PHYSICAL EXERCISE
AND THE PSYCHOLOGY OF
THE MENSTRUAL CYCLE

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Doctor of Philosophy

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The effect of physical exercise on emotional changes throughout the menstrual cycle has remained largely unexplored despite suggestions that it may help to alleviate premenstrual symptoms and symptoms of dysmenorrhea. Three studies were carried out to examine this association.

In the first, a sample of 342 women were surveyed to discover how they coped with menstrual cycle changes and how helpful these methods were. Physical exercise was found to be among the most helpful ways of coping. This is consistent with the popular contention that women who exercise experience fewer menstrual cycle related problems.

In the second study, a mood adjective checklist was constructed specifically for monitoring mood change in women. This questionnaire was then used to monitor menstrual cycle changes in 143 women who exercise and women who do not for one month. The greatest positive affect was seen in women who exercised 3 or more times a week and the least in sedentary women. Similar findings were revealed for negative affect. The differences between exercise groups were greatest during the premenstrual and menstrual phases suggesting that exercisers are to some extent protected from deterioration of mood before and during menstruation.
If these results are due to the effect of exercise, this begs the question: how might this effect be mediated? One mechanism through which the psychological benefits of exercise might be mediated is through an increased resistance to stress. How exercising and non-exercising women respond to a stressful laboratory task during different phases of the menstrual cycle was the subject of investigation in the third study. Results revealed that while the exercise group did indeed have a physiological protection from stress, their psychological responses did not differ from the non-exercisers. The results are discussed in relation to personality differences between exercisers and non-exercisers as well as psychological mechanisms of the exercise effect.
ACKNOWLEDGEMENTS

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1. DISORDERS OF THE MENSTRUAL CYCLE

Abstract

Dysmenorrhea and Premenstrual Syndrome are the two most prevalent menstrual cycle disorders with a tremendous range of incidence estimates. This chapter describes each disorder separately and reviews the physiological and psychological evidence concerning their aetiologies and treatments.

1.1 Introduction

The menstrual cycle is the result of highly regulated cyclic fluctuations of the protein hormones from the anterior pituitary that act on the ovary. These fluctuations are followed by corresponding fluctuations of steroid hormones from the ovary that act on the endometrium. Typically, the cycle is divided into five phases (Asso 1988). The first, the period of menstrual bleeding, is called the menstrual phase and occurs from days 1-5. During this time oestrogen levels are low which stimulates a rise of follicle stimulating hormone (FSH) from the pituitary. Following menstruation is the follicular phase where, under the influence of luteinizing hormone (LH) and FSH, a follicle is developed. Rising oestrogen levels leads to a thickening of the endometrial lining of the uterus. Around mid-cycle (days 13 - 15) is the ovulatory phase where one follicle ovulates. Following this is the luteal phase which is characterised by a decline in LH and FSH and a rise in oestrogen and progesterone. During the few days before menstruation is the premenstrual phase or late luteal phase where there is a
sharp decline in oestrogen and progesterone. **Figure 1.1** below illustrates these hormonal changes.

![Graph showing plasma hormone concentrations during the menstrual cycle](image)

*Figure 1.1 Plasma hormone concentrations during the menstrual cycle*

### 1.2 Dysmenorrhea

Dysmenorrhea or painful cramps during menstruation is one of the most common gynaecological complaints. Primary dysmenorrhea occurs when there is no macroscopically identifiable pelvic pathology (Dawood 1987). Discomfort is most
severe on the first or second day of menses. Pain is spasmodic and strongest over the lower abdomen but may radiate to the back and inner thighs. Accompanying symptoms may include nausea and vomiting, diarrhea, and even fainting and collapse. It is estimated that more than 50% of menstruating women experience dysmenorrhea regularly, about 10% of whom have severe and disabling symptoms with incapacitation for 1 to 3 days each month (Richardson 1990, Dawood 1987). This means that about 600 million working hours may be lost annually (assuming that women make up 42% of the work force). Thus, dysmenorrhea is a truly significant malady.

There is ample documentation that the direct cause of menstrual cramping and pain is abnormal contractility of the myometrium (Gannon 1989). It is widely held that the aetiology of this abnormal contractility places prostaglandins in a central role. These unsaturated fatty acids have potent actions on blood cells, smooth muscles, fat cells and nervous tissue and are found in almost every tissue in the body including menstrual fluid and the endometrium. Studies have demonstrated dramatically increased levels of prostaglandins in endometrial tissue during menstruation as compared to other phases of the cycle (Downie et al 1974, Willman et al 1976). It is believed that dysmenorrheic women have an excessive release of prostaglandins or an excessive sensitivity to their presence as differences in prostaglandin levels between normal and dysmenorrheic women during menses have been found in uterine washings (Pulkkinen et al 1987) and in the plasma (Lundstrom & Green 1978). Further evidence comes from research studying the effects of exogenous administration of
prostaglandins. Lundstrom et al (1976) induced severe cramps and spastic contractions with intravenous infusion of prostaglandins. Additionally, the similarity between the symptoms of dysmenorrhoea and the side effects produced by administering prostaglandins to induce abortion and labour has been reported by Halbert et al (1975).

Oral contraceptives became a popular treatment for primary dysmenorrhea when it was noted that women taking them reported a decrease in symptom severity (Metheny & Smith 1989). Oral contraceptives have been found to inhibit ovulation and endometrial development so that menstrual blood, production of prostaglandins and uterine contractility is reduced (Dawood 1986, Alvin & Litt 1982). Despite the efficacy of the pill, not all women can or wish to take it, particularly if it is solely to relieve menstrual symptoms.

Prostaglandin inhibitors therefore are the more favoured treatment for dysmenorrhea. A wide variety are currently available. For the majority of dysmenorrheic women these drugs have afforded significant or total relief of symptoms with minimal side effects (Stromberg et al 1981, Larkin et al 1979, Elder & Kapadia 1979, Schwartz et al 1984). In addition to relief of symptoms, the use of these drugs have shown significant reductions in prostaglandin levels in menstrual fluid collected in a cervical cup (Pulkkinen et al 1978) and from tampons (Chan et al 1983, Chan et al 1979). They have also been seen to reduce uterine contractions (Lundstrom et al 1976, Henzl et al 1979, Smith & Powell 1982, Csapo et al 1977). All of these studies vary considerably in their methodology with some lacking control and others being well
designed. Overall, the research provides impressive evidence for the use of prostaglandin inhibitors as a treatment for primary dysmenorrhea.

Since prostaglandins are released from tissue in response to squeezing or stretching, elevated levels of prostaglandins may be a response to the cramping and, in turn, serve to exacerbate but not initially cause it. Still open to question, therefore, is the cause of the elevated prostaglandins. Oxytocin and vasopressin influence uterine contractility and abnormal oestrogen and progesterone levels have also been implicated (Ylikorkala & Dawood 1978, Dalton 1964). As yet, empirical support for an aetiiological role for any of these hormones is lacking (Gannon 1989).

In spite of the clear physiological basis of dysmenorrhea and its treatment success, psychological factors have been implicated in its aetiology. In particular, the influence of attitudes towards menstruation has been salient. More recently, stress, as mediated by the autonomic nervous system, has been considered. Disruptive life events as a measure of stress modestly correlate with retrospectively reported frequency and severity of menstrual cycle symptomatology (Logue & Moos 1986, Gannon et al 1989, Metheny & Smith 1989). Negative life events and daily stressors have been found to correlate with retrospectively reported pain, water retention, behaviour change and the degree of menstrual bleeding (Woods 1985). The smooth muscle of the uterus and the vasculature that supplies it with blood is innervated by the sympathetic nervous system. As the myometrium contains both alpha and beta adrenergic receptors, it is therefore responsive to both adrenalin and noradrenalin. The autonomic response to environmental stress is typically one of enhanced sympathetic activity which would
lead to increased motility of the uterine muscle and vasoconstriction of the arterioles - both of which would act to increase pain (Gannon 1989). In this way, stress, anxiety or fear might increase a woman’s vulnerability to dysmenorrhea.

1.3 Premenstrual Syndrome

Disturbances in mood and behaviour in relation to the menstrual cycle have been described for centuries and may be one of the earliest recorded biobehavioural disorders (Rubinow et al 1988). Indeed, beliefs about the regulation of behaviour by the menstrual cycle were reported in the Talmud and the Bible, and descriptions of menstrual cycle related depression and mania were documented during the 18th and 19th centuries. Modern research on menstrually related mood disorders, however, is said to have begun with Robert Franks’ study in 1931 where he first described cyclic changes occurring before menses. Franks’ (1931) study was of 15 women who reported "premenstrual tension" (anxiety, mood lability, headache, fatigue and breast swelling) during the 7 - 10 days prior to onset of menses with cessation of symptoms soon after menstruation began. Since then, a wealth of research has been generated which claims that most women experience some symptoms of Premenstrual Syndrome (PMS) with estimates ranging from 5 - 40% reporting symptoms that are severe to disabling (eg. Andersch et al 1986, Reid & Yen 1981).
Investigations into the aetiology of PMS have taken two different perspectives resulting in alternative lines of research. From a biological perspective premenstrual changes are consequences of the hormonal changes that occur throughout the menstrual cycle; a psychological perspective, on the other hand, focuses on the psychological concomitants of the physiological changes and leaves open the possibility of complex social processes mediating the relationship between physiological and psychological changes (Parlee 1982).

Biological enquiry into the aetiology of PMS has, not surprisingly, implicated endocrine abnormalities. No single theory, however, has been consistently proven to be linked to symptoms of PMS. A list of biological aetiological suggestions are contained in Table 1.1 and psychological suggestions in Table 1.2. This discussion will be limited to those theories that are more than just speculative and have been substantially researched.

**Table 1.1 Suggested biological theories of PMS**

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<td>Oestrogen progesterone</td>
<td>Morton et al 1953, Smith 1975</td>
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<td>Altered activity of cortex</td>
<td>MacKinnon and Mackinnon 1956</td>
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<td>Plasma monoamine oxidase activity</td>
<td>Klaiber et al 1974, Belmaker et al 1974</td>
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<td>Mineralocorticoids</td>
<td>Janowsky et al (1973)</td>
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<td>Pyridoxine deficiency</td>
<td>Biskind &amp; Biskind 1943</td>
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<td>Prolactin</td>
<td>Horrobin et al 1971</td>
</tr>
<tr>
<td>Gonadotrophin imbalances</td>
<td>Backstrom 1975</td>
</tr>
<tr>
<td>Prostaglandins</td>
<td>Craig 1980, Jakubowicz 1983</td>
</tr>
<tr>
<td>Sodium-potassium</td>
<td>Varma 1983</td>
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<tr>
<td>Dopamine</td>
<td>Haspels 1983</td>
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Ovarian Hormones

Because PMS occurs at a time in the cycle when progesterone is normally at its peak, most theories attribute the symptoms to progesterone. It has been suggested that PMS sufferers produce too little progesterone (Mundy et al 1977, Backstrom & Corstensen 1974, Smith 1976, Endo et al 1978), or that the oestrogen-progesterone ratio is too high or too low (Israel 1938, Greene & Dalton 1953, Dalton 1964) or that, although the absolute quantities of progesterone and oestrogen may be normal, women who suffer from PMS have an abnormal physiological response to one or both of the hormones (Gannon 1985). The few studies in which women suffering from PMS have been compared to symptom-free women on levels of oestrogen and progesterone offer empirical validation for this theory (Smith 1975, Backstrom & Mattsson 1975, Dennerstein et al 1983). Perhaps most damaging to this theory are the data on the treatment effectiveness of progesterone (Gannon 1985). Though progesterone has been reported to be efficacious in treating PMS (Gray 1941, Rees 1953, Dalton 1977), double blind trials show it to be no more efficacious than placebo (Jordheim 1972, Sampson 1979, Andersch & Hahn 1985, Maddocks et al 1986, Freeman et al 1990).

Mineralocorticoids

Because some premenstrual symptoms may be related to fluid retention, a mineralocorticoid hypothesis of premenstrual changes was developed which implicated renin, angiotensin and aldosterone. These substances have known influences on sodium, potassium and water retention and excretion and their variability throughout
the menstrual cycle has been the focus of several studies. In samples of women not selected on the basis of PMS complaints there has been support for phase related changes in urinary and serum sodium and potassium (Janowsky et al 1973, Voda 1980) but there have also been reports of no changes (Gray et al 1968, Michelakis et al 1971). Perhaps more relevant is research in which fluid and electrolytes were assessed in women who suffer from PMS. Andersch et al (1978) measured total body water, total potassium and weight in both PMS and non PMS women. PMS women experienced more variability in body water and had more body water per mol of body potassium in the luteal phase than did the controls but body water was not higher during the luteal phase than the follicular. The authors concluded that PMS symptoms are accompanied by changes in fluid retention but as weight did not vary, they suggested that these changes are a function of a redistribution of fluid rather than an absolute increase. Wong et al (1972) found that women with PMS showed clear cyclic fluctuations of water retention but Herzberg (1971) found no significant differences among cycle phases in sodium or water retention. Should PMS be related to changes in the mineralocorticoid system, one would expect diuretics to help alleviate the symptoms. O'Brien et al (1979) gave the aldosterone antagonist spironolactone to 28 women in a double-blind crossover trial during four menstrual cycles and reported reduced weight and relief of psychological symptoms in more than 80% of women in the symptomatic group. Werch & Kane (1976) administered the potent diuretic metolazone and placebo to 46 women with PMS in a double-blind crossover trial. They reported a statistically significant improvement in mood symptoms and in discomfort due to water retention. However, Mattson & Schoultz (1974) in a study comparing lithium, placebo and a diuretic found that all drugs
ameliorated the symptoms: placebo most, diuretics second and lithium the least.

**Prolactin**

Like oestrogen and progesterone, the pituitary hormone prolactin has been proposed as a cause of PMS. Prolactin may cause sodium and water retention by potentiating the renal action of aldosterone and antidiuretic hormone (Horrobin et al 1971). Some, but not all studies, have shown an increase in prolactin during the luteal phase which might account for symptoms of weight gain and breast enlargement as well as psychological symptoms occurring then. Halbreich et al (1976) found that women with PMS had higher prolactin levels throughout the cycle than non symptomatic women and that the levels were increased premenstrually. Bromocriptine, a dopamine agonist that lowers the prolactin level, has been shown to alleviate premenstrual symptoms in some studies (Benedek-Jaszmann et al 1976, Andersch et al 1978, Andersen et al 1979, Ghose & Coppen 1977, Steiner et al 1984). However, well-controlled studies have not shown Bromocriptine to be more efficacious than placebo in treating PMS (Anderson et al 1977, Graham et al 1978). Conflicting with a prolactin hypothesis is the fact that elevations of prolactin from other causes, such as dopamine-blocking agents and pituitary tumours do not seem to lead to psychological upset and physical symptoms of PMS (Rausch & Janowsky 1982).

**Endogenous Opiates**

Following the discovery of Beta-endorphin, investigators suspected its involvement in the regulation of the menstrual cycle because of two prior
observations: morphine could block ovulation in the rat, and, several premenstrual symptoms mimic those of narcotic withdrawal (Seifer & Collins 1990). Furthermore, endorphin and oestrogen levels have been shown to covary and progesterone is also associated with an increase in endogenous opiate peptide activity (Wehrenberg et al 1982, Wardlaw et al 1982). Therefore, during the luteal phase of the cycle when plasma levels of oestrogen and progesterone rise as the corpus luteum functions, so too do levels of endorphins. Then during the late luteal phase, these levels fall as the corpus luteum regresses. Reid & Yen (1981) therefore have proposed that PMS may result from gonadal steroid-induced changes in endogenous opioid activity. They have theorised that symptoms of PMS result from excessive abrupt withdrawal of beta-endorphin. This theory does not seem unreasonable as Naloxone, an opiate receptor antagonist has been found to produce symptoms similar to those of PMS when it was administered in high doses to normal volunteers (Cohen et al 1981).

Since then, researchers have shown women with PMS to have lower levels of beta-endorphin during the luteal phase when compared with their own follicular phase and/or with controls (Chuong et al 1985, Facchinetti et al 1987, Tulenheimo et al 1987, Facchinetti et al 1988, Giannini et al 1990). Such findings have led to the hypothesis that PMS is a manifestation of Beta-endorphin withdrawal. Treatment has involved an opiate antagonist given before a peak in Beta-endorphin and before its withdrawal to maintain a constant level of Beta-endorphin (Chuong et al 1988). In a double blind placebo controlled cross over study to evaluate the efficacy of naltrexone on PMS symptoms in 20 women, symptoms were improved in those who
took naltrexone compared with those taking placebo (Chuong et al. 1988). In this study plasma Beta-endorphin levels were not evaluated however. The testing of the Beta-endorphin withdrawal hypothesis therefore is still in its infancy and, as yet, no consensus about its validity can be made.

From this discussion of these biological theories of PMS it can be seen that research and clinical reports have yielded contradictory results and left many questions unanswered. PMS symptomatology has been seen to correlate with and possibly be regulated by fluctuations in the menstrual cycle. However, not enough information exists to define the precise neurohormone, hormone or combination of hormones causative of menstrual cycle changes. This reflects, in part, methodological difficulties as discussed earlier. On the other hand, the confusion in the literature could well be a reflection of the enormous complexity of the problem. This has led to the suggestion that factors other than biochemical are involved. Psychological factors have been very much implicated in the aetiology of PMS as a result of large placebo responses found in controlled clinical drug trials to treat PMS (Abraham 1984, Magos et al. 1986). They have also been implicated as a result of the correlational studies linking PMS with personality and/or psychiatric disorder. Sufferers have been portrayed as vulnerable personalities who are unable to cope with the demands made upon them (Goudsmit 1988). Table 1.2 contains a list of psychological theories that have been suggested over the years. Attitudes, personality and stress will be the focus of the discussion to follow as theories concerning these variables have been and/or are being more extensively researched than the others.
Table 1.2  Suggested psychological theories of PMS

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<tr>
<td>Acceptance of femininity</td>
<td>Paige 1973</td>
</tr>
<tr>
<td>Embarassed mother</td>
<td>Slade &amp; Jenner 1979</td>
</tr>
<tr>
<td>Locus of control</td>
<td>Scott-Palmer &amp; Skevington 1981</td>
</tr>
<tr>
<td>Expectations</td>
<td>Rodin 1976</td>
</tr>
<tr>
<td>Negative attitude to body</td>
<td>Dinardo 1974</td>
</tr>
<tr>
<td>Personality traits (eg. anxiety or neuroticism)</td>
<td>Halbreich &amp; Kas 1977,</td>
</tr>
<tr>
<td></td>
<td>Rees 1953, Gruba &amp; Rohrbaugh 1975</td>
</tr>
<tr>
<td>Life stress</td>
<td>Siegal et al 1979, Clare 1983</td>
</tr>
<tr>
<td>Marital problems</td>
<td>Sampson 1979</td>
</tr>
<tr>
<td>Psychiatric disturbance</td>
<td>McClure et al (1971)</td>
</tr>
<tr>
<td>Emotional instability</td>
<td>Levitt &amp; Lubin 1967, Sheldrake &amp; Cormack 1976</td>
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<tr>
<td>Attitude</td>
<td>Woods et al 1982, Dennerstein et al 1982</td>
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The Influence of Attitudes

In our society, menstruation is generally viewed as a negative event and the premenstrual and menstrual phases are considered unpleasant times for women. The World Health Organization (1981) conducted a cross-cultural survey on menstruation in 14 countries with a minimum of 500 women per country. It was found that the percentage of women in each country who viewed menstruation as dirty ranged from 7% to 93%; those who viewed it as an illness ranged from 3% to 67% (see also Snowden & Christian 1983). Also in 1981, the Tampax Corporation (Tampax 1981) commissioned a large scale study of women’s and men’s attitudes towards menstruation in the United States (n = 1,034). Most people were reticent about discussing menstruation and most believed that women experience a significant amount of stress during menstruation. About half of the sample of women and men believe that menstruation is painful and 87% think that women are particularly
emotional when menstruating. A substantial minority believe that women cannot function as well at work when menstruating.

Beliefs that women do not perform as effectively at work during certain times of her cycle are still pervasive today in spite of objective evidence that has found little or no variation (Ussher 1989). For example, Sommer (1972) examined the performance of 207 female university students on standardised tests. Comparisons were made both between individuals in different phases of the menstrual cycle and within individuals on tests administered during different phases. Neither type of comparison showed any significant difference in the students performance. Similar results have been reported since then (Bernestein 1977, Walsh et al 1981, Richardson 1988, Richardson 1991, Ussher & Wilding 1992).

There is a great deal of controversy about the relation between attitudes towards menstruation and symptoms of menstrual distress. Most studies have been correlational, but this has not stopped some investigators from speculating that women who have negative attitudes are more likely to have symptoms as a result of these negative attitudes. Several studies suggest that attitudes towards menstruation are more negative than is the actual experience of menstruation (Brooks-Gunn & Ruble 1979, Golub 1981, Richardson 1989) and women who perceive menstruation as debilitating have reported more symptoms than those who do not (Brooks-Gunn & Ruble 1980, Woods, Dery & Most 1982). Care must be exercised in the interpretation of such findings as the direction of causality is not known. Common logic supports either direction of causality, although this is rarely suggested. For example, Levitt & Lubin (1967) report that frequency and severity of menstrual complaints were correlated with a negative attitude toward menstruation and suggested that their data
"...support the gynecologists contention that an unwholesome attitude toward menstruation may be involved in the aetiology of menstrual complaints" (p.269). But, is it not equally logical to suppose that, if a woman suffers from regular episodes of pain and depression, which she attributes to menstruation, she then resents being a woman and has a negative attitude towards menstruation?

Notwithstanding the views that negative attitude causes menstrual distress or that menstrual distress causes negative attitude, there is also the view that reporting of menstrual cycle symptoms is influenced by attitudes. This issue was first raised by Parlee (1974) who demonstrated that women's reports concerning their own menstrual cycle symptoms were similar to the profiles given by both men and women when asked to describe symptoms which "women sometimes experience" during three different phases of the cycle. She found that men scored higher than the women on all but one of the MDQ subscales although both groups agreed as to which symptoms tend to change during the cycle and which do not. Parlee suggested that the women had probably based their responses on their own experiences while the men had probably based theirs on what they had learned about menstruation through a myriad of social sources. However, because of the high correlations between the female and male data, she put forward the possibility that both groups had been influenced by stereotypic beliefs about menstruation.

A later study by Clarke & Ruble (1979) asked premenarcheal girls what they expected to experience during menstruation and postmenarcheal girls what they did experience, and found no significant differences between the two groups. Brookes-Gun & Ruble (1980) argued that reported menstrual symptomatology reflected stereotypic beliefs and expectations and that these beliefs were incorporated at a fairly
early age. These stereotypical views subsequently influence tendencies to attribute negative changes occurring premenstrually to menstrual cycle causes while attributing positive feelings occurring in this phase to other origins (Bains & Slade 1988).

Koeske & Koeske (1975) asked subjects to provide attributions for other persons, identified as being premenstrual women, non premenstrual women, or men, who were experiencing positive or negative moods in pleasant or unpleasant environments. A clear pattern emerged in which menstrual cycle attributions were given for negative moods of premenstrual women while other attributions were given for positive moods and for other persons. Campos and Thurow (1978) evaluated attributions provided by women for their self-reported physical and psychological symptoms. They hypothesised that those taking oral contraceptives would be more likely to make menstrual cycle attributions during the premenstrual phase than during other phases because they would be more likely to be aware that they were premenstrual. This was found to be the case. Women who who were not taking oral contraceptives made more cycle attributions during the menstrual phase. This suggests that when menstrual cycle cues are salient, the phase of the cycle is likely to be viewed as causing physical and psychological symptoms.

The Influence of Personality

Many researchers have tried to identify personality characteristics which may be related to the experience of menstrual cycle disorders. The vast majority of this research is correlational and the methodology typically consists of measuring menstrual cycle symptoms and personality variables in normal women. It has been found, for example, that there is a significant association between complaints of
premenstrual distress and high trait anxiety scores (Halbreich & Kas 1977, Watts et al 1980, Goudsmit 1983). Similarly, Coppen & Kessel (1963) and Slade & Jenner (1980) found a positive correlation between certain premenstrual symptoms and neuroticism while Taylor (1979) reported that 15 subjects with PMS scored positively on several subscales of the 16 Personality Factor Questionnaire indicating that they were suspicious, apprehensive, tense, easily upset and undisciplined. Premenstrual symptoms have also been correlated with the MMPI scales for schizophrenia, hysteria, hypochondria (Gruba & Rohrbaugh 1975). While these studies suggest that some women reporting premenstrual symptoms may have certain personality abnormalities, research has also indicated that there are many PMS sufferers who do not suffer from either primary or secondary psychiatric problems, nor do they show any psychological difficulties (Rees 1953, Seagul 1974, James & Pollitt 1974, Haskett et al 1980, Clare 1983). Moreover, there are methodological problems that prevent definitive conclusions. For example, one difficulty in interpreting the resulting correlations lies in the similarities between the standardized personality inventories employed and the measures of menstrual distress (Gannon 1985). The MMPI contains items such as "often I can't understand why I have been so cross and grouchy" and " I have periods of such great restlessness than I cannot sit long in a chair"; it would seem likely that women who endorse items such as irritability or restlessness on the Moos Menstrual Distress Questionnaire would also endorse the MMPI items. Gannon (1985) has also criticised these studies for not distinguishing between symptoms experienced during the paramenstruum and other times of the cycle. Stating that a woman experiences premenstrual negative affect does not mean she suffers from PMS if she experiences negative affect to the same extent throughout her cycle. Thus, significant correlations
between scores on menstrual questionnaires and personality scales could be due to similarity in items and/or a lack of distinction between symptoms occurring during the paramenstruum and those occurring throughout the cycle.

**The Influence of Stress**

There has been much discussion concerning the relationship between a woman's experience of menstrual cycle symptomatology and her ability to cope with internal and external stressors. Gannon et al (1989) have found small correlations between stress and menstrual cycle symptoms. It has also been noted that many PMS sufferers have marital problems, feelings of inadequacy as a wife and a mother (Sampson 1983, Clare 1983) and sexual and emotional problems (Wood et al 1979). Laws (1985) has claimed that many women focus on PMS instead of facing and dealing with their other problems such as stressful relationships or adverse circumstances. Consequently they find it more difficult to cope with otherwise unobtrusive premenstrual alterations in mood. Siegel et al (1979) have suggested that stressful life events may adversely affect the physical condition of women predisposing them to greater cycle-related discomfort. Gannon (1989), on the other hand, has suggested that hormonal changes may have a positive or negative impact on mood premenstrually depending on psychological factors. Parlee (1980), who found evidence of premenstrual elation rather than premenstrual depression, suggested that her subjects were generally healthy and happy women who may have interpreted their hormonal changes positively. These theories have yet to acquire empirical validation. They have, however, been included in this discussion because they offer a possible rationale for psychological treatments of PMS.
1.5 Conclusion

Dysmenorrhea and PMS are the two most prevalent menstrual disorders with a tremendous range of incidence estimates. It would appear that their respective aetiologies are neither strictly psychological nor strictly physiological. This has been derived from a number of sources: there are both psychological and physical components in the symptomatology and the disorders seem to be exacerbated by stress which suggests a psychological aetiology; yet they covary with distinct hormonal changes which implies organic causation. In general, psychological factors have tended to be emphasised more in PMS than in dysmenorrhea. This is undoubtedly due to the fact that psychological symptoms such as depression comprise the major symptoms of PMS while physical symptoms such as abdominal pain are characteristic of dysmenorrhea. Hence, successful treatments have been identified for dysmenorrhea but not for PMS. Consequently an enormous amount of research has been generated that has examined the psychological symptoms of PMS. The results of this research is inconclusive however and has led to a questioning of the assumption that most women do experience menstrual cycle mood change and that they are negatively affected by this. Discussion of these studies and their findings will be the subject of Chapter 2.
2. Menstrual cycle related mood change

Abstract

The high incidence estimates of PMS would indicate that most women experience feelings of irritability, depression, anxiety and less positive mood premenstrually. While studies have supported this hypothesis, there are also those that have failed to do so. Drawing conclusions from this literature is thwarted by numerous methodological criticisms. This chapter describes and discusses these methodological considerations and in the light of them, examines the evidence for menstrual cycle mood change and the existence of the Premenstrual Syndrome. It is concluded that cyclical variation in mood does occur in women and for some, these can be perceived to be disabling.

2.1 Introduction

From menarche to menopause, women regularly experience endocrinological and physiological changes associated with the cyclical process of ovulation and menstruation. In particular, these changes are linked to a variety of negative mood changes that are widely held to be experienced by women during the period prior to onset of menstruation. The theory that the majority of women suffer from cyclical mood change has been put forward as the evidence for the widespread existence of PMS (Ussher 1989). However, in terms of the psychological research, the picture is inconclusive with some studies reporting that women do experience more negative

One explanation for these inconsistent findings is the lack of a universal definition of PMS. Definitions have ranged from the 'recurrence of any symptom(s) always at the same time in each menstrual cycle' (Dalton 1964) to combinations of over 150 symptoms including back pain, elation, depression, sexual desire and tension (Moos 1969). PMS has been found not to be a single discrete entity or a specific syndrome which is suffered by all women who menstruate. Menstrual cycle changes are variable not only between different women (Schilling 1981, Reid 1985, van den Akker & Steptoe 1985) but also between different cycles in the same woman (e.g. Hart et al 1987, Schnurr 1989, Walker 1991). It is, in part, because of this heterogeneity, that no universally accepted definition has been adopted.

However, the most profound methodological problem that has contributed to the inconclusive results is that there are no objective measures of the variables of interest. Subjective report has, it seems, unlimited potential for confounding, for example, by context, emotional state, personality, attribution, expectation etc. (this of course is not unique to menstrual cycle research). Other methodological considerations such as the use of prospective or retrospective ratings and the salience of the menstrual cycle in the study with the associated possibility of stereotyped symptom reporting have preoccupied researchers for the last 15 years and continue to do so. In an attempt to
understand the nature of women's menstrual cycle experience, let us first examine these methodological preoccupations. In the light of these issues, the evidence for menstrual cycle mood change will be examined.

2.2 Measuring menstrual cycle mood change

The Menstrual Distress Questionnaire

By far the most widely used instrument in the measurement of menstrual cycle mood change is the Menstrual Distress Questionnaire (MDQ) devised by Moos (1968). In its original retrospective form, respondents were required to rate the severity of each of 47 symptoms on a 6-point scale (there is now also a prospective form which respondents can fill in daily). Moos reported retrospective data from 839 "wives of graduate students at a large western university" (mean age was 25.2 with a standard deviation of 3.9), each of whom made separate ratings for the menstrual, premenstrual and intermenstrual phases of her most recent menstrual cycle and for her "worst" menstrual cycle. By means of factor analysis, he identified eight "symptom clusters", six of which showed large differences between the phases of the cycle. Of these, four (pain, concentration, behavioural change and autonomic reactions) produced higher mean scores during the menstrual phase than during the premenstrual phase, while the other two (water retention and negative affect) produced higher mean scores during the premenstrual phase than during the menstrual phase. The two remaining clusters
(arousal and control, the latter containing symptoms not necessarily associated with the menstrual cycle) showed no variation across the three phases of the cycle.

In addition to this sample, Moos obtained MDQ scale means and standard deviations for a total of 1542 women who participated in a number of studies conducted by other investigators (Abplanalp, Donnelly & Rose 1979, Brennan 1980, Doty et al 1981, Garling & Roberts 1980, Golub 1976a, Golub 1976b, Gruba & Rohrbaugh 1975, Markum 1976, Persky 1974, Rouse 1978). These samples were composed mainly of women between the ages of 20 and 35 years who did not report severe symptoms. Moos (1985) reports that the means and standard deviations from these women were "quite comparable" to those obtained from Moos's own sample with the means "generally" higher in the premenstrual and menstrual than in the intermenstrual phases. The menstrual and premenstrual phase means were slightly higher than those in Moos's own sample however, but this he attributed to the somewhat higher proportion of women in his sample taking oral contraceptives.

Moos accordingly combined his data with those of the other investigators to produce MDQ scale means and standard deviations for an overall normative sample of 2381 women. This group of relatively young women tended to have normal menstrual cycles and report mild to moderate symptoms. On average they experienced few, if any, symptoms during the intermenstrual phase.

The general consistency of results across these studies would indicate that the MDQ is a reliable and accurate indicator of the psychological changes associated with menstruation (Logue & Moos 1986, Richardson 1990). It should be noted, however, that the MDQ has been subjected to some criticisms.

The first is of course related to the retrospective version of the MDQ.
Retrospective assessment has been considered unreliable because the woman might not accurately remember her menstrual cycle symptoms but neither Moos nor any other researcher has shown any effects of forgetting upon symptom recall (Richardson 1990). Hart et al (1987) found that recall of a cycle accounted for 72% of the variance in that cycle's prospective scores, whereas prospective scores from one cycle predicted only 14% of the variance in scores for the next cycle. The problem with retrospective reporting of menstrual cycle research therefore is not one of memory but one of variability between one cycle and another (this will be discussed further in the pending section on retrospective versus prospective measurement. The MDQ has also been criticised because the respondent is asked to recall her last menstrual cycle. Several researchers have suggested that asking the woman to report a typical cycle rather than her most recent might be more appropriate. But, as women’s experiences vary from month to month, then how does she determine her typical cycle? As this may prove problematic, asking her to report her most recent cycle might actually be best. Another criticism has been that Moos not only asks his respondents to report on the menstrual, premenstrual and intermenstrual phases of their most recent cycle, but also on their "worst" menstrual cycle. There is here the danger that the responses in one condition might have contaminated those in the other and as the four tasks are carried out in the same sequence, any carry-over effects would have gone completely undetected (Richardson 1990). Indeed, Clare (1977) reported that in a pilot study, the majority of respondents had found the task of rating symptoms for three different phases confusing which resulted in inaccurate data.

These methodological problems are serious and it is concluded that the MDQ does not provide an adequate basis for future research.
The Premenstrual Assessment Form

A more recent instrument explicitly intended for clinical use is the Premenstrual Assessment Form (PAF) devised by Halbreich and Endicott (1982). It provides categorical and numerical scores for each of 18 subcategories of physical, psychological and behavioural change. The subcategories were defined empirically and validated by measures of internal consistency (Halbreich et al 1982). It contains 95 items covering physical, emotional and behavioural changes during the premenstrual phase. The respondent is asked to rate the typical degree of change from her usual "nonpremenstrual state" during the premenstrual phases of her last three menstrual cycles along a 6-point scale. The questionnaire was developed on the basis of responses from a sample of 154 female volunteers (Halbreich et al 1982). Breast pain and weight gain were the most frequently reported premenstrual symptoms although more than half of the women reported psychological symptoms including feeling sad or blue, tearful, intolerant, impatient, irritable and anxious. A daily PAF has been developed containing 21 selected items from the full questionnaire (Endicott & Halbreich 1982).

However, in this study of 154 women, 64% of them filled criteria for a major or minor depressive syndrome. This raises questions about the validity of the categorical scales in diagnosing symptomatic premenstrual change. A comparison of prevalence reports of individual symptoms common to the PAF and the MDQ (Logue & Moos 1986) shows that at least twice as many women report premenstrual symptoms on the PAF than on the MDQ. The PAF appears therefore to categorize relatively large numbers of non-complaining women as having "syndromes" (Youdale
& Freeman 1987). Recently, when Yuk et al (1990) administered the PAF to 133 "normal" volunteers not seeking or using treatment for premenstrual or menstrual symptoms 80% of the sample met criteria for a PAF syndrome. Most common were minor and major depressive syndromes, general physical discomfort syndrome and fluid retention syndrome. The authors recognise that a non-complaining group may well experience cyclic symptoms but it is inappropriate to have such a high frequency of normal, non-complaining women meeting criteria for PAF syndromes and conclude, together with Youdale & Freeman (1987), that an increase in strictness of interpretation with the inclusion of a quantitative symptom severity score is necessary.

2.3 Retrospective versus prospective reports

Because of the effects of stereotyping and attributions on retrospective reporting, this suggests that valid information concerning menstrual cycle changes can only be gained using longitudinal prospective methods. Certainly, since the original report by McCance et al (1937) of discrepancies between the retrospective reports of 167 women and subsequent prospective data, retrospective self report has been criticised as being unreliable. These researchers administered a brief preliminary questionnaire concerning whether the woman usually experienced pain or discomfort associated with menstruation and then obtained daily reports of 19 symptoms from 167 women over a total of 780 cycles. Discrepancies between the questionnaire responses and the day
to day responses were so frequent that they considered the value of work on PMS based upon histories or questionnaires to be doubtful. Since then, many studies have compared retrospective data to data obtained prospectively over one or two menstrual cycles and have also found inconsistencies (Vila & Beech 1980, Parlee 1980, Endicott & Halbreich 1982, Woods, Derry & Most 1982, Strauss & Appelt 1983). These studies have reinforced the need for prospective data.

However, these discrepancies between retrospective and prospective ratings may be that subjects complete retrospective questionnaires on the basis of their "typical" experience or their last cycle while the cycle over which daily ratings are collected may not be similar, thereby reflecting variability between cycles which was discussed earlier in this chapter. Alternatively, retrospective assessments may be based on the worst day of the cycle while repeated ratings are generally averaged over several days to produce a single symptom score for each cycle. Furthermore, many studies used different procedures to collect the two types of data and they therefore confounded variation due to the procedures themselves with that due to the nature of the assessment (Richardson 1990). When Metcalf & Hudson (1985) studied 31 women presenting with PMS according to a detailed self-evaluation questionnaire, such diagnosis was confirmed by the examination of daily records in only 21 cases. The daily reports had been obtained using eight visual analogue scales and five three-choice alternative items that do not appear to have been adequately validated in advance. Thus a non significant correlation between retrospective and prospective data in such cases might mean that it was the instrument used to collect the prospective data that was at fault rather than that which was used to collect the
retrospective reports. Logue & Moos (1986) emphasise that both reports "should be obtained on the same or a directly comparable version of one instrument" (p.394). Comparisons of the retrospective and concurrent forms of the MDQ have been found to correlate (Ward et al 1983, Schilling 1981, Abraham 1983) which implies that retrospective reports are reasonably accurate.

It could be argued however that failure to find a significant correlation between retrospective and prospective data does not mean that either of the instruments are at fault. Given that there is cycle variability between and within women, is it surprising that some studies find a significant correlation between retrospective and prospective data and some studies do not? The choice of either retrospective or prospective measures therefore must depend on the research questions being asked and the experimental designs to be implemented. For example, retrospective report is the only measurement method practicable for large scale surveys but the emphasis should be on the most recent cycle rather than on a "typical" experience. On the other hand, for clinical studies or those involving experimental manipulation, prospective measures might be more appropriate.

2.4 Attitudes and expectations

The controversial relationship between attitudes towards menstruation and menstrual cycle symptoms has been discussed in Chapter 1. Recall that the expectations
surrounding menstruation are very much of a negative and disabling nature and while this might be a cause of increased reporting of negative symptoms, a greater experience of negative symptoms might also be the cause of a negative attitude. Whatever the cause of the attitude, there is much evidence to suggest that people in general are more likely to recall previous events that tend to support their current attitudes (Ross et al 1983, Ross et al 1981). This also likely to be true of menstrual cycle symptomatology reporting.

However, what also needs to be addressed is how these expectations are also present in the experimenter as well as in the subject. Most of the research concentrates on negative aspects of cyclicity, using questionnaires which only contain the opportunity to report negative symptoms. The MDQ, for example, contains only 5 items which could be deemed positive out of a total of 48 and it has been suggested that these items should not be included (Richardson 1990). It is hardly surprising, therefore, that women report only negative feelings such as depression and anxiety if those are the only feelings which are being investigated. However, when positive items are included most women report high incidences of positive mood at all cycle stages, including the premenstrual or menstrual phases which are traditionally seen as periods of anxiety or depression (Ussher 1989). Peaks of positive feelings are more frequently recorded in the ovulatory or mid-cycle phase of the cycle (eg. Little & Zahn 1974, Rossi & Rossi 1977, Moos 1969, Voda 1980) but Logue & Moos (1988) and Parlee (1982), for example, have reported positive mood during the premenstrual phase. Ussher (1987) however found women to feel happy, elated and generally positive about themselves throughout the whole cycle with no decrease or increase
premenstrually. It seems therefore, that given the opportunity to report positive experiences, a somewhat different picture emerges and experimenters negative assumptions are erroneous.

2.5 To be aware or unaware

Given the negative biases that are inherent in menstrual cycle reporting, it makes sense that subjects should be blind to the nature and purpose of the study. The use of retrospective questionnaires where the responses are to be related to particular cycle phases makes this very difficult however. Prospective reports, on the other hand, have the advantage of allowing manipulation of awareness or unawareness although as Sampson & Prescott (1981) point out, in clinical research disguising the purpose of a study will be difficult or impossible because women will have been recruited and preselected for their symptoms. For these treatment seeking women the relevance of the menstrual cycle will have been made explicit if they have given their informed consent to participate in the study. Nevertheless, a number of studies have been carried out with nonclinical samples.

Slade (1984) monitored 118 women for 8 weeks on a daily basis using a disguised version of the prospective MDQ. The subjects were told that the study was an investigation into the general health of a non-patient population. While there was
evidence of cyclic changes peaking premenstrually and menstrually for physical
symptoms, psychological changes occurred randomly throughout the cycle. Ainscough
(1990) replicated this study with 51 women and confirmed Slade’s (1984) findings.
However, when Van Den Akker & Steptoe (1985) assessed 100 women for 35 days
in a study concerning "mood fluctuations and changes in body temperature", they did
find that significantly more symptoms were reported in the premenstrual and menstrual
phases with few during the follicular phase. While some of the women guessed the
true purpose of the study, there was no difference between those who did so and those
who did not.

Markum (1976) similarly found no significant differences in the ratings produced on
the prospective MDQ between 47 women who were informed of the nature of the
study and 47 who were not. But two subsequent studies did find significant
differences between blind and informed groups on their questionnaire responses
finding that blind respondents tended to produce lower ratings of premenstrual severity

More recently Gallant et al (1991) reported that no effects of awareness was found in
their study except for food cravings with the aware women reporting lower cravings
than unaware women. There were cyclic effects for both aware and unaware groups
of women with ratings of dysphoric moods and depression highest and ratings of
wellbeing lowest during premenstrual and menstrual phases. The authors conclude
that even when women are aware of the nature of the study they do not necessarily
report exaggerated changes consistent with stereotypes and their findings do not
support the idea that awareness effects complicate daily ratings of moods and symptoms.

This mixture of findings means that the question of whether women should be blind to the nature and purpose of the menstrual cycle study remains, as yet, unanswered.

2.6 Is there really a Premenstrual Syndrome?

The discussion so far can be summarised quite easily. While self reports are vulnerable to bias as a result of women's stereotypical expectations, the evidence suggests that their recall of previous menstrual cycles, preferable the most recent one, is generally good. Depending on the research questions and design, retrospective methods therefore can still be a valid means of collecting data.

The pattern of menstrual cycle change that has emerged from prospective reports is that the incidence and severity of negative symptoms reach a peak during the premenstrual phase. These findings are entirely in accordance with the expectations and stereotypes prevalent in contemporary society. While the emphasis has been on negative experiences, positive mood, when investigated paints a somewhat different picture. While many prospective reports have shown significant variation across
menstrual cycles, others have not. These equivocal findings persist even when attempts are made to disguise the researcher's interest in the subject. Prospective reports have demonstrated poor consistency between successive cycles within individual respondents and it is conceivable that much of the research using prospective reports is hampered by the fact that cycles do vary. In addition, many studies have also adopted their own definitions and criteria for PMS diagnosis which makes comparisons across studies problematic.

In an attempt to address some of these methodological problems and to add diagnostic rigor to the study of PMS for both research and clinical purposes, the National Institute of Mental Health (NIMH) developed criteria for its definition in 1983. Two key criteria for diagnosis were put forward: (1) a 30% increase in intensity of symptoms in the premenstrual phase (the 6 days before menses) compared with the intermenstrual phase (days 5-10 of the cycle); and (2) documentation of these changes for at least two consecutive cycles. These guidelines reflect the fact that PMS does not present uniformly and although no core symptoms were specified in this definition, limitations were set on the timing and intensity of changes in symptomatology. The work of the NIMH was continued in 1985 and a diagnostic category for PMS developed for inclusion in the DSM-III-R (see Table 2.1). The aim was to establish rigorous operational criteria for definitional purposes to achieve comparability of research findings across studies and to facilitate communication among researchers, clinicians and their patients (Spitzer et al 1989). The new name of Late Luteal Phase Dysphoric Disorder (LLPDD) was given to PMS.
Table 2.1  
**Diagnostic criteria for Late Luteal Phase Dysphoric Disorder**

A. In most menstrual cycles during the past year, symptoms in B. occurred during the last week of the luteal phase and remitted within a few days after onset of the follicular phase.

B. At least five of the following symptoms have been present for most of the time during each symptomatic late luteal phase, at least one of the symptoms being (1), (2), (3) or (4).

1. marked affective lability
2. persistent and marked anger or irritability
3. marked anxiety, tension, feelings of being 'keyed up' or 'on edge'
4. markedly depressed mood, feelings of hopelessness, or self-deprecating thoughts
5. decreased interest in usual activities
6. easy fatiguability or marked lack of energy
7. subjective sense of difficulty in concentrating
8. marked change in appetite, overeating or specific food cravings
9. hypersomnia or insomnia
10. other physical symptoms such as breast swelling or tenderness, headaches, bloatedness, joint or muscle pain

C. The disturbance seriously interferes with work or with usual social activities or relationships with others.

D. The disturbance is not merely an exacerbation of the symptoms of another disorder such as Major Depression etc.

E. Criteria A, B, C and D are confirmed by prospective daily self ratings during at least two symptomatic cycles.

In assessing the existence of the syndrome PMS, the NIMH guidelines recommend longitudinal documentation of menstrual cycle changes and many successful observations of cyclical variations in mood and symptoms have been found with PMS patients (ie. treatment seeking women) (eg. Sanders et al 1983, Rubinow et al 1984, Morse & Dennerstein 1988, York et al 1989, van den Akker & Steptoe 1989). Many studies of non treatment seeking women that have been discussed in various sections of this chapter have also found cyclical mood change, but other longitudinal studies

In the light of the aforementioned methodological problems, many of these results, both finding and not finding cyclical variation, could be deemed unreliable. In addition, it has been found that mood varies as a function of the day of the week or subjective stress (eg. Ussher 1987, Kernooff et al 1989, Laessle et al 1990, Gallant et al 1991). Indeed, in Gallant et al's (1991) study, when they compared men with women who were aware of the menstrual cycle nature of the study and women who were not to assess differences in mood change, unaware women had lower ratings of wellbeing premenstrually than men but no other differences between women's and men's mood emerged. Taken together, the results of these different studies would indicate that people in general do show mood fluctuations over time and, as women spend approximately 25% of their time in the premenstrual phase, it is likely that negative moods will sometimes coincide with the premenstrual phase.

However before rushing to the tempting conclusion that PMS does not exist one further point needs to be made. Gallant et al (1992) assessed cyclical mood change for two cycles in treatment seeking PMS women and a no PMS control group. It was found that while half of the PMS group failed to meet DSM III criteria for PMS (30% degree of change), half of the non PMS control group did. Similar findings have been reported by Morse et al (1988) who found that nearly 40% of their self identified no PMS group met a 30% change criteria. These findings show that women clearly differ
in their perception of their premenstrual changes and future studies should consider the nature of differences in perception of premenstrual changes among women. Thus, the answer to the question does PMS exist is 'yes' because some women perceive them to be so troublesome as to warrant seeking treatment for a premenstrual syndrome. As others find premenstrual changes only somewhat troublesome and others not at all troublesome, this reduces prevalence rates considerable.

Strong opposition has voiced about the inclusion of LLPDD in the DSM-III-R. There were concerns about: stigmatizing women for mood changes associated with a normal biological process, ie. menstruation; the lack of sufficient evidence to warrant naming PMS a psychiatric disorder; and disputes over whether PMS is a gynaecological or emotional problem. As a result of this controversy, LLPDD has not been accepted as a DSM-III-R diagnostic category but has been included in the appendix. Nonetheless, the notion of a syndrome implies the existence of a pathological condition that demands and legitimates clinical intervention and treatment. PMS, therefore, is now a 'recognized' psychiatric illness alongside those such as schizophrenia and manic depression, in the eyes of many practitioners and researchers (Ussher 1989).

In general, however, the term premenstrual syndrome has been adopted to refer to the clustering of mood changes and somatic symptoms that occur regularly before the onset of menses and which subside once menses begins with at least one week of symptom free intervals (Ussher 1989). This has its problems though as it may lead to confusion between the premenstrual discomfort that many women experience without significant disability and the syndrome that may well be incapacitating. Goudsmit (1983) has suggested that it would be more "useful" to differentiate between
cyclical changes that are mild and do not cause distress, and moderate or severe changes which interfere to an unacceptable degree with the woman’s everyday life. In the light of the work reviewed in this chapter, this would seem reasonable and, under this definition, prevalence rates of PMS are around 5-10% (e.g. Andersch et al 1986, O’Brien 1987) which offers the comfort that not all women are cyclically dysfunctional.

In subsequent chapters this viewpoint will be adopted and the terms menstrual cycle changes or experiences will be used.

2.7 Conclusions

The field of menstrual cycle research is a methodological minefield - very few studies avoid criticism from one viewpoint or another. It could be argued that such problems arise because researchers and clinicians are attempting to define and study a phenomenon that does not exist. The lack of comparability between studies, which is attributed to methodological factors, could also be attributed to an attempt to impose a hypothetical syndrome on behavioural and emotional changes which are not related to reproduction function but to daily stressors for example. However, the fact remains that cyclical changes in well-being do occur amongst women and these changes are temporally related to her hormonal changes. For some, these changes may be
manifest by negative emotions and/or physical symptoms around or before menstruation; for others, positive feelings occur at this time. However, by no means do all women experience noticeable cyclical changes and by no means do all of the women who do notice cyclical changes perceive them to be problematic. The assumption that all women experience and suffer from negative symptoms premenstrually is misleading.
3. HOW DO WOMEN COPE WITH MENSTRUAL CYCLE CHANGES?

Abstract

A sample of 342 women were surveyed to discover how they coped with menstrual cycle changes and how helpful these methods were. Principal components analysis of responses to a specially devised coping checklist revealed four components: menstrual cycle specific, active-behavioural, active-cognitive and active-avoidance. Analysis of variance of component based scores revealed the most popular ways of coping to be active-cognitive. The most helpful were active-behavioural and active-cognitive. Further analyses of variance did not show any effect of parity or occupation on coping endorsement or helpfulness; nor was there an association with age. Modest correlations of coping methods with symptom severity emerged.

3.1 Introduction

The National Council of Women (NCW) of Great Britain has recently issued a Charter for Womens Health based upon a national survey of 10,000 women (NCW 1991). In an analysis of a sample of 1,000 replies, when asked whether they ever felt overstressed, 79% of respondents said they did. The Charter indicates areas where stress may occur that is specific to the female sex and one of these is in relation to menstrual cycle changes. In Chapter 2 it was seen that cyclical changes do occur in
women and for some, they are perceived to be troublesome. Furthermore, publicity in the mass media has communicated the dominant ideology of a premenstrual "illness" to women which has led to enormous numbers labelling themselves as sufferers and seeking medical methods to alleviate their suffering. As discussed in Chapter 1, to date, no single medical treatment for PMS has proven to be unequivocally effective. Corney & Stanton (1991) report that of a sample of 658 treatment seeking women, most had tried more than one type of medicaton but no single treatment was found to be particularly helpful. Many of the women commented that 'some medications seemed to work for the first month or two and then the effect would fade completely so that they were no better off.

If medication is considered to be so ineffective, there is a need for clinicians to consider alternative methods. Such methods could be based on non-medical strategies that women already use such as vitamins, dietary changes or physical exercise. The NCW (1991) report that physical exercise, relaxation techniques and over or under eating were the main ways that respondents had used to cope, followed by smoking and alcohol. Similarly, Johnson et al (1988) reported that of 630 women with a "positive lifetime history of premenstrual symptoms", many of them used non-medical coping techniques (see Table 3.1) such as 'exercised' (41.8%), 'talked to friends' (27.6%), 'changed diet' (26.6%) and . Friedman & Jaffe (1985) surveyed 384 women using a 147 item questionnaire that contained a checklist of 16 non-medical "coping mechanisms" (Table 3.2) and they found, for example, that 28% 'increased physical activity' and 27% 'stayed at home and avoided people'. It would appear, therefore, that women adopt a variety of coping behaviours when dealing with menstrual cycle
changes. However, to facilitate the development of effective management programmes for menstrual cycle changes, information alone concerning what women do to cope is not sufficient; what they find most helpful also needs to be assessed.

Table 3.1  *Johnson et al (1988) Coping and treatment methods used by women with a positive lifetime history of premenstrual symptoms (n = 630)*

<table>
<thead>
<tr>
<th>METHODS</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>See physician</td>
<td>107</td>
<td>17.0</td>
</tr>
<tr>
<td>Talk to friends</td>
<td>174</td>
<td>27.6</td>
</tr>
<tr>
<td>Change diet</td>
<td>155</td>
<td>24.6</td>
</tr>
<tr>
<td>Exercise</td>
<td>263</td>
<td>41.8</td>
</tr>
<tr>
<td>Vitamins</td>
<td>119</td>
<td>18.9</td>
</tr>
<tr>
<td>Nonprescription medication</td>
<td>198</td>
<td>31.4</td>
</tr>
<tr>
<td>Prescription medication</td>
<td>79</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Table 3.2.  *Friedman & Jaffe (1985)*

<table>
<thead>
<tr>
<th>Coping Mechanisms</th>
<th>N</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for greater self control</td>
<td>373</td>
<td>52</td>
<td>48</td>
</tr>
<tr>
<td>Dissatisfied with look or feel</td>
<td>380</td>
<td>37</td>
<td>63</td>
</tr>
<tr>
<td>Feeling more affectionate</td>
<td>374</td>
<td>58</td>
<td>42</td>
</tr>
<tr>
<td>Feeling less affectionate</td>
<td>361</td>
<td>73</td>
<td>27</td>
</tr>
<tr>
<td>Tendency to nag</td>
<td>376</td>
<td>54</td>
<td>46</td>
</tr>
<tr>
<td>Increased physical activity</td>
<td>376</td>
<td>72</td>
<td>28</td>
</tr>
<tr>
<td>Lack pep and energy</td>
<td>378</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Increased ambition</td>
<td>377</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Avoid social activity</td>
<td>375</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Easily become involved in a disagreement</td>
<td>378</td>
<td>54</td>
<td>46</td>
</tr>
<tr>
<td>Stay at home and avoid people</td>
<td>378</td>
<td>73</td>
<td>27</td>
</tr>
<tr>
<td>Outbursts over small irritants</td>
<td>379</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>Tendency to use sick time</td>
<td>372</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>Thoughts of suicide</td>
<td>378</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>Violence or destructiveness</td>
<td>379</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>'At war' with the world</td>
<td>378</td>
<td>79</td>
<td>21</td>
</tr>
</tbody>
</table>
Research on coping has largely been confined to the United States and this research has focused on coping with ordinary day to day life stresses. A number of different classifications of coping behaviours have been proposed. For example Gurin et al (1960) distinguish between 'active' and 'passive' methods of coping; Folkman & Lazarus (1980) distinguish between 'problem' and 'emotion' focuses of coping and Billings & Moos (1981) distinguish between 'active-behavioural', 'active-cognitive' and 'avoidance' methods. These conceptual models of coping have been decided either on largely a priori grounds ("according to cluster analysis, the ratings of several judges and previous research"; Billings and Moos 1981, p.145) or by using factor analyses to form scales reflecting distinct coping classifications (Folkman & Lazarus 1980, Kaloupek et al 1984, Ho et al 1988). To date no single classification has been agreed upon, possibly because of their similarities. Billings & Moos (1981, p. 141) describe various coping classifications as follows. Problem-focused coping is said to include "attempts to modify or eliminate the sources of stress through one's own behaviour"; active-behavioural coping involves "overt behavioural attempts to deal directly with the problem". The descriptions of these classifications are not different! Similarly, emotion-focused coping encompasses "cognitive responses to manage the emotional consequences of stressors" and active-cognitive coping refers to "attempts to manage one's appraisal of the stressfulness of the event". Once again, the descriptions of these classifications are not different. Thus active-behavioural coping could be problem focussed coping and vice versa. Similarly, active-cognitive coping could be emotion focussed coping and vice versa. Whichever classification one chooses, therefore, is arbitrary.
How women cope with menstrual cycle changes has not been addressed in the coping literature and was not the primary question of the NCW (1991), Johnson et al (1988) or Friedman & Jaffe (1985) studies. Thus, none of them utilised available coping instruments when constructing their questionnaires. In fact, in Friedman & Jaffe's (1985) study, many of the items listed under 'coping mechanisms', for example, 'need for greater self control' or 'feeling less affectionate', are not listed in standard coping checklists. It could be argued, on rational grounds, that these items are not really ways of coping but side effects of the problem that needs coping with. Thus, a more extensive and appropriate list of coping methods needs to be identified using the rationale from previously developed models of coping.

Barker et al (1990) have examined coping and help seeking in relation to "psychological problems" in a large UK sample. They chose to label their three main methods of coping according to the distinctions suggested by Holahan & Moos (1987). Active-cognitive coping encompasses covert methods of coping, for example, trying not to worry; active-behavioural coping attempts to deal directly with the problem by using overt behaviour such as keeping busy; avoidance coping is actively avoiding confronting the problem by, for example, drinking alcohol. Barker et al’s (1990) data has illustrated "what people in the UK say they do when faced with psychological problems". What British women do when faced with menstrual cycle changes, and how helpful they find what they do, are the questions for the present study.

Women were asked to report their experiences of their most recent menstrual period, their experiences the week before and the week after in order to compare different
phases of the menstrual cycle. Using Barker et al's (1990) coping classifications and items as a model, the coping questionnaire was constructed with further items chosen from the coping literature and additional items specific to menstrual problems included (eg. taking evening primrose oil, B vitamins, and dietary modifications). Because different forms of physical exercise have been reported by a substantial number of women as a way of coping with menstrual cycle changes in all of the aforementioned studies, several items related to different types of physical activity were also included. Principal components analysis was used as an objective check on the conceptual groupings of coping strategies. Comparisons were then made between the use of categories of coping strategies that emerged and their helpfulness. In addition, correlations between these strategies and reported severity of menstrual cycle symptoms were calculated.

3.2 METHODS

Questionnaire

This comprised three sections: demographic details, menstrual cycle symptoms and coping measures.
Demographic details - The woman was first asked to provide information about herself (age, number of children and their ages) and identify her marital status from the following options: married, co-habiting, single, separated, divorced or widowed. She was then asked to write what her job is and to identify its occupational category from: unskilled manual, skilled technical, shop/office/secretarial, student, unemployed, skilled manual, professional/managerial, administrative, housewife or other.

Menstrual cycle changes - The inadequacy of the MDQ has been discussed in Chapter 2. It was not therefore deemed suitable for this study, hence 16 physical and feeling states were chosen from Warner & Bancroft’s (1990) Menstrual Health Questionnaire which was especially designed for a large scale survey. These same items are also found in the MDQ. While retrospective self-report, when applied to menstrual-cycle phenomena, has been criticised (see previous chapter), it is the only measurement practicable for large surveys. If it pertains to the woman’s most recent cycle rather than some usual experience over a number of cycle, it is considered to be generally reliable (Warner & Bancroft 1990). The instructions read "Below is a list of feeling and physical states that women sometimes experience. Please describe your experience of each of these for the week before your most recent period, for the week of your most recent period and for the week after it. Subjects responded on a scale of 1-3 where 1 = not experienced, 2 = mild to moderate and 3 = severe to disabling. A single severity score was then calculated by summing the ratings given for all of the item under each of the three menstrual cycle phases."
Coping section - An extensive list of coping items from Billings & Moos (1981) and Barker & Pistrang (1990) were drawn up. Additional items from Corney & Stanton (1991) and Johnson et al (1988) specific to coping with menstrual problems (eg. took evening primrose oil) were also included. A pilot study was conducted with 20 female psychology undergraduates from UCL in order to screen the list for items that did not pertain to the menstrual cycle and to identify any items additional items that did. It became clear from the pilot study that exclusions and inclusions to the list were needed. Some items that were not relevant to the menstrual cycle such as "refused to believe it had happened" were excluded and items that applied only to the menstrual cycle such as "went to bed with a hot water bottle" were included. The final list contained 39 items. The instructions read: "Below is a list of ways that women cope with changes in feelings and physical state throughout the menstrual cycle. If you experienced any changes during your most recent menstrual cycle please tell us how you coped by answering yes or no to the list below. Could you please also signify how helpful you found or how helpful you would expect to find the coping methods below by using the following scale". The helpfulness of the items were rated on a scale of 1 - 4 from 'not at all helpful' to 'extremely helpful'. If the woman did not experience any changes she was asked what she would do if she did and how helpful she would expect to find the coping methods. Confusion arose concerning this request for "expected" ratings of helpfulness that did not become evident in the pilot study. This data was therefore considered erroneous and not included in the analysis.
Procedure

A total of 364 questionnaires were distributed. In order to ensure that diverse socio-economic groups were sampled the data were collected in a number of ways. Women were approached in waiting rooms of surgeries in the London area and asked to complete the questionnaire while waiting to see the doctor. Questionnaires were sent to female school teachers in South Wales and Birmingham and were returned by post. Additional questionnaires were sent to various businesses in London and surrounding areas and also returned by post. Where the questionnaires were being returned by post, they were distributed and collected by an employee of the school or company.

Three hundred and fifty five questionnaires were returned, 13 of which were discarded because the women no longer menstruated or the questionnaire had been incorrectly completed. Thus a total of 342 questionnaires remained for the analyses (94% of those distributed).

Statistical Analyses

Menstrual cycle experience scores were derived by summing the ratings of the 16 items separately for the week before, during and after menstruating. One way analyses of variance was carried out on the positive items and the negative items to compare experiences between these three phases of the cycle.
The number of yes responses for each of the 39 coping items was calculated and transformed into percentages of the total sample. Those items that were endorsed by less than 5% of the sample were excluded from the principal components analysis of coping items that followed. The remaining items were rank ordered for frequency endorsement. The mean helpfulness rating for each coping item was calculated and also rank ordered. Assessment of this non parametric data was carried out using a Spearman Rank Correlation to test the relationship between these two measures.

For the principal components analysis of the endorsement data, the correlation matrix was used to standardise the scores. The number of factors to retain for varimax rotation was determined using Cattell’s (1966) scree test. Items loading at 0.30 or above were used for interpretation. The internal consistency and reliability of the scales were assessed by Cronbach’s Standardised Alpha (Cronbach 1951).

Component based scale scores were calculated for each component by summing the items that loaded at 0.30 or more and, because each scale contained a different number of items, this sum total was divided by the number of items in the scale. Where an item loaded on more than one component, it was allocated only to the component on which it loaded most highly. For this parametric data, one way analyses of variance were then performed to test for differences in frequency of endorsement between the different types of coping and differences in their helpfulness. Correlation coefficients between severity of negative menstrual cycle symptoms and coping endorsement and coping helpfulness were assessed using the Pearson Product Moment Correlation Coefficient with a predetermined significance level of 0.01.
Further correlations between age and coping endorsement and helpfulness were also calculated. In addition, the sample was divided into three age groups: 22 years and under, 23-35 years and 36 years and over. Two way analyses of variance were used to assess any differences between these three age groups in coping endorsement and in helpfulness. To determine any effect of parity and occupational category on methods of coping, two way analyses of variance were also conducted.

For all analyses of variance, significant findings were followed by post hoc t-tests using the error from the analysis of variance.

3.3 Results

Subjects

The ages of the respondents ranged from 16 to 53 with a mean of 30. Of the total sample, 43% had at least one child, 39% were married, 38% single with 14% cohabiting. The remaining 9% were either divorced, separated or widowed. Of the sample, 27% were taking oral contraceptives; 40% were employed in either professional/managerial, administrative and skilled technical occupations; 32% in shop/office, skilled and unskilled manual positions; 13% were students and 13% were either housewives, unemployed or 'other' (eg. creative writer).
Menstrual cycle changes

The percentage of subjects reporting each of the 16 physical and feeling states in the three phases of the cycle are listed in table 3.3. One way analysis of variance showed that positive and negative experiences differed significantly between phases of the cycle ($F = 23.44, (2, 1023) P < .001$; Fig. 3.1; $F = 319.25, (2, 1023), P < .001$, fig 3.2 respectively). Positive experiences were more pronounced the week after menstruation than during menstruation ($t = 5.42, P < .001$) and in the premenstrual week ($t = 6.71, P < .001$). Negative symptoms were more severe in the premenstrual week than during menstruation ($t = 7.48, P < .001$) and after menstruation ($t = 25.00, P < .001$). They were also more severe during menstruation than after ($t = 17.5, P < .001$).

![Figure 3.1](image_url)

*Figure 3.1. Mean degree scores for positive experiences in different phases of the menstrual cycle. SED = .07 (STANDARD ERROR OF THE DIFFERENCE OF MEAN)*
Following the exclusion of the coping items 'smoked less', 'took tranquillisers', 'took diuretics' and 'hormone therapy' because they were endorsed by less than 5% of the sample, 35 items remained for the principal components analysis. Four components emerged which explained 31.5% of the variance. Table 3.4 shows the item loadings after rotation. The components were readily interpretable and have been labelled menstrual cycle specific (eg. went to bed with a hot water bottle), active-behavioural (eg. vigorous exercise), active-cognitive (eg. tried not to worry) and active-avoidance (eg. drank more alcohol). The Alpha reliability values were .58, .60, .79 and .53 respectively.
Table 3.3. Percentage of subjects reporting menstrual cycle physical and feeling states

<table>
<thead>
<tr>
<th>Experience</th>
<th>Week Before</th>
<th>Week During</th>
<th>Week After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive emotions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feel energetic</td>
<td>19</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Feelings of well being</td>
<td>16</td>
<td>22</td>
<td>37</td>
</tr>
<tr>
<td>Negative emotions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feel depressed</td>
<td>71</td>
<td>47</td>
<td>09</td>
</tr>
<tr>
<td>Get angry for no good reason</td>
<td>73</td>
<td>47</td>
<td>07</td>
</tr>
<tr>
<td>Poor concentration or memory</td>
<td>43</td>
<td>37</td>
<td>04</td>
</tr>
<tr>
<td>Irritable</td>
<td>78</td>
<td>59</td>
<td>09</td>
</tr>
<tr>
<td>Feeling tense</td>
<td>72</td>
<td>49</td>
<td>07</td>
</tr>
<tr>
<td>Mood swings</td>
<td>72</td>
<td>52</td>
<td>10</td>
</tr>
<tr>
<td>Easily upset/feel like crying</td>
<td>69</td>
<td>45</td>
<td>10</td>
</tr>
<tr>
<td>Feel bad about myself</td>
<td>53</td>
<td>37</td>
<td>06</td>
</tr>
<tr>
<td>Feel more tired than usual</td>
<td>92</td>
<td>66</td>
<td>12</td>
</tr>
<tr>
<td>Physical symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headaches</td>
<td>38</td>
<td>38</td>
<td>08</td>
</tr>
<tr>
<td>Feel bloated in abdomen</td>
<td>76</td>
<td>62</td>
<td>10</td>
</tr>
<tr>
<td>Period type pains</td>
<td>43</td>
<td>73</td>
<td>03</td>
</tr>
<tr>
<td>Food Cravings</td>
<td>45</td>
<td>28</td>
<td>03</td>
</tr>
<tr>
<td>Tender breasts</td>
<td>64</td>
<td>43</td>
<td>04</td>
</tr>
</tbody>
</table>

Coping

The mean helpfulness and percentage endorsement of the individual coping items are shown in Table 3.5. No relationship was found between endorsement and helpfulness (Spearman Rank Correlation r = .07). This shows that while an item might be endorsed, it does not necessarily follow that it is considered to be particularly helpful. Similarly, where an item is considered to be helpful, this does not mean it will be endorsed.
Table 3.4  

<table>
<thead>
<tr>
<th>Coping item</th>
<th>Menstrual</th>
<th>Active</th>
<th>Active</th>
<th>Avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cycle</td>
<td>Behavioural</td>
<td>Cognitive</td>
<td>Avoidance</td>
</tr>
<tr>
<td>Avoided certain foods/substances</td>
<td>0.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drank less coffee</td>
<td>0.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drank less alcohol</td>
<td>0.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talked to GP/Nurse/pharmacist about it</td>
<td>0.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Took B vitamins</td>
<td>0.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kept my feelings to myself</td>
<td>-0.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Went to bed with a hot water bottle</td>
<td>0.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Took evening primrose oil</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Took pain killers</td>
<td>0.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Went out with friends</td>
<td></td>
<td>0.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigorous exercise</td>
<td></td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kept busy</td>
<td></td>
<td>0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team sports</td>
<td></td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady exercise</td>
<td></td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accepted it, nothing could be done</td>
<td></td>
<td></td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>Tried not to worry</td>
<td></td>
<td></td>
<td></td>
<td>0.68</td>
</tr>
<tr>
<td>Talked to friend/relative/partner about it</td>
<td></td>
<td></td>
<td></td>
<td>0.65</td>
</tr>
<tr>
<td>Told myself things to make me feel better</td>
<td></td>
<td></td>
<td></td>
<td>0.62</td>
</tr>
<tr>
<td>Told myself it would be over soon</td>
<td></td>
<td></td>
<td></td>
<td>0.61</td>
</tr>
<tr>
<td>Tried to see the positive side of things</td>
<td></td>
<td></td>
<td></td>
<td>0.61</td>
</tr>
<tr>
<td>Thought about ways of overcoming the problem</td>
<td></td>
<td></td>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td>Talked to women with similar experiences</td>
<td></td>
<td></td>
<td></td>
<td>0.52</td>
</tr>
<tr>
<td>Tried to find out more about what I was going</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>through</td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td>Relaxation exercise</td>
<td></td>
<td></td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>Smoked more</td>
<td></td>
<td></td>
<td></td>
<td>0.59</td>
</tr>
<tr>
<td>Drank more alcohol</td>
<td></td>
<td></td>
<td></td>
<td>0.57</td>
</tr>
<tr>
<td>Drank more coffee</td>
<td></td>
<td></td>
<td></td>
<td>0.56</td>
</tr>
<tr>
<td>Ate more than usual</td>
<td></td>
<td></td>
<td></td>
<td>0.51</td>
</tr>
<tr>
<td>Got angry and took it out on others</td>
<td></td>
<td></td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td>Avoided people</td>
<td></td>
<td></td>
<td></td>
<td>0.41</td>
</tr>
<tr>
<td><strong>Alpha Reliability</strong></td>
<td><strong>0.58</strong></td>
<td><strong>0.60</strong></td>
<td><strong>0.79</strong></td>
<td><strong>0.53</strong></td>
</tr>
</tbody>
</table>

Note: 'Watched TV', 'prayed', 'ateless' or 'took oral contraceptives as a treatment for menstrual difficulties' did not load on any of the components at > 0.30.
Table 3.5.  
Mean helpfulness of coping items, in descending order, and percentage endorsement

<table>
<thead>
<tr>
<th>Coping Item</th>
<th>Mean Helpfulness</th>
<th>%</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Went to bed with hot water bottle</td>
<td>2.9</td>
<td>33</td>
<td>MC</td>
</tr>
<tr>
<td>Relaxation exercise</td>
<td>2.9</td>
<td>30</td>
<td>AC</td>
</tr>
<tr>
<td>Took pain killers</td>
<td>2.8</td>
<td>52</td>
<td>MC</td>
</tr>
<tr>
<td>Took evening primrose oil</td>
<td>2.8</td>
<td>10</td>
<td>MC</td>
</tr>
<tr>
<td>Vigorous exercise</td>
<td>2.7</td>
<td>33</td>
<td>AB</td>
</tr>
<tr>
<td>Team sports</td>
<td>2.6</td>
<td>11</td>
<td>AB</td>
</tr>
<tr>
<td>Went out with friends</td>
<td>2.6</td>
<td>43</td>
<td>AB</td>
</tr>
<tr>
<td>Avoided certain foods</td>
<td>2.6</td>
<td>16</td>
<td>MC</td>
</tr>
<tr>
<td>Tried to find out more</td>
<td>2.6</td>
<td>25</td>
<td>AC</td>
</tr>
<tr>
<td>Steady exercise</td>
<td>2.6</td>
<td>41</td>
<td>AB</td>
</tr>
<tr>
<td>Talked to friend/relative/partner</td>
<td>2.6</td>
<td>51</td>
<td>AC</td>
</tr>
<tr>
<td>Talked to women with similar experience</td>
<td>2.5</td>
<td>45</td>
<td>AC</td>
</tr>
<tr>
<td>Kept busy</td>
<td>2.5</td>
<td>62</td>
<td>AB</td>
</tr>
<tr>
<td>Tried to see the positive side of things</td>
<td>2.4</td>
<td>52</td>
<td>AC</td>
</tr>
<tr>
<td>Drank less coffee</td>
<td>2.4</td>
<td>14</td>
<td>MC</td>
</tr>
<tr>
<td>Talked to GP/nurse/pharmacist</td>
<td>2.4</td>
<td>15</td>
<td>MC</td>
</tr>
<tr>
<td>Took B vitamins</td>
<td>2.4</td>
<td>18</td>
<td>MC</td>
</tr>
<tr>
<td>Thought about ways of overcoming the problem</td>
<td>2.4</td>
<td>41</td>
<td>AC</td>
</tr>
<tr>
<td>Avoided people</td>
<td>2.3</td>
<td>20</td>
<td>AA</td>
</tr>
<tr>
<td>Told myself it would be over soon</td>
<td>2.2</td>
<td>51</td>
<td>AC</td>
</tr>
<tr>
<td>Told myself things to make me feel better</td>
<td>2.3</td>
<td>32</td>
<td>AC</td>
</tr>
<tr>
<td>Drank less</td>
<td>2.2</td>
<td>11</td>
<td>MC</td>
</tr>
<tr>
<td>Tried not to worry</td>
<td>2.2</td>
<td>52</td>
<td>AC</td>
</tr>
<tr>
<td>Drank more</td>
<td>2.0</td>
<td>22</td>
<td>AA</td>
</tr>
<tr>
<td>Accepted it, nothing could be done</td>
<td>2.0</td>
<td>42</td>
<td>AC</td>
</tr>
<tr>
<td>Smoked more</td>
<td>1.7</td>
<td>13</td>
<td>AA</td>
</tr>
<tr>
<td>Ate more</td>
<td>1.7</td>
<td>40</td>
<td>AA</td>
</tr>
<tr>
<td>Drank more coffee</td>
<td>1.7</td>
<td>22</td>
<td>AA</td>
</tr>
<tr>
<td>Kept my feelings to myself</td>
<td>1.6</td>
<td>32</td>
<td>MC</td>
</tr>
<tr>
<td>Got angry and took it out on others</td>
<td>1.6</td>
<td>45</td>
<td>AA</td>
</tr>
</tbody>
</table>

Note: MC=menstrual cycle specific, AB=active behavioural, AC=active cognitive, AA=active avoidance.
Analyses of variance  Mean endorsement of the four types of coping identified by
the principal components analysis differed significantly \( (F = 64.25, (3,1307) P <
.001, \text{figure 3.2}) \). Active-cognitive coping was more frequently endorsed than
active behavioural coping strategies \( (t = 2.22, P < .05) \) but both were more
popular than menstrual cycle specific (minimum \( t = 9.5, P < .001 \)), and avoidance
(minimum \( t = 8.66, P < .001 \)) strategies. There was no difference in endorsement
between menstrual cycle specific and avoidance coping). Helpfulness of the
different types of coping also differed significantly \( (F = 73.33, (3,1297) P < .001,
\text{figure 3.3}) \). Active-behavioural and active-cognitive methods were considered
equally helpful \( (t = .84) \). Both were considered to be more helpful than menstrual
cycle specific methods (minimum \( t = 2.76, P < .01 \)) and avoidance methods
(minimum \( t = 12.34, P < .01 \)). In turn, menstrual cycle specific methods were
considered to be more helpful than avoidance methods \( (t = 9.57, P < .01) \).

Coping and severity of menstrual cycle symptoms  The statistically significant
correlations for menstrual cycle symptom severity with coping endorsement and
helpfulness are presented in Table 3.6. Due to the large sample size, some of these
significant correlations are very modest indeed. This makes interpretation difficult
and needs to be kept in mind. Frequency of endorsement was more clearly related
to severity of symptoms than was helpfulness. Women with more severe
symptoms the week before and the week of menses were markedly more likely to
use avoidance methods followed by active-cognitive and menstrual cycle specific
ways of coping. Avoidance and menstrual cycle specific methods were found to be
helpful when symptoms were severe but active-cognitive were not. Neither the use
of active-behavioural coping nor its helpfulness was related to symptom severity.

**Age, parity and occupation**  Coping endorsement or helpfulness were not found to be related to age, parity or occupation.

**Table 3.6** Product moment correlation coefficients for symptom severity with coping endorsement and helpfulness

<table>
<thead>
<tr>
<th>Symptom severity</th>
<th>Frequency of endorsement</th>
<th>Helpfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week Before</td>
<td>During</td>
</tr>
<tr>
<td>Menstrual cycle specific</td>
<td>0.20*</td>
<td>0.24*</td>
</tr>
<tr>
<td>Active-Behavioural</td>
<td>0.24*</td>
<td>0.24*</td>
</tr>
<tr>
<td>Active-Cognitive</td>
<td>0.24*</td>
<td>0.24*</td>
</tr>
<tr>
<td>Avoidance</td>
<td>0.45*</td>
<td>0.29*</td>
</tr>
</tbody>
</table>

* = P < .01
Figure 3.3  Mean endorsement of coping components, SED = .01

Figure 3.4  Mean helpfulness of coping components, SED = .04
3.4 Discussion

Previous studies that have reported ways that women use to cope with menstrual cycle changes did not use measures that have been developed to assess coping behaviour. Barker et al (1990) investigated behavioural, cognitive and avoidance methods of coping with psychological problems, finding behavioural and cognitive to be the most popular in a UK sample. In the present study, the coping classifications used by Barker et al (1990) were adopted and subjected to principal components analysis. The coping items were statistically categorised into four classifications: menstrual cycle specific, active-behavioural, active-cognitive and avoidance coping methods. Barker et al’s behavioural category included "keep busy", "go out" and "active exercise" items. In the present study the first two of these three items loaded onto the active-behavioural component together with three different types of exercise items. (The final item "accepted it, nothing could be done" that also loaded onto this component seems odd and inexplicable.)

Similarly, the majority of Barker et al’s cognitive and avoidance items loaded onto the active-cognitive and avoidance components respectively. The similarity between the conceptual categorisations and the classifications derived from the principal components analysis strengthens confidence in the existence of these groupings.

These four components accounted for 31.5% of the variance and were found to have reasonable reliability. While the percentage of variance accounted for may
seem low, it needs to be borne in mind that a fairly stringent criterion for the number of components to retain for rotation was used. Furthermore, coping behaviours may not be very appropriate for analyses based on looking for intercorrelations. For example, the use of a particular coping behaviour does not mean the use of another of the same type will also be adopted. Thus, keeping busy as a way of coping does not necessarily mean vigorous exercise will also be used. Similarly, trying not to worry does not necessarily mean that one will try to see the positive side of things.

The emergence of menstrual cycle specific items that loaded onto a single component is interesting. Included in this component were primarily non-medical items such as dietary changes, but also included non prescription medications such as vitamins and evening primrose oil. These treatments have become a method for coping with many physical disorders and conditions, not just those of the menstrual cycle, (eg. Say 1991) but do not represent orthodox medical treatments. The active-behavioural component that contains primarily physical exercise items is also unrepresentative of orthodox treatments for menstrual cycle disorders. Physical exercise has been advocated by health professionals and in the lay literature for decades as a way of alleviating menstrual cycle problems but these recommendations have been based on anecdotal and unsystematic reports (Cowart 1989).

The menstrual cycle changes checklist showed that positive experiences were greatest in the postmenstrual week. In contrast, negative symptoms were most
severe premenstrually followed by the week of menstruation. This confirms that our sample experienced menstrual cycle changes. The most popular ways of coping with these changes in physical and feeling states were active-cognitive followed by active-behavioural. It is noteworthy that active-cognitive was more frequently endorsed than active-behavioural even though both were rated to be equally helpful. When dealing with personal difficulties and emotional problems, both coping methods are equally endorsed (Barker et al 1990). The findings of this study suggest that dealing with the menstrual cycle is different. It may be that when dealing with the menstrual cycle, active-cognitive coping methods, such as trying not to worry, are easier to endorse than such active-behavioural methods as physical exercise and going out with friends in spite of the belief that both are as helpful. Perhaps severe menstrual cycle symptoms prevent active-behavioural coping. Although the small correlations between symptom severity and coping methods are difficult to interpret it is interesting to note that symptom severity the week before and during menstruation did not correlate with endorsement of active-behavioural methods while correlations were seen for menstrual cycle specific, active-cognitive and avoidance methods. This may reflect difficulty in going out with friends and in exercising when symptoms are severe. However, physical exercise was considered to be as helpful as active-cognitive methods which might reflect promotion by the media of exercise as a panacea for menstrual cycle problems. This begs the question "do women who exercise actually experience fewer menstrual cycle symptoms than women who do not exercise?" and will be the subject of investigation in the next chapter.
4. MENSTRUAL CYCLE CHANGES IN COMPETITIVE SPORTSWOMEN, KEEPFITTERS AND SEDENTARY WOMEN

Abstract

Anecdotal accounts and unsystematic reports have suggested that exercising women experience fewer premenstrual symptoms and less severe dysmenorrhea than women who are sedentary. The present study tested this belief by monitoring the mood states and physical symptoms of 143 women for five days in each of three phases of the cycle (mid-cycle, premenstrual and menstrual). The women were 35 competitive sportswomen, 2 groups of keepfitters (33 high exercisers and 36 low exercisers) and 39 sedentary women. Principal components analysis of their responses to a mood and physical symptom checklist revealed 5 dimensions: positive affect, negative affect, physical symptoms, fatigue and irritability. Component-based sub-scale scores were calculated for all dimensions. In general, mood and symptoms were worse menstrually and premenstrually than mid-cycle. The high exercisers experienced the greatest positive affect and sedentary women the least. The high exercisers also reported the least negative affect. The differences between the groups were greatest during the premenstrual and menstrual phases suggesting that exercisers are to some extent protected from deterioration of mood before and during menstruation although cause and effect were not established. If our findings are an effect of exercise, the mechanism responsible has yet to be discovered.

4.1 Introduction

In the last two decades there has been an increasing emphasis in our society on health and fitness which has meant extensive promotion by the mass media of lifestyle variables, such as physical exercise, as a panacea for all ills. The belief expressed by women in the previous study (Chapter 3) that physical exercise is a helpful method of coping with menstrual cycle changes may reflect this promotion. While increased
exercise has been found to be directly related to symptom reduction for a variety of disorders including obesity (Rauramaa 1984), coronary artery disease (eg. Rigotti et al 1983) and hypoglycaemia (Rauramaa 1984), the recommendations of physical exercise as a treatment for menstrual cycle disorders have been based mostly on anecdotal and unsystematic reports (Boyden et al 1983, Dale et al 1978) as only a small number of studies assessing exercise and menstrual cycle changes have been carried out.

Timonen & Procope (1971) found that, although female physical education students (assumed to be more physically active) reported experiencing more pain during menses, premenstrually they experienced fewer headaches, less anxiety and less depression than did female students from other faculties (assumed to be less physically active). But, conclusions cannot be drawn from this study as the assumption that physical education students are more active than other students may, of course, be incorrect.

A more recent study, that did assess levels of physical activity and did not reveal the menstrual cycle nature of the study, revealed that student nurses who exercised regularly reported more severe dysmenorrhea symptoms than those who classified themselves as sedentary (Metheny & Smith 1989). These findings might, however, be explained by the inclusion of a 'legache' item in the dysmenorrhea questionnaire. Recall from the discussion of dysmenorrhea in Chapter 1 that menstrual pain, which is primarily focused in the lower abdomen, may also be present in the thighs. The inclusion of the 'legache' item in the dysmenorrhea questionnaire is therefore justified
but remember that the women in this study were not aware that the questionnaire was about the menstrual cycle. Those who regularly exercised complained of more legache than the sedentary women but legache correlated significantly with aerobic activity (running, aerobics and biking) while none of the other dysmenorrhea items did. As running, aerobics and biking are vigorous activities that involve the legs and can cause 'legache', this correlation is not surprising. The serious problem with this study is that it cannot be ascertained whether the exercising women were reporting legache that can be a symptom of dysmenorrhea or muscular aches in the legs as a result of strenous aerobic exercise. As they were blind to the nature of the study it seems likely that even if they were reporting dysmenorrhea induced legache, they were also reporting exercise induced legache.

Two intervention studies have been conducted to assess the effect of exercise on menstrual cycle symptomatology. In the first, Israel et al (1985) evaluated the effects of a 12 week aerobic training programme on symptoms of dysmenorrhea. Prior to the training programme, the experimental and control groups reported similar levels of symptomatology while afterwards the experimental group reported significantly less severe symptoms during menstruation than the control group. There were no group differences before or after training during the premenstrual or intermenstrual phases. These results need to be treated with caution, however, as it is not clear how active these subjects were at the beginning of the study and because the experimental group contained only 11 subjects.

The second intervention study was concerned with PMS and monitored sedentary
women who embarked on a running programme for six months (Prior & Vigna 1987). There was decreased breast tenderness and fluid retention premenstrually for these exercising women, while the no-exercise control group did not change. There were no significant changes in depression and anxiety in either group. Unfortunately there were only eight women in the experimental group which limits interpretation of these results in spite of the controlled nature of the study.

No conclusions can be made therefore about the efficacy of physical exercise in alleviating PMS and dysmenorrhea. On the other hand, the psychological effects of exercise have been well documented in studies not concerned with the menstrual cycle and much evidence has been gleaned to support positive benefits (Layman 1960, Folkins & Sime 1981, Morgan 1985). Four surveys carried out in Canada and the United States found level of physical activity to be positively associated with general wellbeing, lower levels of anxiety and depression and more positive mood (Stephens 1988). Recent results from a British survey (Thirlaway & Benton 1990) similarly found a strong correlation between greater physical activity and better mental health. Furthermore, competitive runners have been found to have a more positive mood profile than recreational runners (Tooman et al 1985), marathon runners have been found to have more positive mood profiles than joggers (Wilson et al 1980), and athletes have been found to have more positive mood profiles than the normal population (Morgan & Pollock 1977). Morgan (1980) has described this configuration as the "iceberg profile" (Figure 4.1). However, while Stephens (1988) and Thirlaway & Benton (1991) found their correlations to be stronger for women than men, very little evidence exists for an "iceberg profile" amongst women
exercisers (Biddle & Mutrie 1991).

![Figure 4.1. The Iceberg Profile](image)

Intervention studies of aerobic (eg. running) and anaerobic (eg. weightlifting) exercise have demonstrated decreases in depression, anxiety and fatigue, greater positive mood and enhanced self esteem (Mutrie 1987, Steptoe & Bolton 1988, Steptoe & Cox 1988, Ossip-Klein et al 1989, North et al 1990, Petruzello et al 1991). As many women are susceptible to feelings of irritability, depression, anxiety, and less positive mood either premenstrually or during menstruation or perhaps on both occasions, it seems logical for exercise to alleviate these symptoms.
The belief that this is so prevails in spite of the paucity of scientific evidence (Chapter 3). Therefore, the present study aimed to test this belief by examining the association between physical exercise and menstrual cycle experiences. Shangold (1988) has suggested that although regular exercise may relieve stress and anxiety, this action may be outweighed in competitive sportswomen who must incorporate a specific amount of exercise into their daily schedules. This argues against the notion of an "iceberg profile" for these women as the physical and emotional stress of training for competition may eliminate the beneficial effects of exercise. Moreover, for those competitive sportswomen who do menstruate regularly, their menstrual cycle experiences might be different to other exercising groups. Thus, as well as sedentary women and women who trained to keep fit, competitive sportswomen were also studied. The emotional and physical changes of these women who routinely exercised at different levels were monitored throughout the menstrual cycle.

Recent years have seen a growing acceptance of longitudinal studies using daily ratings as the most reliable way of obtaining valid menstrual cycle data (see Chapter 2 for discussion concerning retrospective and prospective menstrual cycle studies). The most commonly used instrument has been the Moos Menstrual Distress Questionnaire (Moos 1968). This has been criticised however for including insufficient emotional symptoms (Rubinow et al 1984) and mostly negative items, ie. unpleasant symptoms and negative mood states (Parlee 1974, Ussher 1989). Recall from Chapter 2 that as well as feelings of negative mood there have also been indications that positive mood can be greater at certain times, in particular mid-cycle (eg. Sanders et al 1983, Gallant et al 1991). Moreover, Logue & Moos (1988) have
reported increases in excitement, energy and wellbeing during the menstrual and premenstrual phases. Indeed, Parlee (1982) has suggested a possible premenstrual elation syndrome. The present study also aimed to assess positive and negative mood changes equally and because the MDQ, contains only 5 positive items out of a total of 48, is was not considered suitable.

One alternative is to use a standardised mood change questionnaire that was not devised to measure menstrual cycle mood change. The Profile of Mood States (POMS) is one of the most popular of such instruments which measures either six unipolar mood states (tension, depression, anger, vigour, fatigue and confusion) or six bi-polar mood states (composed-anxious, agreeable-hostile, elated-depressed, confident-unsure, clearheaded-confused, energetic-tired) by means of a mood adjective checklist (McNair et al 1980) and both have been used extensively in physical exercise research. The unipolar version was not considered suitable for the present study as it contains only one positive mood factor, vigour.

Mood state questionnaires such as the bi-polar version suggest either only one dimension on which positive and negative affect are bipolar ends, or else separate, highly correlated factors, but in either case, positive and negative affect do not appear to be independent (Diener & Emmons 1985). Recent research questions the bipolarity of mood. Watson & Tellegen (1985) have conducted the most comprehensive review and analysis of mood structure to date. Their own research and reanalysis of previous studies has consistently found positive affect and negative affect to be independent orthogonal dimensions that emerge in factor analysis after a varimax rotation. These
two dimensions consistently account for one half to three quarters of the common variance between emotional terms in factor analytic solutions. Dominant dimensions of positive affect and negative affect have been found across cultures (Watson et al 1984), in both idiographic and nomothetic factor analytic solutions (Zevon & Tellegen 1982), across rated time frames and response formats (Watson 1988a), and in reanalyzed solutions that had previously argued for the existence of multiple discrete emotional factors (Watson & Tellegen 1985). Additionally, positive affect and negative affect have shown differential relations to a variety of daily activities and health complaints (Clark & Watson 1988, Watson 1988b).

It would appear therefore that positive affect and negative affect are independent mood states, ie. the extent to which an individual experiences one is unrelated to their experience of the other. The use of a mood questionnaire derived from this research would, at first sight, appear suitable. Under scrutiny, however, this is questionable as the aforementioned research carried out by Watson and various colleagues has been conducted mostly on men. Not only might such mood questionnaires not be sensitive to women's mood changes, they might not be sensitive to menstrual cycle related mood changes.

Thus, a daily mood and physical symptom questionnaire was constructed for the present study. It emphasised positive and negative mood equally and its dimensionality was first examined by principal components analysis. The questionnaire was completed daily for one complete menstrual cycle and comparisons were made between four groups of women: competitive athletes, high-exercisers, low-
exercisers and sedentary women across three phases of the cycle: menstrual, premenstrual and mid-cycle.

The objectives of the present study were as follows:-

1. To assess the sensitivity of the specially devised mood questionnaire to changes experienced by women during the menstrual cycle
2. To monitor positive as well as negative mood fluctuations throughout the menstrual cycle
3. To test the hypothesis that women who exercise experience fewer menstrual cycle problems

4.2 Methods

Questionnaire

Adjectives were selected from the mood state questionnaire devised by Morris et al (1988) which consists of both negative and positive adjectives and which was shown to be sensitive to the effects of running on both positive and negative mood in both women and men. Further items were chosen following interviews with 10 psychology postgraduate women about their feelings throughout the cycle. These were: strong,
in control, assertive, powerful, motivated and tearful. Descriptions of physical symptoms relevant to the menstrual cycle were taken from the Moos Menstrual Distress Questionnaire (e.g. sore breasts). The final list contained 42 items. The instructions read: "below is a list of words that describe moods and physical states that people experience. For each one, please tick the box which best describes your experience throughout TODAY". The women responded on a scale of 0 - 4 where 0 = not at all and 4 = extremely. Two further questions were also added: "did you menstruate today?" and "did you exercise/train today?". These required a yes/no answer.

Subjects were also asked to provide information about themselves: age, marital status and number of children. They were also asked to identify their employment category out of: unskilled manual, skilled manual, skilled technical, clerical/office/shop, professional/managerial, other; to answer yes or no to "are you currently taking the contraceptive pill?" and "are you currently taking any prescribed medication?". They were asked to describe any medication that they were taking, provide the dates of their last three menstrual periods and answer yes or no to "do you experience/have you ever experienced any menstrual/gynaecological problems?" and to provide brief details. In addition subjects were asked to answer yes or no to the question "Do you regularly participate in any sport/exercise (at least twice a week)? and, if so to write what sport(s). They were then asked how often they participated (1-2, 3-4 or 4+ hours), for how long each time (less than 1, less than 2, more than 2 or more than 4 hours) and to rate how important competitive or public events were in motivating their training.
A total of 368 women were asked to "participate in a study of exercise and the menstrual cycle". They were offered free tampons or sanitary towels for their participation. In order to secure both exercising and non-exercising women from different socioeconomic groups, subjects were recruited in a variety of ways: from sports centres, women's groups, department stores, two London based companies and university staff and students. Further subjects were randomly selected from respondents to a brief article that appeared in a national newspaper, sports magazines and a popular magazine that is distributed free in Central London. Complete data were collected from 190 women. Following the exclusion of contraceptive pill and psychoactive medication users, as well as those who suffered from menstrual/gynaecological problems, 143 subjects remained for the analyses. Their ages ranged from 15 - 48 with a mean age of 30 years.

Allocation of subjects to one of the four groups was based on the information they provided about their exercising habits. Those not regularly participating in any sport or exercise were labelled sedentary and, for those who did, if preparation for competitive or public events was important, they were labelled competitive. For the physiological benefits of exercise to be realised, the American College of Sports Medicine (1986) recommend that exercise is carried out three times a week. On this
basis, the non competitive sportswomen, ie. keep-fitters, were divided into high-exercisers (exercising three or more times a week) and low-exercisers (less than three times).

The competitive group contained 35 women. The sports were mainly rowing, running, swimming and athletics. There were 33 women in the hi-exercise group and 36 in the lo-exercise group. The most popular sports for these keep-fitters were keep-fit and aerobics classes, swimming, running, walking, and weight training. All of the sportswomen and most of the keep-fitters participated in more than one type of sport or activity. The sedentary group consisted of 39 women. The complete sample population was made up mostly of professional/managerial workers (N = 65) and women who did clerical or shop work (N = 27). 110 of the women were single and 33 married.

An additional 91 female undergraduates recruited from the university completed the questionnaire once to provide further data for the separate principal components analysis (see below).

Procedure

Subjects in the main study were asked to complete one questionnaire every night for one month beginning on the first day of their next menstrual period and ending on the first day of their following period. To encourage the women to continue completing
their questionnaires for the month, they were telephoned a few days before their period was due to start and then weekly until their next period was due. If necessary they were telephoned again to remind them to return the completed questionnaires in the stamped addressed envelope that was provided.

In view of the absence of hormonal or other physiological markers it was decided to examine just three phases of the cycle. The menstrual phase was defined as the first 5 days of menstrual bleeding (5 days being the average). No problems exist with defining this phase as when menstrual bleeding occurs, it is observable to the woman in whom it occurs and can be demonstrated to others if need be. Days without menstrual bleeding during this phase were not included (only 20 subjects bled for fewer than 5 days). The premenstrual phase however is somewhat different. Dalton (1974) has asserted that this phase can begin 14 days before menstruation. However, as the beginning of this phase is characterised by the beginning of the decline in oestrogen and progesterone (see Chapter 1) and hormonal markers have shown this to occur around 5 days before menstruation in most women (eg. Saunders et al 1983), most researchers have defined the premenstrual phase as 4-7 days before menstruation. In order to be consistent with the 5 day menstrual phase, the premenstrual phase was the 5 days preceding menstruation. The ovulatory phase occurs around mid-cycle (approximately days 13-15). As ovulation could not be determined, the 5 days in the middle of the woman’s cycle were chosen and were termed the mid-cycle phase. Therefore, for each woman, only 15 questionnaires were used. This had the advantage of allowing for variation in cycle length from woman to woman.
Statistical analysis

For the separate principal components analysis one questionnaire from each subject in the main study was randomly chosen and added to the questionnaires from the 91 students (total N = 234). The correlation matrix was used to standardise the scores. The number of factors to retain for varimax rotation was determined by Cattell's (1966) scree test. Items loading at 0.50 and above were used for interpretation. In the main study, scale scores were calculated for each component by summing items loading at 0.50 or more. Repeated measures analysis of variance was then used on each of the resulting variables to examine the differences between the four groups and across the three phases. Where necessary, significant effects were examined by post hoc t-tests using the error from the analysis of variance. Comparisons between groups for occupational categories and marital status were tested by $X^2$. Groups were compared on age and number of days out of fifteen on which the women exercised by analysis of variance.

4.3 Results

Subjects
The groups did not differ in distribution of occupational category \( (X^2 = 23.24, \ df = 15, P > .05) \), marital status \( (X^2 = 1.04, \ df = 3, P > 0.05) \) or age \( (F = 2.46, (3, 139), P > .05) \). The number of days per week that the groups usually exercised (reported at the start of the study) was significantly different \( (F = 281.41, (2, 101), P < .00001) \). The competitive athletes and high-exercisers did not differ (mean days per week = 4.62 and 4.22 respectively) but both groups exercised more often than the low exercisers (mean days per week = 1.97). The sedentary women reported not usually exercising at all. The duration of each exercise session also differed significantly \( (F = 3.96 (2, 101) P < .05) \). The high-exercisers and the low exercisers did not differ (mean hours = 1.68 and 1.91 respectively) but the competitive athletes exercised for longer than the other groups (mean hours = 2.14). These retrospective exercise frequency data were confirmed from the daily questionnaires \( (F = 50.98 (3, 139) P < .05) \). The competitive athletes and high-exercisers did not differ in number of days that they exercised during the study (mean number of days out of 15 = 8.43 and 7.67 respectively) but both exercised more than the low-exercisers (5.17 days) who, in turn, exercised more than the sedentary women (0.97 days).

**Principal components analysis**

Five components emerged which explained 57.6\% of the variance. Table 1 shows the item loadings after rotation. The components were readily interpretable and were labelled positive affect (feelings of pleasure, confidence and competence), negative affect (feelings of sadness and worry), physical symptoms, fatigue and irritability.
Table 4.1. Item loadings (> 0.50) for rotated factors from principal components analysis

<table>
<thead>
<tr>
<th>Positive Affect</th>
<th>Negative Affect</th>
<th>Physical Symptoms</th>
<th>Fatigue Ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert</td>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentive</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearheaded</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can concentrate</td>
<td>0.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivated</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In control</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assertive</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>0.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheerful</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleased</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lively</td>
<td>0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerful</td>
<td>0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overjoyed</td>
<td>0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carefree</td>
<td>0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lonely</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uneasy</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sad</td>
<td>0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worried</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearful</td>
<td>0.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tearful</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td>0.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sore breasts</td>
<td>0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shaking hands</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloating</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cramps</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty breathing</td>
<td>0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dizziness</td>
<td>0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pounding heart</td>
<td>0.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tired</td>
<td></td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Drowsy</td>
<td></td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Sluggish</td>
<td></td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Weary</td>
<td></td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>Angry</td>
<td></td>
<td></td>
<td>0.81</td>
</tr>
<tr>
<td>Annoyed</td>
<td></td>
<td></td>
<td>0.78</td>
</tr>
<tr>
<td>Badtempered</td>
<td></td>
<td></td>
<td>0.78</td>
</tr>
<tr>
<td>Irritable</td>
<td></td>
<td></td>
<td>0.65</td>
</tr>
</tbody>
</table>

Note: 'Troubled by spots', 'nausea' and 'headaches' did not load on any of the components at > 0.50.
Analyses of variance

**Positive affect**  This was clearly affected by cycle phase ($F = 19.67, (2, 1377) P < .001$) being higher mid-cycle than either premenstrually ($t = 4.92, P < .001$) or menstrually ($t = 5.87, P < .001$; Figure 4.2). The significant group effect ($F = 3.5 (3,139), P < .01$) confirmed that the high-exercise and competitive groups were generally happier than the sedentary women ($t = 3.16 & 2.01$ respectively; $P$'s <.01, .05), with the low-exercisers being intermediate and not significantly different from any other group. However, the group x phase interaction ($F = 2.32 (6,1377), P < .05$) showed that the cycle affected groups differently. Sedentary and low-exercise groups were similar: positive affect deteriorated both menstrually and premenstrually by comparison with mid-cycle (minimum $t = 2.79, P < .01$). The high exercisers also deteriorated menstrually ($t = 3.24, P < .0005$) but, uniquely, they were just as happy premenstrually as mid-cycle. In the competitive group, by contrast, only premenstrual mood deteriorated by comparison with mid-cycle ($t = 2.89, P < .01$); menstrual scores were intermediate between these two.

Comparing exercise groups with the sedentary subjects in each phase: menstrually, both competitive and high-exercise groups were happier ($t's = 2.43 & 2.37$ respectively, $P$'s <.05); mid-cycle and premenstrually, only the high-exercisers were happier ($t's = 2.29 & 4.00, P$'s < .05, < .001).

**Negative affect**  Figure 4.2 shows a similar effect of cycle to that seen in positive
affect. Mood was worse premenstrually and menstrually than mid-cycle \( (F = 21.00 (2,1377) P < .001; \ t's = 5.23 \ & \ 5.94 \ \text{respectively P's} < .001) \). The differences between groups formed a different pattern however \( (F = 2.94 (3, 139), P < .05) \). Negative mood was less in high exercisers than in either low-exercisers \( (t = 2.79 , P < .01) \) or the competitive group \( (t = 2.45, P < .05) \). The comparison with sedentary women approached significance \( (t = 1.9, P < .10) \). Figure 1 suggests that, as with positive mood, negative mood did not deteriorate premenstrually in high-exercisers but the group x cycle interaction failed to reach significance \( (F = 1.89 (6, 1377) P < .10) \).
Figure 4.2 Mean scores for positive affect and negative affect dimensions. Bars show SED for a: differences between groups within a single phase and b: differences between menstrual cycle phase within groups.
Physical symptoms. These were greater menstrually and premenstrually than midcycle \( F = 123.65 \ (2, 1377); t's = 15.60 \) & \( 9.49 \) respectively, \( P's < .001 \); Figure 4.3). Although the group effect was not significant, differences between groups emerged menstrually and premenstrually (group x phase \( F = 2.99 \ (6, 1377) \ P < .007 \). Premenstrually, Figure 4.3 suggests that the sedentary and low-exercising women had most symptoms; both groups were significantly worse than the high-exercisers (sedentary \( t = 2.09 \ P < .05 \); low-exercisers \( t = 2.19, P < .05 \)).

Comparisons with the competitive group, however, fell short of significance (minimum \( t = 1.6 \)). Menstrually, the low-exercisers had more symptoms than any other group (minimum \( t = 2.62, P < .01 \). The high exercisers and competitive groups were indistinguishable throughout on this measure (figure 4.3). Despite the group x phase interaction, the deterioration in symptoms menstrually and premenstrually occurred clearly in all groups (minimum \( t = 6.17, P < .001 \).

![Figure 4.3: Mean scores for physical symptoms. Bars show SED for a: differences between groups within a single phase of the menstrual cycle and b: differences between menstrual cycle phase within groups.](image-url)
Fatigue. Again, significant phase effects were seen \((F = 59.98 \ (2, \ 1377), \ P < .0001; \ Figure \ 4+)\). Fatigue was greater menstrually than premenstrually \((t = 5.6, \ P < .001)\) and, in turn, greater premenstrually than mid-cycle \((t = 5.35, \ P < .001)\).

As with physical symptoms, group differences emerged only in interaction with phase \((F = 3.48 \ (6,1377) \ P < .002)\). Changes resembled the pattern seen in positive affect: only the high-exercisers did not deteriorate from mid-cycle to premenstrually \((other \ t's: \ minimum = 2.55, \ P's < .02)\). Therefore the high exercisers had the least fatigue of all the groups premenstrually (comparisons with sedentary and competitive groups were significant: \(t's = 2.5\) for both, \(P's < .05\)). By contrast, only the competitive group failed to increase significantly in fatigue from mid-cycle to menstrually; as a result, their fatigue menstrually was significantly less than in the sedentary group \((t = 1.99, \ P < .05)\), although other comparisons were not significant. No differences were significant mid-cycle.

Irritability. This, like fatigue, was higher during menstruation than premenstrually \((F = 56.72 \ (2, \ 1377) \ P < .001; \ t = 5.16, \ P < .001)\) and higher premenstrually than mid-cycle \((t = 5.48, \ P < .001)\). Although figure suggests that only the high-exercisers failed to become more irritable premenstrually, neither the group effect nor the group by phase interaction reached significance.
Figure 4.4 Mean scores for fatigue and irritability dimensions. Bars show SED for a: differences between groups within a single phase of the menstrual cycle and b: differences between menstrual cycle phase within groups.
4.4 Discussion and Conclusions

From the questionnaire five components emerged that were readily interpretable. These were positive affect, negative affect, physical symptoms, fatigue and irritability. The emergence of the positive and negative affect dimensions adds further support to the view that these are independent mood states, i.e. the extent to which an individual experiences one is unrelated to their experience of the other (Watson & Tellegen 1985, Watson 1988). The finding of the independence of these two types of affect have important clinical implications. For example, clinicians have often conceptualized distress and well-being as lying at opposite ends of a single continuum. But if these two dimensions are indeed independent, some clinical problems might result from the absence of positive affect, whereas others may result from the presence of excessive negative affect. The distress of clients could therefore be alleviated by either increasing positive affect or by reducing negative affect. If this is the case, it could also be expected to apply to menstrual cycle changes.

Watson & Tellegen (1985) do stress, however, that they are not suggesting that all emotional experience can be reduced to only two variables and emphasise that positive and negative affect dimensions do not exclude the operation of additional systemic sources of variance. Thus, the emergence of irritability as an additional factor while uncommon in the mood literature, is not theoretically impossible. This component might be specific to women since previous studies have only rarely
used an exclusively female sample and, when women were included, separate principal components analyses for men and women were not reported. This suggests that it is important in assessing menstrual cycle changes to use mood questionnaires which have been validated on women.

The questionnaire was sensitive to the changes experienced by women during their menstrual cycle. Highly significant phase effects emerged for all components: the sample in general felt better mid-cycle than premenstrually and menstrually. Interestingly, positive mood, negative mood and physical symptoms did not differ significantly in the premenstrual and menstrual phases while fatigue and irritability were significantly greater during menstruation rather than premenstrually. These results stand in contrast to the findings of the previous study where, retrospectively, the sample reported significantly more problems premenstrually than menstrually. This discrepancy may be an indication of the greater value in using prospective measurements.

Although reports of changes in positive mood across the cycle are few, the present study has found further evidence that this does fluctuate across the cycle. It increased during the mid-cycle phase, as is more commonly reported in the few studies that have examined menstrual cycle positive mood changes. It did not however increase premenstrually or while menstruating which does not support suggestions that positive affect increases during these phases. These suggestions are, however, not firmly based. Logue and Moos' (1988) claim that positive affect increased premenstrually was based in part on a retrospective study in which only a minority of women reported such an increase (Moos 1968). In contrast, Parlee’s claims are based on contradictory data: retrospective questionnaires found no evidence of improved mood premenstrually whereas feelings of general activation increased and depression decreased when measured prospectively.

Turning now to group differences, a very clear picture emerges with both positive and negative affect. The high-exercisers felt better than did all other groups over
the whole cycle. This is consistent with previous evidence which associates regular exercise with greater positive mood and lower negative mood. Furthermore, exercise groups differed in the lability of mood and symptoms across the cycle. In particular, the high-exercisers did not experience the decline in positive mood and increase in fatigue from mid-cycle to premenstrually which was seen in other groups. A similar trend was seen in negative affect. This pattern of findings suggests that women who routinely take high levels of exercise may be, to some extent, protected from feelings of physical and emotional deterioration premenstrually.

In general, women who exercised only a moderate amount were not different from sedentary women. Indeed, in one instance their experience was worse (physical symptoms in the menstrual phase), but this was an isolated finding; without replication it would be premature to conclude that mild exercise can be associated with a poorer state.

The clear absence, in high exercisers, of any protection from deterioration in the menstrual phase contrasts with their premenstrual protection. This may reflect different mechanisms which lower mood premenstrually and menstrually. For example, acute pain that is often present while menstruating, but not premenstrually (Richardson 1990), suggests one obvious way in which the sources of distress and discomfort may be different.

While our competitive sportwomen and high-exercisers did not differ in the number
of times they exercised per week, the general failure of the competitive sportswomen to show the same protection from premenstrual deterioration as the non-competitive high-exercisers argues against the notion of the "iceberg profile" in competitive athletes and a simple relationship between physical exercise and improved mood and symptoms. The competitive sportswomen did report exercising for longer than the high-exercisers and it is possible that, this greater exercise intensity causes harmful effects (Carlberg et al 1986). However, while the prevalence of menstrual dysfunction (eg. amenorrhea, menstrual cycle mood changes have not been a consideration in these studies) is higher among competitive athletes than among the general population, it does not correlate with exercise intensity measured by average weekly mileage, running pace and number of years of training (Shangold & Levine 1982, Wakat et al 1982). Alternatively, it may be the stress of competition that is causing harmful effects (Shangold 1988). The present study did not, however, find evidence that the competitive group experienced worse premenstrual or menstrual deterioration than sedentary women.

Some methodological criticisms of this study are necessary. Firstly, the groups studied were selected on the basis of pre-existing levels of exercise. Although they did not differ on the demographic variables measured, it is possible that they differ in some other way, not attributable to variations in exercise training, that resulted in these findings. For example, differences in personality between people electing or not electing to exercise or compete are likely. Secondly, it is unknown why the sedentary women were sedentary; conceivably, this might be a result of their more severe menstrual cycle symptoms.
Notwithstanding these methodological concerns, the importance of the results of this study is the support that has emerged for the popular contention that physical exercise is associated with fewer premenstrual symptoms. If these results are an effect of regular exercise, there are a number of ways in which regular exercise might improve mood and, although they have arisen from research which has not been concerned with the menstrual cycle, each would be expected to be applicable to premenstrual deterioration. For example, exercise may improve feelings of self esteem and mastery (Mutrie 1987, Sonstroem 1984), provide a distraction from external sources of stress or from distressing thoughts (Bahrke & Morgan 1978, Wilson et al 1981) or increase resistance to stress (Morris et al 1986, Salmon et al 1988). These effects could, in turn, be mediated by physiological changes such as increased work capacity (Mutrie 1987, Hughes 1984) or reduced cardiovascular responsiveness to stress (Van Doornen & DeGeus 1988).

Recall from Chapter 1 that environmental stress has been found to modestly correlate with frequency and severity of menstrual cycle symptomatology and it has been suggested that menstrual cycle disorders may be initiated and exacerbated by stress. Because of this link between stress and menstrual cycle problems, perhaps the premenstrual protection seen in this study was a result of exercise being a distraction from stress or that the high exercisers have an increased resistance to stress mediated by reduced cardiovascular responsiveness to stress. The following study will test these mechanisms to delineate the processes involved in the relationship between exercise and menstrual cycle mood change.
5. STRESS RESPONSIVITY IN EXERCISERS AND NON-EXERCISERS DURING DIFFERENT PHASES OF THE MENSTRUAL CYCLE

Abstract

The possibility that premenstrual protection experienced by high-exercisers is mediated through an improved stress response was raised in the previous chapter. The study in this chapter investigates how exercising and non-exercising women respond to a stressful laboratory task during different phases of the menstrual cycle. Heart rate and blood pressure responses as well as subjective mood states were measured in each of three phases of the cycle (premenstrual, menstrual and postmenstrual). Results revealed that while the groups differed in their physiological responses to stress, they did not differ in their psychological responses. For both groups, stress reactivity was not affected by menstrual cycle phase.

5.1 Introduction

Background

The theoretical link between physical exercise and stress proposes that the fitter the individual (usually aerobic fitness is referred to) the quicker the body systems return to normal after a stress-inducing experience (Hatfield & Landaeus. 1987, Sinyor et al 1983). Furthermore, aerobic fitness, it is proposed, may have a buffering effect on the extent to which the body responds to the stressful situations (Biddle & Mutrie 1991).
This link between aerobic fitness and stress is based on the substantial body of evidence demonstrating firstly that exposure to stressful experiences and participation in aerobic exercise both result in increases in several cardiovascular (CV) parameters and indices of sympathetic nervous system (SNS) functioning (Claytor 1991, van Doornen et al 1988) and secondly that chronic physical exercise is associated with altered CV and SNS functioning as a result of increased fitness (Blomquist & Saltin 1983, Christensen & Galbo 1983, Peronnet et al 1981, Rowell 1974, Winder et al 1979).

The exercise training induced adaptations in CV functioning have provided the rationale for many studies to examine the relationship between physical fitness and cardiovascular response patterns to behavioural stress. A meta-analysis performed by Crews & Landers (1987) yielded 92 effects from 1500 subjects and showed that the overall effect size was 0.48 indicating that subjects who were aerobically fit had a reduced physiological and psychological response to psychosocial stressors of about one half of a standard deviation, compared to either control groups or baseline values.

However, the majority of the studies reviewed by Crews & Landers (1987) were correlational. Several cross-sectional and longitudinal studies not included in their meta-analysis have failed to detect differences or have detected only subtle differences between trained and untrained individuals in their CV and SNS responses to a variety of stress inducing laboratory tasks (eg. Albright et al 1992, Claytor et al 1988, Cleroux et al 1985, Sothmann et al 1987). Conversely, data from other cross-sectional and longitudinal studies suggest that heart rate, blood pressure and/or plasma

van Doornen et al (1988) accept the notion that fitness is associated with a reduced response to stress but have argued that the inconsistent findings result from the underlying assumption being too simplistic. They emphasise that HR level during exercise, for example, is dictated by the heavy muscular work that is being performed. During laboratory stress tasks, relatively minor muscular work is performed and therefore there is an absence of the metabolic needs that are present during exercise. Similarly, the increase in metabolic activity during exercise which affects vasodilation in the working muscles alters diastolic blood pressure in a way that stress does not. While van Doornen et al’s hypothesis might appear logical, it still does not explain why Light et al (1987) found reduced HR and systolic BP in fit subjects but not a reduced diastolic BP, while on the other hand, Hull et al (1984) did not find reduced HR or systolic BP but they did find a reduced diastolic BP!

Notwithstanding Van Doornen et al’s (1988) argument, the conflicting results in the literature may stem from methodological considerations such as familiarity with the stress task, use of inappropriate control groups or inadequate measures of CV or SNS response (Claytor 1991). However, what must also contribute to the conflicting results are the stress tasks themselves. A wide variety of tasks have been used in different studies which begs the question: can it be assumed that a cold pressor test, for example, is as stressful as a mental arithmetic test or that either of them are in fact

- 99 -
stressful? Bear this point in mind as the adequacy of laboratory stress tasks will be raised again and discussed later.

Environmental stressors range from major disasters to minor hassles, from cognitive overload to sleep deprivation and from overcrowding to isolation and it is now accepted that menstrual cycle disorders can be exacerbated by increasing levels of external stress (see Chapter 2). In addition to such external stressors, menstruation itself may be seen as a potential stressor (Ussher & Wilding 1992) and the now considerable body of evidence demonstrating that physiological activation or sensitivity varies during the menstrual cycle supports this contention (e.g. Asso & Braier 1982, Little & Zahn 1974, Parlee 1973, Ussher & Wilding 1991). It can be argued, for example, that these internal increases in physiological arousal recorded premenstrually may be interpreted by women as negative and thus experienced as a stressor (Ussher & Wilding 1992). Menstrual cycle phenomena, conceptualized within a stress research framework have, therefore, two independent variables: the internal physiological stressors and the external environmental stressors. It has consequently been hypothesized that (i) the internal physiological stressors may influence CV responses to the external environmental stressors and, (ii) the premenstrual phase may be a particularly sensitive time for the woman where she may be more vulnerable to the effects of potential external stressors than she would be during other phases of her cycle.

Some support for this has been obtained by experimental work investigating reactions to stress in different phases of the cycle. These studies have found heightened
cardiovascular responses to laboratory stress tasks in the premenstrual phase of the cycle (Hastrup & Light 1984, Marinari et al 1976, Ladisch 1977, Tersman et al 1991). However, one study found the heightened cardiovascular response to be in the follicular phase (mid-cycle) rather than premenstrually (Polefrone & Manuck 1988). In addition, a large number of researchers have failed to demonstrate any menstrual cycle variability in reactions to stressors (Abplanalp et al 1977, Plante & Denney 1984, Stoney et al 1990, Weidner & Helmig 1990). These mixed results make it difficult to draw any conclusion about the relationship between stress and the menstrual cycle.

Stoney et al (1990) have put forward some possible reasons for the discrepancies in this literature. Firstly, most studies did not employ suitable procedures such as hormone analyses for verification of cycle phase. Secondly, the eligibility criteria for acceptance into the study may not have been stringent enough to exclude women with menstrual cycle irregularities. Furthermore, the choice of phases to compare and whether to employ between subject or within subject designs may be relevant.

What has yet to be mentioned in relation to this area of study, however, is the laboratory stressors that have been used. Recall that this point was raised above when discussing exercise and stress. The discussion that will now follow pertains to exercise and stress investigations as well as menstrual cycle and stress studies.
Stress in the laboratory

Hastrup & Light (1984) found differences in reactivity between cycle phase in response to a reaction time task but, in the same study, no differences were found in response to a cold pressor test (immersing one foot into a bucket of iced water for 90 seconds). On the other hand, Tersman et al (1991) found differences in response to a different cold pressor test (immersing one arm into a bucket of iced water for 90 seconds) but not to a mental arithmetic test. Conflicting results within and between studies may simply reflect the different types of stressor. Alternatively or additionally, contradictory results in the literature may stem from poor ecological validity of the laboratory stressors.

Studies of psychophysiological responses to laboratory stress tasks have assumed that the processes seen in the laboratory also occur at other times, in real life, in the same people, to a similar extent and with significant frequency (Johnston et al 1990). Van Egeren & Sparrow (1989) report that, on the whole, there has been poor agreement between subjects’ responsiveness to standardized laboratory stress tests and their responsiveness to the stresses of everyday living. The authors suggest that possible reasons for these discrepancies are that laboratory and field settings differ in several ways known to influence cardiovascular activity (eg. whether sitting or standing) and that physical activity level in the laboratory is lower than it is outside. This suggests that the usual laboratory tasks of mental arithmetic and cold pressor tests etc. are not comparable with real life stressors and were therefore not used in the present study.
In view of this lack of ecological validity, design of the laboratory stress task for the present study considered recent psychological models of stress. Many of these see stress as the outcome of a cognitive appraisal process in which a threat is perceived, the ability to control the threat is assessed and finally a computation of discrepancy is made (Evans 1991, Fisher 1986, Lazarus 1974). Stress can therefore be seen as a consequence of a perceived feeling of uncontrollability. Complete lack of control, however, leads to helplessness where the subject would not respond (Seligman 1975). The stressors therefore need to be difficult but not impossible, i.e. just within one’s control, in order to elicit cardiovascular responses (Obrist et al 1978, Carroll et al 1987, Langer et al 1985).

Standard procedure in laboratory stress testing has been for the subject to perform one task and then another. In real life, we are faced with many simple tasks that, on their own, are not difficult. When several of these simple tasks have to be carried out simultaneously, they then become difficult. In the present study, in order for the laboratory task to be difficult but just within one’s control, two separate stress manipulations were performed at the same time and will be described in the Methods section.

The present study

Given the possibility that the premenstrual phase may be a time when the woman is particularly vulnerable to stress and may have heightened stress responses, and the fact
that fitness is associated with reduced CV responses, it seems logical that women who exercise will have lower CV stress responses than women who are sedentary. It also seems logical that this will protect them during their times of increased vulnerability. To the author's knowledge, no study has been published to date that has investigated the stress responses of women who exercise and women who do not in different phases of the menstrual cycle. This therefore was the aim of the present study. It was hypothesised that women who exercised would show attenuated responsivity to the stressors and, if greater stress responses were exhibited premenstrually, these would be attenuated in the exercisers. Two groups of women, exercisers and non-exercisers, completed a stress task on three occasions during the menstrual cycle. Heart rate, blood pressure and mood state were monitored before, during and after the task. Testing in the follicular phase was not included because, without hormonal markers, verification of this phase would not be possible. The postmenstrual phase however could be verified and this therefore substituted for the follicular phase. As the majority of studies have compared only the premenstrual phase with the follicular phase, it was decided to include the menstrual phase in this study. The three phases therefore were the premenstrual, menstrual and postmenstrual.
5.2 METHODS

Subjects

Posters were displayed in local libraries and women's centres inviting women to take part in a study concerning stress and the menstrual cycle. They were offered a payment of £25, free tampons or sanitary towels and a free health and fitness assessment. The same poster was also sent to administration staff at the University and displayed on the staff notice board at University College Hospital. One hundred and forty five women responded and were sent a screening questionnaire which asked them their age, marital status and number of children. They were also asked their occupation and to identify their employment category out of: unskilled manual, skilled manual, skilled technical, clerical/office/shop, professional/managerial, administrative, housewife, student, unemployed or other; to answer yes or no to "do you take oral contraceptives?" and "do you take any prescribed medication?". They were asked to describe any medication that they were taking, how frequent were their periods and how long they lasted. In addition they were asked to answer yes or no to "do you experience any problems with your periods?" and "have you ever experienced any gynaecological problems?". If their response was yes, they were asked to provide brief details. Finally, they were asked to answer yes or no to the question "do you take part in any sport/exercise (at least once a week)?" and if so, to write what sport(s)/exercise. They were then asked how often they participated (1-2, 3-4, or 4+ hours), for how long each time (less than 1, less than 2, more than 2 or
more than 4 hours) and if they trained for competitive or public events.

To answer a criticism of earlier studies, very stringent criteria for inclusion of subjects were adopted. One hundred and nine women returned their screening questionnaire and, of these women, 73 fulfilled the criteria and were considered suitable as they were menstruating regularly, were not using oral contraceptives, were not taking any psychoactive medication, did not have any menstrual or gynaecological problems, and were not competitive sportswomen. Of these 73 women, 42 were successfully contacted by telephone and invited to participate and to attend an "introductory session" where the requirements of the experiment would be explained to them, where they would be familiarised with the laboratory equipment and where they would participate in a modified version of the mental stress task. Half of these women were regular exercisers (took part in sport/physical activity at least once a week) and the other half were sedentary. They all agreed to attend and following their introductory session all of them agreed to participate in the experiment. They then signed an informed consent form, completed three personality questionnaires and an appointment was made for their first test session. During the course of the experiment one of the women began competitive running which excluded her from the study. A second woman had to leave the country. This left a total of 40 women (20 exercisers and 20 non-exercisers) from whom full data was collected. The most popular physical activity for the exercising women was aerobics/keep fit classes followed by swimming. The exercise group reported exercising between one and four times a week ($\bar{x} = 2.5$ times) and between 20 minutes and two hours ($\bar{x} = 1$ hour) each time. None of the sedentary women reported taking part in any physical activity for any length of time.
Four of the exercising women and 5 of the non-exercising women were smokers.

Design

Two groups of women, 20 exercisers and 20 non-exercisers were tested on three occasions: once during the five days before their period was due, once while they were menstruating and once during the five days after cessation of menstruation. The order of testing was distributed across all possible combinations of the three cycle phases in order to control for systematic practice and habituation effects. Phases were calculated by counting the days onward from the woman’s last menstrual period. If any phase was miscalculated due to unpredictable variability in cycle length or if the woman failed to attend a test session for whatever reason, it was rescheduled for the following month. Of course this could not continue indefinitely so it was decided that there would be a limit of three cycles. If the woman had not been tested three times within three cycles she would be withdrawn from the study. Fortunately none of the women had to be withdrawn.

The mental stress task

In order for the task to be difficult but just within one’s control, two separate stress manipulations were to be performed at the same time. These manipulations ensured the use of visual, auditory, oral and motor processes together. Clear physiological and
psychological responses to a modified version of the Stroop Colour Word Conflict Test (Stroop 1935) have been previously reported (Morris et al 1988, Morris et al 1990) and this was used in the present study. Colour names were presented in their own or different colours on the VDU (eg. "RED" printed in blue) at one second intervals for five minutes. In response, the woman had to decide whether the word and the colour were the "same" or "different" and to respond by pressing the appropriate of two keys. If the wrong key was pressed in response, or if no key was pressed within the one second interval, a loud buzzer sounded. The woman was told that for every mistake she made, an extra word would be added to the list (in reality, the list was always the same length).

While the woman was undergoing this modified Stroop test she also had to undergo an audio-verbal task. Names of household items were being heard through headphones. Every 42 seconds, the word "carpet" was transmitted. The woman was instructed to listen out for this target word and, when she heard it, to repeat it out loud into a microphone. Self esteem was threatened by informing the woman that these tasks were a measure of brain function and that her scores would be compared with others.

To ensure that the stress manipulations were not totally uncontrollable, eight women (4 postgraduate students and 4 employed women) completed the entire stress task with the Stroop stimuli being presented at either 2-second or 1-second intervals. Those who completed the 2-second version reported that it was easy and not at all stressful to complete while those who completed the 1-second version reported that it was very
difficult but not impossible and was certainly stressful.

**Cardiovascular measurements**

Heart rate was measured throughout as minute-by-minute averages with a photoplethysmograph (Tunturi TPM 200) attached to the earlobe and automatically recorded by an Acorn BBC microcomputer. Blood pressure was measured with an automatic sphygmomanometer (Copal UA251) at start and end of relaxation, at the start, mid-point and end of the stress task and at the mid-point and end of recovery. The sphygmomanometer was attached to the woman's non-dominant arm to eliminate movement artifact due to task performance and was activated automatically by the computer program.

**Psychological measurements**

**Personality** - Trait measures of anxiety, Locus of Control and self concept were obtained from the Spielberger Trait Anxiety Inventory (Spielberger et al 1970), Levenson's Locus of Control (Levenson 1974) which measures 3 aspects of LOC: internal, powerful others and chance, and the adult version of the Coopersmith Self Concept Inventory (Coopersmith 1984). These were completed by each woman at her introductory session.
Activity - In order to ensure that the exercise group were exercising regularly and that the non-exercisers were not, each woman reported what form(s) of exercise she had participated in during the week preceding each test session by completing a Physical Activity Questionnaire (Thirlaway & Benton 1992) upon arrival at the laboratory. This questionnaire consists of a list of 19 activities plus "anything else not mentioned above" (see appendix). The woman was asked to tick those that she had engaged in over the past week and to report how often and for how long. If she mentioned running, cycling or walking, she was also asked the average distance she covered each time in miles.

Feeling states - Self reports of anxiety, self concept and mood were obtained upon arrival at the laboratory, at the end of baseline, directly after the stress task and at the end of recovery. Anxiety was measured using the Spielberger State Anxiety Inventory (Spielberger et al 1970).

The use of a semantic differential has been found to provide a useful measure of self concept in a population of clinically depressed women who were put on an eight week exercise programme (Ossip-Klein et al 1989). It consists of 13 items, each rated on a scale of one to seven (eg. 1 = hopeful, 7 = hopeless) and was administered at the end of baseline and immediately after the stress task. The instructions read "Please rate how you feel about yourself on a scale of one to seven using the items listed below".

Positive mood, negative mood, irritability, fatigue and physical symptoms were measured using the adjective checklist described in the previous chapter.
Performance

The number of Stroop test errors and the number of audio-verbal task errors were recorded as a measure of performance.

Physical fitness

Maximal oxygen uptake (VO$_2$ max) was calculated from submaximal pulse rates. These were recorded from a photoplethysmograph (Tunturi TPM-200) attached to the earlobe while the woman cycled on a Tunturi cycle ergometer. The submaximal test used was the one described and recommended by Astrand & Rodahl (1986) where after cycling gently for 2 minutes (warm up) the work load was increased to raise the woman’s heart rate to between 130 and 160 beats per minute. Once this was achieved, the woman pedalled at the same load until her pulse remained static within 5 beats per minute for 4 minutes. This was then followed by a 2 minute cool down of gentle pedalling. The woman’s steady state pulse during the 4 minutes before cool down was recorded and maximal oxygen uptake per litre was predicted from this heart rate and work load on the cycle ergometer from Astrand’s nomogram (Astrand & Rodahl 1986). The value was then corrected for age and converted to oxygen uptake per kilogram of bodyweight per minute (Astrand & Rodahl 1986).
**Procedure**

At the introductory session the woman sat comfortably in the laboratory while the experimenter explained the procedure that would be used in the experiment. No physiological measures were taken but in order to acquaint her with the equipment that would be used, the photoplethysmograph was attached to the earlobe, a pair of Sanyo headphones were placed over the ears, a Sony tie-pin microphone attached to her collar and the inflatable cuff for measuring blood pressure was attached to the non-dominant arm. The woman then took part in 20 trials of the Stroop Colour-Word Conflict Test (Stroop 1935) in order to acquaint her with the stress task and to overcome rapid habituation. A new colour name appeared on the screen only when the woman had responded to the previous one and if an incorrect button was pressed there was no beep.

The experimental sessions took place between 3 - 8 pm, Mondays to Fridays. The woman was asked to refrain from eating, caffeine, nicotine and alcohol 3 hours prior to attending the laboratory. See Figure 5.1 for a schematic representation of the experimental procedure. Upon arrival, she was seated comfortably in an armchair with a headrest in the laboratory and asked to complete a Physical Activity Questionnaire (PAQ), a Spielberger State Anxiety Inventory (SAI) and a mood adjective checklist (MAC). Following this, the equipment was put in place and the lights dimmed. The experimenter then left the room. The experiment was fully automated but the experimenter remained in the adjoining room to monitor the proceedings. An outline of the experimental procedure was displayed on the woman's
VDU, followed by relaxation for 10 minutes during which time soothing kaleidoscopic colour patterns were shown on the screen. At the end of this relaxation period, a blood pressure measurement was taken. Following this, instructions were displayed on the VDU requesting the woman to complete an SAI, MAC and a semantic differential (SD). When she had done so, a description of the mental stress task was displayed on the VDU. Prior to the start of the stress task, another blood pressure measurement was taken. Immediately after the stress task, blood pressure was again measured. This was followed by instructions to complete an SAI, MAC and SD and then a 10 minute recovery period during which the woman once more watched relaxing colour patterns. Halfway through this period, blood pressure was measured again. At the end of this period a final blood pressure measurement was taken followed by instructions to complete a final SAI and MAC.

To summarise, HR was measured continuously, BP was measured 7 times: pre relaxation, post relaxation, pre stress, mid stress, post stress, mid recovery and post recovery; mood was measured 4 times: pre relaxation, post relaxation, post stress and post recovery; and self esteem was measured twice: pre stress and post stress. Performance was automatically recorded by the computer program. When the final questionnaires had been completed the experimenter returned to the woman to remove the equipment.

Physical fitness was measured when the woman returned to the laboratory for a fourth time. She was also debriefed and paid on this occasion.
Figure 5.1 Schematic representation of experimental procedure
Statistical Analyses

To check that the 3 cycle phases were randomly distributed across the sequence of 3 visits to the laboratory for test sessions, a X^2 was carried out. Comparisons between groups for occupational category and marital status were also tested by X^2. Groups were compared on age, trait anxiety, locus of control and self concept by t-tests. Unequal variability in physical fitness measures between the groups meant that parametric statistics could not be used. Thus, groups were compared on physical fitness by a Mann Whitney U-test. Differences in performance on the stress task between groups and within menstrual cycle phases were tested by two way analyses of variance. Preliminary analyses of heart rate during relaxation, stress and recovery were conducted using a three way (group x phase x time) split plot analysis of variance. The main HR analyses then analysed the relaxation, stress and recovery periods separately using three-way analyses of variance. To test the effects of time (successive minutes during the experimental procedure), menstrual cycle phase and group, a polynomial expansion to linear trend was fitted to time. Analysis of covariance to assess the initial HR response to stress after relaxation was also conducted with the last minute of relaxation as the covariate and the first minute of stress as the variate. Blood pressure and questionnaire variables throughout the procedure were also analysed using three-way analyses of variance. Significant F-ratios were examined by post hoc t-tests using the error from the analysis of variance. In addition, similar analyses (1st, 2nd or 3rd visit x group x time) were carried out to determine any possible effect of the order of testing.
5.3 Results

Order of testing

The $X^2$ confirmed that the phases of the cycle were distributed randomly over the sequence of test sessions ($X^2 = 6.55$, df = 4, $P > .10$). Analyses of variance revealed no effect of order of testing on all of the dependent variables except HR during the stress task. This was highest on the first visit ($\bar{x} = 82.81$), less so on the second visit ($\bar{x} = 79.43$) and lowest on the third visit ($\bar{x} = 77.71$).

Group differences

Subjects The groups did not differ in distribution of marital status ($X^2 = 2.84$, df = 1, $P > .05$), occupational category ($X^2 = 3.5$, df = 5, $P = > .50$) or age ($t = 1.2$, df = 38, $P > .20$, means = 31.10 ± 7.64 & 32.10 ± 7.01). As expected, a significant difference between groups emerged for physical fitness ($U = 407.0$, $P < .05$). This difference was in the predicted direction: the exercise group ($\bar{x} = 59 ± 19.57$) had higher $\text{VO}_2\text{max}$ than the non-exercisers ($\bar{x} = 46.66 ± 12.68$). The groups did not differ on any of the personality variables measured: trait anxiety ($t = 1.04$, df = 38, $P > .20$), self concept ($t = 1.25$, df = 38, $P > .20$) or the 3 measures of locus of control (Internal LOC $t = 1.08$, df = 38, $P > .20$; Powerful Others LOC $t = 1.5$, df =
38, P > .20 or Chance LOG t = 1.26, df = 38, P > .20).

**Performance**  The groups did not differ on the number of Stroop test errors or the number of audio-verbal task errors made (min F = 1.45, (1,38), P > .20). Errors on both these tasks did not differ according to phase of the cycle (min F = .24, (2,74) P > .50) nor was the interaction between group and phase significant (min F = .26, (2,76) P > .50)

**Analyses of variance - physiological measures**

**Heart rate (HR)**  Preliminary analyses revealed a highly significant effect of time (F = 127.46, (24,2709) P < .001) confirming a clear cardiovascular response to the experimental manipulations (Figure 5.2). Figure 5.2 suggests that the exercisers had lower HR than the non-exercisers throughout the experimental procedure but this group effect only approached significance (F = 3.17, (1,38), P<.08).
Figure 5.2 Mean heart rate scores during relaxation, stress and recovery. For overall changes in time, SED = 0.45. For comparisons between groups within a single minute, SED = 2.54

Turning now to the separate analyses of variance for relaxation, stress and recovery, for both groups, after an initial increase, HR gradually decreased during the relaxation period. This decrease was confirmed by the polynomial expansion fitted to linear trend (F = 21.91, (1,1017) P < .001). Both groups were also clearly affected by the stress manipulations (F = 11.78, (4,452) P < .001). HR increased at the start before decreasing slightly until the end of the task (polynomial linear trend F = 31.36, (1,452) P < .001). Figure 5.2 above shows that the exercisers' HR was lower than the non-exercisers throughout the stress task (F = 6.27, (1,38) P < .01). To assess the initial effect of stress on HR in both groups, the analysis of covariance with the last minute of the relaxation period as the covariate and the first minute of the stress task as the variate was carried out. It revealed that the groups did not differ in their initial
response to stress ($F = 0.26$ (1,37) n.s). A significant analysis of variance group x minute interaction ($F = 2.33$, (4,452) $P < .05$) revealed that the groups differed in their responses after the first minute of stress however. The non-exercisers’ HR increased even further in the second minute ($t = 3.36$, $P < .001$). In contrast, the exercisers HR did not increase further after their initial increase in the first minute ($t = 0.74$, ns) but steadily decreased over the remaining three minutes of the task ($t = 3.08$, $P < .01$). There was no steady decrease for the non-exercisers however whose HR returned to the initial increased level of the first minute ($t = 4.36$, $P < .001$) and did not significantly decrease over the remainder of the stress task.

During recovery there was also a significant effect of time ($F = 60.51$ (9,1014) $P < .001$) with HR gradually decreasing (polynomial linear trend $F = 45.45$, (1,1014) $P < .001$). Figure 5.2 above suggests that recovery progressed slightly further in the exercisers which was confirmed by the interaction of group with polynomial linear trend ($F = 8.18$, (1,1014) $P < .005$).

Moving onto phase differences analyses also revealed HR to be affected by phase ($F = 4.34$, (2,76), $P < .01$; Figure 5.3) being higher premenstrually than either menstrually ($t = 2.60$, $P < .01$) or postmenstrually ($t = 2.53$, $P = .02$). No interactions of phase with group or time emerged during relaxation, stress or recovery.
Systolic blood pressure (SBP)  Once again there was a significant effect of time (Figure 5.4) with SBP demonstrating clear changes in response to the relaxation and recovery periods as well as to the stressors ($F = 83.97$, $(6,651)$, $P < .001$). SBP was significantly reduced following relaxation ($t = 3.28$, $P < .001$) but increased again just before onset of the stress manipulations ($t = 9.88$, $P < .001$). Halfway through the stress task it was significantly higher than at any other time (min $t = 11.68$, $P < .001$) and decreased significantly immediately afterwards ($t = 13.27$, $P < .001$). SBP immediately after the stress task returned to the pre relaxation level ($t = 1.05$, ns). Halfway through the recovery period it was lower than it had been immediately after the stress task ($t = 5.43$, $P < .001$) and at this point was the same as it had been after the relaxation period ($t = 1.09$, ns). It did not change after this.

There was no group effect for SBP but the group by time effect approached significance ($F = 1.91$, $(6,651)$ $P < .10$). Figure 5.4 suggests a trend for the
exercisers to have higher SBP than the non-exercisers but both groups' SBP was the same halfway during the stress task.

Figure 5.4 Mean systolic blood pressure during experimental procedure. Bars show SED for a: differences between groups within a single occasion and b: differences between occasions within groups

SBP was also affected by phase of the cycle ($F = 3.22$, (2,76) $P < .05$; Figure 5.5) being higher premenstrually than postmenstrually ($t = 2.54$, $P < .05$). Premenstrual SBP was not significantly higher than menstrual SBP which in turn was not significantly higher than postmenstrual SBP (min $t = 1.12$). These phase effects were consistent between groups and across the stress task since phase did not interact with group or time.
**Figure 5.5** Mean systolic blood pressure in different phases of the cycle. Bar shows SED for differences between phase.

*Diastolic blood pressure (DBP)*

While there were no significant phase or group effects for DBP there was a significant effect of time ($F = 36.27, (6,651), P < .001$; *Figure 5.9*). DBP did not decrease following relaxation ($t = .50$, ns) but did increase just before the stress task ($min t = 4.63, P < .001$). Halfway through the stress task it increased further and was higher than it had been before and after relaxation as well as just before the stress task ($min t = 7.86, P < .001$). Just after the stress task it reduced from the mid stress level ($t = 8.08, P < .001$) but was still higher than it had been before and after relaxation ($min t = 4.97, P < .001$). It did not differ from the pre stress level however ($t = .22$, ns). Halfway through the recovery period DBP was not significantly lower than it had been just after the stress task nor was it reduced further after the recovery period ($min t = .81$, ns).
No significant interactions with time emerged.

![Figure 5.6 Mean diastolic blood pressure during experimental procedure. Bar shows SED for differences between occasions](image)

**Analyses of variance - questionnaire measures**

**Physical symptoms**  These changed over the testing procedure \((F = 10.24, (3,342), P < .001; \text{Figure 5.7})\) with the most symptoms before relaxation \((\text{min } t = 2.15, P < .05)\). The least symptoms were reported after the recovery period \((\text{min } t = 2.23, P < .05)\). No significant interactions of group or phase with time emerged.

Physical symptoms were greater premenstrually and menstrually than postmenstrually \((F = 14.95, (2,76), P < .005; t = 4.79 & 4.72 \text{ respectively, } P < .001; \text{Figure 5.8})\). Although the effect of group was not significant, differences between the
groups premenstrually and menstrually emerged (group x phase $F = 4.64, (2,76), P < .01$). Figure 5.10 shows that premenstrually the non-exercisers had more symptoms than the exercisers ($t = 9.56, P < .001$) but menstrually the exercisers had more symptoms than the non-exercisers ($t = 4.47, P < .001$).

**Figure 5.7** Mean physical symptoms scores over experimental procedure. $SED = .1372$

**Figure 5.8** Mean physical symptoms scores during different phases of the cycle. Bars show $SED$ for $a$: differences between groups within a single phase and $b$: differences between phase within groups.
Positive mood This was also affected by time \( (F = 12.52, (3,342) P < .001) \) and Figure 5.9 shows that the groups differed in their responses to the testing procedure \( (F = 2.76, (3,342) P < .05) \). The exercisers felt worse after relaxation than they did before \( (t = 2.27, P < .05) \) and even worse still after the recovery period \( (t = 3.5, P < .001) \). In contrast, the non-exercisers were not affected by relaxation or stress but their mood was lower after the recovery period than it was before the start of the procedure \( (t = 2.25, P < .05) \).

![Figure 5.9 Mean positive mood scores during experimental procedure. Bars show SED for a: differences between groups within a single occasion and b: differences between occasions within group](image)

Positive mood was also affected by cycle phase \( (F = 4.95, (2,76), P < .005) \) being higher post menstrually than either premenstrually \( (t = 3.0, P < .01) \) or menstrually \( (t = 2.32, P < .05) \). Furthermore, the effects of the experimental procedure differed between the three phases of the cycle \( (F = 2.13, (6,342), P < .05; \) Figure 5.10). Postmenstrual positive mood was higher throughout the experimental
procedure than it was premenstrually (min $t = 2.09, P < .05$). In the menstrual phase, positive mood declined significantly after relaxation ($t = 3.41, P < .001$) and remained at that level. In the premenstrual and the postmenstrual phases, however, positive mood remained at the same level until the end of the recovery period when the women became less happy (min $t = 2.62, P < .01$). No significant interaction between group and phase emerged.

![Figure 5.10](image)  
**Figure 5.10** *Mean positive mood scores in different phases of the cycle. Bars show SED for a: differences between phases within a single occasion and b: differences between occasions within phase.*

Negative mood This changed over the testing procedure ($F = 7.20, (3,342), P < .001$; Figure 5.11). It did not change significantly after relaxation or after stress but the women felt better after the recovery period than they did throughout the testing procedure (min $t = 3.04, P < .01$). No other significant effects emerged.
Irritability

Figure 5.12 shows how feelings of irritability were affected by the testing procedure ($F = 5.03, (3,342), P < .005$). It was less after relaxation than it was before ($t = 2.6, P < .01$), but increased to pre-relaxation levels after stress. It significantly decreased again after recovery ($t = 2.8, P < .01$) returning to post-relaxation levels.

A significant phase effect ($F = 6.08 (2,76) P < .005$) and a significant phase x group interaction emerged ($F = 3.41, (2,76), P < .005$; Figure 5.13). The exercisers felt more irritable menstrually than they did postmenstrually ($t = 2.85, P < .01$) but the non-exercisers felt most irritable premenstrually ($\min t = 2.65, P < .05$).
Fatigue Figure 5.14 illustrates how fatigue changed during the test procedure ($F = 3.5, (3, 342) P < .01$). It did not change significantly after relaxation ($t = .63, ns$) but was reduced by the stress task ($t = 2.18, P < .05$). It was increased after recovery ($t = 3.31, P < .001$) returning to the pre-relaxation levels ($t = 1.77, ns$).
Fatigue also differed according to phase ($F = 6.52, (2,76) \ P < .005$; Figure 5.15) with the women feeling less fatigued postmenstrually than menstrually ($t = 3.42, \ P < .01$) and premenstrually ($t = 2.9, \ P < .01$).

There were no other significant results.

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**Figure 5.14** Mean fatigue scores during the experimental procedure. Bar shows SED

**Figure 5.15** Mean fatigue scores during different phases of the cycle. Bar shows SED
State anxiety This clearly changed over the testing procedure ($F = 16.60$, $(3, 342), P < .001$). The women felt less anxious after relaxation than they did before ($t = 3.15, P < .01$) but anxiety increased after the stress task ($t = 6.54, P < .001$) to above pre-relaxation levels (comparison with pre-relaxation $t = 2.23, P < .05$). It subsequently recovered to pre-relaxation levels ($t = 5.44, P < .001$).

Changes in anxiety across the test procedure differed slightly between the groups ($F = 2.89$, $(3,342), P < .05$; Figure 5.16). In general, changes were more accentuated in the exercisers. Anxiety was significantly reduced in the exercisers after relaxation ($t = 4.02, P < .001$) but not in the non-exercisers ($t = .43, ns$).

A significant phase effect emerged ($F = 5.74$, $(2,76) P < .005$; Figure 5.17) with anxiety being lower postmenstrually than it was premenstrually ($t = 3.24, P < .01$) and menstrually ($t = 2.44, P < .05$). No interaction between group and phase emerged.

![Figure 5.16 Mean state anxiety scores during experimental procedure. Bars show SED for a: differences between groups within a single occasion and b: differences between occasions within group](image-url)
Figure 5.17 Mean state anxiety scores in different phases of the cycle. Bar shows SED for comparisons between phases.

Self esteem: After the stress task self esteem was significantly lower than it was before \( (F = 7.80, (1,113) \ P < .01; \ \text{Figure } 5.18) \).

Self esteem was higher in the postmenstrual phase \( (F = 3.77, (2,76) \ P < .01; \ \text{Figure } 5.19) \) than it premenstrually \( (t = 2.64, \ P < .05) \) or menstrually \( (t = 2.06, \ P < .05) \). There were no other significant effects.
Figure 5.18 Mean self esteem scores before and after stress. SED = 0.87.

Figure 5.19 Mean self esteem scores in different phases of the cycle. Bar show SED for comparisons between phases.
5.4 Discussion and conclusions

The responses elicited to the mental stress task demonstrate the success of the stress manipulations. HR, SBP and DBP showed significant increases in response to the task and returned to baseline or near baseline values afterwards. In addition these effects remained with repeated testing. On all of the questionnaire measures, highly significant effects emerged: in general the women were in a worse emotional and subjective physical state after the stress task than they were before.

As expected the exercisers' HR was lower than the non-exercisers' HR and this was true of the relaxation, stress and recovery periods. This finding, together with the VO_{max} results illustrates the enhanced aerobic fitness of the exercisers. Comparisons of the fitness data from this study with other studies are difficult as the majority of previous studies have used male undergraduates or middle aged men as subjects. However, according to Astrand's fitness results, the sedentary group's mean fitness level is "good" and the exerciser's mean fitness level is "very good".

Although the groups did not differ in their initial HR response to stress, the exercisers' HR gradually decreased as they continued with the task which was not the case with the non-exercisers. Thus, the exercisers adapted to the demands of the stress task more favourably than the non-exercisers. In addition, their recovery was also more favourable. These findings confirm that aerobic fitness has a buffering effect on the extent to which the body responds to stress.
However, in contrast to an attenuated HR response in the exercisers, no evidence of an attenuated blood pressure response emerged. A trend was seen for the exercisers to have higher SBP than the non-exercisers during relaxation and recovery but this group × time interaction did not reach significance. No trends of any sort were evident for DBP. Discrepancies between HR and BP results within studies have been reported previously (Light et al 1987, Hull et al 1984). Although van Doornen et al (1986) have suggested that this is because the resemblance between the exercise response and the stress response is no more than superficial because of the different metabolic needs that are present during exercise and stress, this does not explain the results of the present study. To evaluate their hypothesis, further information about the cardiovascular response to stress needs to be gleaned from more sophisticated physiological measures such as cardiac output and total peripheral resistance as well as catecholamines.

Turning now to the mood measures. Some group differences in positive mood and anxiety responses to the experimental procedure did emerge. The positive mood and anxiety interactions revealed group differences to be in response to relaxation and recovery rather than the stress task. There were no significant group differences in mood responses to stress. Thus, it can be said therefore that the groups did not significantly differ in their psychological responses to stress.

One explanation for this lack of group differences may be the sample size. While the number of subjects in this study is relatively high in comparison to other menstrual cycle studies, several analyses approached significance. With a larger sample size,
clearer indications of the trends in the data may have been gleaned.

Another explanation may be that the sedentary women in this study were quite fit, although not as fit as the exercisers. Not having separate high exercise and low exercise groups in this study may also explain the lack of group differences. Recall from Chapter 4 that the high exercisers felt better than the low exercisers and the sedentary women and that in general, the low exercisers were not different from the sedentary women. In this study the exercise group consisted of both high and low exercisers. Alternatively or additionally, personality factors that differentiate exercisers from non-exercisers could account for the failure to find group differences in psychological responses to stress. For example, the exercisers may be more competitive, more Type A or have a higher need for achievement than the non-exercisers. Any or all of these may have influenced their stress responses.

There is, of course, the possibility that the improved psychological state and premenstrual protection found in the high exercisers in the previous chapter is not a result of increased resistance to stress mediated by a reduced cardiovascular response but a result of some other mediating factor or factors. Physical activity but not physical fitness has been found to be associated with better mood (Thirlaway & Benton 1992) which suggests that how often one takes part in exercise is more important than how fit one is in obtaining psychological benefits. Thus, other mechanisms, besides a physiological one, that might explain the association of exercise with improved mood state need to be examined. These could be psychological mechanisms such as self concept and feelings of control and mastery.
Although in this study the groups did not differ on self concept or locus of control, once again having both high- and low-exercisers in the same group might explain these results.

Turning now to phase differences, highly significant results emerged. General HR and SBP were found to be highest during the premenstrual phase but cardiovascular reactivity in response to stress did not differ. These findings argue against the contention that the cycle-related physiological changes are enhancing responses to external stress.

For both groups, clear cycle related changes in overall positive mood, irritability, fatigue, anxiety and self esteem were revealed. The women felt better post menstrually than premenstrually or menstrually but, similar to the previous chapter, there were no significant differences found between the premenstrual and the menstrual phases. Although the groups did not differ in overall mood in this study as they did in the previous one, bear in mind that general day to day mood state, measured in the previous chapter, is surely different from mood anticipation of and just after stress which was the concern of this chapter.

Only positive mood responses to the experimental procedure were found to differ according to phase of the cycle. However, changes were in response to relaxation and recovery and no evidence was found on any of the psychological measures for a worse cycle-related reaction to stress. Once again this is inconsistent with the hypothesis that women are more vulnerable to external stressors during the premenstrual phase. Similarly, a failure to find phase related performance differences argues against the myth that women's performance deteriorates premenstrually.
A couple of group x phase differences did emerge. The non-exercisers were more irritable premenstrually but it was the exercisers who were more irritable menstrually. Interestingly, this coincided with a similar finding with physical symptoms. The non-exercisers reported more physical symptoms in the premenstrual phase while the exercisers reported more in the menstrual phase. These findings suggests that premenstrual and menstrual physical symptoms are in some way related to irritability. Why the groups should differ in this way is unclear. It is possible that, as in the previous chapter, exercise provides some protection from premenstrual deterioration but not from menstrual deterioration.

In summary, clear phase differences in psychological measures were found in this study and these are consistent with phase differences seen in the previous chapter. Phase differences in physiological state were also found which is consistent with previous studies. However, no phase differences in physiological or psychological responses to stress were revealed which argues against the notion that premenstrually, women will exhibit a heightened stress response. Similarly, a failure to find phase related performance differences argues against the myth that women’s performance deteriorates premenstrually.

In conclusion, the hypothesis that women who exercised would show a more favourable response to stress was supported physiologically by the HR findings. This physiological response was not mirrored in the psychological responses, however, as the exercisers did not report feeling any different from the non-exercisers. These findings stand in contrast to the previous chapter where high-exercisers experienced
more favourable mood states than low-exercisers or sedentary women. This highlights one methodological criticism of the present study: as both high and low exercisers were included in this exercise group, conclusive explanations for the failure to find group differences are not possible. Another methodological consideration may be the sample size which was relatively robust but a larger number of subjects may have permitted more conclusive findings.

Of course, there is the possibility that the psychological benefits of physical exercise are not a result of an increased resistance to stress mediated by a reduced cardiovascular response. Other mechanisms, besides a physiological one, warrant further investigation.
6. CONCLUSIONS

6.1 Overview

This thesis began by describing the research endeavours in respect of the menstrual cycle that have continued unabated despite the conceptual uncertainties and methodological difficulties that beset the field. Virtually the only certainty that has emerged from all of this research is that cycle-related changes of some sort are experienced by almost all women of reproductive age. For a small proportion of women the changes are perceived as potentially beneficial or positive. However, for very many women the premenstrual and/or menstrual phases of the cycle bring physical symptoms and pain, increased negative mood and decreased positive mood. The aetiology of these menstrual cycle changes seems to be neither strictly physiological nor strictly psychological. They seem temporally related to the normal hormone fluctuations of the menstrual cycle but whether they are perceived to be problematic and, if they are problematic, how severe the problem is, appears to be related to psychological factors. In this thesis, no evidence for premenstrual or menstrual increases in positive mood were found. The results of all three studies revealed the opposite: overall, the times that the woman is not premenstrual or menstruating are more favourable.
In the first study, which involved retrospective reports of menstrual cycle change, it was revealed that the premenstrual phase was the most problematic and this ties in with the accepted view of PMS where there is a "cessation of symptoms soon after menstruation began" (Chapter 1, p. 15). The results of the two prospective studies showed this not to be the case however - menstrual experiences did not significantly differ from premenstrual experiences and some were even worse. Discrepancies between retrospective and prospective measures are common (see Chapter 2) but the problem has been with retrospective reports of cyclicity that have not been confirmed prospectively. In this thesis both the retrospective and prospective measures revealed cyclicity but in the two prospective studies, premenstrual and menstrual experiences were similar. This might not be that surprising however given the emphasis on a premenstrual syndrome by researchers and the media that is communicated to women and which shapes their expectations. Thus, while the menstrual phase receives little attention in comparison, and as retrospective reports are vulnerable to bias as a result of expectations, this may account for the results of the first study.

Although the emphasis of menstrual cycle research has been on premenstrual symptoms, several other studies have found cyclical change to peak both premenstrually and menstrually (eg. Slade 1984, Van Den Akker & Steptoe 1985, Ainscough 1990) but these findings seem to have been largely ignored. Perhaps this is because one of the DSM-III-R criteria for PMS is an increase in intensity of symptoms in the premenstrual phase compared with the intermenstrual phase. No mention is made of comparing the menstrual phase and this has meant that it often is not studied and when it is, the findings receive little attention.
Another reason why the menstrual phase receives relatively little attention may be because mood change during this phase does not fit in neatly with the raging hormones model of the menstrual cycle. The decline in ovarian hormones a few days before onset of menstruation is the most popular explanation of PMS and as levels begin to rise following onset, it is expected that symptoms will ease. This seems not necessarily to be the case not least because different mechanisms might be operating to lower mood premenstrually and menstrually, for example acute pain while menstruating which is not present premenstrually. Of course, the biological basis for dysmenorrhea is different to that of PMS and ovarian hormone levels are also different during these times, but similar psychological profiles were present during these two phases. This questions a hormonal basis only for psychological premenstrual changes. There is therefore the argument that PMS does not have a hormonal aetiology. As discussed in Chapter 2, menstrual cycle changes may be temporally related to hormonal changes but their severity (which is what distinguishes the PMS sufferer) is clearly not.

It could, of course, be argued that the samples in both of the prospective studies have unusual hormonal profiles that might explain the findings in this thesis. Without hormonal measurements this cannot be ruled out but, as already mentioned, similar findings have been reported by previous researchers. Furthermore, the hormonal fluctuations that occur throughout the menstrual cycle have been well established in clinical and non-clinical samples, thus there is no reason to assume that the hormonal profiles in the samples in this thesis were any different.

In Chapter 2 the attitudes and expectations of the researchers were discussed. The persistence of experimenters to find premenstrual pathology in spite of years of inconsistent findings is intriguing and ignoring the menstrual phase may reflect these attitudes and expectations. It cannot be said often enough that the findings of a premenstrual peak in severity of symptoms are entirely in accordance with the expectations and stereotypes of our society. Given that the menstrual and premenstrual
experiences have been found to be similar in previous research as well as in this thesis, it appears that premenstrual obsession is not warranted. Premenstrual and menstrual experiences are normal experiences, not pathological ones, and in the other phases of the cycle there are even better than normal experiences. These effects have been obscured by the dominance of PMS research in the literature. A reappraisal of the normal menstrual cycle is therefore warranted and researchers time would be better spent in reversing the negative thinking that surrounds the menstrual cycle by demonstrating and promoting the positive changes that can take place. Resistance to do so is misleading and misogynist.
The Charter for Women’s Health (NCW 1991) reports that menstrual cycle changes can be stressful for women and that physical exercise, relaxation techniques and over or under eating were the main ways that respondents had used to cope. Two other studies have also reported strategies, such as physical exercise, as ways that women cope with their menstrual cycle. These studies however did not utilise test instruments from the coping literature, nor did they ascertain how helpful the reported coping methods were. These therefore were the aims of the study reported in Chapter 3. It was seen that a variety of coping behaviours are adopted and that they fall into four categories: menstrual cycle specific (eg. evening primrose oil), active-behavioural (eg. vigorous exercise such as running), active-cognitive (eg. trying not to worry) and avoidance (eg. drinking more alcohol). The most frequently used coping methods were active-cognitive methods. However alongside active-cognitive methods, active-behavioural methods were also considered most helpful when dealing with menstrual cycle changes. This category of active-behavioural methods consists primarily of sports and physical activities, thus their perceived helpfulness reflects the popular belief that exercise is a beneficial way of coping.

This view that physical exercise is an effective treatment for menstrual cycle disorders has been prevalent in the lay literature and among health professionals for some time now but empirical support for this popular belief has been lacking. In contrast, a wealth of evidence has consistently found physical exercise to be associated with increased positive mood, wellbeing, self esteem and decreased depression and anxiety. Because decreased positive affect and increased depression and anxiety are characteristic of the premenstrual and/or menstrual phases of the cycle, it seems
logical that physical exercise should alleviate these problematic experiences. The study described in Chapter 4 examined this possibility by prospectively testing the belief that women who exercise experience fewer menstrual cycle related problems. The results were favourable for women who exercised three or more times a week (high-exercisers) who were found to experience greater positive affect and less negative affect than women who exercised less than three times a week (low-exercisers), sedentary women and competitive sportswomen. The differences between exercise groups were greatest during the premenstrual and menstrual phases suggesting that high-exercisers are to some extent protected from mood deterioration before and during menstruation. This is, of course, a tentative suggestion as it may be possible that women exercise more because they are less limited by menstrual cycle problems. Nevertheless, physical exercise was found to be associated with fewer premenstrual changes. If exercise is mediating this effect, this begs the question: how might it be doing so?

A variety of mechanisms have been put forward to explain the relationship between physical exercise and improved mood. One of these has been that exercise reduces stress responses. Given the possibility that the premenstrual phase may be a time when the woman is particularly vulnerable to stress and may have heightened stress responses, and the fact that fitness is associated with reduced CV responses, it seems logical that women who exercise will have lower CV stress responses than women who are sedentary. It also seems logical that this will protect them during their times of increased vulnerability. To the author’s knowledge, no study has been published to date that has investigated the stress responses of women who exercise and women
who do not in different phases of the menstrual cycle. This therefore was the aim of the study described in Chapter 5.

The results of this study found that for both exercisers and non-exercisers, there was no evidence for a heightened stress response during the premenstrual or menstrual phases. There was also no evidence for a performance decrement. These findings therefore argue against the popular myth that "raging hormones" renders the woman incapable at certain times of her menstrual cycle.

Interestingly, the women who exercised did show a more favourable heart rate response to stress as predicted, but their psychological responses did not differ from those of the non-exercisers. Thus, the exercisers may have had a physiological protection from stress but not a psychological one as they did not report feeling any better than the non-exercisers. Notwithstanding the methodological criticisms of this study that may have contributed to these results, there now exists the possibility that protection from premenstrual deterioration is not a result of increased resistance to stress associated with a reduced cardiovascular response but an effect of other mechanisms which have yet to be examined. This, of course, is true also of the association between physical exercise and improved mood that has been found in studies not concerned with the menstrual cycle.
6.2 Recommendations for future research

Previous evidence which associated regular exercise with greater positive mood and lower negative mood has arisen from studies that have not considered the menstrual cycle. In this thesis, the menstrual cycle has been considered and these results together with the small number of previous studies suggest that exercise may have a role to play in the management of menstrual cycle changes. This thesis has found exercise to be associated with menstrual cycle related mood change and that women who routinely take high levels of exercise are to some extent protected from feelings of emotional deterioration premenstrually. It cannot be ruled out, however, that women who exercise regularly might do so because they are not limited by menstrual cycle problems. The efficacy of physical exercise as a treatment for menstrual cycle disorders remains to be delineated. Random assignment of large numbers of sedentary women from both clinical (ie. treatment seeking) and non-clinical populations to exercise or no-exercise groups are now necessary to establish the cause and effect relationship.

The most commonly assessed form of physical exercise has tended to be aerobic activity such as running. Given the variety of physical activities that are available, assessment of different forms of exercise is also warranted. This is particularly important in order to provide guidelines concerning type of exercise and what intensity would be most suited to what menstrual cycle problems.
How physical exercise might be efficacious as a treatment for menstrual cycle problems is as relevant a question as is it efficacious. Therefore future research should also examine the mechanisms underlying any possible effects. This thesis did not find a reduced physiological stress response to be a mediating mechanism of more favorable psychological responses but further study is needed before conclusions can be drawn. What also needs to be examined are the psychological mechanisms such as feelings of mastery and control and self esteem.

In theory, these mechanisms could equally apply to improved mood resulting from non-physical activities (e.g. playing the piano or knitting) and it was intended to include in Chapter 4’s study a group of sedentary women who participated in such activities. The search for these women proved futile however as the only volunteers who did take part in non-physical activities also took part in physical ones! Nonetheless, this is an area worthy of investigation as physical exercise may not be an option for some and, if other activities can provide similar benefits, so much the better.

A substantial body of research has been conducted examining menstrual cycle disorders, such as amenorrhea, in competitive sportswomen. The normal menstrual cycle of the competitive sportswoman has been very much neglected. This thesis has found that in spite of their high levels of exercise, competitive sportswomen do not experience the same psychological benefits that high-exercisers do. Clearly, training for competitive sport is different from keep-fit training. Physical exercise may not be a viable coping method for the competitive sportswoman and might even add to stress resulting from her menstrual cycle changes. The psychological changes experienced
by the competitive sportswomen with a normal menstrual cycle are therefore an area worthy of future study.

6.3 Methodological considerations

The field of menstrual cycle research is a methodological minefield - very few studies avoid criticism from one viewpoint to another and the studies in this thesis are no exception. One salient criticism is the absence of hormonal markers. The reasons for this criticism are twofold. Firstly, from a practical point of view, using a calendar to determine menstrual cycle phase is unreliable given the variation in cycle length within women. Secondly, without hormonal markers ovulation cannot be verified. Apart from the usefulness of verification of ovulation in order to determine the ovulatory (follicular) phase, anovulatory cycles do occur and can alter the nature and severity of the premenstrual experience from month to month in the same woman. However, given that the women in this thesis were non-clinical samples from the community with jobs and children, had there been no financial and practical constraints, their availability to give plasma samples every few days as well as attend test sessions is doubtful.

The heterogeneity of the menstrual cycle and its implications for PMS diagnosis, treatment and research have already been discussed in Chapter 2. It could be argued
that while hormonal markers would certainly have been useful and interesting, they were not strictly necessary for this thesis as it was not concerned with PMS diagnosis and treatment. It was concerned with women's experiences at different times of her menstrual cycle. Moreover, it has recently been reported that anovulatory cycles are not as frequent as originally had been supposed (Metcalf 1992) which argues against the necessity for verification of ovulation. In addition, given the fact that the hormonal fluctuations that occur throughout the menstrual cycle are now well established, it can be fairly safely assumed that these same fluctuations occurred in the samples used in this thesis.

Another methodological concern is that in all three studies, the women were aware that the subject of investigation was the menstrual cycle. Although the question "to be aware or unaware" (see Chapter 2) has not been answered due to inconsistent findings from previous studies, the fact remains that being aware of the topic of investigation in any human research area may influence subjects' responses. As the first study included asking how women coped with menstrual cycle changes, for obvious reasons they had to be aware. But, in the subsequent study, initial attempts were made to mask the true nature of the study. It was not long before the realisation that this was going to be impossible dawned. Quite simply, the women guessed. Sometimes, even before agreeing to participate they would ask if the study was concerning the menstrual cycle and any denial was met with the suggestion that the menstrual cycle should be a consideration! With others it would take a couple of weeks, but they too guessed.
One strength of the studies in this thesis however is that the women were from the general population. They were not psychology undergraduates coerced into participating for course credits, nor were they clinical samples of PMS sufferers with a vested interest in taking part. Certainly not all previous menstrual cycle research has consisted of such samples but a substantial majority of them have. The women in this thesis were drawn from the community and were therefore representative of the general female population.

Interestingly, when the menstrual cycle nature of this research was not salient, women were not particularly interested in taking part. When they were aware of the topic of investigation, quite literally, hundreds of women volunteered. Having large community samples, even if they were aware of the menstrual cycle nature of the studies, was felt to be more favourable than very few subjects who were unaware or a lot of subjects who were not representative of the general population.

Turning now to the physical exercise aspect of this thesis, none of the studies were intervention studies and associations, of course, do not provide evidence that physical exercise causes psychological benefits. The original goal of this thesis was to conduct an intervention study using sedentary women and randomly assigning them to either a physical exercise condition or a control condition (see appendix 9 for details). Collaboration with the Occupational Health Department of British Gas Plc was set up and employees of this company had volunteered to take part. Unfortunately, before the study could begin, British Gas withdrew their support.
The relationship between exercise and affect, as described in this thesis, therefore remains associative rather than causal. However, correlational studies, despite their limitations, are nevertheless valuable because they provide hypotheses that can be tested in experimental situations. The results that have emerged from this thesis have indeed generated hypotheses for future testing and given the paucity of research in the area of physical exercise and menstrual cycle psychological changes, the associative nature of this thesis is another of its strengths.

6.4 Epilogue

There have been anecdotal suggestions that physical exercise is particularly beneficial to women (Harris 1981, Berger 1984). Recent empirical evidence suggests that this is the case. Four surveys carried out in Canada and the United States not only found level of physical activity to be positively associated with general wellbeing, lower levels of anxiety and depression and more positive mood, but these associations were found to be particularly strong for women (Stephens 1988). Recent results from a British survey (Thirlaway and Benton 1990) found that, in women over 30, there was a strong correlation between greater activity and better mental health. Morris & Salmon (1988), in a study of regular runners, found improvements in mood to be greater in women than in men when measured immediately after a run.
Choi (1992) has put forward the hypothesis that these greater benefits might be a function of exercise alleviating menstrual cycle problems. The findings from the few earlier studies together with this thesis suggest that the answer to this question could well be 'yes'. Should physical exercise prove efficacious in the management of menstrual cycle problems, a safe, convenient and effective treatment that can be self administered may offer an alternative to conventional medical treatments.
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As a woman you will be aware of changes that can occur in your feelings and your body as a result of your monthly menstrual cycle. We would like to know what you do to cope with these changes and how effective you find your coping methods.

We should be grateful if you would answer the questions overleaf - they will take about 10 mins to complete. It is not necessary for you to tell us your name.

Many thanks for your help.

Precilla Choi
Richard Darby
Katrina Davies

Department of Psychology
University College London
Tel: (071) 387-7050 Ex 5358
Section A - some questions about you

AGE _______ NO OF CHILDREN ________ AGES OF CHILDREN _______

MARITAL STATUS (tick box): Married □ Co-habit □ Single □ Separated □ Divorced □ Widowed □

DO YOU TAKE ORAL CONTRACEPTIVES: Yes/No

Please write what your job is _____________________________

What occupational category does this job belong to (tick box):

Unskilled manual □ Skilled manual □
Skilled technical □ Professional/Managerial □
Shop/office/secretarial □ Administrative □
Student □ Housewife □
Unemployed □ Other □

Please write what your partners job is ____________________

What occupational category does this job belong to (tick box):

Unskilled manual □ Skilled manual □
Skilled technical □ Professional/Managerial □
Shop/office/secretarial □ Administrative □
Student □ Housewife □
Unemployed □ Other □

Section B

Below is a list of feeling and physical states that women sometimes experience. Please describe your experience of each of these for the week before your most recent period, during your most recent period and for the week after.

Please respond on a scale of 1-3 where:

1 = no experience
2 = present, mild/moderate
3 = present, severe and/or disabling

<table>
<thead>
<tr>
<th>Feeling/Physical State</th>
<th>Week Before</th>
<th>During</th>
<th>Week After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Headaches</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>2. Feel bloated in the abdomen</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>3. Feel depressed</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>4. Get angry for no good reason</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>5. Period type pains</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>6. Food cravings</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>7. Poor concentration or memory</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>8. Irritable</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>9. Tender breasts</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>10. Feeling tense</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>11. Mood swings</td>
<td>1 2 3</td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>
Below is a list of ways that women cope with changes in feelings and physical state throughout the menstrual cycle. If you experienced any changes during your most recent menstrual cycle please tell us how you coped by answering yes or no to the list below.

If you consider that you experienced NO changes during your most recent cycle please tick here [ ], and answer what you would do if you experienced changes in your next cycle. Irrespective of whether you did or did not experience changes in your last menstrual cycle could you please signify how helpful you found or how helpful you would expect to find the coping methods below by using the following scale:

1 = not at all helpful
2 = quite helpful
3 = very helpful
4 = extremely helpful

<table>
<thead>
<tr>
<th>Section C</th>
<th>Helpfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kept busy</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>2. Watched TV</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>3. Went out with friends</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>4. Avoided being with people in general</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>5. Vigorous exercise (eg. swimming, running, aerobics class)</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>6. Team sports (eg. squash, badminton, volleyball)</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>7. Steady exercise (eg. walking, weight training gymnastics)</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>8. Relaxation exercise (eg. yoga, meditation)</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>9. Got angry and took it out on others</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>10. Told myself things to make me feel better</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>11. Thought about ways of overcoming the problem</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>12. Tried to find out more about what I was going through</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>13. Tried not to worry</td>
<td>Yes No 1 2 3 4</td>
</tr>
<tr>
<td>14. Feel energetic</td>
<td>1 2 3 1 2 3</td>
</tr>
<tr>
<td>15. Feelings of well being</td>
<td>1 2 3 1 2 3</td>
</tr>
<tr>
<td>16. Feel more tired than usual</td>
<td>1 2 3 1 2 3</td>
</tr>
<tr>
<td>17. Other (please specify)</td>
<td>1 2 3 1 2 3</td>
</tr>
</tbody>
</table>
14. Told myself it would be over soon
Yes No 1 2 3 4
15. Prayed
Yes No 1 2 3 4
16. Talked to GP/Nurse/pharmacist about it
Yes No 1 2 3 4
17. Talked to friend/partner/relative about it
Yes No 1 2 3 4
18. Talked to women with similar experiences
Yes No 1 2 3 4
19. Accepted it, nothing could be done
Yes No 1 2 3 4
20. Drank more coffee/tea than usual
Yes No 1 2 3 4
21. Drank less coffee/tea than usual
Yes No 1 2 3 4
22. Avoided certain foods/substances
Yes No 1 2 3 4
23. Ate more than usual
Yes No 1 2 3 4
24. Ate less than usual
Yes No 1 2 3 4
25. Drank more alcohol than usual
Yes No 1 2 3 4
26. Drank less alcohol than usual
Yes No 1 2 3 4
27. Smoked more than usual
Yes No 1 2 3 4
28. Smoked less than usual
Yes No 1 2 3 4
29. Took tranquillisers
Yes No 1 2 3 4
30. Took diuretics (water tablets)
Yes No 1 2 3 4
31. Took pain killers
Yes No 1 2 3 4
32. Slept more than usual
Yes No 1 2 3 4
33. Took B vitamins
Yes No 1 2 3 4
34. Took evening primrose oil
Yes No 1 2 3 4
35. Took oral contraceptives as a treatment for menstrual difficulties
Yes No 1 2 3 4
36. Other hormone therapy
Yes No 1 2 3 4
37. Went to bed with a hot water bottle
Yes No 1 2 3 4
38. Tried to see the positive side of things
Yes No 1 2 3 4
39. Kept my feelings to myself
Yes No 1 2 3 4
40. Other (please specify)
Yes No 1 2 3 4

Thank you for your co-operation. There is just one final task. Please indicate what coping methods you use regularly to help prevent symptoms occurring by placing a circle around the numbers that correspond with the appropriate method.

Many thanks.

If there is anything you would like to add that you feel we have not covered, please use the remaining space.
APPENDIX 2 MOOD ADJECTIVE CHECKLIST

END OF DAY QUESTIONNAIRE

Name .................................................. Todays day & date ..................

Below is a list of words that describe moods and physical states that people experience. For each one please tick the box which best describes your experience throughout TODAY. Please work quickly and answer every question.

0 = not at all, 1 = a little, 2 = moderately, 3 = quite a bit, 4 = extremely

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</table>

DID YOU MENSTRUATE TODAY? .......................... YES/NO

DID YOU TRAIN/EXERCISE TODAY? .......................... YES/NO

- 186 -
APPENDIX 3 LOCUS OF CONTROL QUESTIONNAIRE

54. Below is a series of statements which represent commonly held beliefs. You will probably agree with some and disagree with others. Please indicate the extent to which you agree or disagree with each.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree Strongly</th>
<th>Disagree Somewhat</th>
<th>Agree Somewhat</th>
<th>Agree Strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether or not I get to be a leader depends mostly on my abilities.</td>
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<tr>
<td>To a great extent my life is controlled by accidental happenings.</td>
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<td>I feel like what happens in my life is mostly determined by powerful people.</td>
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<td>My behaviour will determine whether or not I ever go to the hospital.</td>
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<td>When I make plans, I am almost certain to make them work.</td>
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<tr>
<td>Often there is no chance of protecting my personal interests from bad luck happening.</td>
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<td>When I get what I want, it's usually because I'm lucky.</td>
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<td>Even if I were a good leader, I would not be made a leader unless I play up to those in positions of power.</td>
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<td>How many friends I have depends on how nice a person I am.</td>
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<td>I have often found that what is going to happen will happen.</td>
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<td>My life is chiefly controlled by powerful things.</td>
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<td>It is impossible for anyone to say how long I'll be in good health.</td>
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<tr>
<td>People like myself have very little chance of protecting our personal interests when they conflict with those of powerful other people.</td>
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<td>It's not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune.</td>
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<tr>
<td>Getting what I want means having to please those people above me.</td>
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<tr>
<td>Whether or not I get to be a leader depends on whether I am lucky enough to be in the right place at the right time.</td>
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<tr>
<td>If important people were to decide they didn't like me, I probably wouldn't make many friends.</td>
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<tr>
<td>I can pretty much determine what will happen in my life.</td>
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<td>I am usually able to protect my personal interests.</td>
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<td>How often I go on holiday depends on other people who have power over me.</td>
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<tr>
<td>When I get what I want, it's usually because I worked hard for it.</td>
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<tr>
<td>In order to have my plans work, I make sure that they fit in with the desires of people who have power over me.</td>
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<td>My life is determined by my own actions.</td>
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<td>It's chiefly a matter of fate whether or not I have a few friends or many friends.</td>
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Coopersmith Inventory

Stanley Coopersmith, Ph.D.
University of California at Davis

Please Print

Name ________________________________ Age __________
Institution __________________________ Sex: M ___ F ___
Occupation ___________________________ Date ________

Directions

On the other side of this form, you will find a list of statements about feelings. If a statement describes how you usually feel, put an X in the column "Like Me." If a statement does not describe how you usually feel, put an X in the column "Unlike Me." There are no right or wrong answers. Begin at the top of the page and mark all 25 statements.
Like
Me

Unlike
Me

1. Things usually don't bother me.
2. I find it very hard to talk in front of a group.
3. There are lots of things about myself I'd change if I could.
4. I can make up my mind without too much trouble.
5. I'm a lot of fun to be with.
6. I get upset easily at home.
7. It takes me a long time to get used to anything new.
8. I'm popular with persons my own age.
9. My family usually considers my feelings.
10. I give in very easily.
11. My family expects too much of me.
12. It's pretty tough to be me.
13. Things are all mixed up in my life.
14. People usually follow my ideas.
15. I have a low opinion of myself.
16. There are many times when I would like to leave home.
17. I often feel upset with my work.
18. I'm not as nice looking as most people.
19. If I have something to say, I usually say it.
20. My family understands me.
21. Most people are better liked than I am.
22. I usually feel as if my family is pushing me.
23. I often get discouraged with what I am doing.
24. I often wish I were someone else.
25. I can't be depended on.

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MYSELF AS I AM

Please rate how you feel about yourself on a scale of one to seven using the items listed below.

Please work quickly and do not puzzle over any of the items. There is no right or wrong response, it is your immediate feelings that are wanted.

Example

GOOD 1 2 3 4 5 6 7 BAD

If you feel very good about yourself, circle 1; if you feel very bad about yourself, circle 5.

HOPEFUL 1 2 3 4 5 6 7 HOPELESS
GOOD 1 2 3 4 5 6 7 BAD
SUCCESSFUL 1 2 3 4 5 6 7 UNSUCCESSFUL
POWERFUL 1 2 3 3 5 6 7 POWERLESS
IMPORTANT 1 2 3 4 5 6 7 UNIMPORTANT
SKILLFUL 1 2 3 4 5 6 7 UNSKILLFUL
STRONG 1 2 3 4 5 6 7 WEAK
ACTIVE 1 2 3 4 5 6 7 PASSIVE
CONFIDENT 1 2 3 4 5 6 7 UNCONFIDENT
FIT 1 2 3 4 5 6 7 UNFIT
ENERGETIC 1 2 3 4 5 6 7 TIRED
EFFECTIVE 1 2 3 4 5 6 7 UNEFFECTIVE
COMPETENT 1 2 3 4 5 6 7 INCOMPETENT

How well do you feel you did at the task?

Extremely well 1 2 3 4 5 € 7 Not at all well
<table>
<thead>
<tr>
<th>Activity</th>
<th>Done Please</th>
<th>No. of Times in 1 Week</th>
<th>Average Time each Time</th>
<th>Average Distance each Time, in Miles</th>
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<td>CRIBICS ETC</td>
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<td>CYCLING</td>
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<td>GOLF</td>
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<td>RUNNING</td>
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<td>SWIMMING</td>
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<td>CRABLE TENNIS</td>
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<td>ASKETBALL</td>
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<td>SELF DEFENCE</td>
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<td>WALKING</td>
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<td>DANCING</td>
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<td>JARATE ETC</td>
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<tr>
<td>ANYTHING ELSE</td>
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<td>NOT MENTIONED ABOVE</td>
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APPENDIX 7 SCREENING QUESTIONNAIRE (STUDY 2)

Department of Psychology

UNIVERSITY COLLEGE LONDON

PHYSICAL EXERCISE STUDY

Thank you for agreeing to take part in this study to assess the psychological effects of sport and physical exercise on women. If you would like to know the outcome of the study, please fill in your name and address in the space provided. This will not be given to anyone else.

Overleaf you will find an end of day questionnaire to be completed before you go to bed at night. Please begin filling in a questionnaire on the first day of your next menstrual period and continue completing a questionnaire every night until the first day of the following menstrual period. Extra copies of the questionnaire have been included so do not worry if you have some left over. Please return everything to me in the stamped addressed envelope provided.

It is important that you supply me with all of the following personal details. All information will be treated as strictly confidential. Thank you again.

SECTION A

Name & Address (Optional)

AGE _______ MARITAL STATUS __________ NO. OF CHILDREN _______

OCCUPATION (please tick appropriate box)

Unskilled Manual ☐ Skilled Manual ☐ Skilled technical ☐

Clerical/Office/Shop ☐ Professional/managerial ☐

Other (please state) ___________________________________________

SECTION B

DATES OF YOUR LAST 3 MENSTRUAL PERIODS _____________________________

DO YOU EXPERIENCE/HAVE YOU EVER EXPERIENCED ANY MENSTRUAL/GYNECOLOGICAL PROBLEMS? Yes ☐ No ☐

IF YES PLEASE GIVE BRIEF DETAILS
ARE YOU CURRENTLY TAKING THE CONTRACEPTIVE PILL  Yes ☐ No ☐
ARE YOU CURRENTLY TAKING ANY PRESCRIBED MEDICATION Yes ☐ No ☐
IF YES PLEASE GIVE BRIEF DETAILS?

SECTION C
DO YOU REGULARLY PARTICIPATE IN ANY SPORT/EXERCISE (at least twice a week)  
Yes ☐ No ☐
If no please go to Section D, if yes please answer the following:
WHAT SPORT(s)/EXERCISE____________________________________________________________
Please rate how important the following reasons for taking part is to you:  
0 = not important, 1 = slightly important, 2 = quite important, 3 = very important (please circle appropriate number)
To keep your body healthy 0 1 2 3  Relaxation 0 1 2 3
To meet people 0 1 2 3  Fun/interest 0 1 2 3
To prepare for competitive/public events 0 1 2 3
Other(s) (please state) ___________________________ 0 1 2 3

ON AVERAGE HOW MANY TIMES A WEEK DO YOU PARTICIPATE? (please tick)
1-2 ☐ 3-4 ☐ 4+ ☐
ON AVERAGE HOW MANY HOURS IS EACH SESSION? (please tick)
less than 1 ☐ less than 2 ☐ more than 2 ☐ more than 4 ☐

SECTION D
DO YOU REGULARLY PARTICIPATE IN ANY HOBBIES/LEISURE ACTIVITIES (at least twice a week)  
Yes ☐ No ☐
If yes please answer the following:
WHAT HOBBIES/LEISURE ACTIVITIES__________________________________________
Please rate how important the following reasons for taking part is to you:  
0 = not important, 1 = slightly important, 2 = quite important, 3 = very important (please circle appropriate number)
To keep your mind healthy 0 1 2 3  Relaxation 0 1 2 3
To meet people 0 1 2 3  Fun/interest 0 1 2 3
To prepare for competitive/public events 0 1 2 3
Other(s) (please state) ___________________________ 0 1 2 3

ON AVERAGE HOW MANY TIMES A WEEK DO YOU PARTICIPATE? (please tick)
1-2 ☐ 3-4 ☐ 4+ ☐
ON AVERAGE HOW MANY HOURS IS EACH SESSION? (please tick)
less than 1 ☐ less than 2 ☐ more than 2 ☐ more than 4 ☐

- 192 -
Thank you for your interest in my study concerning women's reactions to mental stress during her menstrual cycle. In order to assess your suitability to take part, it is important that you supply me with all of the following personal details. All information will be treated as strictly confidential. If you are suitable, I will contact you to provide further information and answer any questions that you might have.

Please return the questionnaire to me in the envelope provided.

Many thanks.

Precilla Y L Choi
Department of Psychology
University College London
SECTION A

Name & address __________________________________________

__________________________________________________________________________

Telephone ______________________ (day) ______________________ (eve)

Age ___ No. of children ___ Ages of children ____________

Marital status Married [ ] Co-habit [ ] Single [ ]
(tick box): Separated [ ] Divorced [ ] Widowed [ ]

Please write what your job is __________________________________________

What occupational category does this job belong to (tick box):

Unskilled manual [ ] Skilled manual [ ]

Skilled technical [ ] Professional/Managerial [ ]

Shop/office/secretarial [ ] Administrative [ ]

Student [ ] Housewife [ ]

Unemployed [ ] Other [ ]

SECTION B

Do you take any prescribed medication Yes / No

If yes please provide the following details:

Name of drug ______________________ Dosage ___________________

Reason for taking ____________________________________________

Do you take oral contraceptives: Yes / No

How frequent are your periods? Every ____ days

How long do they last? ____ days

Do you experience any problems with your periods: Yes / No

If yes, please briefly describe the problem(s)

Have you ever experienced any gynecological problems: Yes / No

If yes, please provide brief details

SECTION C

Do you take part in any sport/exercise at least once a week: Yes / No

What sport(s)/exercise ______________________

On average, how many times a week do you exercise (tick box):

less than 2 [ ] 2-3 [ ] 3-4 [ ] 4+ [ ]

On average, how many hours is each session (tick box):

half an hour [ ] 1-2 [ ] 2-3 [ ] 3+ [ ]

Do you train for competitive/public events: Yes / No
Dear Miss Choi

Further to your visit to Marble Arch on 12th February, I am writing to confirm our agreement for you to carry out your study on physical exercise and premenstrual syndrome, on a sample of female employees at our Holborn offices later this year. I look forward to receiving a copy of your proposed research protocol in due course.

It is a condition of this agreement that no information resulting from this work may be published or communicated to the media without the prior and written agreement of Dr B Ballantine of Occupational Health Department, British Gas Plc.

I would be grateful if you would kindly acknowledge receipt of this letter and your acceptance of the above.

Yours sincerely

Dr B Ballantine
Senior Medical Officer Group

...
Dear Ms Choi

PHYSICAL EXERCISE/PMT PROJECT

Following our detailed discussions I understand that there has been some comment from the Ethical Committee.

Health Screening

So far as the health screening of subjects is concerned, The Occupational Health Department already holds clinical records on all employees. These are made up of self administered questionnaires (checked by the nursing officer and medical officer), screening results from the nursing officer and the medical officer's clinical examination.

The Occupational Health Nursing Officers work within departmental standing instructions, which require both the nursing officer and myself to sign to say that they are fully trained and both sides confirmed their competence and willingness.

Each procedure is separately itemised.

It is proposed that those employees should be screened in a similar way, to include:

- perusal of their existing notes.
- Health questionnaire.
- Screening test by nursing officer.
- All the results will be reviewed by the Occupational Health Nursing Officer.
- Where adverse features are identified the individual will be referred to the medical officer.
This protocol is routine for occupational health and well within the competence of the nursing officer.

Occupational Health Department

I would like to confirm that your discussions with the department have involved both myself and the Principal Nursing Officer.

I have contributed to, sought and received your detailed protocol. I have approved the protocol and am discussing the implementation with the Principal Nursing Officer.

Additionally approval is being obtained within the Company.

We will be assisting with the implementation, monitoring progress throughout and will discuss the results with you.

I hope to contribute to the final paper in due course.

We have already agreed that written permission to publish will be required from me, but this is usually not a problem.

Eventually publication is intended under joint authorship.

It may well be that we shall present the paper at various meetings.

I trust that these comments clarify the position and assist your ethical committee's clearance.

Yours sincerely

Dr B Ballantine, M.B., B.S., B.Sc, MFOM, DIH
Senior Medical Officer Group

cc: Principal Nursing Officer
From: Dr B Ballantine  
Senior Medical Officer Group  
Occupational Health Dept  
2 MA  

Gas Industry Telephone Number ____________________ Date _________________________________  
Subject Reference  

LADIES, DO YOU RARELY GET ANY EXERCISE?  
HAVE YOU BEEN MEANING TO GET FIT FOR SOME TIME NOW  
BUT JUST HAVE NOT GOT ROUND TO IT?  

WOULD YOU LIKE:  
FREE exercise classes (held on site)  
FREE physical fitness assessments  
(to include aerobic capacity, body fat level, muscular strength, endurance and flexibility)  
FREE health screening test  

The opportunity to have fun and get fit with your colleagues?  

University College London Department of Psychology, in collaboration with your Occupational Health Department will be conducting a study to assess the psychological benefits of exercise in female employees. In return you will be asked to provide valuable scientific research data by completing questionnaires to monitor your physical and emotional states over a six month period. Absolute confidentiality assured.  

TO:  
Ms POLLY PERKINS  
Principal Nursing Officer  
Occupational Health Department  
Marble Arch  

I would like more information on the Free exercise classes and the Physical Exercise study.  

NAME  
FLOOR  
LOCATION  
EXT NO.