and represents the continuum of the subject's experience of pain. One extreme represents no pain and the other extreme represent unbearable



pain or maximum pain imaginable. The degree of pain is indicated by a vertical mark on the line. Scale values are obtained by measuring the distance from the "no pain" end to the mark. Andersch and Milsom (1982) obtained significant correlations between the grading of severity of dysmenorrhea on the VAS and the MSS. Moreover, Revill, Robinson, Rosen and Hogg (1976) obtained a high reproducibility of the VAS. The potential use of the VAS in evaluating the medical treatment of dysmenorrhea has been suggested by Andersch and Milsom (1982).

### Etiology and Treatment of Dysmenorrhea

#### Psychological Factors

Primary dysmenorrhea has received considerable attention from psychologists. Because it occurs in the absence of any identifiable organic disease, it is hypothesized to be associated with personality maladjustment, neuroticism, as well as with negative attitudes toward menstruation and the 'feminine role' (Lenane, 1980). According to Kinch (1980), women's reaction against the 'weaker sex' label led to the advancement of the theory on the psychogenic origin of dysmenorrhea. In a biographical study by Witthower and Wilson (1940), dysmenorrheic women were found to have been four times more maladjusted as children when compared to nondysmenorrheic women. Also, these women were found to show 'resentment toward the feminine role', shyness, withdrawal, and anxiety. Dysmenorrheic women have

also been found to score higher on neuroticism measures (Gregory, 1957; Levitt and Lubin, 1967; Rees, 1953). However, Schuck (1951) studied 800 women and concluded that neuroses were no more prevalent in those with primary dysmenorrhea than in symptom-free women. Moreover, Coppen and Kessel (1963) found no evidence to justify dysmenorrhea as a psychosomatic condition. They evaluated 500 women and found no relationship between dysmenorrhea and neuroticism as measured by the Maudsley Personality Inventory (MPI). They argue that dysmenorrhea is very frequent in the general population and is not related to underlying personality characteristics. Bloom, Shelton, and Michaels (1978) found dysmenorrheic women to be more depressed, anxious, worrying, and withdrawn, and less autonomous, playful, and satisfied with themselves than nondysmenorrheic women as assessed with the Minnesota Multiphasic Personality Inventory (MMPI). However, differences in personality functioning between the two groups of women lay within normal limits and did not suggest that dysmenorrheic women were neurotic.

Many of the above studies suffer from methodological weaknesses, lack of appropriate controls, differences in diagnostic criteria, dependence on hospitalized patients, and the physician's untested impressions of psychopathology. Moreover, statistical associations between personality scales and menstrual symptom questionnaires may simply reflect the similarity of their items rather than any real relationship between menstrual problems and

maladjustment (Gannon, 1981). Also, psychogenic factors may be consequences rather than causes of dysmenorrhea. It is not uncommon for women who experience pain, weakness, dizziness, and nausea during menstruation to feel tense and nervous in anticipation of such symptoms. These women may be among those women perceived as neurotic (Wildman & White, 1986). Also, these women may be likely to take prescription medications and thus more likely to be included in studies of clinical populations.

Several studies have investigated whether women who resent the feminine role or have a negative attitude toward menstruation are more likely to suffer from menstrual symptoms than those who accept this role (Berry and McGuire, 1972; Gough, 1975; Levitt and Lubin, 1967; May, 1976; Paige, 1973). Although such an association seems to be suggested by some studies, no cause and effect conclusions can be drawn. Gannon (1981) points out that "one could logically argue either way, that is, that psychological health is adjusting to one's role, even though it requires being passive and accepting the more active social role of man, or psychological health is rebelling against the inferior role of women in our society" (p. 103). Given that the roles of women in society have undergone considerable change within the last 15-20 years, it would be interesting to re-investigate this question.

Despite the rather extensive research into the psychogenic etiology of dysmenorrhea, there does not exist adequate research into

the psychological intervention for this condition. A few studies, however, have shown the beneficial effects of behavior therapy in treating dysmenorrheic symptoms (Chesney and Tasto, 1975; Cox and Meyer, 1978; Mullen, 1968). These studies utilized muscle relaxation in order to reduce muscle tension. Chesney and Tasto (1975) assigned 69 nulliparous women with menstrual complaints into three treatment conditions: A behavior-therapy condition (muscle relaxation and imagery), a pseudotreatment condition (discussion groups), and a waiting list condition (no treatment). These groups contained an equal number of women suffering from 'spasmodic' and 'congestive' dysmenorrhea, assessed by using the MSQ. Severity of dysmenorrhea was assessed through the SSS. The investigators hypothesized that muscle relaxation would only benefit the 'spasmodic' type since this was characterized by muscle tension and uterine hypercontractility. Congestive dysmenorrhea was thought to be characterized by muscle ischemia and water retention (Dalton, 1964). Treatment lasted for five weeks and it was followed up for two months after the end of the program. The results revealed that muscle relaxation and imagery reduced dysmenorrheic symptoms for women suffering from 'spasmodic' dysmenorrhea only.

Cox and Meyer (1978), however, found behavior therapy equally effective in treating 'both types' of dysmenorrhea. These investigators used multiple dependent measures to assess the effects of systematic desensitization on dysmenorrheic women. Dysmenorrhea

was assessed using daily and retrospective symptom scales. Dependent measures included menstrual symptoms, medication usage, additional hours spent in bed, and menstrual attitudes. Fourteen volunteer college women comprised the dysmenorrheic group, an equal number of women comprised the nondysmenorrheic group, and 55 women comprised the normative group. Systematic desensitization, administered over four sessions during one menstrual cycle was shown to be effective for all the above measures following a 6-month follow-up period.

The above studies demonstrate the therapeutic value of behavior therapy in dysmenorrhea. However, due to medical advances in the pathophysiology of dysmenorrhea, psychological treatment is no longer prominent in the literature.

#### Biochemical Factors in Dysmenorrhea

The pathophysiology of primary dysmenorrhea has no single explanation. Etiological factors include excessive release of prostaglandins, gonadal hormone imbalance, vasopressin imbalance, decreased blood flow, and abnormal myometrial activity. All these factors contribute to uterine hyperactivity (Akerlund, 1979; Csapo, 1980; Marx, 1979; Pickles, 1957; 1979).

#### Blood flow and myometrial hypercontractility

It is a well known fact that increased myometrial activity

and elevated uterine pressure are associated with dysmenorrhea (Filler & Hall, 1970; Hendricks, 1966; Jacobson, Lackner, & Sinykin, 1940; Renear, 1984; Smith, 1984; 1987; Wilson & Kurzrok, 1940; Woodbury, Torpin, Child, Watson, & Jarboe, 1947). Women with primary dysmenorrhea have been found to have a hyperactive myometrium during painful menstruation (Akerlund, 1979; Ylikorkala & Dawood, 1978). High uterine pressure is associated with muscle ischemia (lack of blood flow) and pain (Akerlund, Andersson, & Ingemarsson, 1976). Ischemia results in compressing uterine blood vessels and thus decreasing blood flow. Decreased blood flow is associated with dysmenorrheic pain. Relaxation of the uterine muscle through the administration of terbutalin results in increased blood flow and pain relief (Akerlund, 1979). Application of heat in the abdominal area is also very effective since it results in vasodilation and increased blood flow (Ylikorkala & Dawood, 1978).

### Prostaglandins

The uterus expels menstrual fluid through forcible and coordinated contractions. These contractions are found to be caused by substances identified as prostaglandins (Pickles, 1957). Prostaglandins are produced in the endometrium and reach the myometrium through the blood stream. The main constituents were shown to be prostaglandins E2 and F2a (Pickles, Hall, Best, & Smith, 1965). Primary dysmenorrhea has been hypothesized to result from excessive

release of prostaglandins E2 and F2 (Pickles, 1979).

Interrelationships between the concentration of prostaglandins in uterine tissue and the changing pattern of myometrial contractions have been repeatedly discussed in the literature. It has been shown that at the early part of the cycle, uterine contractions are of short duration, high frequency, and low amplitude. Throughout the secretory (luteal) phase, the amplitude increases and the frequency decreases until the onset of menstruation at which time they resemble those recorded during labor (Bengtsson, 1973).

Dysmenorrheic women were found to have plasma levels of prostaglandin 15-keto 13, 14-dihydro-F2a ranging between 32 to 105 pg.per millimeter during menstruation (Lundstrom & Green, 1978). These levels were higher than those found in nondysmenorrheic women, ranging between 20 to 33 pg.per millimeter. Also, concentration of F2a in the endometrium was found to be four times higher (300-2,600 pg.per milligram) in dysmenorrheic women. Similar results were also reported by Willman, Collins and Clayton (1986). These investigators also measured endometrial prostaglandin levels in various groups of women at different phases of the menstrual cycle. They found that the highest levels were obtained during the late secretory and menstrual phase as compared to the proliferative and early secretory phases in normally menstruating women. These levels were significantly higher in all phases in dysmenorrheic women, in women with irregular bleeding, and in women with endometriosis and endometrial carcinoma.

When prostaglandins are administered exogenously, they produce contractions in the myometrium as well as diarrhea, vomiting, and headache (Roth-Brandel, Bygdeman, and Wigvist, 1970). Moreover, when Martin and Bygdeman (1975) administered prostaglandin F2a locally, they found that the uterus was more responsive during the late secretory and premenstrual phases. The amount of prostaglandin required to elicit a response was similar to that found in endometrial tissue.

The role of prostaglandins in dysmenorrhea is further supported by the fact that prostaglandin synthetase inhibitors (flufenamic acid or indomethacin) provide pain relief in the majority of dysmenorrheic women. This has been documented by a number of well controlled double-blind clinical studies using a variety of prostaglandin inhibitors (Csapo, 1980; Csapo, Pulkkinen, & Henzl, 1977; Halbert, Demens, Fontana, & Jones, 1976; Henzl, Buttram, Segre, & Besser, 1977; Henzl, Masey, Hanson, Buttram, Rosenwaks, & Pauls, 1980; Jacobson, Cavalli-Bjorkman, Lundstrom, Green, & Svanborg, 1979; Ogden, Wade, Anderson, & Dewis, 1970; Schwartz, Zor, Linder, & Naor, 1974).

Csapo (1980) suggests that prostaglandin synthetase inhibitors should be the preferred method of treatment of patients with suspected primary dysmenorrhea. However, the efficacy of these agents in the treatment of dysmenorrhea is only about 80-85% (Dawood, 1985). The remaining 15-20% of the women do not respond to any kind



of medication. Also, since prostaglandin levels are not elevated in all women with dysmenorrhea, the prostaglandin hypothesis might not be the only explanation for myometrial activity in all cases (Halbert, Demens, Darnell, & Jones, 1976). In such cases, further examination such as ultrasonography or laparoscopy is necessary in order to determine the presence of secondary dysmenorrhea. Using laparoscopy, Goldstein et al. (1980) found the incidence of endometriosis to be 34% of 140 adolescents with chronic pelvic pain. Rosenwaks and Segar-Jones (1980) suggest the use of the term "idiopathic dysmenorrhea" for those women with no organic pelvic pathology and who fail to respond to prostaglandin treatment. In such cases, psychological treatment such as behavior therapy may be helpful (Chesney & Tasto, 1975b).

#### Gonadal Hormones: Estrogen and Progesterone

Ovarian steroids control the development and activity of the endometrium. Estrogen levels increase at the proliferative (follicular) phase of the cycle, and progesterone levels increase during the secretory (luteal) phase of the cycle. Prostaglandins are higher during the secretory than during the proliferative endometrium. Progesterone is thought to regulate prostaglandin synthesis since the concentrations of PGF in menstrual fluid are higher in ovulatory than in anovulatory cycles (Pickles, 1967). Also, progesterone has been found to inhibit PF2a-induced uterine contractility in nonpregnant rabbits (Porter & Behrman, 1971). However, the exact relationship of

this hormone to dysmenorrhea is not yet clear. More research on the role of progesterone in dysmenorrhea is needed.

Bell and Lorraine (1966) found differences in the urinary excretion of estrogens and pregnanediol between dysmenorrheic and nondysmenorrheic women. However, circulating hormones do not necessarily reflect intrauterine levels (Akerlund, 1979; Ylikorkala & Dawood, 1978). Oral contraceptives, which suppress the menstrual cycle and provide fixed exogenous levels of estrogen and a progestin throughout the cycle, reduce prostaglandin levels in the menstrual fluid and provide pain relief (Ylikorkala & Dawood, 1978). Oral contraceptives indirectly prevent synthesis of PG in the thickened uterine lining by suppressing growth and thickening in this lining necessary for the implantation and growth of the fertilized egg (Glick & Bennet, 1982). The disadvantage of oral contraceptive treatment of dysmenorrhea is that it requires daily usage of medication and continuous suppression of endogenous levels of steroids and gonadotrophins instead of providing symptomatic treatment (Heinrichs & Adamson, 1980). Moreover, their success rate does not exceed that of prostaglandin inhibitors (Henzl, Massey, Hanson, Buttram, Rosenwaks, & Paul, 1980). Hormonal treatment through the entire month in order to avoid an event that only occurs once a month and lasts for one to two days is seen as a drastic measure. Also, there are many women who do not want to use oral contraceptives and not all of those who do benefit from their use (Wiquist, 1979). Several investigators suggest

that treatment of dysmenorrhea with oral contraceptives should not occur unless all other methods fail. However, until the discovery of prostaglandins, dysmenorrhea was being treated hormonally.

#### Anovulatory cycles and dysmenorrhea

Ovulation becomes more or less established 2-3 years after menarche (Brooks-Gunn & Ruble, 1983). Anovulatory cycles are frequently recorded the first year after menarche (Rauh, Lukas, Shepperd, & Burket, 1985). Until recently, the six months following menarche were considered to be anovulatory and thus painless (Gant & McDonough, 1981). Prostaglandin production was found to be lower in anovulatory cycles (Pickles, 1967). However, Buttram and Kaufman (1969) provided evidence to suggest that this effect depended on the state of the endometrium and not on the absence of ovulation. Moreover, the assumption that the onset of menstrual pain is related to ovulation does not hold in all cases since 67.5% of adolescent women with dysmenorrhea reported the experience of pain from the beginning of their menses (Widholm, 1979). Also, Golub and Catalano (1983) found that 30% of the women they studied recalled having pain at menarche. McKeever (1984) cites an American epidemiological survey indicating that dysmenorrhea occurs in 60% of adolescents and increases from 39% in 12 year olds to 72% in 17 year olds. Lawlor and Davis (1981) reported that 49-85% of adolescents experience some menstrual discomfort while 5-19% are incapacitated each month.

Moreover, Widholm and Kantero (1971) found that dysmenorrhea does not always occur in women who ovulate. This finding is also supported by the fact that oral contraceptives do not always provide relief for all dysmenorrheic women, even though they suppress ovulation. Thus, the "anovulation hypothesis" is currently being challenged.

#### Oxytocin and Vasopressin

Oxytocin, a posterior pituitary hormone, is important in stimulating activity of the myometrium during labor in pregnant women but not in nonpregnant women (Akerlund, 1979). The finding that oxytocin was lower in dysmenorrheic women (Warren & Hawker, 1969) was considered as paradoxical. When oxytocin levels are low, the stimulating effect is exerted primarily by vasopressin. Vasopressin stimulates uterine activity during menstruation and also causes decrease in blood flow (Akerlund & Andersson, 1976). Concentration of vasopressin in dysmenorrheic women was found to be twice as much as that of nondysmenorrheic women (Akerlund, 1979). However, the role of these hormones in dysmenorrhea is not yet clearly understood.

#### Cervical obstruction

This theory, traced back to Hippocrates, attributes painful menstruation to narrowing of the cervical opening and stagnation of menstrual blood. Although this theory is substantiated by the fact that cervical dilatation results in pain relief, no significant

differences in cervical narrowing have been found between dysmenorrhic and nondysmenorrhic women (Akerlund, 1979). However, this ancient idea prevailed until the discovery of prostaglandins. Prior to this discovery, dysmenorrhea was being treated by dilatation and curettage (Kinch, 1985) in addition to hormonal intervention.

#### Uterine nerves

Presacral neurotomy was extensively used for treating dysmenorrhea and it is considered effective in 50-90% of the cases (Black, 1964). Decrease in dysmenorrhea in parous women may result from degeneration of uterine nerves. However, the role of these nerves is not yet known (Akerlund, 1979).

#### Overview

Dysmenorrhea is a condition of recurrent pain and as such requires careful assessment and follow-up. In order for the treatment to be successful, the multiple etiological factors outlined above must be reexamined. Heinrichs and Adamson (1980) suggest that the patient and the physician must view 'maintenance' and not 'cure' of the patient as their goal. However, medical treatment of dysmenorrhea is symptomatic. The goal of medication is to relieve symptoms rather than cure and alter the causes of the symptoms. It is obvious from the above that the treatment of dysmenorrhea is a complex process. As such, it requires a full appreciation of the interaction among

psychological and biochemical causes (Brooks-Gunn & Ruble, 1983).

Gannon (1981) encourages researchers to 'relax the barriers separating the various disciplines' and collaborate in order to investigate this complex phenomenon.

Perhaps the chapter on the medical profession's treatment of dysmenorrhea can best conclude by the following quote (Lenane, 1980):

"It seems that dysmenorrhea patients have had erratic and unsatisfactory treatment by the medical profession. Treatment has ranged from none (overt, or concealed as 'psychotherapy') to insistence on treatment that may be unacceptable (ovulation suppression) to draconian (hysterectomy, oophorectomy). The prostaglandin synthesis inhibitors have opened up possibilities of treatment that is effective and relatively free of side effects and needs to be used only at the relevant time. Simple and effective treatment for a previously troublesome condition can take the focus off the previously troubled patient's psyche. The 'trichomonad personality', for example, disappeared without a trace when metronidazole appeared and if prostaglandin synthetase inhibitors live up to their present promise the 'dysmenorrhic personality' should go the same way. Having gone through menstruation-as-illness cycle, we are now in the downswing of menstruation as health" (p. 206).

#### Sensory Factors in Dysmenorrhea

Dysmenorrhea, as a condition of recurrent pain, has received some attention from pain researchers. The main question asked by these investigators is whether dysmenorrhic women differ from nondysmenorrhic women in their pain perception. It has been suggested by several investigators that dysmenorrhic women are more sensitive to pain and cope less adequately with it than do nondysmenorrhic women (e.g., Cox & Meyer, 1978; Haman, 1944; Petrie,

1967). This section will review such studies. However, it will be useful to first examine pain perception in the normal population in order to understand that of a supposed pathologic population.

#### Pain Sensitivity in Women

Pain researchers found that normally menstruating women show cyclical variation in their pain reactions (Goolkasian, 1980; Herren, 1933, Procacci, Zoppi, Manesca, & Romano, 1974; Tedford, Warren, & Flynn, 1977). Methods of measurement of pain threshold include pressure, radiant heat, and electric shock. These studies are summarized on Table 1 of Appendix I.

Herren (1933) repeatedly measured the two-point threshold of pain and touch through pressure applied on the lower part of the right arm. Measurements were obtained in five women premenstrually (within five days prior to the onset of menses), postmenstrually (within three days following the cessation of menses, follicular phase), and intermenstrually (ovulatory phase) for eleven menstrual cycles. Lower thresholds (higher sensitivity) were obtained during the premenstrual phase as compared to the postmenstrual phase for all subjects. Postmenstrual thresholds were similar to the intermenstrual ones. However, no statistical analyses were performed on these data. Herren interpreted the increased pain sensitivity during the premenstrual phase in terms of changes in the levels of gonadal hormones:

"This lowering and heightening of the two-point thresholds and the limen for tactile sensitivity corresponding

respectively to an increase and decrease in sex hormone concentration in the blood indicates that the hormone increases the sensitivity of central nervous system cells to incoming impulses" (pg. 326).

Procacci et al. (1974) used the radiant heat method to measure thresholds in both men and women over one month. Cyclical variation was demonstrated only for women. Threshold values showed a peak 7 days after the onset of menses and a low point approximately 22 days after the onset of menses. Cyclicity of pain thresholds was not demonstrated in women taking oral contraceptives or in men. This finding reinforces the view that fluctuating levels of gonadal hormones might be responsible for these changes.

Cyclical effects were also obtained when the shock aversion technique was used (Tedford, Warren, & Flynn, 1977). These investigators tested volunteers for five weeks in 10-min. tri-weekly sessions. However, cyclic variation in this study occurred in the opposite direction. Normally menstruating women but not oral contraceptive users or men, exhibited least sensitivity (maximum thresholds) at ovulation, and most sensitivity (lowest threshold) postmenstrually. These investigators explained their findings in terms of cyclic fluctuations in gonadal hormone levels. In oral contraceptive users, estrogen and progesterone are artificially maintained at constant levels. In normally menstruating women, estrogen fluctuations modify monoamine oxidase (MAO) levels in the blood and CNS (Klaiber, Kobayashi, Broverman, & Hall, 1971). MAO, an enzyme believed to regulate catecholamine levels in the brain, has



been found to reduce serotonin (5-HT) which has been implicated as a neurotransmitter for pain sensitivity (Cooper, Bloom, & Roth, 1974; Lints & Harvey, 1969). Depletion of 5-HT results in increased sensitivity to pain. These results could also be explained in terms of changes in the water balance occurring during the premenstruum (Moos, 1968). Aversiveness of electrical stimulation could result from increased conductance of the skin due to changes in the extracellular fluid. This hypothesis could also explain Herren's (1933) results of increased sensitivity during the premenstrual phase.

In measuring pain perception, all of the studies reviewed above obtained threshold estimates. Threshold measures are thought to confound sensory sensitivity with the observer's willingness to report pain (response bias or criterion) (Chapman, 1974; Chapman, Murphy, & Butler, 1973; Clark, 1969; Clark & Mehl, 1971). Receiver operating characteristics (ROC) analysis takes into account both measures of threshold. Goolkasian (1980) used such modern psychophysics to analyze pain responses to radiant heat stimuli. She showed that cyclicity of pain reactions in normally menstruating women was due to an enhanced ability to discriminate painful stimuli during the luteal (day 15-21, postovulatory phase). Sensitivity was equally lower during the menstrual, follicular, and premenstrual phases. No differences were obtained for the criterion measure. That is, there were no phase differences in willingness to report pain. No cyclicity was observed for oral contraceptive users or for men. Again, this finding was

taken to suggest that gonadal hormones play a significant role in pain perception.

This study differed from the Procacci et al. (1974) study in that the pain sensitivity during the menstrual phase was no different from that observed during the pre- and post-menstrual phases. In general, however, Goolkasian's (1980) and Procacci et al's. (1974) results were largely consistent with each other, but totally opposite from those obtained by Tedford et al. (1977). Discrepancies among these findings could be attributed to the differences in the techniques used to measure pain perception as well as to the differences in the pain responses being measured (Liebeskind & Paul, 1977). Pain tolerance rather than threshold was probably measured by Tedford et al. (1977) since the shocks were applied in increasing strengths until the subjects indicated that they had become uncomfortable. More studies are needed in this area in order to clarify the above differences. Studies could be designed to measure both threshold and tolerance to pain as well as utilize a method of pain induction which best resembles clinical pain (Rollman, 1983).

#### Pain Sensitivity in Dysmenorrheic Women

Haman (1944) was the first to measure pain threshold in dysmenorrheic women. He asked "whether dysmenorrheic patients actually receive more intense pain stimuli than do nondysmenorrheics or whether they are more sensitive to pain than their more fortunate

sisters" (p.686). Pain sensitivity was measured by using the sensimeter, an instrument measuring pressure as applied to the proximal phalanx of the thumb. Comparisons were made between dysmenorrheic, nondysmenorrheic, postmenopausal women, and men. A sample of 100 subjects was studied in each group. Although no statistical analyses were performed on these data, the investigator reported that the lowest mean threshold ( $X = 12.2$ ) was obtained for the dysmenorrheic women. Nondysmenorrheic, postmenopausal women, and men had mean thresholds of 14.9, 15.2, and 14.6 respectively. This study suggested that women suffering from dysmenorrhea are more sensitive to pain than symptom-free women, menopausal women, and men.

Cox and Meyer (1978) measured muscle ischemia thresholds in dysmenorrheic and nondysmenorrheic women undergoing behavior therapy. Pain threshold measures were taken by using the blood pressure cuff prior to and following treatment. No differences were obtained between subjects or as a result of treatment. Cox (1977) suggests that the pain threshold may be a less adequate measure of pain sensitivity than the pain tolerance measure.

Goolkasian (1983) hypothesized that dysmenorrheic women would differ from nondysmenorrheic women in their pain perceptions throughout the menstrual cycle. These differences would exist as a result of the different concentrations of prostaglandins found in the two groups of women (Dawood, 1981). Reactions to radiant heat stimuli were measured in 12 dysmenorrheic and 12 nondysmenorrheic women across

a four week period. These subjects were chosen randomly from 124 healthy, normally menstruating volunteers. Dysmenorrhea was assessed through the SSS (Chesney & Tasto, 1975) and through a direct question asking women to rate the pain they experienced during menstruation. Three stimulus intensities of radiant heat were delivered randomly through a dolometer onto an ink-blackened spot of the right forearm of the subjects. These stimuli were rated from 1 (nothing) to 6 (strongly painful). Testing occurred in 12 30-min sessions during which the sessions received 180 trials - 60 at each intensity level. Data were grouped according to the menstrual, follicular, luteal, and premenstrual phases of the cycle. ROC curves were then computed for each phase. Results demonstrated a cyclical pattern in pain sensitivity for the nondysmenorrheic women only. This cyclicity was due to an increased pain discriminatability during the luteal phase as compared to the premenstrual and follicular phases, and not to an increased willingness to report pain. As such, this result was consistent with those of Procacci et al. (1974) and Goolkasian (1980), in that highest pain sensitivity was obtained during the luteal phase.

In summary, Goolkasian (1983) demonstrated that dysmenorrheic women are stable in their responses to thermal painful stimuli throughout the menstrual cycle whereas nondysmenorrheic women show fluctuations. However, the two groups do not differ within each of the four menstrual phases. The fact that willingness to report pain does not show any changes between or within groups indicates that pain

sensitivity, as assessed by the above studies is due to sensory factors, i.e., to changes in the women's ability to sense pain across phases. Biochemical differences between the two groups are implicated to account for these results. Goolkasian (1983) attributed the levelling of pain sensitivity in dysmenorrheic women to their higher level of prostaglandins as compared to nondysmenorrheic women (Dawood, 1981; Pickles, 1979).

## SECTION II. NEW RESEARCH DIRECTIONS

The studies reviewed above have dealt with the frequency of occurrence of painful menstruation, the possible contribution of psychological and biochemical factors in its etiology and treatment as well as with the delineation of differences in pain sensitivity between dysmenorrheic and symptom-free women. Of all the areas reviewed, the latter seems to deserve more investigation. To-date, only three experimental studies have examined pain perception in dysmenorrheic women. Of these three studies, only one has taken menstrual cycle phase into account. This study demonstrated that menstrual cycle phase has differential effects on pain sensitivity in normally menstruating women. Pain sensitivity was assessed through radiant heat, mechanical pressure, and electric shock thresholds.

Several questions remained to be asked in investigating dysmenorrhea. In order to understand any pain phenomenon, a comparative perspective should be employed. This would require the comparison of a variety of pain induction techniques and pain measures (Liebeskind & Paul, 1977; Rollman, 1983). Common pain induction techniques in the laboratory include the cold pressor task, radiant

heat, pressure pain, electric shock, and muscle ischemia (see Turk, Meichenbaum and Genest, 1983, for a review). Rollman discusses the differences between experimentally-induced pain and clinical pain and suggests that methods of pain induction should be evaluated in terms of their relevance to the clinical situation. Clark and Hunt (1971) and Turk et al. (1983) consider muscle-ischemic and cold-pressor pain to be the most analogous to clinical pain in the kinds of sensations produced and length of tolerance.

Wolf & Hardy (1941) studied the nature of cold pressor pain and made the following observations: Immersion of the hand (or any part of the body) in water at temperature of 18°C and below causes a sudden deep aching crushing pain which reaches its maximum at 60 sec. The pain sensation is separate from the sensation of cold. This pain begins to subside after the first minute and is no longer experienced 4-5 minutes later, if the arm is kept in the water for that long. During this time, the hand has "adapted" to the pain of the cold water. The pain experienced during the first minute radiates to the inner arm and up to the shoulder, accompanied by a rise in blood pressure and irregular respiration. The intensity and the total degree of pain depends on the coldness of the water. The rise in blood pressure is proportionate to the pain intensity and to the coldness of the water. These investigators concluded that "the cold pressor effect is a measure of reaction to pain".

According to Clark and Hunt (1971), cold pressor pain

resembles clinical pain more than radiant heat and electric shock-induced pain in that it persists longer whereas "brief shocks and pinpoints of pricking heat quickly go away (particularly when the tolerance or withdrawal threshold is determined). One feels that something serious could go wrong and experiences a desire to escape; and as action is postponed, affect begins to develop" (p. 380).

Only one study in the dysmenorrhea literature has utilized any of these preferred methods of laboratory-induced pain. Cox and Meyer (1978) obtained two measures of muscle-ischemic pain prior to and following a two-week systematic desensitization therapy session in 14 dysmenorrheic women. However, these measurements were made without any reference to menstrual cycle phase. The necessity of more research utilizing clinically analogous pain is obvious.

All studies examining pain sensitivity thus far have utilized threshold measurements. Whether employing traditional or modern psychophysical measurements, they all assessed the point at which a stimulus is first perceived as painful. None of these studies has measured tolerance to pain that is, how long a painful stimulus could be tolerated. Measurement of pain tolerance would seem to be a more meaningful variable to study in a recurrent pain situation such as dysmenorrhea. It is not only important to determine when a particular stimulus first becomes painful but also how long this painful stimulus can be tolerated before it becomes alarming or dangerous to the individual. Thus, tolerance is a measure that is mostly relevant in



clinical conditions.

The Adaptation-Levels Model and the Hypervigilance Model for Pain Judgments

Rollman (1983) discusses an anecdotal report about an arthritic woman who failed to recognize an attack of acute appendicitis because she was already suffering from such an intense pain that she could not notice the addition of a new intense pain. Rollman (1979) proposed an adaptation-levels model for pain judgments. This model states that pain judgments are always based on comparisons with other pain levels. This model then suggests that chronic pain patients may utilize their endogenous pain levels as an "anchor" in describing the intensity of an external stimulus, whereas pain-free individuals simply use other stimuli in the pain-inducing situation to evaluate their pain. This model also predicts that chronic pain individuals will have higher pain thresholds since they use their internal pain as a reference point or an "anchor" in judging external painful stimuli. Another model of pain judgment, known as the hypervigilance model (Chapman, 1978), assumes that the chronic pain patient becomes sensitized to pain sensations and thus has lower thresholds than does the pain-free individual.

Naliboff, Cohen, Schandler, and Heinrich (1981) have obtained support for the adaptation model in comparing thresholds to radiant

heat stimuli in low-back pain patients, chronic respiratory patients, and controls. Support for the hypervigilance model was also obtained in patients with myofascial pain dysfunction (Malow, Grimm, & Olson, 1981). Since the myofascial pain syndrome is usually attributed to muscle tension and anxiety, Rollman (1983) suggests that the hypervigilance model may be useful when considering disorders of psychogenic origin. It would be useful to examine the question of pain judgment in dysmenorrhea within the context of these models. The question becomes whether dysmenorrhea is perceived as an "anchor" pain in dysmenorrheic women so as to be used as a reference point in making other pain judgments.

Another important question that has not yet been addressed at all concerns the relationship between measures of dysmenorrhea and measures of laboratory-induced pain. Do women who report severe menstrual symptomatology also rate laboratory pain as highly severe (hypervigilance model)? Or, in using the adaptation-levels model, dysmenorrheic women provide lower ratings of laboratory pain than women without severe menstrual symptoms? Is there a good analogue of dysmenorrhea in the laboratory? Can measures of other types of pain discriminate between dysmenorrheic and nondysmenorrheic women?

More questions can be asked about dysmenorrhea and its relationship to other types of pain. For example, are dysmenorrheic women more likely to report other types of pain as well, or is dysmenorrhea an independent pain phenomenon? Also, what is the

relationship between fatigue as measured by lack of sleep and pain sensitivity to laboratory pain, or dysmenorrhea?

Study 1 was designed to answer the above questions by employing the cold pressor test, first used by Hines and Brown (1936). The cold pressor, which involves immersion of a limb in ice water, has been found to produce a continuing aching or crushing pain (Lovallo, 1975; Turk et al., 1983). The intensity of cold pressor-induced pain depends on the amount of time for which it is endured. Responsiveness to cold pressor-induced pain was investigated in dysmenorrheic and nondysmenorrheic women over the course of the menstrual cycle.

SECTION III. STUDY 1: PAIN SENSITIVITY IN DYSMENORRHEA AS A  
FUNCTION OF MENSTRUAL CYCLE PHASE

INTRODUCTION

The purpose of this study was to investigate responsiveness to laboratory-induced pain in dysmenorrheic and nondysmenorrheic women over the course of the menstrual cycle. The cold pressor test was chosen as the technique of pain induction because of its clinical relevance. It has been found to cause pain that is most similar to clinical pain in the types of sensations produced and length of tolerance (see Turk, Meichenbaum & Genest, 1983, for a review). Thus, this study introduced an improvement over previous studies in that it employed a technique of pain induction that is comparable to that of clinical conditions. Another improvement over previous studies is that multiple dependent variables of pain assessment were employed. While all the previous studies employed only assessment of pain threshold, this study employed measures of pain tolerance and subjective pain ratings as well.

Measurements of cold pressor pain threshold, tolerance, and

subjective ratings were obtained across one menstrual cycle in young university women. Previous investigations demonstrated menstrual cyclicity in pain sensitivity measured as threshold to radiant heat (Goolkasian, 1980, 1983; Procacci et al., 1974) and avoidance of electric shocks (Tedford et al., 1977). There were, however, some discrepancies in the direction of change in pain sensitivity in the above studies. The present study was designed to clarify some of these discrepancies.

This study was also designed to examine psychological variables such as pain tolerance and subjective pain reports in light of the adaptation-levels model (Rollman, 1979) or the hypervigilance model (Chapman, 1978). According to the former model, dysmenorrheic women should "anchor" their pain judgments according to their menstrual pain. In doing so, they would provide more conservative judgments of cold pressor pain than nondysmenorrheic women. According to the latter model, dysmenorrheic women should be less conservative than nondysmenorrheic women because of a general sensitization to pain due to the recurrence of menstrual pain. Haman (1944) reported lower threshold to mechanical pressure in dysmenorrheic women whereas Goolkasian (1983) showed no differences in pain sensitivity to radiant heat between dysmenorrheic and nondysmenorrheic women.

## METHOD

### Subjects

Sixty-five introductory psychology students volunteered for this study for course credit. Subjects were naive to the purposes of this investigation. The study was advertised as involving four laboratory sessions, separated by about one-week intervals, during which subjects had to immerse their arm in ice cold water and make some judgments as well as complete standard questionnaires. Age ranged from 18 to 34 years ( $X = 20.02$ ,  $SD = 2.76$ ). All subjects were administered a medical screening questionnaire (See Appendix II) for two purposes: To exclude pregnant women or those suffering from cardiovascular problems, hypertension, epilepsy, and fainting history, and to obtain information on menstrual cycle length and regularity and the incidence of dysmenorrhea. All menstrual cycle-related questions were 'hidden' among other health-related questions. Based on this initial information, the experimental sessions were scheduled to occur in the different phases of the menstrual cycle.

### Assessment of Dysmenorrhea

Subjects were categorized as dysmenorrheic or nondysmenorrheic according to their response to a question about the presence or absence of menstrual pain/cramps, as part of the medical screening questionnaire. Again, this question was included in a group of questions on the incidence of different types of pain that people

usually experience (headache, low back pain, other). Women who reported mild or no pain at all associated with menstruation comprised the nondysmenorrheic group. Those reporting moderate to severe pain comprised the dysmenorrheic group. This categorization did not occur until the end of the study in order to minimize experimenter bias. Information about medication requirements and home remedies used to counteract dysmenorrhea was also obtained.

#### Initial Exclusions

Four subjects were screened out due to medical reasons (cardiac problems, fainting history). One subject declined participation due to the fact that the experimental procedure included videotaping. Another subject was screened out after the first session due to her fainting during the experimental session. Five subjects dropped out at various points during the course of the study. Finally, out of the 54 subjects who completed all four experimental sessions, only those with normal and regular menstrual periods were included in the data analysis (see later section for more details).

#### Demographics

Cycle length ranged between 21-45 days. Acceptable cycle length ranged between 26-32 days. All but one of the subjects were single (98%). Two women were parous (4%). Length of menstrual flow

ranged between 3-7 days with a mean of 4. The majority of the subjects who completed the study (70.38%) reported some form of menstrual pain ranging from mild to severe. Almost half of the women (44.17%) reported moderate to severe pain and thus comprised the dysmenorrheic group. The incidence and severity of dysmenorrhea reported in this study agrees with that reported in previous studies (Hirt et al., 1967; Stephenson, Denney & Aberger, 1983; Wallach, 1985; Wildman & White, 1986). Most dysmenorrheic women also reported the use of prescription or nonprescription prostaglandin inhibitors, oral contraceptives, or home remedies to alleviate their pain. Some nondysmenorrheic women also reported the use of nonprescription medication and home remedies. Women using oral contraceptives were excluded from data analysis as sample size was too small to comprise a separate group (n = 9 with 3 exclusions). Also, the oral contraceptive users were not a homogeneous group as some were dysmenorrheic and some were not.

Subjects were asked to abstain from alcohol and analgesics for at least 10 hours prior to each experimental session. No smokers were included in the study as smoking has been found to be associated with pain reduction (Pomerlau, Turk & Fertig, 1984). There were only two smokers who were also excluded due to oral contraceptive usage.

Menstrual Cycle Phase Definition : Hormonal Patterns over the Cycle

(see Appendix III).



The normal and regular 28-day menstrual cycle is usually divided into four phases: The menstrual phase (day 1 of menstrual onset to day 7), the follicular phase (day 8 to day 14), the luteal (day 15 to day 21) and the premenstrual phase (day 22 to 27) (Fielding & Bosanko, 1984; Goolkasian, 1980, 1983; Tedford et al., 1977). This division is based on patterns of the ovarian hormones estrogen (estradiol) and progesterone observed at each of the cycle phases (Abplanalp, Livingston, Rose, & Sandwisch, 1983). The menstrual phase is characterized by low and stable levels of estradiol and progesterone. The follicular phase, also known as postmenstrual or preovulatory, is characterized by a striking rise and a subsequent abrupt drop of estradiol. The luteal phase, also known as intermenstrual or postovulatory, is characterized by a second peak of estradiol levels and a continuous rise of progesterone levels. The premenstrual phase, also known as late luteal, is characterized by a decrease in secretion of both ovarian hormones (Abplanalp et al., 1983).

Although no laboratory tests were conducted to verify ovulation in this study, Metcalf (1983) has reported rates of ovulation of at least 65% among women 5-8 years postmenarche, the approximate age range of the subjects in this study. (Average menarche occurs at around 13 years of age in women of Southern Ontario (Surbey, 1988), and the average age of women in this study is 20 years). It therefore seemed reasonable to assume that the majority of subjects

did ovulate during the study. Ovulation is thought to occur 14 days prior to menses based on the fact that the corpus luteum has a two-week life span (Speroff, Glass, & Kase, 1983). The postovulatory phase, during which progesterone is secreted, is quite constant in length, lasting between 12 and 14 days. The preovulatory phase, on the other hand, is much more variable in length lasting less than 14 days in short cycles and more than 14 days in long cycles (O'Connor, Shelley & Stern, 1974). Thus, time of ovulation was estimated by reverse cycle day 14, that is, counting backwards from the onset of the succeeding menses (Harvey, 1987). Subjects with cycles longer than 28 days (up to 32 days) were given the 1-4 extra days in their preovulatory phase.

Most subjects provided approximate dates of last and next expected menses during the medical screening questionnaire as well as at the end of the study, while completing the Retrospective Symptom Scale. This combined information was used to schedule and then calculate the menstrual phase during which laboratory sessions occurred.

### Apparatus

The cold pressor consisted of a 57 x 36 x 32 cm insulated plastic tank which contained ice and water. A plastic mesh screen divided the tank into one section containing crushed ice and another containing ice-free water. The water was maintained at 0° to 1°C and

was circulated during each immersion by means of a submersible pump. A lightweight aluminum armrest contained a microswitch which activated an adjacent computer in order to record total immersion time (see Figure 1).

Subjects received a standard set of taped instructions which included a description of possible sensations (e.g. tingling, muscle cramping and pain) and appearance changes (e.g. discoloration of hand or arm) associated with the cold pressor test (see Appendix IV). They were instructed to report the moment at which they first felt pain and try to keep their arm in the water for "as long as possible". Subjects were also told that they could withdraw their arm at any point if they did not wish to continue.

After a cue provided on the taped instructions, subjects lowered their dominant arm into the water which activated the computer-controlled microswitch. Immersion was terminated at the end of 4 minutes for subjects who had not yet withdrawn their arm. After 3-4 minutes, the painful sensations become numb and if the subject persists more than 6-7 minutes, tissue damage may result. Most studies have utilized a ceiling effect of five minutes (Ashton, Ebenezer, Golding & Thompson, 1984; Turk et al., 1983).

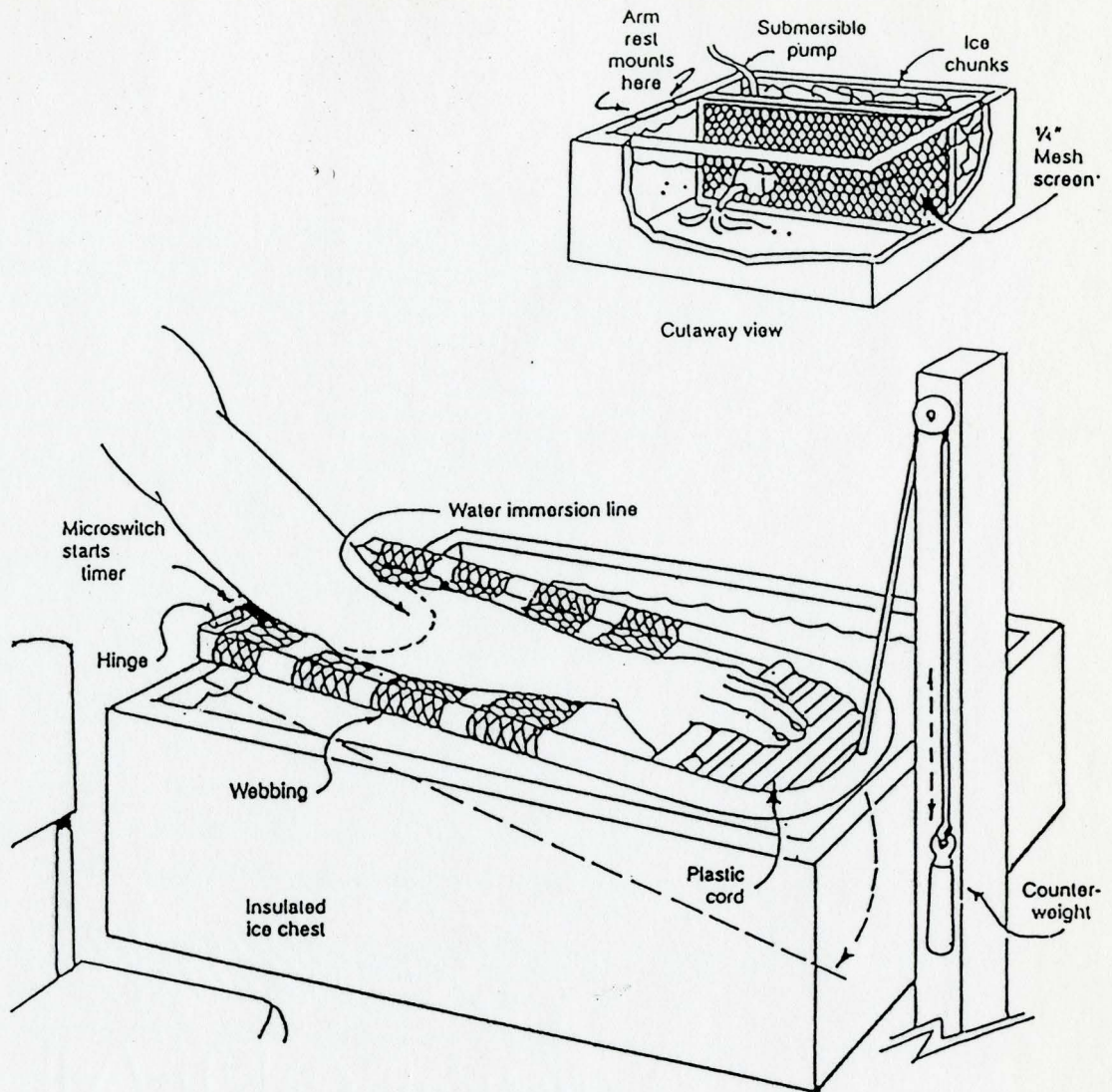


FIGURE 1. Apparatus employed in cold-pressor test.

Adapted from Turk et al. (1983)

## Measures

### Cold Pressor Pain Threshold and Tolerance and Subjective Pain Ratings.

Threshold measures were recorded by the experimenter through the use of a stopwatch whereas tolerance measures were automatically recorded by the computer. Subjective pain ratings were obtained after the completion of the cold pressor test. Subjects were asked to rate the degree of pain experienced during the cold pressor by using a Visual Analogue Scale. This measure was employed in order to obtain a direct measure of pain intensity.

Visual Analogue Scale (VAS). This technique, developed by Huskisson (1974), involves the use of a scale representing the continuum of the subject's experience of pain and is considered to be a very sensitive and simple method for measuring pain. The scale used in the present study was linear, horizontal, and 100 mm long. The extremes were "no pain at all" (left) and "maximum pain you can imagine" (right). A score from 0 to 100 was determined by measuring the distance from left to right. The VAS was used twice, once for rating the cold pressor pain experienced at each session, and once for rating menstrual pain and overall cold pressor pain, at the end of all four experimental sessions. This comparative judgment was obtained in order to see how the anchoring of pain judgments (if any) occurred in the two groups.

The Pain Diary (Tursky, Jamner & Friedman, 1982). This

measure was optional. Subjects were asked to keep a daily log of hours of sleep and types and severity of pain experienced. Pain was rated as mild, moderate or severe, in order to be consistent with the pain rating method of the medical screening questionnaire. These measures were taken to assess the relationship between fatigue (absence of or little sleep) and pain sensitivity, as well as between dysmenorrhea and others types of pain. No particular types of pain were specified. It was up to each participant to record the type(s) experienced.

Retrospective Symptom Scale (RSS) (Cox & Meyer, 1978) (See Appendix V). This scale was administered once during the last session, to obtain a multidimensional measure of dysmenorrhea and corroborate the initial reports of menstrual pain assessed by the medical screening questionnaire. The experimenter added a new item on menstrual cycle information. This was done for obtaining the most recent menstrual onset dates. This information along with that obtained during the initial interview (medical screening questionnaire) was used to calculate the exact menstrual cycle phase during which testing occurred.

Post-Experimental Questionnaire (See Appendix VI). This open ended questionnaire was devised by the experimenter for the purposes of this study. Subjects were asked to comment on their experience of the cold pressor test, to say whether they could distinguish between the cold and the painful sensation, to explain why they kept their

hand in the water for as long as they did, and to provide their initial hypothesis of why the study was conducted. The primary interest was to find out whether the subjects guessed the purposes of the study.

### Procedure

All volunteer subjects were administered a brief medical screening by telephone. This was done primarily to exclude subjects for whom the procedure might have presented a health risk and to obtain relevant menstrual cycle information. The subjects were told that this was a standard demographic and health information questionnaire administered in these types of investigations. Eligible subjects were then scheduled for their first experimental session corresponding to either one of the four phases of the menstrual cycle. All four experimental sessions were scheduled for approximately the same time and day of the week. Upon arrival to the laboratory, and prior to the first actual experimental session, the subjects signed an informed consent form (See Appendix VII), and were given a 10-sec practice trial on the cold pressor test and then given the opportunity to withdraw. This demonstration and practice trial included a full taped verbal description of the sensations experienced in the cold pressor, as well as immersion of the arm into the ice water for 10 seconds. Following this demonstration, the actual cold pressor test commenced. The subjects were asked to indicate the moment at which

they experienced the first painful sensation (threshold) by saying "now" and to try to keep their arm in the water for as long as they could (tolerance). The cold pressor test was terminated by the experimenter after four minutes in cases where the subjects showed prolonged tolerance.

The other three sessions were identical to the first one. The subjects were telephoned prior to each session in order to be reminded of their appointment. Following the completion of the fourth cold pressor session, the subjects were asked to complete the Retrospective Symptom Scale (RSS) and to rate the cold pressor pain as experienced overall, as well as their menstrual pain as experienced during the last menstrual period using the VAS, one VAS for each type of pain. Information about onset of last menstrual period was also obtained at this time. Subjects then completed the post experimental questionnaire and were subsequently debriefed (see Appendix VIII).

Due to an earlier hypothesis of this study, the performance of the subjects in the cold pressor test during the actual experimental sessions was videotaped in order to allow analysis of facial expression. For the purpose of obtaining a baseline measure of facial expression, subjects were asked to immerse their forearm in a bucket of room temperature water for 1 min prior to the cold pressor test in each session. The subjects were told that this was done so that their arm could get used to the wet feeling. Data on facial expression will not be presented because no such analysis occurred.



This research was subsequently conducted in a different laboratory in which the facilities for facial analysis did not exist. However, since videotaping comprised a significant procedural aspect of this investigation, this explanation was deemed necessary at this point.

The first and last sessions lasted for 30 min due to the introduction and/or completion of scales and questionnaires whereas the two intermediate sessions lasted for 10-15 min. An approximately equal number of subjects began at each of the four menstrual phases.

#### Design and Data Analyses

Two different subsamples were subjected to data analysis. The first subsample consisted of dysmenorrheic and nondysmenorrheic women (N = 24) tested in all four menstrual cycle phases. The second subsample consisted of dysmenorrheic and nondysmenorrheic women (N = 37) in only the two intermediate phases of the menstrual cycle.

Subsample # 1: Out of 54 women who completed the four experimental sessions, only 31 provided measurements in all four phases of the menstrual cycle. From these, 7 (5 dysmenorrheic and 2 nondysmenorrheic) were excluded from the analysis because they provided outlier scores. Cold pressor pain tolerance data were excluded for three subjects who had tolerated cold immersion of the hand up to the time limit of 4 min. In these subjects, it was not possible to assess accurately either the initial tolerance or the

magnitude of subsequent changes. One subject had a very extreme threshold score ( more than 3 SDs above the mean), and another subject had a very extreme RSS score for menstrual symptomatology and medication usage. The exclusions resulted in two groups of equal sample size (N = 12).

Subsample # 2: The second subsample consisted of all subjects in the first subsample and 13 more subjects who provided data corresponding to the follicular and luteal phase of the cycle. Although these subjects had normal and regular menstrual cycles, due to miscalculations and scheduling difficulties that resulted in early or delayed testing, measurements were taken either twice for one particular phase or they were taken at phase overlap points. Because it was difficult to assign phase overlap points at either one of two phases, these data were excluded. However, data were available for the follicular and luteal phase for these subjects. Cyclical effects have repeatedly been reported for these particular phases and for this reason, they are being further investigated here.

Data were analyzed using analysis of variance, correlations and t-tests. The same two series of analyses were performed on each subsample and they will be presented in sequence.

## RESULTS

### Subsample # 1 (N = 24)

#### Cold Pressor Pain Measures

To preclude the possibility that repeated testing was contaminated by carry-over effects, the data were analyzed by session in all subjects who completed the four sessions. This analysis yielded no significant session effects for any of the measures. It was then concluded that the phase effects, if any, would be independent of carry-over effects. Descriptive statistics (means and standard errors) for cold pressor pain measures in all four sessions for this sample are presented in Table 1.

A 2 (group) by 4 (phase) repeated measures ANOVA was performed on the three cold pressor measures (threshold, tolerance, and VAS). No significant effects were obtained. Means and standard errors for all three cold pressor pain measures are presented in Table 2.

A priori contrasts showed a nonsignificant trend for differences in threshold between the follicular ( $\bar{X} = 19.01$ , SE = 3.63) and luteal phase ( $\bar{X} = 15.94$ , SE = 2.96) of the cycle,  $F(1,22) = 3.12$ ,  $p = 0.09$ . This trend was further investigated in the second and larger subsample.

**TABLE 1**  
**DESCRIPTIVE STATISTICS FOR COLD PRESSOR PAIN MEASURES ACROSS ALL FOUR**  
**SESSIONS (N = 24)**

|                        | Session 1 | Session 2 | Session 3 | Session 4 |
|------------------------|-----------|-----------|-----------|-----------|
| <b>Threshold</b>       |           |           |           |           |
| $\bar{X}$              | 19.09     | 17.61     | 17.12     | 16.54     |
| SE                     | 2.84      | 2.33      | 2.31      | 2.39      |
| <b>Tolerance</b>       |           |           |           |           |
| $\bar{X}$              | 49.60     | 60.40     | 53.85     | 62.32     |
| SE                     | 7.61      | 10.86     | 10.79     | 12.28     |
| <b>VAS Pain Rating</b> |           |           |           |           |
| $\bar{X}$              | 57.56     | 60.92     | 60.96     | 63.80     |
| SE                     | 3.64      | 3.66      | 3.99      | 4.38      |

TABLE 2

DESCRIPTIVE STATISTICS ( $\bar{X}$ +SEM) FOR COLD PRESSOR PAIN MEASURES OF THRESHOLD, TOLERANCE AND VAS RATINGS FOR DYSMENORRHEIC AND NONDYSMENORRHEIC WOMEN ACROSS THE FOUR MENSTRUAL CYCLE PHASES

|                        | MENSTRUAL<br>(Days 1-7) |       | FOLLICULAR<br>(Days 8-14) |       | LUTEAL<br>(Days 15-21) |       | PREMENSTRUAL<br>(Days 22-28) |       |
|------------------------|-------------------------|-------|---------------------------|-------|------------------------|-------|------------------------------|-------|
|                        | $\bar{X}$               | SEM   | $\bar{X}$                 | SEM   | $\bar{X}$              | SEM   | $\bar{X}$                    | SEM   |
| -----                  |                         |       |                           |       |                        |       |                              |       |
| THRESHOLD (sec.)       |                         |       |                           |       |                        |       |                              |       |
| -----                  |                         |       |                           |       |                        |       |                              |       |
| DYSMENORRHEA (N=12)    | 15.01                   | 2.73  | 17.68                     | 3.59  | 15.94                  | 2.65  | 16.16                        | 3.19  |
| NONDYSMENORRHEA (N=12) | 17.63                   | 3.70  | 20.34                     | 3.69  | 15.95                  | 3.26  | 16.28                        | 3.58  |
|                        |                         |       |                           |       |                        |       |                              |       |
| TOLERANCE (sec.)       |                         |       |                           |       |                        |       |                              |       |
| -----                  |                         |       |                           |       |                        |       |                              |       |
| DYSMENORRHEA           | 52.35                   | 14.68 | 65.23                     | 21.51 | 41.60                  | 10.13 | 46.88                        | 13.17 |
| NONDYSMENORRHEA        | 57.15                   | 13.47 | 56.96                     | 12.28 | 52.88                  | 16.78 | 62.74                        | 17.89 |
|                        |                         |       |                           |       |                        |       |                              |       |
| VAS RATINGS (mm.)      |                         |       |                           |       |                        |       |                              |       |
| -----                  |                         |       |                           |       |                        |       |                              |       |
| DYSMENORRHEA           | 53.25                   | 6.86  | 53.91                     | 5.81  | 53.16                  | 4.71  | 58.66                        | 5.99  |
| NONDYSMENORRHEA        | 61.08                   | 4.54  | 64.41                     | 5.36  | 64.83                  | 3.14  | 64.50                        | 4.36  |

As can be seen from Table 2, there was a tendency for dysmenorrheic women to exhibit a lower mean tolerance to cold pressor pain in all but the follicular phase of the cycle. However, due to the large variability of the scores, this trend did not reach significance. Inspection of Figure 2 indicates a steady tendency for the dysmenorrheic group to provide lower ratings for cold pressor pain across the menstrual cycle. This tendency, however, did not reach significance.

Significant positive correlations were obtained within all levels of each cold pressor pain measure. Pain threshold and tolerance were also significantly positively correlated. No significant correlations were obtained between pain tolerance and VAS pain ratings at any level. Pain threshold was only negatively correlated with VAS pain ratings in the luteal phase of the cycle,  $r(22) = -0.39$ ,  $t = -1.99$ ,  $p = 0.05$ .

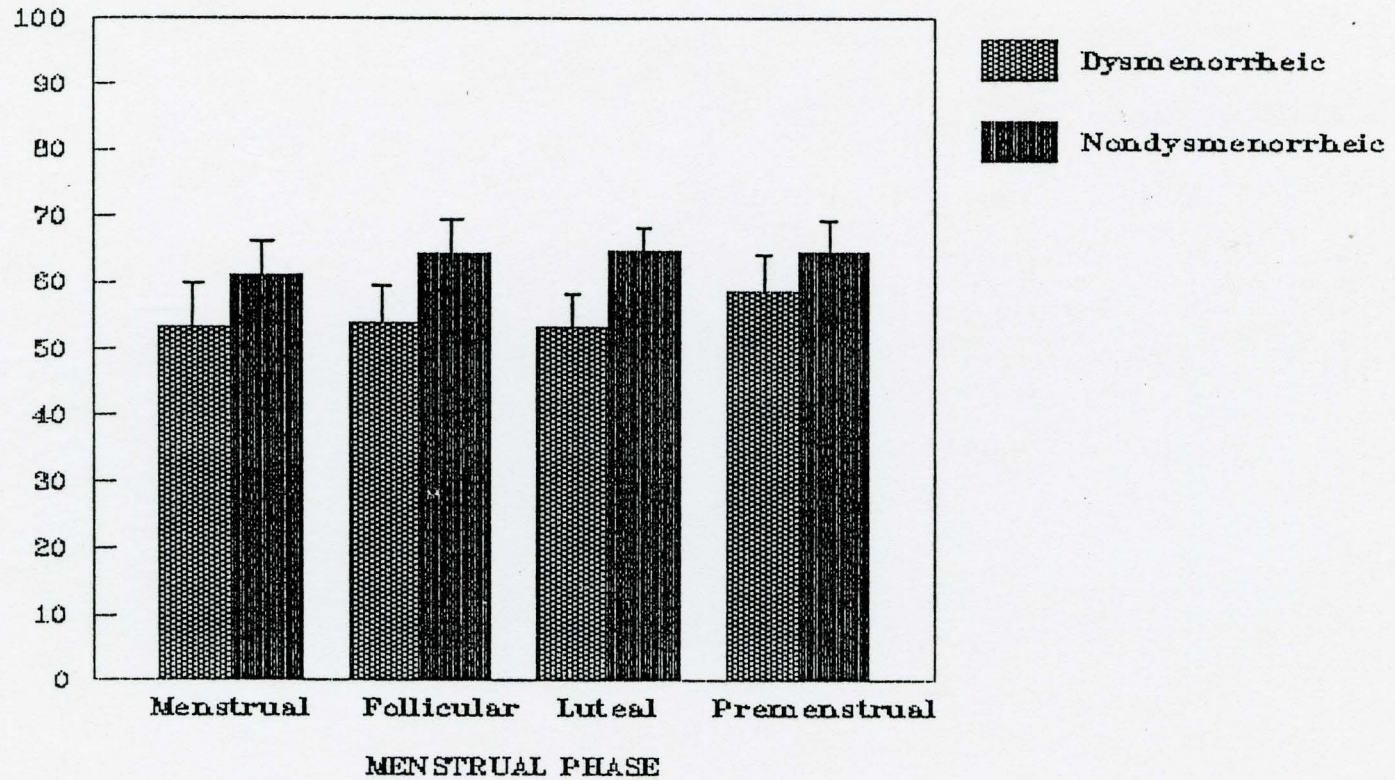
#### Overall Cold Pressor Pain and Last Menstrual Period Pain Ratings

Dysmenorrheic and nondysmenorrheic women provided identical ratings of overall cold pressor pain ( $\bar{X} = 59.01$ ,  $SE = 6.10$  and  $\bar{X} = 60.08$ ,  $SE = 5.29$ , respectively,  $t(22) = 0.02$ ,  $p = 0.86$ ). Ratings for the menstrual pain experienced during their last menstrual period were only marginally different ( $\bar{X} = 39.67$ ,  $SE = 7.02$  and  $\bar{X} = 23.25$ ,  $SE = 6.53$ , respectively,  $t(22) = 2.93$ ,  $p = 0.09$ ). VAS ratings of cold pressor pain were significantly higher than VAS

FIGURE 2

# VAS RATINGS FOR DYSMENORRHEIC AND NONDYSMENORRHEIC GROUPS ACROSS CYCLE PHASE

MEAN (SEM) VAS RATING



ratings of menstrual pain,  $t(23) = 4.92$ ,  $p < 0.001$ . The two types of pain were not significantly correlated in this study,  $r(22) = 0.19$ ,  $t = 0.95$ ,  $p = 0.35$ .

#### Retrospective Symptom Scale

The RSS total score for menstrual symptomatology was calculated by summing up the products of frequency-severity ratings for the 18 symptoms. Construct validity of the RSS in terms of its ability to discriminate between the two groups on the three measures of menstrual distress was assessed with a between-groups multivariate analysis of variance (MANOVA). Results showed a significant multivariate effect,  $F(3,17) = 2.60$ ,  $p < 0.05$ . Significant univariate effects were obtained for menstrual symptoms and medication usage,  $F(1,22) = 13.79$ ,  $F < 0.001$ , and  $F(1,22) = 4.89$ ,  $p = 0.03$ , respectively. The univariate effect for invalid hours only showed a trend,  $F(1,22) = 3.01$ ,  $p = 0.09$ . Menstrual symptomatology was significantly correlated with medication usage,  $r(22) = 0.44$ ,  $t = 2.28$ ,  $p < 0.03$  but not with invalid hours,  $r(22)$ ,  $t = 1.57$ ,  $p = 0.12$ . For means and standard errors on the RSS measures, see Table 3.

#### Pain Diary

Even though this measure was optional, all 24 subjects in this subsample returned their Pain Diaries. The most commonly reported types of pain experienced were headache, stomachache, sinus



TABLE 3

DESCRIPTIVE STATISTICS FOR MENSTRUAL SYMPTOMS (RSS), MEDICATION UNITS (RSS), INVALID HOURS (RSS), TOTAL MONTHLY PAIN SCORE (PAIN DIARY), AND VAS RATINGS FOR MENSTRUAL AND OVERALL COLD PRESSOR PAIN

|                              | DYSMENORRHEA<br>(N - 12) |      | NONDYSMENORRHEA<br>(N - 12) |      |
|------------------------------|--------------------------|------|-----------------------------|------|
|                              | $\bar{X}$                | SEM  | $\bar{X}$                   | SEM  |
| MENSTRUAL SYMPTOMS           | 40.00                    | 7.49 | 10.91                       | 2.30 |
| MEDICATION UNITS             | 3.16                     | 0.91 | 0.91                        | 0.45 |
| INVALID HOURS                | 1.83                     | 0.60 | 0.58                        | 0.39 |
| TOTAL MONTHLY<br>PAIN SCORE  | 10.75                    | 2.45 | 7.41                        | 1.56 |
| MENSTRUAL PAIN               | 39.66                    | 7.02 | 23.25                       | 6.53 |
| OVERALL COLD<br>PRESSOR PAIN | 59.00                    | 6.11 | 60.00                       | 5.39 |

pain, and sports-related pain (i.e., sore muscles due to aerobics and squash).

Total Monthly Pain Score: The total monthly pain score obtained from the pain diary was calculated by summing up the products of severity ratings (mild = 1, moderate = 2, severe = 3) by each type of pain reported. For example, if a subject reported two types of pain with ratings of mild and moderate, the score was calculated as follows:  $1 \times 1 = 1$ ,  $1 \times 2 = 2$ ,  $1 + 2 = 3$ . Thus, total score for this subject was 3. Means and standard deviations for the two groups are shown on Table 3.

A t-test for independent samples between the dysmenorrheic ( $\bar{X} = 10.58$ ,  $SE = 2.45$ ) and nondysmenorrheic groups ( $\bar{X} = 7.17$ ,  $SE = 1.51$ ) did not reveal any significant differences in total monthly pain score,  $t(22) = 1.41$ ,  $p = 0.25$ , even though the score for the dysmenorrheic group did include reports of menstrually related pain for some subjects. Also, no significant correlations were obtained between the monthly pain score and RSS measures or the VAS rating for menstrual pain. However, the total monthly pain score was significantly positively correlated with the VAS rating for overall cold pressor pain,  $r(22) = 0.46$ ,  $t = 2.40$ ,  $p = 0.02$ . This indicated that a higher incidence of pain during the month tended to predict higher levels of laboratory pain.

Hours of Sleep: Another measure obtained with the Pain Diary

was number of hours of sleep per night. A t-test for independent samples revealed no significant differences between dysmenorrheic and nondysmenorrheic women in monthly average hours of sleep.

Correlations were calculated between each cold pressor pain measure and the number of hours of sleep that the subject obtained the night before the experimental session. None was significant.

#### Summary

The results of this analysis can be summarized as follows: Women who reported moderate to severe levels of menstrual pain during the initial medical screening questionnaire and were thus classified as dysmenorrheic, were significantly different from women who reported mild or no pain on their responses to two out of three RSS measures, menstrual symptomatology and medication usage. They were marginally different in the number of additional hours they spent in bed due to menstruation and in the degree of pain they experienced during their last menstrual period. These women, however, were no different from nondysmenorrheic women in their reactions to the cold pressor task, as measured through pain tolerance, threshold and VAS pain ratings. No significant menstrual phase differences were observed in any of the groups although a trend was revealed between the follicular and luteal phase of the cycle for cold pressor pain threshold. The pain diary failed to reveal any significant group differences in the reporting of different types of pain and sleep patterns. However, a significant

positive correlation was obtained between total monthly pain score and cold pressor pain ratings. Discussion of these results will be withheld until the presentation of results from subsample # 2.

### Subsample # 2

The postmenstrual (day 8-14) and the intermenstrual (day 15-21) phases of the menstrual cycle corresponding to the follicular and luteal phases as defined in this study were compared. This post hoc analysis was undertaken in order to further investigate the trend shown in the previous analysis by employing a larger sample size. This menstrual phase comparison is justified also in terms of the corresponding different hormonal profiles of the two phases. It is known that estrogen reaches peak levels during the follicular phase whereas progesterone reaches its peak during the luteal phase (Fielding and Bosanko, 1984).

From the 54 subjects who completed the four experimental sessions, forty normally and regularly menstruating women provided cold pressor data in the follicular and luteal phases of the cycle. Measurements obtained during the other two experimental sessions did not exactly coincide with either of the remaining phases. Three of these subjects were excluded due to extreme tolerance scores. The remaining 37 subjects (19 dysmenorrheic and 18 nondysmenorrheic) were included in this data analysis which utilized a 2 (group) by 2 (phase) repeated measures ANOVA, t-tests, and correlations.

### Cold Pressor Pain Measures

Means and standard errors for these three dependent measures are presented in Table 4.

The analysis revealed a significant phase effect for cold pressor pain threshold,  $F(1,35) = 5.70$ ,  $p < 0.02$  (see Figure 3). Threshold was significantly higher during the follicular ( $X = 22.27$ ,  $SE = 3.05$ ) as compared to the luteal phase of the cycle ( $X = 16.83$ ,  $SE = 3.64$ ). No other significant results were revealed through this analysis.

Again, significant correlations existed within the levels of the threshold measure,  $r(35) = 0.57$ ,  $t = 4.14$ ,  $p < 0.001$ , the tolerance measure,  $r(35) = 0.64$ ,  $t = 4.92$ ,  $p < 0.001$ , and the VAS measure,  $r(35) = 0.64$ ,  $t = 4.98$ ,  $p < 0.001$ .

Between-groups analysis of the RSS measures, the total monthly pain score, the ratings of overall cold pressor and menstrual pain yielded results consistent with those obtained with the previous subsample. Means and standard errors for these measures are presented in Table 5.

### Overall Cold Pressor Pain and Menstrual Pain Ratings

No differences were obtained for overall cold pressor pain ratings. However, whereas group differences in menstrual pain ratings only showed a trend in the previous sample, they emerged as

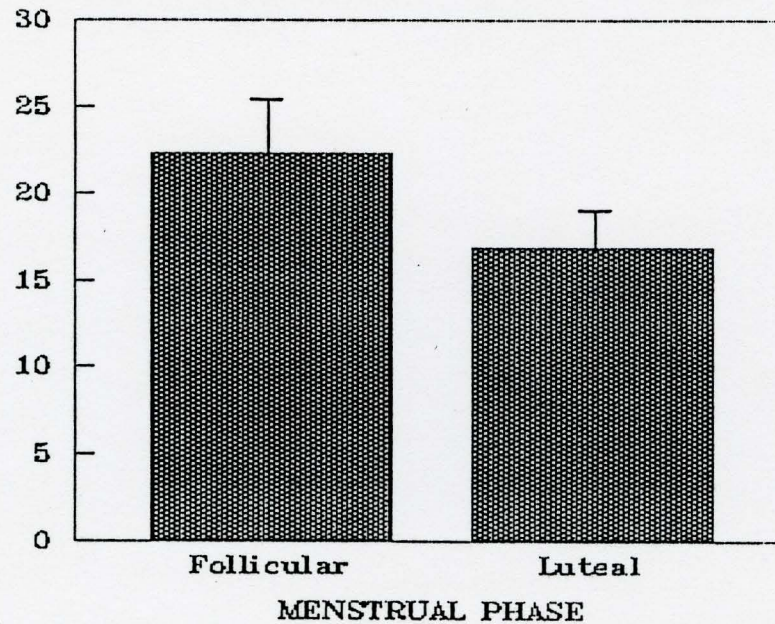
**TABLE 4**  
**DESCRIPTIVE STATISTICS FOR COLD PRESSOR MEASURES OF PAIN SENSITIVITY**  
**IN THE FOLLICULAR AND LUTEAL PHASE OF THE CYCLE**

|                              | FOLLICULAR<br>(Day 8-14)        | LUTEAL<br>(Day 15-21)          |
|------------------------------|---------------------------------|--------------------------------|
|                              |                                 |                                |
| <b>COLD PRESSOR MEASURES</b> |                                 |                                |
|                              |                                 |                                |
| <b>THRESHOLD *</b>           | $\bar{X} - 22.27$<br>SE - 3.05  | $\bar{X} - 16.83$<br>SE - 2.07 |
|                              |                                 |                                |
| <b>TOLERANCE</b>             | $\bar{X} - 63.12$<br>SE - 10.19 | $\bar{X} - 51.90$<br>SE - 7.44 |
|                              |                                 |                                |
| <b>VAS RATING</b>            | $\bar{X} - 62.62$<br>SE - 3.35  | $\bar{X} - 62.89$<br>SE - 2.66 |
|                              |                                 |                                |

\*  $\underline{p} < 0.02$

FIGURE 3

THRESHOLD TO COLD PRESSOR PAIN IN THE  
FOLLICULAR AND LUTEAL PHASE OF THE CYCLE  
MEAN (SEM) COLD PRESSOR PAIN THRESHOLD



**TABLE 5**  
**DESCRIPTIVE STATISTICS FOR RETROSPECTIVE SYMPTOM SCALE (RSS) MEASURES,**  
**MENSTRUAL PAIN (VAS), AND THE PAIN DIARY**

|                               | DYSMENORRHEA |      | NONDYSMENORRHEA |      |
|-------------------------------|--------------|------|-----------------|------|
|                               | (N - 19)     |      | (N - 18)        |      |
|                               | X            | SE   | X               | SE   |
| MENSTRUAL SYMPTOMS *<br>(RSS) | 46.21        | 6.09 | 13.67           | 2.84 |
| MEDICATION UNITS *<br>(RSS)   | 2.95         | 0.69 | 1.00            | 0.37 |
| INVALID HOURS *<br>(RSS)      | 2.00         | 0.55 | 0.89            | 0.40 |
| MENSTRUAL PAIN *<br>(VAS)     | 47.47        | 5.60 | 21.69           | 4.87 |
| PAIN DIARY                    | 11.61        | 2.05 | 7.35            | 1.46 |

\*  $\underline{p} < 0.05$



significant in the present subsample,  $F(1,35) = 12.02, p < 0.001$ .

The dysmenorrheic group experienced more menstrual pain during their last menstrual period ( $\bar{X} = 47.47, SE = 5.60$ ), in comparison to the nondysmenorrheic group ( $\bar{X} = 21.61, SE = 4.87$ ).

Means and standard errors of the VAS menstrual pain and overall cold pressor ratings from this subsample are presented in Figure 4. Inspection of this figure indicates that, as in the smaller subsample, the dysmenorrheic group rated their menstrual pain higher than the nondysmenorrheic group. However, in both samples, the two groups did not differ in their rating of the cold pressor pain. They both rated cold pressor pain as more intense than menstrual pain.

#### Retrospective Symptom Scale

Again, a highly significant multivariate effect was obtained for the RSS,  $F(6,30) = 3.54, p = 0.009$  (MANOVA was performed on the RSS, the VAS, and the Total Monthly Pain Score). Significant univariate effects were obtained for menstrual symptoms,  $F(1,35) = 15.88, p < 0.001$ , invalid hours,  $F(1,35) = 3.99, p < 0.05$ , and medication units,  $F(1,35) = 7.01, p < 0.001$ . Whereas, group differences in invalid hours only showed a trend in the analysis performed on the smaller sample,  $F(1, 22) = 3.01, p = 0.09$ , these differences were found to be significant in the analysis of the second subsample.

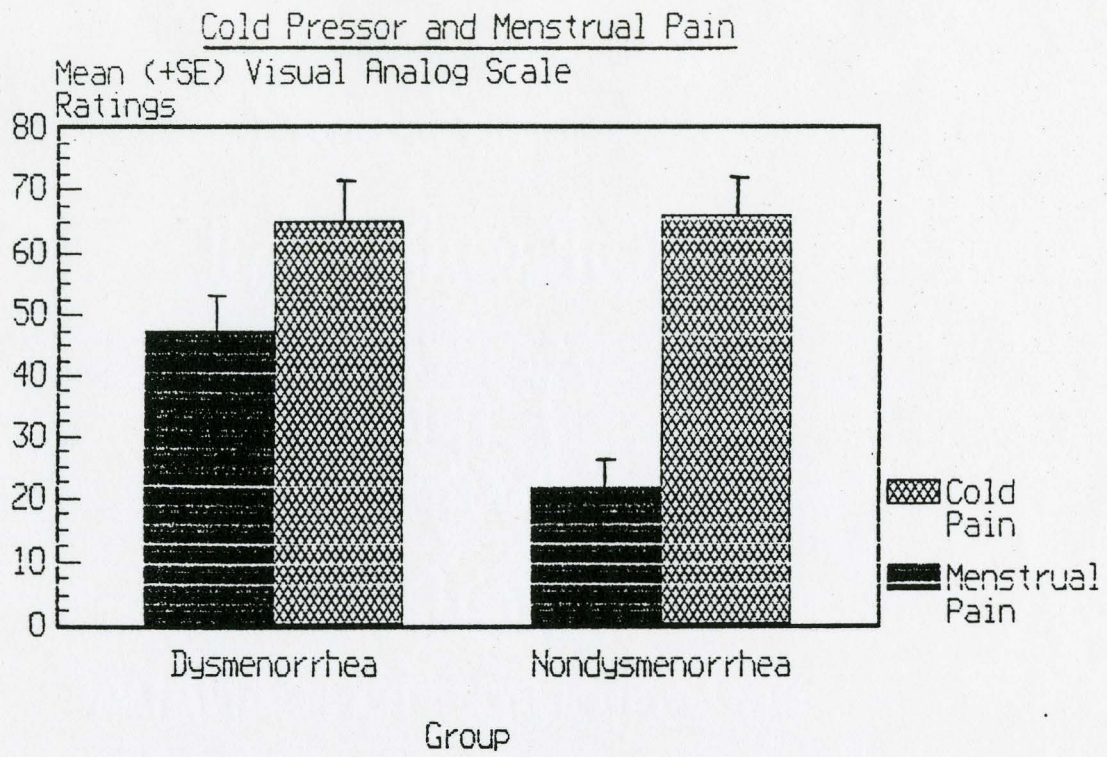


FIGURE 4

Significant correlations were found for all RSS measures. The more the menstrual symptoms, the more the additional hours spent in bed,  $r(35) = 0.38$ ,  $t = 2.39$ ,  $p < 0.02$ , and pills taken,  $r(35) = 0.32$ ,  $t = 1.97$ ,  $p < 0.05$ . The last two measures were also positively correlated,  $r(35) = 0.37$ ,  $t = 2.33$ ,  $p < 0.02$ .

RSS measures for menstrual symptoms and invalid hours were positively associated with the VAS rating for menstrual pain,  $r(35) = 0.69$ ,  $t = 5.57$ ,  $p < 0.0001$ , and  $r(35) = 0.51$ ,  $t = 3.49$ ,  $p < 0.002$ , respectively.

### Pain Diary

Total Monthly Pain Score: There were only 2 missing pain diaries in the second subsample. Again, there were no significant differences between dysmenorrheic and nondysmenorrheic women in their monthly pain score. However, there were significant correlations between RSS symptomatology and total monthly pain score,  $r(33) = 0.41$ ,  $t = 2.58$ ,  $p < 0.01$ , as well as between RSS invalid hours and total monthly pain score,  $r(33) = 0.42$ ,  $t = 2.67$ ,  $p < 0.01$ . When reports of menstrual pain/cramps were excluded from the total monthly pain score, only the RSS invalid hours measure retained the positive association with the pain score,  $r(33) = 0.34$ ,  $t = 2.05$ ,  $p < 0.05$ . Further analysis revealed that this correlation held only for the dysmenorrheic group,  $r(16) = 0.50$ ,  $t = 2.29$ ,  $p < 0.05$ .

The positive association between the total monthly pain score

and the VAS rating of overall cold pressor pain found in the previous analysis, approached significance in the analysis of this subsample,  $r(33) = 0.32$ ,  $t = 1.93$ ,  $p = 0.059$ .

Hours of Sleep: No significant relationships were found between hours of sleep and any of the cold pressor measures. Also, no group differences existed.

#### DISCUSSION

In general, this study found that the cold pressor test did not discriminate between women who reported pain associated with menstruation and those with relatively pain-free menstrual periods. Cold pressor pain was assessed using threshold, tolerance and subjective ratings (VAS). Dysmenorrheic and nondysmenorrheic women did not differ significantly on any of these measures. Analysis of both subsamples yielded identical findings in this respect. Similar findings have also been reported by Aberger, Denney, and Hutchings (1983) who employed an ischemic pain procedure to measure pain threshold, tolerance, and subjective pain ratings in different groups of dysmenorrheic women. Results from both these studies are also in agreement with those reported by Cox and Meyer (1978). All studies thus far that investigated dysmenorrhea with the most clinically analogous experimental techniques yielded no between-group differences in pain sensitivity.

Reports of dysmenorrhea, as assessed according to the subject's responses during the medical screening questionnaire, were validated by the RSS measures and the VAS rating of menstrual pain (Cox & Meyer, 1978). Dysmenorrheic women experienced significantly more frequent and severe menstrual symptoms, consumed more medications, spent more additional hours in bed, and rated their menstrual pain higher than did nondysmenorrheic women. The VAS has also been found to be a valid measure in the evaluation of premenstrual symptoms (Casper & Powell, 1986; Rubinow, Roy-Byrne, Hoban, Gold, & Post, 1984; Sanders, 1982) as well as in various types of chronic pain (Beery & Huskisson, 1972; Huskisson, 1974; Joyce, Zutshi, Hrubes, & Mason, 1975; Levine, Gordon, & Fields, 1982; McGuire, 1983; Onhaus, 1975; Price, McGrath, Rafii & Buckingham, 1983; Revill, Zutshi, Hrubes & Mason, 1975; Scott & Huskisson, 1976; Woodforde & Merskey, 1971).

Goolkasian's (1980, 1983) finding of cyclical effects in pain sensitivity was not replicated when all four menstrual cycle phases were investigated in 24 women. Goolkasian showed that the luteal phase was associated with maximum discriminatability of painful thermal stimuli as compared to either the follicular or the premenstrual phases of the cycle. In a subsequent study (1983), she also showed that this discriminability was only demonstrated by nondysmenorrheic women. Dysmenorrheic women were stable in their pain sensitivity to radiant heat over the four phases of the menstrual

cycle.

Even though the subjects in the present study provided measurements in all four phases of the menstrual cycle, the order of testing was not completely counterbalanced for each phase. Initially, all subjects were scheduled for their first experimental session to correspond to a particular menstrual cycle phase. An approximately equal number of subjects was scheduled to begin in each of the four phases. However, due to a host of factors (delayed testing, inconsistent menstrual cycle information, attrition, etc), counterbalancing was rendered incomplete by the end of the study. As a result, only three subjects (12.5%) began the cold pressor sessions in the menstrual phase, five (21%) in the follicular phase, eleven (46%) in the luteal phase, and five (21%) in the premenstrual phase. Due to time limitations, this investigation of the four menstrual phases had to be terminated without achieving complete counterbalancing. For this reason, the results pertaining to menstrual phase in the first subsample should be interpreted with caution. There were also large individual differences and thus, large within-group variances in both cold pressor pain threshold and tolerance measures.

The question of cyclicity of pain sensitivity was further investigated in the analysis of data provided by a larger subsample (N=37). Comparisons were made between the follicular and luteal phase of the cycle. Counterbalancing was more adequate in this sample in

that an approximate number of subjects began in the follicular (n=12) and luteal phases (n=15). Subjects also provided measurements in these two phases appearing in different orders. That is, nine subjects provided measurements in these two phases during the first two sessions (session 1-follicular, session 2-luteal). Eight subjects were tested in the second and third session (session 2-follicular, session 3-luteal). Eight subjects were tested during the third and fourth session (session 3-follicular, session 4-luteal) and twelve subjects were tested in the fourth and first session (session 4-follicular, session 1-luteal). Despite the fact that there were still large individual differences in these data, some significant results did emerge from the analysis.

Results supported those of Procacci et al. (1974) as well as those of Goolkasian (1980) in that the luteal phase was associated with the lowest threshold or maximum discriminability. However, these results only partially supported those of Goolkasian's (1983) in that no significant interaction effects were obtained in the present study. On average, both groups showed higher sensitivity (lower threshold) in the luteal phase of the cycle as compared to the follicular phase. However, inspection of the data indicates that the nondysmenorrheic group showed the largest difference between the two phases, but due to the larger variance in the follicular phase, the interaction was not significant. Perhaps with the addition of more subjects into the design, this interaction might have become

significant.

These discrepancies may be also explained in terms of differences in the painful stimuli and measures employed in the two studies. Goolkasian (1980, 1983) used radiant heat stimuli which cause cutaneous pain whereas the present study employed the cold pressor test which induces deep pain. The differences between these two types of pain have been discussed by Procacci (1969). In contrast to deep pain, cutaneous pain is "bright" and well localized, and it is not accompanied by autonomic reactions, such as changes in blood pressure, sweating, and nausea. Deep somatic pain, such as that induced by the cold pressor, is accompanied by autonomic reflexes such as rise in blood pressure, muscle ischemia, and irradiation of pain. Procacci (1969) considers the study of experimentally induced deep pain as fundamental for understanding similar phenomena of clinical pain.

It is also possible that the discriminability measure employed by Goolkasian (1983) was sensitive enough to discriminate between the two groups in the different phases whereas the cold pressor pain threshold was not. Moreover, Goolkasian's method of menstrual phase assignment might have been more accurate in that she employed basal body temperature charts (BBT) for determining ovulation. Even though BBT is only 80% accurate in demonstrating ovulation as compared to direct hormone assays (Moghissi, 1976), it is still more accurate than relying on the natural 65% rate of ovulation



occurring in young women (Metcalf, 1983). It is possible that the large within-group variances obtained in this study were partly due to absence of ovulation in some women. However, the logistics of this study did not allow us to employ sophisticated techniques for determining ovulation. Firstly, subjects had to remain naive to the purposes of the study, and secondly, we did not have the adequate financial and temporal resources to employ such techniques. Moreover, it is not at all uncommon to rely on the occurrence of normal and regular cycles in order to conduct studies on menstrual phase effects. A number of studies on the menstrual cycle relied on information on menstrual regularity, and onset of most recent menses for phase definition (Kelleher, Joyce, Kelly, & Ferriss, 1986; Olasov & Jackson, 1987). However, Albplanalp et al. (1977) found that this indirect method for determining ovulation is no better than chance (50%). Investigators must make explicit how they define menstrual phase when this variable is included in studies on the menstrual cycle (Gannon, 1985). Even though Aberger et al. (1983) took menstrual phase into account as a confounding variable, they did not use it as an a priori independent variable in their study. However, upon collapsing their data across dysmenorrheic and nondysmenorrheic groups, they found "significantly greater threshold and tolerance for subjects in the premenstrual phase of their cycle relative to subjects in the menstrual or postmenstrual phases". Apart from the fact that no definition of menstrual phase was provided, these findings can be

criticized in that unequal percentages of subjects were in the different phases with the majority being in the premenstrual phase (50-53%).

Due to the post hoc nature of the analysis of the second subsample, the finding of phase differences in pain threshold should be interpreted with caution until these results are replicated.

However, some evidence exists to support these tentative results in terms of fluctuating gonadal hormone levels. In measuring changes in breast sensitivity with two-point discrimination thresholds, Robinson and Short (1977) obtained maximal sensitivity at ovulation and at menstruation. Since no changes occurred in oral contraceptive users, the elevated pain thresholds were attributed to declining levels of hormones around menstruation and ovulation.

Kenshalo (1966) found that cool thresholds decrease in the luteal phase as compared to the follicular phase. These differences were attributed to the release of progesterone following ovulation. When progesterone derivatives were administered on the fifth day of the cycle, cool sensitivity was increased. Differences between the follicular and luteal phases have also been demonstrated on vibrotactile sensitivity (Gescheider, Verillo, McCann & Aldrich, 1984). Lower thresholds to a vibrotactile stimulus of 250 Hz occurred in the luteal phase as compared to the follicular phase in normally menstruating women only. Further differences between the two phases have been demonstrated by Hastrup and Light (1984). These

investigators showed that cardiovascular responsiveness to a reaction time task was higher in the luteal than in the follicular phase. Presence of estrogen and progesterone during the luteal phase was implicated for increasing cardiac output since combined estrogen/progestin oral contraceptives are known to increase blood volume, stroke volume, and cardiac output (Lehtovirta, 1974).

All the above studies point to the validity of cyclicity of a variety of effects over the course of the menstrual cycle and further demonstrate that explanation in terms of gonadal hormone fluctuations is tenable. However, these conclusions are tentative unless these effects are corroborated by direct measurements of hormonal levels.

Although significant correlations were found between pain threshold and tolerance, no phase differences in tolerance were obtained. Tolerance is considered to be a learned component of pain, mostly related to ethnic, cultural, psychological and situational factors (Ahles, Blanchard & Leventhal, 1983; Bandura, O'Leary, Taylor, Gauthier, & Gossard, 1987; Clark, 1969; Clark & Clark, 1980; Gelfand, 1964; Friedman, Thompson, & Rosen, 1985; Lambert *et al.*, 1960; Tursky, 1973; Weisenberg, Kreindler, Schachat, & Werboff, 1975; Wolff, 1978; Wolff, Krosnegor, & Far, 1965). Threshold is considered to be an unlearned component, mostly dependent on physiological variables (Gelfand, 1964; Wolff *et al.*, 1965; Wolff & Horland, 1967). The fact that only threshold varies across menstrual phase may indicate that, as a sensory phenomenon, threshold is influenced by the hormonal

changes occurring around ovulation.

The tolerance measure, with its psychological and motivational components, failed to discriminate between the two groups. It has been the implicit assumption of clinicians and gynecologists that dysmenorrheic women differ from nondysmenorrheic women in non-sensory factors such as attitudes toward menstruation and the feminine role (Cox & Meyer, 1978; Levitt & Lubin, 1967; Petrie, 1967). The tolerance measure was used in this study in order to allow such psychological differences between these two groups to emerge. However, tolerance was correlated with threshold, and did not discriminate between the two groups in any of the phases. If anything, the tolerance measure was also quite variable and skewed. Also, Aberger *et al.* (1983) and Ashton *et al.* (1984) obtained tolerance data that were highly variable and skewed to the right.

Post-experimental questionnaire data provided by the two groups of subjects was treated as anecdotal information and was used to further support the general lack of difference between the groups as well as the view that tolerance depends on psychological factors. Both the dysmenorrheic and nondysmenorrheic groups included subjects who reached maximum levels of tolerance, and both groups had subjects who reported the use of distraction techniques or viewed the cold pressor test as a challenge for demonstrating 'self control' and 'strength'. In commenting about their various motives for tolerating pain, a few subjects said that they would tolerate a lot of pain if

that meant saving their children's or their own lives. However, for a psychology experiment, even if that meant course credit, they were not willing to tolerate a lot of pain. This and other similar comments only reinforce the commonly held view that pain tolerance is more of a psychological than a physiological phenomenon. As such, pain tolerance represents the reactive or emotional component of pain that includes emotional reactions to and fearful expectations about the pain experience (Beecher, 1959; Melzack, 1973; Tursky, 1973). Although largely anecdotal, these findings support those of Aberger et al. (1983) who found no cognitive and behavioral coping strategy differences between dysmenorrheic and nondysmenorrheic women.

The two groups did not differ in their overall experience of pain during the month as shown by their pain diary scores. No significant differences were obtained between the two groups in either subsample. Nondysmenorrheic women were as likely or unlikely as dysmenorrheic women to report different kinds of pain (mostly headaches, stomach aches, sinus pain, and sports related pain) during the month. Because the study was conducted in the winter, and around midterm exams, a number of subjects reported sinus pain due to colds and stomach aches "due to stress" (their interpretation). However, some interesting correlations did emerge from the data. The total monthly pain score was significantly correlated with the VAS rating of overall cold pressor pain, that is the higher the reported incidence of pain during the month, the higher the degree of pain as experienced

in the cold pressor test. This correlation was significant in the first subsample and approached significance in the second subsample. Since no between-group differences were obtained, this result may indicate a general tendency of subjects for reacting to pain. This, in turn, supports a hypervigilance or sensitization model of pain judgment. However, this does not apply to dysmenorrhea. A finding obtained in the second subsample relevant to dysmenorrhea was that of a positive correlation between the total monthly pain score and the RSS measure of invalid hours. This may indicate a general tendency of subjects who report more pain during the month to also spend additional time in bed due to menstrual discomfort. This result held only for dysmenorrheic subjects even after reports of menstrual pain were excluded from the monthly pain score. These findings point to patterns of "illness behaviors" (Mechanic, 1962).

No significant between-group differences were obtained in average sleep during the month, or within the different menstrual phases in either subsample. Moreover, number of hours of sleep was not significantly correlated with either measure of cold pressor pain in either subsample. Sleep in the different menstrual phases was not significantly different from the average monthly sleep.

Pain judgment in dysmenorrhea, as investigated in this study, does not lend itself to interpretation in terms of the adaptation levels model (Rollman, 1979), or the hypervigilance model (Chapman, 1978). Dysmenorrheic women were not either less sensitive or more

sensitive than nondysmenorrheic women in their experience of cold pressor pain. The data would fit the hypervigilance model had the dysmenorrheic women shown higher sensitivity than nondysmenorrheic women. This would also have supported the view that dysmenorrhea, as a pain phenomenon, has psychogenic origins. However, with the discovery of prostaglandins as an important etiological factor of dysmenorrhea, it has become more difficult to argue in favor of psychogenic origins (see also Rauh *et al.*, 1985). The data would fit the adaptation-levels model had the dysmenorrheic women shown lower sensitivity than the nondysmenorrheic women and/or provided more conservative judgments of cold pressor pain. The only trend in the data pointing to that direction was obtained with the subjective ratings of cold pressor pain. Dysmenorrheic women in all phases tended to provide lower VAS ratings than nondysmenorrheic women. However, even though this measure was the least variable of the three cold pressor measures, no significant results were obtained. This tendency, if any, disappeared when the subjects were asked to provide an overall measure of cold pressor pain at the end of all sessions. This may be due to the fact that in this instance, subjects used the cold pressor pain (intense and most recent experience) as the comparison point for rating their menstrual pain. However, this tendency for lower pain ratings in dysmenorrheic women was further investigated in the next study. Further discussion of this study will take place after the presentation of Study 2.

SECTION IV. STUDY 2: PAIN SENSITIVITY IN DYSMENORRHEA: A  
REPLICATION OF MENSTRUAL PHASE EFFECTS

INTRODUCTION

In the previous study, a decrease in cold pressor pain thresholds from the follicular (pre-ovulatory, day 8-14) to the luteal phase (post-ovulatory, day 15-21) was obtained in a sample of 37 young university women. The present study was undertaken as a replication of this menstrual phase effect. The previous study also showed a tendency for pain ratings of dysmenorrheic women to be lower than those of nondysmenorrheic women across cycle phase. Since this suggested a possible adaptation-levels effect, the present study was also undertaken to explore this finding further.

A between-subjects design was employed so that menstrual phase would not be confounded by habituation to the cold pressor task. Also, based on the experience of the scheduling difficulties of the first study, it was deemed less complicated to assign subjects into one rather than two menstrual cycle phases.

This study also included a group of oral contraceptive users



in order to provide an indirect test for the hypothesis of gonadal hormone-level fluctuation. On the basis of earlier findings (Goolkasian, 1980; Procacci et al., 1974; Tedford et al., 1977) no cyclical effects in pain sensitivity were expected in users of oral contraceptives.

## METHOD

### Subjects

The subjects in the study were 46 introductory psychology student volunteers participating for course credit. Age ranged from 18 to 39 years ( $X = 20.75$ ,  $SD = 4.43$ ). The following occurred in the same way as in the previous study: study advertisement, application of exclusion criteria, and assessment of dysmenorrhea.

### Assessment of Dysmenorrhea

Women who reported mild pain or no pain at all associated with menstruation comprised the nondysmenorrheic group (42%). Those reporting moderate to severe pain comprised the dysmenorrheic group (58%). The incidence and severity of dysmenorrhea reported in this study agrees with that reported in the previous study as well. However, the number of dysmenorrheic and nondysmenorrheic subjects included in the data analysis was in favor of dysmenorrheic subjects. Information about medication requirements and home remedies used to counteract dysmenorrhea was also obtained during the initial interview. The majority of women who reported moderate to severe

menstrual pain (70%) also reported the use of prescription or nonprescription prostaglandin inhibitors. Two users of oral contraceptives also reported the use of prescription prostaglandin inhibitors. A few women reporting mild menstrual pain (19%) reported the use of nonprescription medication.

### Exclusions

The following were excluded from the study or from the main data analysis: One pregnant subject, one subject with hysterectomy, one subject using the IUD, oral contraceptive users, subjects who provided inconsistent menstrual cycle information, and those who exceeded the 4-minute cold pressor tolerance limit point set in this study. Subjects were asked to abstain from alcohol and analgesics for at least 10 hours prior to the experimental sessions. No smokers were included in the study.

### Normal Menstrual Cycles: Assessment of Menstrual Phase

Forty-six normally and regularly menstruating women (26-32 day cycles) provided data coinciding with the follicular (N = 26) and luteal phases (N = 20) of the cycle (days 8-14 and 15-21 of the cycle, respectively, with day 1 being the onset of menstruation). Cycle phases were assessed according to menstrual cycle information provided before and after the completion of the experimental session. Each subject usually provided dates for two menstrual cycles. Exact dates

of most recent menses were used to calculate the phase during which the experimental session actually occurred. For example, counting backwards 14 days from the onset of last menses, the luteal phase included a period of 8-14 days prior to last menses or 15-21 days following the previous menses. The follicular phase included a period of 8-14 days following the previous menses.

#### Oral Contraceptive Users

Data from 14 oral contraceptive users was analyzed separately because the number of subjects in the cycle points corresponding to the follicular (N = 8) and luteal (N = 6) phases was not large enough to be included in the main data analysis.

#### Apparatus

The cold pressor apparatus was employed as in the previous study.

#### Measures and Procedure

With the exception of videotaping, the procedure was identical to that of the previous study. Following a practice trial, subjects provided measures of cold pressor pain threshold and tolerance, and completed visual analogue scales judging the degree of cold pressor and menstrual pain. They also completed the RSS and the PEQ. The Pain Diary was not employed here due to the shorter duration

of this study.

## RESULTS

The results of this study were largely consistent with those of the previous study. Differences between dysmenorrheic (N = 29) and nondysmenorrheic women (N = 17) in menstrual symptomatology (RSS) and degree of menstrual pain (VAS) are shown in Table 6.

As expected, dysmenorrheic women reported more frequent and severe menstrual symptoms, spent more hours in bed due to menstruation, took more medication, and rated their menstrual pain higher than did nondysmenorrheic women. Between-groups analysis of variance on each dependent measure examined these differences. Results on the RSS revealed significant differences in menstrual symptomatology,  $F(1,44) = 16.85, p < 0.001$ , invalid hours,  $F(1,44) = 7.00, p < 0.01$ , medication usage,  $F(1,44) = 6.37, p < 0.01$ , and VAS ratings of menstrual pain,  $F(1,44) = 14.20, p < 0.001$ , between the nondysmenorrheic and dysmenorrheic groups. The correlation between menstrual symptoms (RSS) and VAS rating of menstrual pain was also significant,  $r(44) = 0.52, p < 0.001$ .

Differences between the follicular and luteal phase of the cycle in dysmenorrheic and nondysmenorrheic women were examined with a 2 (phase) X 2 (group) between subjects ANOVA conducted for each measure of cold pressor pain (threshold, tolerance and VAS pain

**TABLE 6**  
**MEASURES OF MENSTRUAL SYMPTOMATOLOGY (RSS), MEDICATION USAGE (RSS),**  
**INVALID HOURS (RSS), AND DEGREE OF MENSTRUAL PAIN (VAS) IN**  
**DYSMENORRHEIC AND NONDYSMENORRHEIC WOMEN**

|  | SYMPTOMATOLOGY<br>(RSS) | MEDICATION UNITS<br>(RSS) | INVALID HOURS<br>(RSS) | VAS   |
|--|-------------------------|---------------------------|------------------------|-------|
| <b>DYSMENORRHEIC WOMEN (N - 29)</b>    |                         |                           |                        |       |
| $\bar{X}$                              | 36.65                   | 3.71                      | 2.79                   | 43.31 |
| SE                                     | 3.96                    | 0.91                      | 0.65                   | 5.31  |
| <b>NONDYSMENORRHEIC WOMEN (N - 17)</b> |                         |                           |                        |       |
| $\bar{X}$                              | 13.94                   | 0.64                      | 0.64                   | 16.00 |
| SE                                     | 2.78                    | 0.29                      | 0.21                   |       |
|  | 3.63                    |                           |                        |       |

All  $\underline{p} < 0.01$ .

ratings). Because of unequal cell sizes, unweighted means ANOVA was performed on these data (See Design on Table 7).

Figure 5 depicts mean cold pressor pain threshold in the follicular and luteal phases of the menstrual cycle. Threshold measurements were higher in the follicular than in the luteal phase of the cycle in both dysmenorrheic and nondysmenorrheic women,  $F(1, 43) = 5.52, p = 0.02$ . Even though tolerance scores showed the same tendency as did threshold, results were not significant. There was, however, a significant correlation between threshold and tolerance,  $r(44) = 0.39, p < 0.01$ .

Figure 6 shows the significant interaction between phase and group for the VAS ratings of cold pressor pain,  $F(1,42) = 6.76, p < 0.01$ . Post hoc multiple comparisons (Duncan's multiple range test,  $p < 0.05$ ) showed that dysmenorrheic women rated the cold pressor pain as less intense ( $\bar{X} = 49.65, SE = 5.14$ ) than did nondysmenorrheic women in the follicular phase ( $\bar{X} = 67.67, SE = 6.35$ ) and also as compared to the luteal phase ( $\bar{X} = 65.50, SE = 5.00$ ).

A separate analysis of variance performed on the oral contraceptive users (excluded from the main data analysis) revealed no significant differences in threshold between the phases corresponding to the follicular ( $\bar{X} = 19.74, SE = 3.99$ ) and the luteal ( $\bar{X} = 20.59, SE = 4.69$ ).

TABLE 7

## DESIGN

TWO MENSTRUAL CYCLE PHASES BY TWO GROUPS

| MENSTRUAL PHASE |        |
|-----------------|--------|
| FOLLICULAR      | LUTEAL |
| DYSMENORRHEA    |        |
| N = 17          | N = 12 |
| NONDYSMENORRHEA |        |
| N = 9           | N = 8  |

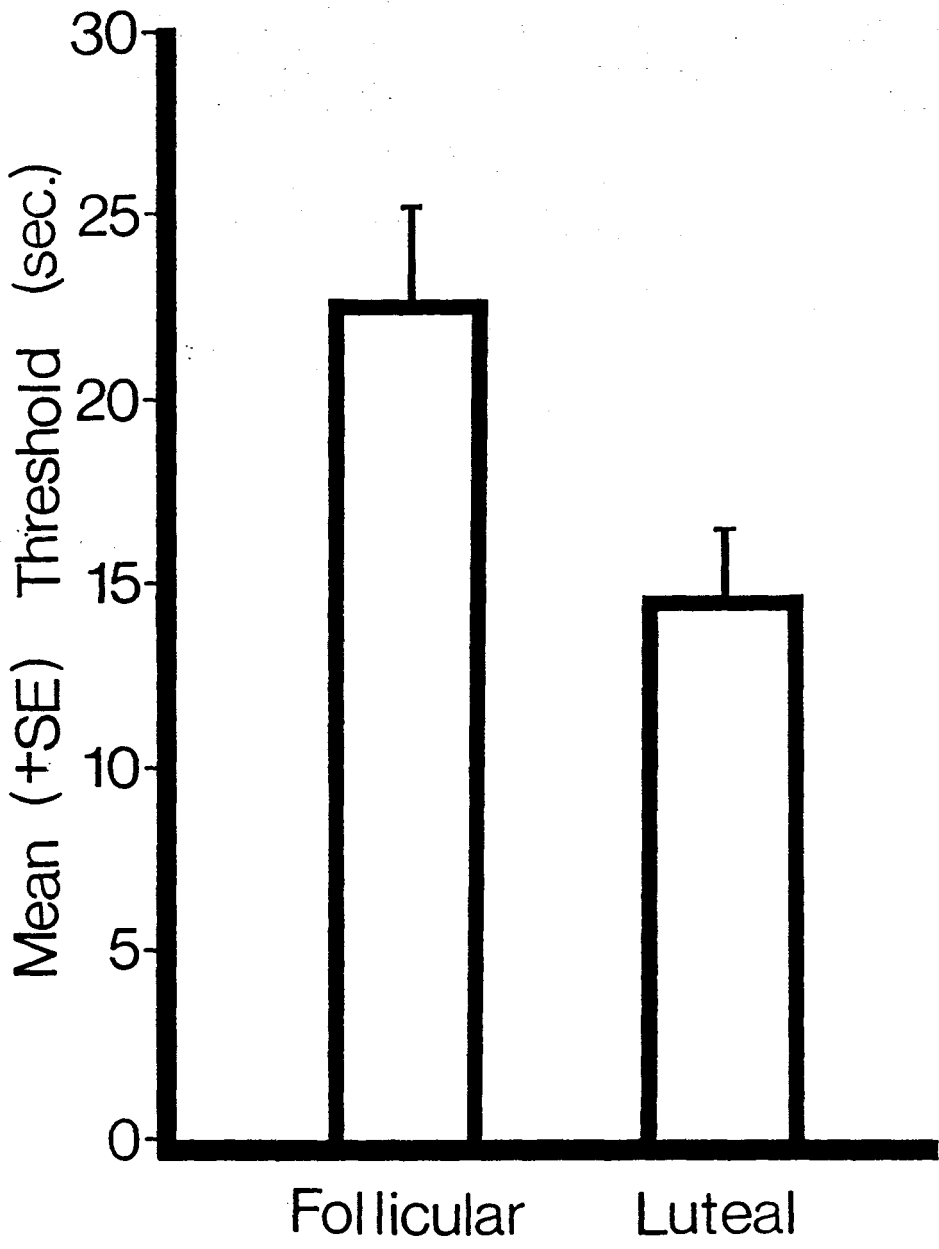


FIGURE 5



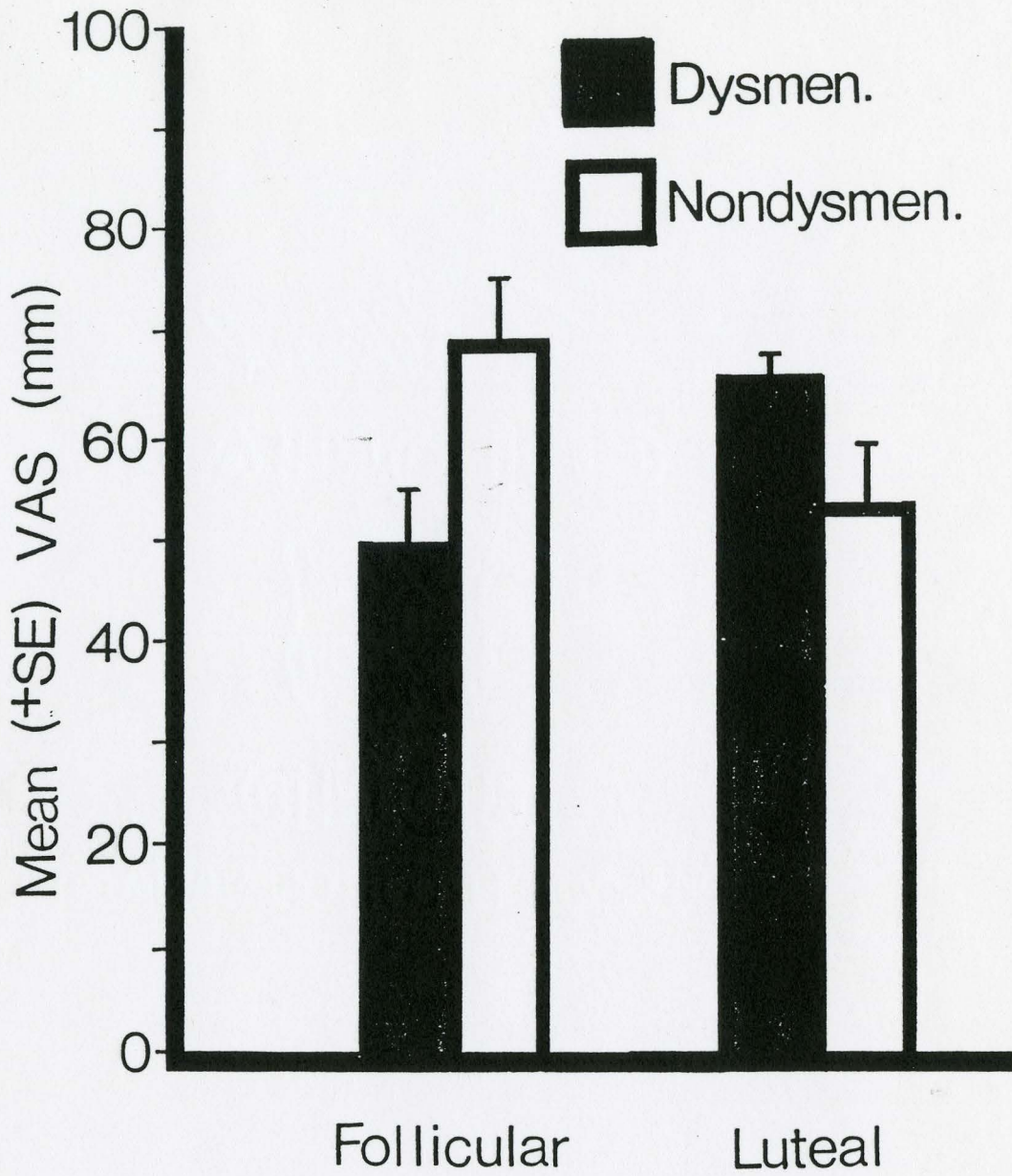


FIGURE 6

## DISCUSSION

The results of Study 2 were largely consistent with those of Study 1. The menstrual phase effect for pain threshold was thus obtained while using both a within- and a between-subjects design.

Results obtained with the RSS and VAS for menstrual pain again provided validation for categorizing subjects on the basis of their initial reports on the presence and severity of menstrual pain. Even though some subjects may have the tendency to exaggerate or minimize their pain reports, this subjective bias is at least consistent across assessment methods. The initial subjective reports obtained in the medical screening questionnaire were reliable across two different measures, a visual analogue scale and a menstrual symptom questionnaire.

The present study replicated the menstrual phase differences in pain threshold of the previous study. In both studies, threshold was consistently found to be lower in the luteal as compared to the follicular phase. These two phases occur prior to and subsequent to ovulation, and the obtained threshold differences may accordingly reflect pituitary-gonadal hormone variations occurring over the female cycle. Hormonal underpinnings are commonly assumed in studies of cyclical effects (Cooper *et al.*, 1974; Gescheider *et al.*, 1984; Hastrup & Light, 1984; Kenshalo, 1966; Klaiber *et al.*, 1971). Although the present study did not provide hormonal assays to

correlate with threshold measurements, the fact that pain threshold differences are not obtained with oral contraceptive users may give indirect support to the hormonal fluctuation hypothesis. This result is consistent with those reported by Goolkasian (1980) Procacci et al. (1974), and Tedford et al. (1977).

Although no significant differences were obtained with tolerance, the significant correlation between threshold and tolerance suggests that subjects who report pain earlier (lower threshold) tend to keep their arm in the ice water for shorter periods of time; subjects who report pain later (higher threshold) tend to keep their arm in the ice water for longer periods of time. This finding is consistent with that of the previous study and those of other investigators (Ashton et al., 1984; Weisenberg et al., 1975). The lack of significant phase differences in tolerance may be due to the multiple motivational factors that affect this measure and thus contribute to variance. Again, the fact that only threshold varies reliably across menstrual cycle phase may indicate that, as a sensory phenomenon, threshold is influenced by the hormonal changes occurring around ovulation.

The significant interaction obtained for the VAS ratings of cold pressor pain provides partial support for the adaptation-levels model. According to this model, dysmenorrheic women would be expected to judge cold pressor pain on the basis of menstrual pain and provide lower subjective ratings of cold pressor pain than would

nondysmenorrheic women. However, dysmenorrheic women seem to be doing so only in the follicular phase. It is unclear why this is not the case with the luteal phase, although it is possible that this is due to the ceiling effects of maximal sensitivity obtained during the luteal phase. Reporting the pain faster (lower threshold) may be producing higher pain reports (VAS ratings). However, there was no significant correlation between threshold and VAS ratings in this study. It is, however, possible that dysmenorrheic women are more affected by the phase of the cycle than are nondysmenorrheic women with respect to making judgments of cold pressor pain. It is also possible that this difference is due to a recency effect. Assuming that dysmenorrheic women are "anchoring" cold pressor pain on menstrual pain, then these women have a better memory of their menstrual pain during the phase immediately following their menses (follicular) as compared to the luteal phase (almost 3 weeks away from their menstrual pain experience).

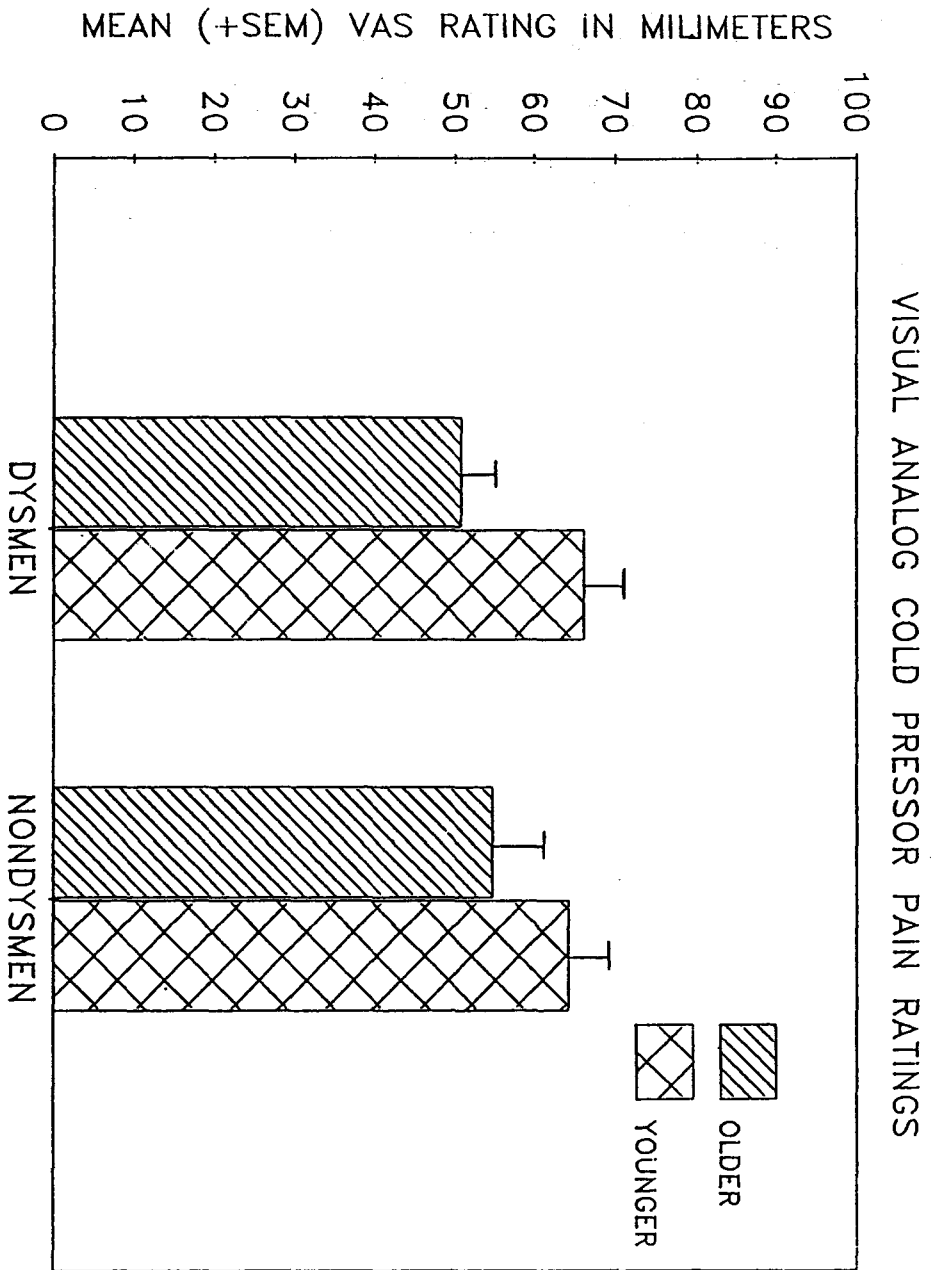
This finding is different from that obtained in the previous study with respect to the VAS cold pressor pain ratings. In study 1, all dysmenorrheic women, irrespective of phase, tended to provide consistently lower but nonsignificant ratings of cold pressor pain. This occurred in both subsamples. Given that the VAS has been found a very reliable and valid technique for assessing within-subjects differences in pain, it is interesting that this significant interaction effect was not obtained in the previous study as well.

The fact that study 2 was a between-subjects study may partially account for that. Different subjects rated cold pressor pain in the two groups and across menstrual phase. It is possible that subjects used different comparison criteria in their cold pressor pain judgment. While some subjects used a maximum degree of pain in the cold pressor as a comparison point, some other subjects might have used maximum points of pain from prior experience, including dysmenorrheic pain. Even though the subjects in study 1 had the same chance of using differential criteria for pain judgments, they might have done so in a consistent manner over the four cold pressor pain sessions. In study 2, however, subjects did not have the chance to repeat their judgment. They only had to make this judgment once, and they might have used whichever criterion came to mind first. All the above are alternative interpretations of the interaction effect obtained for the VAS ratings of cold pressor pain. Regardless of which criterion for pain judgment was used this study, the results point to an adaptation-levels mechanism in that some comparison of pain levels is taking place. Many subjects' verbal reports attested to that. Indeed, some subjects said informally that they could think "of a lot worse pain than that of the cold pressor". The parous women in the study mentioned that no pain could be compared to that of childbirth. Even some nulliparous women said that labor pain is the worse pain that they can imagine and expect to experience. More informal observations indicated that the few older women (over 30 yrs)

in the study were more conservative in their judgments of cold pressor pain than younger women in providing lower VAS ratings (Figure 7). Also, older women often said that in comparison to the cold pressor pain, they experienced more intense pain in their lives and they did not mind participating in the cold pressor experiment. Some of these observations came from written comments provided in the PEQ and some from informal conversations with the experimenter.

An extension of the adaptation-levels model would render age and previous pain experience important variables in pain judgments. The older the dysmenorrheic women, the more pain experiences are likely to have accumulated. These may include, in addition to dysmenorrhea, childbirth, surgeries, and accidents. It would be expected that women with more experience of pain in their lives would differ from relatively pain-free women in their judgments of experimental pain. Study 3 was undertaken to explore these hypotheses.

FIGURE 7



SECTION V. STUDY 3: RESPONSIVENESS TO LABORATORY PAIN  
IN WOMEN WITH CHILDBIRTH PAIN EXPERIENCE

INTRODUCTION

The two previous studies (Hapidou & Lamping, 1988; Hapidou & deCatanzaro, 1988) employed the cold pressor test to investigate pain sensitivity in dysmenorrheic and nondysmenorrheic women in different phases of the menstrual cycle. Cold pressor pain was measured through threshold, tolerance, and visual analog (VAS) pain intensity ratings. In both studies, women reacted faster to cold pressor pain (lower threshold) in the luteal phase as compared to the follicular phase of the cycle. Behavior in the cold pressor test was largely independent of dysmenorrhea as dysmenorrheic women were no different from nondysmenorrheic women on two out of three measures of cold pressor pain. There was, however, a consistent but nonsignificant trend for dysmenorrheic women to provide lower cold pressor pain ratings than nondysmenorrheic women (Study 1) and a significant interaction of menstrual phase and dysmenorrhea (Study 2).

A pattern of results emerging from these studies suggested



that older women (over 30 years old) tended to report less intense cold pressor pain (VAS) than younger women. However, the number of older women in these studies was too small for any reliable statistical tests to be performed ( $N = 8$ ). A few of these women also remarked that no pain could be compared to that experienced during labor. This claim has been supported by empirical research. Melzack, Taenzer, Feldman, and Kinch (1981) compared pain scores obtained using the McGill Pain Questionnaire in women during labor and in several types of chronic and acute pain clinical subjects. Labor pain was found to rank among the most intense kinds of pain and was only exceeded by causalgia and amputation pain. On average, primiparas had higher pain scores than multiparas. A study by Davenport-Slack and Boylan (1974) found that 97% of a sample of 75 women in childbirth said that, in comparison to other painful experiences, labor pain was the most painful experience they had ever had.

Previous literature yielded contradictory findings on the effects of age on pain sensitivity (Harkins, 1987; Woodrow, Friedman, Siegelau, & Collen, 1972). Pain sensitivity has been found both to increase (Woodrow *et al.*, 1972; Collins & Stone, 1966) as well as to decrease with increasing age (Clark & Mehl, 1971; Hall & Stride, 1954; Lambert, Libman & Poser, 1960; Schluderman & Zubek, 1962; Sherman & Robillard, 1964). These studies used mainly mechanical pressure and radiant heat in determining threshold and/or tolerance to pain. According to Woodrow *et al.* (1972), sensitivity to deep pain, as

induced by mechanical pressure stimuli, increases with age, whereas sensitivity to cutaneous pain, as induced with radiant heat stimuli, decreases with age. However, only one study investigated pain responses in the context of age and parity (Winsberg & Greenlick, 1967). The findings indicated that age and parity influenced pain responses in young mothers with spontaneous deliveries. The older and higher parity obstetrical patients appeared to be more cooperative and stoical. These conclusions were based on evaluations of pain made by both physicians and nurses. Amount of pain experienced during childbirth was rated as "very severe - very mild", response to pain was as "very excitedly - very calmly", and cooperation was as "very cooperative - very uncooperative". The findings were based on the analysis of percentages of subjects in every category.

The paucity of research in this area and informal observations from the two previous studies led to the investigation of the hypothesis that age and/or pain experience such as that of childbirth may be potential determinants of sensitivity to laboratory-induced pain. This hypothesis could then be examined in light of the adaptation-levels model. Women with a higher pain experience (older and parous) would be expected to provide more conservative judgments of cold pressor pain than women with low pain experience (younger and nulliparous). In an attempt to determine and separate the differential effects of pain experience variables as well as to control for the effects of other relevant variables, a 'cumulative

pain experience' questionnaire was devised. This provided information on the incidence and degree of various types of pain experience such as childbirth pain, surgeries, and various other common kinds of pain. The latter included headache, low back pain, joint pain, etc. Other aspects of pain experience related to dysmenorrhea were also included. These were age at menarche, age of onset of dysmenorrhea, number of years that dysmenorrhea occurred, frequency of dysmenorrhea (months/year), severity of dysmenorrhea (VAS), and medication usage. Despite all the qualitative and quantitative information on dysmenorrhea, the focus of the present study was not dysmenorrhea per se but the effects of pain experiences such as childbirth and other kinds of pain on responsiveness to laboratory pain. However, since this study employed a group of explicitly older women, and since information on dysmenorrhea in older women does not exist in the literature, the obtained information on dysmenorrhea is used to draw profiles of dysmenorrhea in the different age groups. Therefore, the purpose of the present study is twofold: To examine the effects of age and pain experience such as childbirth on sensitivity to laboratory-induced pain and to delineate the various parameters of dysmenorrhea as they occur in different age groups.

## METHOD

### Subjects

Sixty-one subjects volunteered for the study for a small remuneration (\$5) or course credit. The study was advertised on campus bulletin boards as well as in the student newspaper. The procedural description of the laboratory sessions was identical to that provided in the two previous studies, i.e., "study involving immersion of the hand and forearm in ice-water, and completion of standard questionnaires". One of the advertisements, however, specified that volunteers should be over 30 yrs old. Both parous and nulliparous subjects were obtained with this advertisement. Three subjects dropped out after the first session. Fourteen subjects were excluded due to the various criteria set for this study. These were: Smoking (n=2), oral contraceptive usage (n=4), irregular cycles (n=2), longer or shorter cycles than 26-32 days (n=1), outlier scores in cold pressor tolerance (n=2), tranquilizer usage (n=1), and general anesthesia during labor (n=2). Because the study was designed to explore the effects of childbirth pain on pain sensitivity, women who underwent general anesthesia (Cesarean sections) during childbirth were excluded from the data analysis. Three out of 17 parous women (16%) had undergone Cesarean sections but only two of them were excluded. The other one had one natural childbirth for which she reported a high degree of labor pain on the VAS and was therefore

included. The exclusions and drop-out rate resulted in a group of 44 subjects in the data set.

Age ranged from 17 to 48 years ( $\bar{X}$ =30.93, SD=7.10). Age at menarche ranged from 9 to 17 years ( $\bar{X}$ =13.01, SD= 1.59). Cycle length ranged from 26-30 days and length of flow from 4-7 days. All women were in good health and the majority reported that they engaged in regular exercise.

### Procedure

The procedure was generally similar to that of the previous studies. Subjects participated in two sessions of the cold pressor test scheduled at the same time of the day at least one week apart. After the end of the second session, subjects completed the Cumulative Pain Experience Questionnaire (CPEQ, see Appendix IX), in addition to the RSS and the VAS for menstrual pain.

### Cumulative Pain Experience Questionnaire

This questionnaire included questions on the following variables: age, menarche, various parameters of dysmenorrhea (age pain started, months/year it occurred or occurs, degree of pain (VAS), medication requirements, coping methods to deal with pain, degree of interference in life), types of contraception, parity (number of childbirths, type of childbirth, degree of labor pain), surgeries, number and degree of other pain problems and medication requirements.

## RESULTS

Because no differences existed between the two sessions of the cold pressor test in either pain threshold, tolerance, or VAS ratings, the two sessions were collapsed into one by taking the average of the two. Descriptive statistics for all three cold pressor pain measures in the two sessions, as well as the results of correlated t-tests are presented on Table 8.

The analysis was done in two steps: First, the correlation matrix was calculated between and within the various parameters of pain experience as measured by the CPEQ, RSS, VAS for menstrual pain, and the cold pressor measures (threshold, tolerance, VAS pain ratings). Then, an analysis of variance (ANOVA) was performed in order to separate the effects of age and childbirth pain experience. Descriptive statistics are also presented in order to characterize the various parameters of dysmenorrhea in this sample.

### Correlations

A summary of significant correlations for several variables in the study are presented in Table 9. There were highly significant correlations between cold pressor pain threshold and tolerance

**TABLE 8**  
**DESCRIPTIVE STATISTICS FOR COLD PRESSOR PAIN MEASURES IN THE TWO**  
**TESTING SESSIONS**

|                        | Session 1 | Session 2 |
|------------------------|-----------|-----------|
| <b>Threshold *</b>     |           |           |
| $\bar{X}$              | 13.21     | 12.15     |
| SE                     | 1.20      | 1.11      |
| <hr/>                  |           |           |
| <b>Tolerance **</b>    |           |           |
| $\bar{X}$              | 34.38     | 36.97     |
| SE                     | 3.20      | 4.47      |
| <hr/>                  |           |           |
| <b>VAS Ratings ***</b> |           |           |
| $\bar{X}$              | 55.13     | 56.14     |
| SE                     | 2.49      | 2.44      |
| <hr/>                  |           |           |

\*  $t(43) = 1.05, p = 0.30$

\*\*  $t(43) = -0.79, p = 0.44$

\*\*\*  $t(43) = -0.56, p = 0.58$

**TABLE 9**  
**Significant Correlations - Two-tailed tests (N = 44)**

**Correlations between the Independent Variables**

- 
1. VAS (Menstrual) with Symptoms\*,  $r(42) = 0.58, p < 0.001$
  2. VAS (Menstrual) with Hours\*,  $r(42) = 0.48, p < 0.001$
  3. Vas (Menstrual) with Pills\*,  $r(42) = 0.45, p < 0.005$
  4. Pills with Hours,  $r(42) = 0.52, p < 0.001$
  5. Pills with Symptoms,  $r(42) = 0.46, p < 0.01$
  6. Pills with Cumulative VAS of Other Pain Problems  
 $r(42) = 0.43, p < 0.005$
  7. Pills with Medication Dose for Other Pain Problems  
 $r(42) = 0.31, p < 0.05$
  8. Cumulative VAS of Other Pain Problems with Medication  
Dose for Other Pain Problems,  $r(42) = 0.49, p < 0.001$
  9. Medication Dose with Symptoms,  $r(42) = 0.38, p < 0.02$

**Correlations between the Dependent Variables**

- 
1. Threshold with Tolerance,  $r(42) = 0.52, p < 0.001$
  2. VAS (CP)\*\* with Tolerance,  $r(42) = 0.37, p < 0.02$

**Correlations between Independent and Dependent Variables**

- 
1. Age with Threshold,  $r(42) = 0.41, p < 0.01$
  2. VAS (Menstrual) with VAS (CP) $r = 0.32, p < 0.05$
- 

**One-tailed tests**

- 
1. Age with Surgery,  $r(42) = 0.27, p < 0.05$
  2. Tolerance with Symptoms,  $r(42) = 0.26, p < 0.05$
  3. Symptoms with Cumulative VAS of Other Pain Problems  
 $r(42) = 0.28, p < 0.05$
  4. VAS (Menstrual) with Cumulative VAS of other pain  
problems,  $r(42) = 0.29, p < 0.05$ .
- 

\* Retrospective Symptom Scale Measures

\*\* VAS rating of Cold Pressor Pain



( $p < 0.001$ ) as well as between VAS cold pressor pain ratings and tolerance ( $p < 0.02$ ).

Age was significantly correlated with pain threshold,  $r(42) = 0.41$ ,  $t = 2.77$ ,  $p < 0.01$ , but was not significantly associated either with tolerance or VAS cold pressor pain ratings,  $r(42) = 0.25$ ,  $t = 1.70$ ,  $p > 0.05$ ,  $r(42) = 0.16$ ,  $t = 1.06$ ,  $p > 0.05$ , respectively.

More than half of the older women were parous (55.55%, age range 30-48 yrs,  $X = 35.66$ ). If age was the only variable contributing to the variance in pain threshold, then all older women, those with childbirth pain experience and those without should have similar pain threshold scores and should both differ from those of the younger group of women. In order to investigate this hypothesis, further analyses were performed.

Childbirth pain experience (or parity) was not examined in the correlational analysis because only 15 subjects were parous, having had from 1 to 5 children, whereas the remaining 29 subjects were nulliparous (no children). Childbirth pain experience was therefore coded as a categorical variable and was treated as the independent variable in the analysis of variance (see below). However, parity was examined within the group of the 15 parous women in order to investigate the association between number of painful childbirths and pain sensitivity in the cold pressor test. No significant results were obtained for either threshold,  $r(13) = 0.19$ ,  $t = 0.73$ ,  $p > 0.05$ , tolerance,  $r(13) = 0.15$ ,  $t = 0.55$ ,  $p >$

0.05, or VAS pain ratings,  $r(13) = 0.04$ ,  $t = 0.14$ ,  $p > 0.05$ .

Measures of other pain problems (cumulative degree, and medication usage) were significantly associated with each other. Also, medication usage for other pain problems was significantly associated with medication usage for dysmenorrhea and the latter was associated with the cumulative degree of other pain problems (see Table 9). However, none of these measures was associated with any of the cold pressor pain measures ( $p > 0.05$ ). Also, no significant correlations were obtained between number of surgeries and any of the cold pressor pain measures. Therefore, no experience with other kinds of pain contributed to the variance in any of the cold pressor pain measures.

In agreement with the results of our previous studies, significant correlations were obtained between the various measures of dysmenorrhea (VAS and RSS) (Hapidou & Lamping, 1988, Hapidou & deCatanzaro, 1988) (see Table 9). However, contrary to the results of the previous studies, the present study found a significant moderate positive correlation between the VAS ratings of cold pressor and menstrual pain,  $r(42) = 0.37$ ,  $t = 2.16$ ,  $p < 0.02$ . Women with the highest ratings of menstrual pain as experienced during their last menstrual period also provided the highest ratings of cold pressor pain. Thus, the two types of pain (clinical:menstrual versus laboratory:cold pressor) are associated in terms of intensity, and intensity of cold pressor pain as measured through the VAS was found

to depend on degree of menstrual pain as experienced during the last menstrual period. However, as in the previous studies, intensity ratings were much higher for cold pressor than for menstrual pain ( $p < 0.001$ ).

### Analysis of Variance

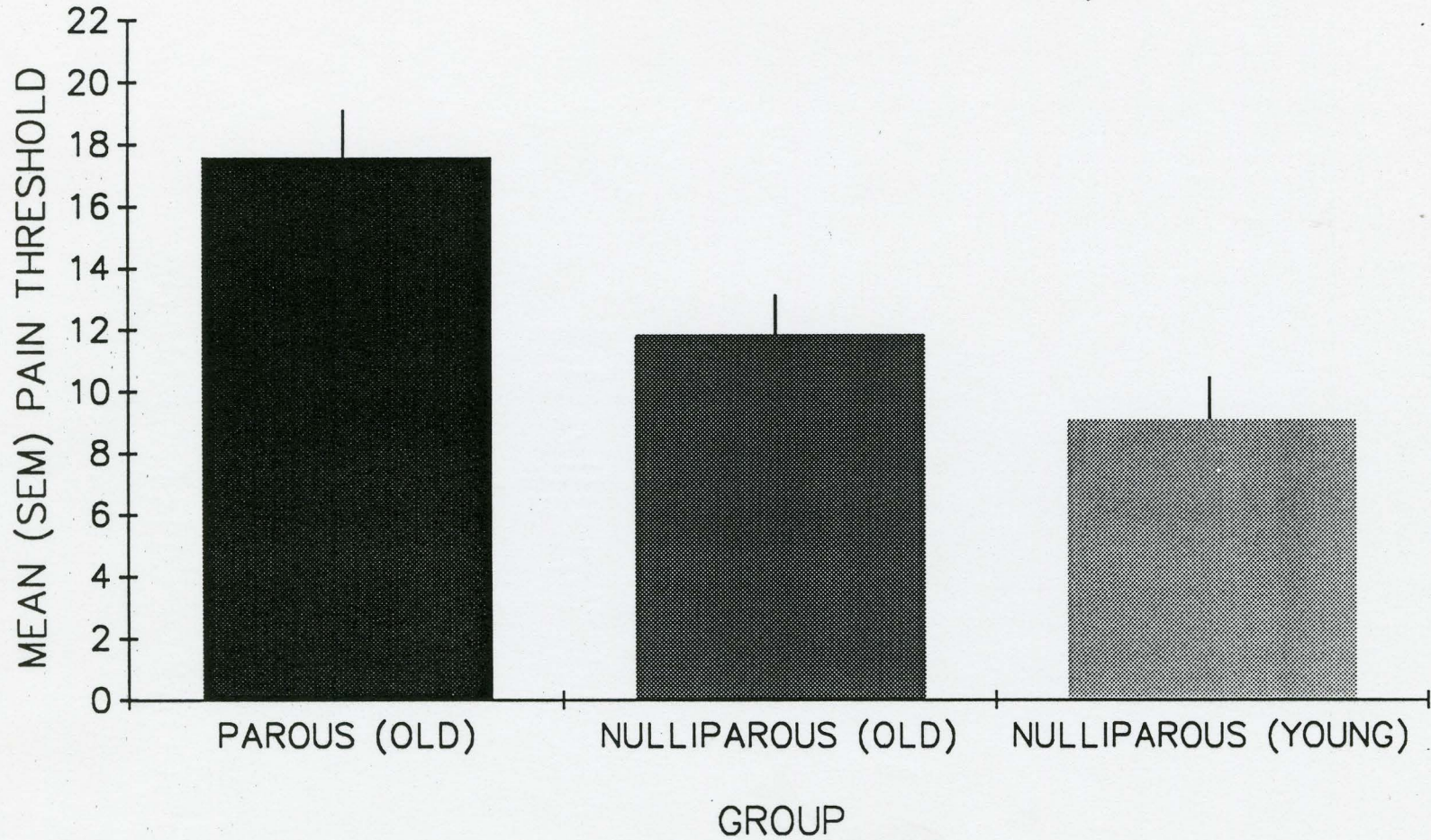
Analysis of variance was performed on the data to further explore the effects of age/childbirth pain experience on pain threshold.

One-way analysis of variance with childbirth experience as the independent variable, and threshold as the dependent variable, was performed on the data. There were three groups of women: Parous women with childbirth pain experience ( $n = 15$ , age range 30-48, mean age - 35.66 yrs,  $SD = 4.49$ ), nulliparous women without childbirth pain experience matched for age with the parous group ( $n = 12$ , age range 30-45, mean age - 35 yrs,  $SD = 5.35$ ), and nulliparous younger women ( $n = 17$ , age range 17-29, mean age - 23.88 yrs,  $SD = 3.37$ ).

Figure 8 depicts the highly significant differences between the three groups,  $F(2,41) = 8.43$ ,  $p < 0.001$ . Tukey's multiple comparisons on the three group means showed that women with childbirth pain experience had higher thresholds ( $X = 17.61$ ,  $SE = 1.90$ ) than women of the same age range but without the experience of childbirth pain ( $X = 11.87$ ,  $SE = 1.39$ ,  $p < 0.01$ ). They were also different from the younger women ( $X = 9.11$ ,  $SE = 1.24$ ,  $p < 0.01$ ). There were no

FIGURE 8

## Threshold to Cold Pressor Pain as a Function of Childbirth Pain Experience



significant differences between the two nulliparous groups ( $p > 0.05$ ). Analysis of variance performed on the other two cold pressor measures yielded nonsignificant results, with all F values being less than one. For means and standard errors for threshold, tolerance, and VAS pain ratings in the three groups, refer to Table 10. For means and standard errors for measures of pain experience in the three groups, refer to Table 11.

**TABLE 10**  
**DESCRIPTIVE STATISTICS FOR COLD PRESSOR PAIN THRESHOLD, TOLERANCE AND**  
**VAS RATINGS IN THE THREE GROUPS**

|                          | Group 1<br>PAROUS<br>(n = 15) | Group 2<br>NULLIPAROUS OLD<br>(n = 12) | Group 3<br>NULLIPAROUS YOUNG<br>(n = 17) |
|--------------------------|-------------------------------|--|--|
| <b>THRESHOLD (SEC.)</b>  |                               |  |  |
| $\bar{X}$                | 17.61                         | 11.87                                  | 9.11                                     |
| SE                       | 1.90                          | 1.39                                   | 1.24                                     |
| <b>TOLERANCE (SEC.)</b>  |                               |  |  |
| $\bar{X}$                | 41.07                         | 35.96                                  | 31.07                                    |
| SE                       | 6.02                          | 8.08                                   | 4.88                                     |
| <b>VAS RATINGS (MM.)</b> |                               |  |  |
| $\bar{X}$                | 53.67                         | 59.58                                  | 53.59                                    |
| SE                       | 4.45                          | 3.71                                   | 4.63                                     |

\*  $F(2,41) = 8.43, p < 0.001$

**TABLE 11**  
**DESCRIPTIVE STATISTICS FOR MEASURES OF PAIN EXPERIENCE IN THE THREE**  
**GROUPS**

|  | Group 1<br>PAROUS<br>(n = 15) | Group 2<br>NULLIPAROUS OLD<br>(n = 12) | Group 3<br>NULLIPAROUS YOUNG<br>(n = 17) |
|--|-------------------------------|--|--|
| <b>AGE</b>                                     |                               |  |  |
| X  | 35.66                         | 35.00                                  | 23.88                                    |
| SE   | 1.16                          | 1.55                                   | 0.82                                     |
| <b>MENSTRUAL VAS</b>                           |                               |  |  |
| X  | 17.46                         | 19.75                                  | 31.18                                    |
| SE   | 5.49                          | 6.81                                   | 7.45                                     |
| <b>RSS SYMPTOMS</b>                            |                               |  |  |
| X  | 27.46                         | 20.91                                  | 25.29                                    |
| SE   | 6.90                          | 5.10                                   | 4.49                                     |
| <b>RSS HOURS</b>                               |                               |  |  |
| X  | 2.66                          | 0.66                                   | 3.29                                     |
| SE   | 1.63                          | 0.51                                   | 1.50                                     |
| <b>RSS PILLS</b>                               |                               |  |  |
| X  | 3.46                          | 0.66                                   | 1.88                                     |
| SE   | 1.40                          | 0.51                                   | 0.32                                     |
| <b>SURGERY</b>                                 |                               |  |  |
| X  | 1.73                          | 1.25                                   | 1.06                                     |
| SE   | 0.37                          | 0.35                                   | 0.42                                     |
| <b>CUMULATIVE VAS FOR OTHER PAIN PROBLEMS</b>  |                               |  |  |
| X  | 185.2                         | 157.91                                 | 192.71                                   |
| SE   | 38.7                          | 22.44                                  | 34.25                                    |
| <b>MEDICATION DOSE FOR OTHER PAIN PROBLEMS</b> |                               |  |  |
| X  | 1.27                          | 0.92                                   | 1.06                                     |
| SE   | 0.32                          | 0.40                                   | 0.34                                     |

### Characteristics of Dysmenorrhea

The present study provided more information on characteristics of dysmenorrhea than did the two previous studies. Within the context of the medical screening questionnaire, the RSS and the VAS for menstrual pain intensity, subjects were asked to report whether they experienced menstrual pain and if they did, to rate their pain as mild, moderate or severe. They were also asked to describe their last menstrual period in the following ways: To rate the frequency and severity of 18 common menstrual symptoms (RSS), to provide information on medication usage (RSS) and invalid hours (RSS) due to last menses as well as to rate the intensity of pain of last menses using the VAS. In addition to this information on dysmenorrhea typically obtained in all three studies reported here, subjects in this third study were also asked to provide information on the various temporal parameters of dysmenorrhea, number of ways of coping with it, and the degree to which dysmenorrhea interfered in their lives. The following variables were included in the CPEQ regarding dysmenorrhea:

- Age at menarche
- Age of onset of menstrual pain
- Number of years of menstrual pain
- Months per year menstrual pain occurred
- VAS rating of menstrual pain
- Medication usage
- Number of coping methods



- Number of areas of interference

All but three women (7%) in this sample (N = 44, age range 17-48) experienced dysmenorrhea for some time in their lives. On average, menarche starts at age 13.01 (SE = 0.24) and menstruation becomes painful at age 14.99 (SE = 0.64). It is experienced as such for about 6-8 months (SE = 0.24) every year for an average of 8 years up to the present time (SE = 0.90). Menstrual pain receives a rating of 46.10% (SE = 4.49) on the VAS, and requires about 2.51 of medication doses (SE = 0.64). Out of four coping methods listed, subjects chose an average of 1.86 (SE = 0.19) and out of 4 areas of interference, they chose an average of 1.41 (SE = 0.21). This is the general profile of the sample of 44 women employed in this study.

The sample is further divided into two groups of equal size according to whether subjects report dysmenorrhea at present (N = 22) or not (N = 22). The latter group is described as nondysmenorrheic in this section. Descriptive statistics are presented in Table 12.

T-tests for independent samples were performed to compare the two groups in terms of all the above variables. Differences were obtained for age, number of years of menstrual pain, and VAS rating of menstrual pain as usually experienced in the past or present. The dysmenorrheic group was significantly younger ( $\bar{X} = 28.41$ , SE = 1.57) than the nondysmenorrheic group ( $\bar{X} = 33.96$ , SE = 1.28),  $t(42) = 2.73$ ,  $p < 0.01$ ). A significant negative correlation between age and menstrual pain (VAS) has also been obtained,  $r(42) = -0.31$ ,  $t =$

**TABLE 12**  
**DESCRIPTIVE STATISTICS FOR VARIOUS PARAMETERS OF DYSMENORRHEA AT**  
**PRESENT AND/OR PAST**

|                                   | DYSMENORRHEA AT PRESENT<br>(N = 22) |      | DYSMENORRHEA IN PAST<br>(N = 22) |           |
|-----------------------------------|-------------------------------------|------|----------------------------------|-----------|
|                                   | $\bar{X}$                           | SE   | $\bar{X}$                        | SE        |
| Age (yrs)                         | 28.41                               | 1.57 | 33.96                            | 1.28 **   |
| Menarche (yrs)                    | 13.10                               | 0.39 | 12.95                            | 0.27 NS   |
| Age Pain<br>Started               | 16.14                               | 0.91 | 15.47                            | 0.79 NS   |
| Years Pain<br>Lasted              | 12.77                               | 1.40 | 4.95                             | 0.70 **** |
| Months/Year<br>Pain Occurred      | 6-8                                 | 0.30 | 6-8                              | 0.36 NS   |
| VAS Rating of<br>Menstrual Pain   | 56.50                               | 5.24 | 37.70                            | 6.68 ***  |
| # of Pills                        | 2.30                                | 0.47 | 2.82                             | 1.10 NS   |
| # Coping<br>Methods               | 1.91                                | 0.27 | 1.90                             | 0.28 NS   |
| # Areas of<br>Interference        | 1.86                                | 0.29 | 1.22                             | 0.33 NS   |
| VAS Last Menstrual<br>Period Pain | 40.27                               | 5.46 | 6.82                             | 2.49 **** |
| RSS Symptoms                      | 33.36                               | 5.10 | 16.31                            | 2.95 **   |
| RSS Hours                         | 4.41                                | 1.50 | 0.32                             | 0.27 **   |
| RSS Pills                         | 3.14                                | 0.95 | 1.05                             | 0.38 *    |

\*  $p < 0.05$

\*\*  $p < 0.01$

\*\*\*  $p < 0.0001$

\*\*\*\*  $p < 0.00001$

2.09,  $p < 0.05$ . The older the women, the lower the pain experienced during the last menstrual period. Inspection of Table 11 shows that older women (both parous and nulliparous) provided lower ratings of menstrual pain as compared to the younger women. Also, whereas the dysmenorrheic group has been experiencing menstrual pain for an average of 12.77 yrs (SE = 1.40), the nondysmenorrheic group only experienced menstrual pain for an average of 4.95 yrs in the past (SE = 0.70),  $t(39) = 4.70$ ,  $p < 0.0001$ . No significant differences were found for age of onset of menstrual pain. Both groups began to experience menstrual pain at about the same age (15-16 yrs of age). Women who report dysmenorrhea at present, rate their pain on average at about 56.5% (SE = 5.24) whereas those who reported dysmenorrhea in the past rated their pain at about 37.70% (SE = 6.68). Significant correlations have also been obtained between the latter variable and number of years of dysmenorrhea. The more the years of dysmenorrhea, the higher the rating of menstrual pain. However, the two groups did not differ in medication usage, number of coping methods, and degree of interference of menstrual pain in different aspects of their lives. This comparison between the two groups is meaningful only for the time that both groups were experiencing menstrual pain, not for the present time.

Naturally, the two groups differed in terms of their most recent menstrual symptomatology and other menstrual pain measures (RSS and VAS) ( $p < 0.05$ ) (See Table 12). Chi-square tests of association

in the two groups revealed significant differences in terms of the number of women who spent additional hours in bed (invalid hours),  $\chi^2 = 9.40$ ,  $df = 1$ ,  $p < 0.01$ , and used medication,  $\chi^2 = 4.54$ ,  $df = 1$ ,  $p < 0.01$  to counteract menstrual pain in their last menstrual period.

Whereas 14 dysmenorrheic women out of 22 (64%) spent extra time in bed during their last menstrual period, only 4 nondysmenorrheic women out of 22 (18%) did so. Also, whereas 16 out of 22 (73%) of the former group took medication, only 9 out of 22 (41%) of the latter group did so. Thus, spending additional time in bed and taking medication are both associated with the experience of dysmenorrhea.

T-tests for independent samples revealed no differences between the two groups in terms of their reports of number and cumulative degree of other pain problems as well as number of surgeries ( $p > 0.05$ ). Again, the two groups did not differ in their responses to cold pressor pain. Descriptive statistics for these variables in the two groups are presented in Table 13.

#### Tolerance to Cold Pressor Pain

This measure of cold pressor pain was highly and positively associated with both the other measures of cold pressor pain, namely, threshold and VAS pain ratings,  $r(42) = 0.52$ ,  $t = 3.95$ ,  $p < 0.001$ , and  $r(42) = 0.37$ ,  $t = 2.62$ ,  $p < 0.02$ , respectively (see Table 9).

**TABLE 13**  
**DESCRIPTIVE STATISTICS FOR CPEQ MEASURES AND COLD PRESSOR MEASURES IN**  
**DYSMENORRHEA AT PRESENT AND/OR PAST**

|  | DYSMENORRHEA AT PRESENT |       | DYSMENORRHEA IN PAST |       |     |
|--|-------------------------|-------|----------------------|-------|-----|
|  | X                       | SE    | X                    | SE    |     |
| <b>CEPQ</b>  |                         |       |                      |       |     |
| # Surgeries  | 0.91                    | 0.23  | 1.50                 | 0.28  | NS* |
| # Other Pain Problems                                  | 3.73                    | 0.53  | 3.00                 | 0.39  | NS  |
| Cumulative VAS for Other Pain Problems                 | 198.05                  | 29.81 | 158.73               | 24.60 | NS  |
| <b>COLD PRESSOR PAIN MEASURES</b>                      |                         |       |                      |       |     |
| Threshold  | 11.40                   | 1.24  | 14.12                | 1.63  | NS  |
| Tolerance  | 31.42                   | 4.74  | 40.12                | 5.16  | NS  |
| VAS Rating   | 54.41                   | 3.76  | 56.09                | 3.45  | NS  |
| * Two-tailed tests were nonsignificant ( $p > 0.05$ ). |                         |       |                      |       |     |

Tolerance was also positively but marginally associated with menstrual symptomatology when examined in the whole sample,  $r(42) = 0.26$ ,  $t = 1.72$ ,  $p < 0.10$ . This correlation between tolerance and menstrual symptomatology reached significance in the group of 15 parous women,  $r(13) = 0.56$ ,  $t = 2.44$ ,  $p < 0.05$ , and became highly significant in the group of the 22 presently dysmenorrheic women,  $r(20) = 0.65$ ,  $t = 3.82$ ,  $p < 0.001$ , whereas it dropped to zero in the group of nondysmenorrheic women,  $r(20) = -0.02$ . Moreover, when this correlation was examined in a subgroup of 15 women with the most frequent and severe dysmenorrhea at present (over 6-8 mos/yr) (see Table 14), it emerged as highly significant,  $r(13) = 0.71$ ,  $p < 0.005$ .

**TABLE 14**  
**DESCRIPTIVE STATISTICS FOR MEASURES OF DYSMENORRHEA AND PAIN**  
**SENSITIVITY IN THE COLD PRESSOR IN A SUBGROUP IN WHICH DYSMENORRHEA AT**  
**PRESENT OCCURS 6-8 MONTHS/YEAR OR MORE**  
**(N = 15)**

|                    | $\bar{X}$ | SE   |
|--------------------|-----------|------|
| Age                | 28.13     | 2.03 |
| VAS Menstrual Pain | 50.33     | 6.20 |
| RSS Symptoms       | 38.66     | 6.07 |
| RSS Hours          | 5.53      | 2.14 |
| RSS Pills          | 4.07      | 1.31 |
| Threshold          | 11.99     | 1.62 |
| Tolerance          | 34.23     | 6.67 |
| VAS CP             | 60.80     | 3.83 |

**Significant Correlations (Two-tailed tests)**

1. VAS Menstrual Pain with VAS Cold Pressor Pain  
 $r(13) = 0.53, p < 0.05$
2. RSS Symptoms with Tolerance,  $r(13) = 0.71, p < 0.005$
3. RSS Symptoms with RSS Pills,  $r(13) = 0.55, p < 0.05$
4. Threshold with Tolerance,  $r(13) = 0.65, p < 0.01$

**One-tailed tests**

1. Age with Threshold,  $r(13) = 0.48, p < 0.05$

## DISCUSSION

The findings of significant correlations between cold pressor pain threshold and tolerance replicated those of our previous studies and other investigators (Ashton, Ebenezer, Golding, & Thompson, 1984; Aberger & Denney, 1983; Clark & Bindra, 1956; Hapidou & Lamping, 1988; Hapidou & deCatanzaro, 1987). The other main findings of this study will be discussed below:

### Effects of Childbirth Pain Experience

Between groups analysis of variance showed that the variable of interest in considering its effects on responsiveness to laboratory-induced pain is not age per se but the experience of childbirth pain. If age was the most relevant variable here, then, the groups of women matched for age would have had identical pain thresholds irrespective of whether they had experienced childbirth pain or not. The analysis performed here separated the effects of age and previous childbirth pain experience by comparing two groups of the same age differing only in childbirth pain experience with a group of younger women without childbirth pain experience. In order to have a more complete design, a group of younger women with childbirth pain experience should have been included. However, due to the nature of the population from which subjects were sampled, the latter group would have been very difficult to obtain. University students of that



age group are not likely to have children. However, it would be interesting to employ a younger group with childbirth pain experience in order to see if they also exhibit higher cold pressor pain thresholds. This is an area towards which future research could be directed. The only similar study in the literature (Winsberg & Greenlick, 1967) that utilized a group of younger mothers (mean age 21 yrs) than the present study (mean age 35.66 yrs) reported more conservative judgments of pain in the older women (mean age of 25.3 yrs) as compared to the younger women (mean age of 21.3 yrs). Thus, even though this study was dealing with clinical and not with laboratory pain, differences could be detected in groups of women in their early and mid-twenties, as related to parity. However, these differences were assessed in terms of the physicians' and nurses' judgments of women's reactions to labor pain. They were not based on the women's own reports.

Only threshold was significantly affected by childbirth pain experience. Neither cold pressor tolerance nor pain ratings were significantly influenced by the experience of childbirth pain. Tolerance showed the same tendency as threshold but the results were not significant. So far, in all our studies, one consistent finding emerges: out of three measures employed to measure sensitivity to cold pressor pain, threshold alone always exhibits the effects of the independent variable. Despite significant correlations between threshold and tolerance, the overlap is not enough to allow tolerance

to vary significantly as well. Usually, tolerance is a far more variable measure than is threshold (The variability increases the mean-squares error in ANOVA which then results in decreasing the F value). The least variable measure of all is the VAS pain rating. However, this measure, despite its low variability and consistency, was only once influenced significantly by the independent variables (in the second study of this series). In the present study, VAS cold pressor pain ratings were only found to be significantly correlated with tolerance and with VAS menstrual pain ratings. Based on the anecdotal information which partly constituted the rationale for this study, and on predictions derived from the adaptations-levels hypothesis concerning this study, VAS cold pressor pain ratings were expected to be lower in older and/or parous women (high pain experience). However, judgment of pain intensity was not the variable influenced by pain experience as defined in this study. Rather, the initial perception of the presence of pain (detection) was the variable influenced by pain experience in terms of childbirth pain. However, once parous women detect the pain, they tolerate it for the same amount of time and rate it as intensely as all nulliparous women. All cold pressor measures were positively correlated in the group of the 15 parous women, which is largely consistent with the findings obtained from the whole sample. That is, the higher the threshold, the higher the tolerance and pain ratings tended to be. This is the group that takes the longest to perceive cold pressor pain (6-9

seconds later than the other groups) and yet, it exhibits the same tolerance as the other groups and rates this pain no differently than the other groups. Despite the fact that pain takes longer to be perceived, it is experienced with the same intensity as in the other groups and bears the same relationship to tolerance and pain ratings as in the other groups. However, correlations between these measures and the absence of significant differences between the groups in tolerance and pain ratings suggest that only aspects of pain threshold independent of those shared by the other variables, are modified by the painful experience of previous labor. These may be the physiological aspects of threshold (Merskey & Spear, 1964).

Tolerance has been considered to be a psychological variable largely dependent on a variety of cognitive and cultural factors (Woodrow et al., 1972). It has been shown repeatedly that pain tolerance is influenced by various cognitive manipulations (Turk et al., 1983). The fact that pain tolerance does not show any differences between groups may be due to the fact that no cognitive or instructional approach was employed in this study. The lack of any such manipulations resulted in maintaining constant (although variable) average levels of tolerance across the different conditions.

It may be that women who have experienced labor pain either have a lower sensitivity or a higher criterion in their detection of pain than women who have not yet experienced labor pain. Given the nature of the pain stimulus and pain measures employed in this

investigation, one cannot separate these aspects of threshold. Signal detection analysis is needed for this purpose. Perhaps, these results should be replicated with a method amenable to signal detection, for example radiant heat detection like that used by Goolkasian (1980, 1983). However, the use of signal detection analysis to differentiate between changes in pain sensitivity and response criteria has been criticized by many investigators (McCreery & Bloedel, 1978; Rollman, 1979). Also, it is not possible to use signal detection with certain pain inducing stimuli. There are already differences in pain responses depending on the method of pain induction used.

Differential analysis of these pain responses would only add to the complexity of interpretation. This methodological and analytical problem might be illustrated with the following example: signal detection procedures were used by Goolkasian and Rimer (1984) to study pain reactions in pregnant women. These investigators found that criterion changes in the last two weeks of pregnancy resulted in the women's increased willingness to report pain induced by radiant heat stimuli. However, a study employing a different pain induction stimulus, namely pressure from an inflated sphygmomanometer, found an increase in pain and discomfort thresholds during the last 10 days of pregnancy (Cogan & Spinnato, 1986). These results were explained in terms of increases in beta-endorphin in late pregnancy and they were also in agreement with those obtained in rats (Gintzler, 1980). The aforementioned studies report contradictory findings in that a higher

response criterion cannot explain increases in pain threshold. This disagreement may be due to the different pain inducing stimuli employed in these studies.

The findings of the present study indicate that experience of childbirth pain is powerful enough to modify women's threshold to cold pressor-induced pain. However, it may be that it is not the experience of childbirth pain per se which is responsible for these findings, but rather the experience of childbirth preparation classes. It is possible that parous women are able to utilize the relaxation and breathing exercises that they learned in their prenatal classes for long periods of time following their childbirth experience. This is possible, particularly in light of Worthington's (1982) findings. This investigator reported that pregnant women who managed the cold pressor pain well, also managed the pain of childbirth well, in contrast to pregnant women who did not manage the cold pressor pain very well. The former reported less childbirth pain and requested less medication during delivery than the latter. This finding suggests that pain management techniques are generalizable from one situation to another.

The effects of childbirth preparation techniques on raising pain perception threshold and thus diminishing pain have been demonstrated in several studies (Mulcahy and Janz, 1973; Norr, Block, Charles, Meyering & Meyers, 1977; Stevens & Heide, 1977; Stone-Demchik-Stone & Horan, 1977). However, some other studies have shown

that prepared childbirth training affects the emotional reactions to pain but not pain intensity itself (Davenport-Slack & Boylan, 1974; Javert & Hardy, 1950). No explicit information was obtained in this study on the experience of psychoprophylactic childbirth techniques. It is not known how many of the parous women in the study attended prepared childbirth classes. It is suspected, though, based on previous reports, that about 20% of these women did (Davenport-Slack and Boylan, 1974).

The Post Experimental Questionnaire was not employed in this study. Information on the PEQ might have shed some light into this hypothesis. It would be interesting to conduct a study employing groups of mothers that differ only in terms of prenatal training. If it is found that this variable exerts a significant long term influence on cold pressor pain threshold then the potential clinical utility of such training for the long term management of pain is obvious.

There are still alternative interpretations as to the threshold differences between parous and nulliparous women. The experience of parenting rather than that of childbirth may be responsible for these effects. It is a well known fact that parents consider their needs secondary to those of their children. This may render parents, especially the mothers who are much more involved with their children, more "stoical" and aloof when encountering painful events. It has already been mentioned in previous discussions that

some women remarked that they would tolerate a lot more pain if that meant saving their child's life. Thus, according to this interpretation, mothers would be less sensitive to pain than non-mothers. In order to separate the effects of childbirth pain and parenting (or motherhood), a study should be designed to compare pain responsiveness in natural and adopted parents. If childbirth pain experience is the relevant variable then the natural mothers would show lower pain responsiveness (higher thresholds) than the adopted mothers. If, on the other hand, motherhood is the relevant variable, no differences would be observed in the two groups.

Another interpretation related to the above is that mothers who are highly involved with housework become desensitized as it were, in their hands. Again, some women remarked that the cold pressor test was not "such a bad experience" because they were used to putting their hands in cold water for housework purposes. Again, this would be related to motherhood, because women with children are also likely to have more increased demands for housework.

The finding of differential sensitivity to laboratory pain as a function of previous childbirth pain experience (or motherhood), has not been reported before. As such, it deserves further investigation.

### Dysmenorrhea

Although menstrual pain had started around the same time for the groups of women with present and/or past experience of

dysmenorrhea (between 15-16 years of age), occurred for about the same number of months (6-8) per year, required the same amount of medication usage, and the same number of coping strategies, and interfered with the subject's life in the same degree, it was rated significantly higher by the women who still experience it now. This may be explained in terms of recency effects, that is, women who still have menstrual pain remember the degree of intensity of that pain better than those who used to have that pain in the past and are now reporting it retrospectively. However, the fact that the two groups differ in terms of chronicity may render comparisons of this sort unreliable.

With respect to the relationship between parity and dysmenorrhea already discussed in clinical and epidemiological literature, the present study failed to support previous reports of the negative association between the two variables (Akerlund, 1979; Andersch & Milsom, 1982; Renear, 1984; Wildman & White, 1986). Even though claims have been made about degeneration of uterine nerves following childbirth, the present study found no significant negative correlations between parity (number of children born) and measures of dysmenorrhea ( $p > 0.05$ ). According to the nerve degeneration hypothesis, one would expect that multiple childbirths would have had an additive effect on nerve degeneration and would subsequently decrease dysmenorrhea. This would result in decreasing menstrual symptoms and pain, medication usage, and invalid hours in multiparous



women. Despite the fact that only 4 out of 15 parous women reported dysmenorrhea (27%), this does not constitute adequate evidence in support of the above hypothesis. However, a significant negative correlation was obtained between age and the VAS rating of menstrual pain. This indicates that menstrual pain decreases with increasing age. This finding is consistent with previous reports (Wildman & White, 1986; Ylikorkala & Dawood, 1978), according to which dysmenorrhea is most common in women between the ages of 17-25 years and tends to subside later on.

The finding of no association between dysmenorrhea and other kinds of pain supports that obtained in the first study with respect to the Pain Diary. According to the results of the Pain Diary, the dysmenorrheic group was not more or less likely than the nondysmenorrheic group to report the experience of other pain problems during the month. Again, no significant correlations were found between measures of dysmenorrhea (RSS and VAS for menstrual pain) and number or cumulative degree of other kinds of pain. Also, number of surgeries was not correlated with any of the dysmenorrhea variables.

The finding of the significant correlation obtained between medication usage for other pain problems and dysmenorrhea may simply show that the same underlying factors that predispose women to take medication in one situation, i.e., low back pain or headache, also operate in another situation, i.e., dysmenorrhea.

Positive correlations were obtained between cold pressor

threshold and tolerance and between tolerance and VAS pain ratings. These findings suggest that subjects who take longer to feel cold pressor pain also tend to leave their hand in the cold pressor longer and to report a high degree of pain. The longer the tolerance the higher the pain rating. Thus, these women keep their hand in the water for as long as they do, not because they feel less pain as it would be suggested by a negative correlation between the two variables but because they persist longer despite the pain. The positive association between tolerance and pain ratings may yet support the claim that tolerance is a psychological variable. Women who keep their hand in the water longer report pain levels accordingly. This relationship is shown both in parous (N = 15) and nonparous women of both groups (N = 29).

The marginal positive association between menstrual symptomatology and cold pressor pain tolerance may suggest that women who experience a high degree of menstrual symptoms also tend to show longer persistence behavior in the cold pressor test. Again, this finding can be used to support an adaptation-levels or a habituation hypothesis. Women who are used to experiencing menstrual discomfort are more likely to show longer persistence behavior in an uncomfortable laboratory situation. This finding was not manifested in the two previous studies. This may be due to the fact that these studies utilized a younger group of women (around 20 yrs of age). As such, younger women, despite the fact that they report a high degree

of menstrual symptomatology, may not attach the same meaning to symptoms as do older women. Older women may tend to have more demands upon their time than do younger women. Learning to tolerate severe symptoms may be a necessary adaptation mechanism for them in order to be able to deal with all demands. It would be interesting to explore the relationship between age and menstrual attitudes in this respect.

It is noteworthy that a small number of significant results can be expected in any study when making a large number of comparisons simply as a result of Type I error. It is therefore possible that some of the significant results of this study are only statistical artifacts, particularly as a 5% significance level was reported for some of the statistical tests for correlations.

## SECTION VI. CONCLUSIONS

Dysmenorrhea: Dysmenorrhea is both a pain phenomenon and a significant part of menstruation. Both pain and menstruation are multidimensional phenomena. As such, dysmenorrhea cannot be seen independently of all the attitudes and views surrounding menstruation (McKeever, 1984; Snow & Johnson, 1978).

Investigation of the latter aspect of dysmenorrhea, however, was beyond the purposes of this study and awaits further investigation. Future research should be directed at examining the complex phenomenon of dysmenorrhea as a function of changing attitudes towards menstruation in our society. It is a well known fact among investigators in many disciplines that menstruation and its consequences are imbued with a variety of cultural beliefs, attitudes, myths and taboos (Dalton, 1969; Gannon, 1981; Snowden and Christian, 1983). Some informal and formal observations from the above studies support this view. Despite the widespread reports of physical discomfort associated with menstruation, few women actively seek relief of pain. A few women use medication while a few more take more rest. While the measures of menstrual pain (VAS), symptoms,

medication usage, and invalid hours (RSS) are correlated in all the studies reported here, the measures of medication usage and invalid hours are highly variable. This indicates that most women are willing to accept the physical discomfort brought about by the experience of menstruation. Thus, they also accept pain as natural and inevitable. According to anecdotal information obtained from some subjects' verbal reports, menstrual discomfort is identified as a "fact of life" by young women. Following debriefing in the first study, when subjects found out about the relevance of the study to menstrual pain, some said that they did not even think of reporting menstrual pain in their pain diaries because such pain was taken for granted. Less than 50% of dysmenorrheic women reported menstrual cramps/pain in their pain diaries. Also, when subjects were asked to indicate whether they experienced menstrual pain during the medical screening questionnaire interview, some did not understand what was meant by menstrual pain and responded by asking if that meant cramps. This shows an unwillingness to identify menstrual discomfort as painful. Menstrual discomfort was something expected and predictable, and taken for granted by most young women. This explains why some dysmenorrheic women had not sought medical help for their dysmenorrhea. They viewed it as an inevitable and "natural" condition, something that would "always be there". These observations also support the findings of Snowden and Christian (1983) from a cross-cultural study of women's patterns and perceptions of menstrual

bleeding. When the experimenter discussed the possible etiology of dysmenorrhea in terms of prostaglandins, and treatment with prostaglandin inhibitors, several subjects said that they were not aware of such "developments" and that they "did not like to take pills, anyway". The present comments by no means advocate a view of menstruation-as-illness. However, the incidence of dysmenorrhea is such that it requires some degree of rational treatment. It is not long ago that women were told that it was "all in their heads", and different personality abnormalities were hypothesized to account for it. }

However, systematic and direct investigation of menstrual attitudes was not investigated here. Rather, these conclusions were drawn while attempting to examine dysmenorrhea as a pain phenomenon in the laboratory. An attempt was made to obtain a laboratory analogue of menstrual pain. It was found that overall, dysmenorrhea does not lend itself to such analogues. Women with menstrual pain were different from women with relatively pain free menstrual periods only once (Study 2), and in only one cycle phase (follicular), with respect to only one pain measure (VAS pain ratings). Thus, experience of menstrual pain is not sufficient to influence responsiveness to laboratory pain induced by the cold pressor test. These results, taken together with those reported in earlier literature, lead us to conclude that dysmenorrheic women cannot be distinguished from nondysmenorrheic women in pain sensitivity. They are neither more or

less sensitive to pain than nondysmenorrheic women. This has already been demonstrated with a variety of laboratory pain induction techniques, including those producing pain most analogous to clinical pain.

**Menstrual Phase Effects:** Although some consistency was obtained with regards to follicular-luteal phase differences in pain threshold, the mechanisms by which hormonal levels affect pain threshold are not well understood. Future research should attempt to correlate hormonal levels with pain threshold across the cycle.

**Childbirth Pain Experience:** This result has never before been reported in the literature. Labor pain was examined in its own right by Melzack and his colleagues (1981) and found to be outranked in intensity only by amputation and causalgia. It is therefore not surprising that it would have such an intense effect on women's subsequent perception of pain. However, more research is needed in order to replicate this effect using a variety of laboratory techniques.

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## APPENDIX I

TABLE 1

## ----- Studies on the Effects of Menstrual Cycle Phase on Pain Sensitivity -----

| Study                  | Subjects  | Methods   | Phases  | Results  |
|------------------------|---|---|---|--|
| Herren (1933)          | -Normally menstruating women                                      | Two-point threshold for pressure with weight stimuli      | Intermenstrual<br>Premenstrual.....<br>Postmenstrual              | Lowest thresholds<br><br>No statistical analysis |
| Procacci et al. (1974) | -Normally menstruating women<br>-Oral contraceptive users<br>-Men | Radiant Heat (dolorimeter) thresholds                     | Ovulatory.....<br>Premenstrual<br>Menstrual.....<br>Postmenstrual | Lowest* threshold<br><br>Highest* threshold      |
| Tedford et al. (1977)  | -Normally menstruating women<br>-Oral contraceptive users<br>-Men | Electric Shock Avoidance Threshold                        | Ovulatory.....<br>Premenstrual<br>Menstrual<br>Postmenstrual....  | Highest* threshold<br><br>Lowest* threshold      |
| Goolkasian (1980)      | -Normally menstruating women<br>-Oral contraceptive users<br>-Men | Radiant Heat (dolorimeter) thresholds<br>Signal Detection | Ovulatory.....<br>Premenstrual<br>Menstrual<br>Postmenstual       | Highest* Discriminability                        |

Source: Compiled by the author \* Only for normally menstruating women

## APPENDIX I (continued)

TABLE 2

## Studies on the Effects of Dysmenorrhea on Pain Sensitivity

| Study              | Subjects  | Methods   | Results  |
|--------------------|---|---|--|
| Haman (1944)       | -Dysmenorrheic<br>-Nondysmenorrheic<br>-Postmenopausal<br>Women<br>-Men | Pressure Thresholds<br>(sensimeter)                       | Lowest<br>thresholds for<br>dysmenorrheic<br>women<br><br>-No statistical<br>Analysis    |
| Cox & Meyer (1978) | -Dysmenorrheic<br>-Nondysmenorrheic<br>-Normative Control<br>Women      | Muscle ischemia<br>Thresholds<br>(blood pressure<br>cuff) | No differences<br>between pre-<br>and post-treatment<br>of systematic<br>desensitization |
| Goolkasian (1983)  | -Dysmenorrheic<br>-Nondysmenorrheic<br>Women                            | Radiant Heat<br>(dolorimeter)<br>Signal Detection         | Highest Discriminability<br>for nondysmenorrheic<br>women in the ovulatory<br>phase      |

Source: Compiled by the author

## APPENDIX II

## MEDICAL SCREENING

## RULES FOR EXCLUDING SUBJECTS FROM PARTICIPATION

A subject will be excluded from participation in the study under any of the following circumstances:

1. There is evidence of present medical disorder that the experimenter has reasonable reason to believe might be exacerbated by participation;
2. The subject reports a current serious medical problem or a serious medical problem recently enough that the subject may not yet have fully recovered her health;
3. The subject reports a significant, ongoing cardiovascular disorder or reports having had a cardiovascular problem that may recur;
4. The subject reports that she is or may be pregnant;
5. The subject reports a problem in the past that suggests she may be more adversely affected than most people by a brief, stressful experience;
6. The subject has taken any analgesic or mood altering drugs within the past 24 hours, or has been receiving such medication regularly.

APPENDIX II (cont.)

MEDICAL HISTORY

Subject \_\_\_\_\_ Date \_\_\_\_\_

Age \_\_\_\_\_ Do you smoke? \_\_\_\_\_ Yes, \_\_\_\_\_ No

Review of Symptoms: Check any which you frequently experience.

Chills \_\_\_\_\_ Fever \_\_\_\_\_ Cold \_\_\_\_\_ Cough \_\_\_\_\_ Headache \_\_\_\_\_ Fainting \_\_\_\_\_

Dizziness \_\_\_\_\_ Chest Pains \_\_\_\_\_ Shortness of Breath \_\_\_\_\_ Labored

Breathing when at rest \_\_\_\_\_ Labored Breathing on Exertion \_\_\_\_\_

Palpitations \_\_\_\_\_ Ankle Edema \_\_\_\_\_ Blueness of Skin \_\_\_\_\_ Leg Cramps \_\_\_\_\_

Nosebleeds \_\_\_\_\_ Spitting Blood \_\_\_\_\_ Blood in Urine \_\_\_\_\_ Vomiting Flood

Easy Bruisability \_\_\_\_\_ Infections; at present \_\_\_\_\_ other \_\_\_\_\_

Pain of any sort. For example

|                | Y/N   |      |     |        | See MD | Prescr Medic | Counter Drugs | Home Remedies |
|----------------|-------|------|-----|--------|--------|--------------|---------------|---------------|
| Headache       | _____ | Mild | Mod | Severe | ___    | ___          | ___           | ___           |
| Low Back Pain  | _____ | Mild | Mod | Severe | ___    | ___          | ___           | ___           |
| Menstrual Pain | _____ | Mild | Mod | Severe | ___    | ___          | ___           | ___           |
| Other          | _____ | Mild | Mod | Severe | ___    | ___          | ___           | ___           |

Comment \_\_\_\_\_

Past Medical History Check those which are applicable.

Scarlet Fever \_\_\_\_\_ Rheumatic Fever \_\_\_\_\_ Heart Trouble \_\_\_\_\_ Heart Murmur \_\_\_\_\_

Elevated Blood Pressure \_\_\_\_\_ Eczema \_\_\_\_\_ Asthma \_\_\_\_\_ Hay Fever \_\_\_\_\_

Infectious Mononucleosis \_\_\_\_\_ Liver Disease \_\_\_\_\_ Kidney Disease \_\_\_\_\_

Anemia \_\_\_\_\_ Other \_\_\_\_\_

Comment \_\_\_\_\_



Family History: Check if applicable to any member of your immediate family

Easy Bruisability\_\_\_ Anemia\_\_\_ Prolonged Bleeding\_\_\_ Hemophilia\_\_\_

Sickle Cell Anemia\_\_\_ Other Blood Disorders\_\_\_ Other\_\_\_

Comment\_\_\_\_\_

Current and Recent Treatment:

Currently pregnant?\_\_\_ When did you have your last period?\_\_\_\_\_

How long did it last? Day it started\_\_\_\_\_ Day it ended\_\_\_\_\_

How regular are your periods? (i.e., every how many days on average\_\_\_\_\_)

When did you last visit a physician?\_\_\_\_\_

For what purpose? \_\_\_\_\_

Have you visited a psychiatrist, psychologist, or counsellor in the last year?\_\_\_\_\_

When?\_\_\_\_\_ What was the general nature of the reason (e.g., academic problems, personal problems, mental illness, etc.)?

What treatment have you received for such problems? \_\_\_\_\_

Current medications and drugs of any type - Are you taking oral contraceptives? IUD?

Other current treatment of any type (specify)\_\_\_\_\_

## APPENDIX III

## THE PHYSIOLOGY OF THE MENSTRUAL CYCLE

Pre-ovulation (follicular, post-menstrual). The hypothalamic follicle stimulating hormone (FSH) releasing factor causes the anterior pituitary to produce FSH which in turn promotes the development of an ovarian follicle and induces the ovary to secrete estrogens. As the circulating levels of estrogens increase, the endometrium undergoes a phase of proliferation. Levels of estrogens in the blood reach a peak prior to ovulation and this marks the beginning of the next phase.

Ovulation (Inter-menstrual). LH (lutenizing hormone) factor from the hypothalamus causes an increase in production of LH from the anterior pituitary. The ovum is released from the follicle and the follicle is then converted into the corpus luteum which now secretes not only estrogens but progestins into the bloodstream. Circulating levels of progestins which remain low during the pre-ovulatory stage now begin to increase and levels of estrogens fall. In this phase the endometrium is acted upon by estrogens and progestins. This has the effect of increasing the secretions of endometrial glands.

Post-ovulation (luteal). During this phase of the cycle the corpus luteum continues to secrete progestins and estrogens. The circulating levels of estrogen again increase reaching a smaller peak approximately six to ten days before menstruation. Thereafter, circulating levels of both hormones begin to fall as the corpus luteum begins to break down. This marks the beginning of the premenstrual period during which many of the psychological, physical and behavioral symptoms are reported as occurring.

Menstruation. The corpus luteum breaks down and hormone production ceases. The endometrium breaks down and is shed during the course of approximately 4-5 days.

From Fielding, D, & Bosanko, C. (1984):

Psychological aspects of the menstruum and the premenstruum.  
In. A. Broome & L. Wallace (Eds.), Psychology and Gynecological Problems.

Cold Pressor Test Protocol (Revised)

[Before subject's arrival, check: temperature of water, towel supply, position of room temperature bucket. Insert disk into drive. DLOAD "COLD". LOAD "COLD". Set tape to 000.]

Practice Trial

[Seat subject in chair which allows dominant arm to be beside tank. Ask that jewellery be removed. Turn on pump. Begin tape. Turn on TV.]

(TAPE) "This task involves immersion of your hand and forearm in ice water. This procedure may cause several different sensations including tingling, numbness, mild muscle cramping and pain. The procedure will not, however, cause any real harm, although it may cause temporary discomfort. The technique we are using is widely used by psychologists and physicians and has been shown to be completely safe and harmless."

(TAPE) "Now, before we begin the experiment you will have one practice trial. What I will ask you to do in a moment is to place your arm on the armrest with your fingers loosely grasping the strings."

(TAPE) "After I explain the instructions and you feel ready for the practice trial, I'd like you to lower your arm into the water by pushing down on the armrest as far as it will go. It is important to keep the armrest firmly down in the lowest position for as long as your arm is in the water."

(TAPE) "Again, as I said before, you may feel a number of different sensations while your arm is in the water. Some of these include tingling, numbness, mild muscle cramping, and pain. Some people notice some discoloration of their hand or arm, for example, white or red or blotchiness. This is completely natural and not in any way harmful to you and will rapidly decrease after you remove your hand from the water."

(TAPE) "Before you begin, I'd like you to get a feel for what the procedure is like by doing one practice trial. Take your arm, place it on the arm rest with your fingers loosely grasping the strings and when you hear the word 'Ready' lower your arm into the water until the armrest is down as far as it will go. You will be told to remove your arm after a brief interval. You are now ready for the practice trial. Lower your arm when you hear the word 'Ready'."

"Ready."

[Let 10 sec. elapse.]

(TAPE) "You may now remove your arm and use the towel beside you to dry it."

## APPENDIX IV (cont.)

Test Trial

[Set up video; focus on subject. Prepare for baseline by positioning room temperature water bucket in front of subject.]

(E) "Before beginning the test I'd like you to simply put your arm in this bucket of water for about a minute so that it gets used to the wet feeling.

[Begin videotaping for a 1 minute period. At end of 1 minute]

(E) "You can remove your arm from the bucket now and place it on the arm rest to get ready for the test. Do you have any questions? I'll now start the tape which will give you further instructions. Please do not lower your arm until you are instructed to do so."

[Start tape]

(TAPE) "You are now ready to begin the cold pressor test. This task involves two things; one to report when you first feel pain and two to keep your arm in the water as long as you possibly can. When you immerse your arm in the water you will immediately notice the cold sensation. However, what I would like you to indicate is when you first feel that the sensation becomes painful. Report the moment you first feel pain by saying 'NOW'. I would also like you to try to keep your arm in the water for as long as you possibly can. [Stop tape and ask questions].

(Tape) "Remember to keep the armrest down as far as it will go during the entire procedure until you stop. [Turn on camera] Whenever you're ready, you may begin by lowering your arm into the water."

[After subject has removed arm, give towel. Shut off tape.]

(E) "You may feel some discomfort and this discomfort may be worse immediately after removing your arm from the water. However, this will decrease rapidly and is only temporary. Also, any discoloration in your arm (e.g. redness or blotchiness) is completely natural and not in any way harmful to you."



Appendix V

Retrospective Symptom Scale (RSS)

Date \_\_\_\_\_

Date your last period started \_\_\_\_\_

Date your last period ended \_\_\_\_\_

Date of next expected period \_\_\_\_\_

Please rate each of these conditions for frequency of and severity of occurrence, on the basis of your experience of your last menstrual period. Total frequency refers to the total amount of time you experienced a condition during your last period, while average severity refers to the average level of pain or distress of the condition when it did occur.

Total Frequency Ratings

- 0. Did not occur
- 1. Lasted less than 3 hr.
- 2. Lasted 3-7 hr.
- 3. Lasted an entire day
- 4. Lasted several days

Average Severity Ratings

- 0. Not noticeable
- 1. Slightly bothersome
- 2. Moderately bothersome
- 3. Severely bothersome
- 4. Very severely bothersome

Condition

Frequency Rating

Severity Rating

|                  |       |       |
|------------------|-------|-------|
| cramps           | ----- | ----- |
| nausea           | ----- | ----- |
| vomiting         | ----- | ----- |
| loss of appetite | ----- | ----- |
| headaches        | ----- | ----- |
| backaches        | ----- | ----- |
| leg aches        | ----- | ----- |
| dizziness        | ----- | ----- |
| weakness         | ----- | ----- |
| diarrhea         | ----- | ----- |
| facial blemishes | ----- | ----- |
| abdominal pain   | ----- | ----- |
| flushing         | ----- | ----- |
| sleeplessness    | ----- | ----- |
| general aching   | ----- | ----- |
| depression       | ----- | ----- |
| irritability     | ----- | ----- |
| nervousness      | ----- | ----- |

How much additional time did you spend in bed because of menstrual problems over the duration of your last menstrual period? Give estimated total number of hours: \_\_\_\_\_ hours.

Considering the number of pills (any kind) taken for menstrual relief and the number of days you take such medication, how many pills did you take last menstrual period? \_\_\_\_\_ What kind? \_\_\_\_\_

## Appendix VI

### Post Experimental Questionnaire

1. In a few sentences, describe your thoughts and feelings about the study you've just completed. Specifically, what is your overall impression of the experiment; what did you think it was all about?
2. Do you think that there was a clear distinction between the cold and the painful sensation? If yes, what's the main difference? If not, how did you determine the pain point?
3. What factors made you keep your arm in the water for as long as you did? Describe any techniques that you might have been using to aid you in keeping your arm in the water for as long as you did, if applicable.
4. How did the Pain Diary influence you to pay attention to your body and any physical sensations that you might have had during the course of the study?
5. Any other comments?....  
Please feel free to express whatever thoughts and feelings you have about this study.

Thank you very much for participating.

APPENDIX VII



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Subject Consent Form

I agree to participate in a research study which will involve four half-hour laboratory sessions. I understand that I will be tested on a laboratory task while being videotaped and will complete some questionnaires related to the task. I will also try to keep a daily calendar of the types of pain that I may experience during the day as well as hours of sleep during the night before.

The laboratory task I will be tested on, called the cold pressor task, involves putting my arm in a tank of ice water. This procedure has been used frequently in previous research and does not involve any physical harm. The procedure may be painful although it will not cause any physical harm and I can discontinue at any point should it become too uncomfortable.

I understand that all information will be confidential and that a study number rather than my name will be used on all forms and on the videotape record. These data will be kept in private research files and will not be available to anyone other than project staff.

I further understand that I may ask questions about the study at any point and that I am free to withdraw consent and discontinue participation at any time. My cooperation is completely voluntary and there will be no penalty or prejudice should I decide to withdraw consent.

I understand that my participation in this study will only be useful to the experimenter if I complete all four sessions. I will receive two course credits in Psychology 1A6 for completion of the four sessions. If I should decide to withdraw from the study at any point after the first session, I will receive one course credit only.

I have read the above information and have had all my questions adequately answered. I agree to participate in this research study.

Signed \_\_\_\_\_

Student ID# \_\_\_\_\_

Date \_\_\_\_\_

Study conducted by:

Eleni Hapidou

Supervised by:

Dr. Donna Lamping



## Appendix VIII

### Debriefing Information Sheet

You signed up for a study involving four sessions, during which you had to immerse your hand and forearm in ice water and complete standard questionnaires. The purpose of this study was to investigate pain sensitivity in women with menstrual pain, otherwise known as dysmenorrhea, and women without menstrual pain. The reason we did not tell you at the beginning that this was a study of pain sensitivity was because we thought that this knowledge would influence your judgments and bias the results.

We assessed pain sensitivity by asking you to report when you first experienced pain (threshold) as well as by asking you to keep your arm in the water for as long as you could (tolerance). Before we could include you in the study, however, we had to make sure that the cold pressor test was not going to pose any health hazards for you. For this reason, we administered the medical screening questionnaire. During that screening, we also asked you some questions about any types of pain that you experience, such as menstrual pain. We needed this information in order to see if our participants suffered from menstrual pain (dysmenorrhea). This information was very important to us since we were interested in comparing how women with and without dysmenorrhea experience pain. Another important variable that we were interested in investigating in this study was how pain experiences varied throughout the monthly menstrual cycle. Therefore, the laboratory sessions corresponded to the four menstrual cycle phases. These are: Menstrual (Day 1-7); postmenstrual (Day 8-14); ovulatory (Day 15-21), and premenstrual (Day 22-28). Specifically, we wanted to determine whether pain perception in the two groups of women (dysmenorrheic versus nondysmenorrheic) varies or remains stable over the course of the menstrual cycle.

By videotaping you during the cold pressor test, we could also study non-verbal expressions of pain. Moreover, this study was undertaken in order to find similarities and/or differences between clinical (menstrual) and laboratory (cold-pressor) pain. For this reason, you completed the Dysmenorrhea questionnaire and rated the degree of pain experienced during the cold-pressor test. We also wanted to see if fatigue would influence your performance during the cold-pressor test. For this reason, we asked you to record the number of hours of sleep every night for the duration of the study. The reason we asked you to record types of pain experienced during the day was to see if there was any relationship between other types of pain, dysmenorrhea, and laboratory pain.



This study excluded women on oral contraceptives because there is evidence showing that pain perception in women on oral contraceptives is different from that of normally menstruating women.

Thank you very much for participating in our study.

#### Debriefing Information Sheet (REVISED)

You signed up for a study involving two experimental sessions, during which you had to immerse your hand and forearm in ice water and complete standard questionnaires. The purpose of this study was to investigate pain sensitivity in women with menstrual pain otherwise known as dysmenorrhea, and women without menstrual pain. The reason why we did not tell you at the beginning that this was a study of pain sensitivity was because this knowledge might influence your judgments and bias the results.

We assessed pain sensitivity by asking you to report when you first experienced pain (threshold) as well as by asking you to keep your arm in the water for as long as you could (tolerance). Before we could include you in the study, however, we had to make sure that the cold pressor test was not going to pose any health hazards for you. For this reason we administered the medical screening, questionnaire. During that screening, we also obtained menstrual cycle information, such as regularity and incidence of pain. This information was necessary in order to compare women with and without menstrual pain, and to arrange the experimental sessions according to cycle phase. Each laboratory session corresponded to either the pre- or post-ovulatory phase of the cycle. We were interested in comparing these two phases since previous research suggested some differences in pain perception. In general, we wanted to determine whether pain perception in the two groups of women varies or remains stable during these phases of the menstrual cycle.

Thank you very much for participating in our study.

## APPENDIX IX

CUMULATIVE PAIN EXPERIENCE QUESTIONNAIRE

This is an anonymous and confidential questionnaire designed to measure the total amount of physical pain that a woman may have experienced in her life. This includes menstrual pain, labor pain, and various other types of pain. Please try to answer all the questions that apply to you as precisely and concisely as possible.

1. Birthdate:.....
2. How old were you when your periods began?  
.....Years and .....Months
3. Have you ever had painful periods? No..... Yes.....
4. At what age did your periods become painful.....  
- For how many years?.....  
- How many days per month?.....
5. Give an estimate of how many months in a menstruating year (no pregnancies) your periods are (or were) painful:  
  
Never..... 1-2 mos/yr..... 3-5 mos/yr.....  
  
6-8 mos/yr..... 9-11 mos/yr..... Always.....
6. Please make a mark on the line indicating how painful your periods are (or were).  
  
No pain  
at all  
  
Maximum pain  
you can imagine  
  
|-----|
7. How many doses of painkillers do (or did) you take in the average menstrual period?.....  
  
- What kind(s).....
8. To cope with painful periods, do (or did) you do any of the following? Please check all those that apply to you.  
  
- go to bed for half-a-day or more.....  
  
- curl up with a hot water bottle or heating pad.....  
  
- use relaxation, distraction, or similar methods.....  
  
- other. Please specify.....

9. Do painful menstrual periods interfere with your life and plans? Please check all those that apply to you.

- |                                       |         |
|---------------------------------------|---------|
|                                       | Ratings |
| - having to cancel appointments....   | _____   |
| - staying home from work....          | _____   |
| - reducing usual activity at home.... | _____   |
| - interfering with sleep....          | _____   |

Now please rate the above from 1 to 4 according to how serious they are, with 1 being less serious and 4 most serious.

10. Have you, at any point, used contraceptive methods:  
 No..... Yes..... If yes, please check any of the following and specify for how long:

- Oral contraceptives. Specify type (name).....
- IUD..... - Diaphragm.....
- Condoms..... - Contraceptive foam(jelly).....
- Tubal ligation..... - Vasectomy.....
- Other.....
- Which method are you presently using?.....
- For how long?.....

11. Have you found your contraceptive method(s) to influence your menstrual periods in any way (e.g. increase/decrease flow, increase/decrease pain)? Please specify:

.....

.....

.....

If you have had children, please answer questions 12-14.

12. Please make a mark on the line(s) indicating how much labor pain or trouble you had at any delivery.

|            |                   |                                 |
|------------|-------------------|---------------------------------|
| Childbirth | No pain<br>at all | Maximum pain<br>you can imagine |
| 1st        | -----             |                                 |
| 2nd        | -----             |                                 |

|     |  |
|-----|--|
| 3rd |  |
| 4th |  |

13. Were any of your deliveries described as 'difficult'?  
 No..... Yes..... Which one(s)?.....

14. Did you have at any delivery (specify which one):

- general anaesthesia.....
- epidural (in the back).....
- pain killers.....
- other. Please specify.....

15. Have you had previous pain problems other than menstrual pain? No..... Yes..... If the answer is yes, please specify timing and indicate how much pain you felt for any of the following that apply to you.

For how long (yrs or mos or wks or days)

- dental pain .....

no pain at all Maximum pain you can imagine

|  |  |  |
|--|--|--|
|  |  |  |
|--|--|--|

- pain due to braces .....

|  |  |  |
|--|--|--|
|  |  |  |
|--|--|--|

- headache .....

|  |  |  |
|--|--|--|
|  |  |  |
|--|--|--|

- neck and shoulder.....

|  |  |  |
|--|--|--|
|  |  |  |
|--|--|--|

- arm .....

|  |  |  |
|--|--|--|
|  |  |  |
|--|--|--|

- low back .....

|-----|

- chest .....

|-----|

- abdominal  
(not menstrual;  
includes stomach,  
bladder, bowels) .....

|-----|

- pelvic pain .....

|-----|

- leg .....

|-----|

- knee .....

|-----|

- joint .....

|-----|

16. Have you had any surgeries?

| Year | Kind of operation | Was it helpful? |
|------|-------------------|-----------------|
| .... | .....             | Yes.... No....  |
| .... | .....             | Yes.... No....  |
| .... | .....             | Yes.... No....  |
| .... | .....             | Yes.... No....  |

17. How many doses of painkillers do you take in the average bad day?.....
18. Do you have pain right now? No.... Yes....
- What kind? .....
  - Do you suffer pain most of the time or very frequently?  
No.... Yes....
  - Have you experienced that pain in the past 2 weeks?  
No.... Yes....
19. Are you unemployed or unable to do your normal work at home on account of pain? Not a problem..... Yes.....
- 

Thank you for taking the time to complete this questionnaire.  
Please feel free to add any comments you might have.