PREMENSTRUAL SYNDROME:
Food preferences, increasing brain serotonin availability and mood in women

Giordana Bruna Cross
BSc Hons, Post Grad Dip Nut & Diet,
Post Grad Dip Public Health

A thesis submitted in fulfilment
Of the requirement for the degree of

DOCTOR OF PHILOSOPHY

Department of General Practice, University of Adelaide
2002
Abstract

Premenstrual syndrome (PMS) describes a group of symptoms, psychological, behavioural and physical, which can have a marked effect on a woman’s quality of life. The symptoms can range from being mild to very severe. In cases where they are severe, the woman’s normal day to day functioning is significantly impaired.

In some women with PMS, there is an increase in appetite during the premenstrual or late luteal phase of the menstrual cycle. Accompanying this increased appetite, an increased desire to consume foods high in carbohydrate content has been reported. This has been called ‘carbohydrate craving’ in some of the literature. Very few studies have investigated food intake in women with PMS over the menstrual cycle. The studies which have been done have varied in method. Only one study has recorded the foods eaten by women with PMS premenstrually and post menstrually and this was in a controlled environment. They found an overall increase in carbohydrate and total energy intake, premenstrually in women with PMS compared to the controls.

This study investigates the food consumption of overweight women over three menstrual cycles within a randomised double blind placebo controlled design. The aims of the study are firstly to determine whether women identified as exhibiting PMS symptoms including increased appetite, have a preference for carbohydrate. Secondly, if low brain levels of serotonin are involved in contributing to increased carbohydrate intake, whether increasing the availability of serotonin by using dexfenfluramine reduce total food intake or solely
selectively reduce carbohydrate intake in women with PMS. Thirdly whether there is a link between changes in food consumption, and the severity of PMS symptoms.

Women that met the study's entry criteria were blindly allocated either to the treatment or placebo group. Women participating in the study recorded their food intake premenstrually (commencing 4 days prior onset of menses) and postmenstrually (from day 5 after commencement of menses). They also completed the Steiner self-rated questionnaire and Nottingham Health Profile both pre and post menstrually.

Eighty-eight of the 144 women that completed the screening process met the study inclusion criteria. Forty-four women were allocated to the placebo and treatment groups. The diet records were analysed for total energy and macronutrients, nutrient and energy intake according to food categories and the number of episodes of food intake per day.

Analysis of the data shows a significant treatment effect on premenstrual food consumption. The mean energy and macronutrient intake for women in both the placebo and treatment (receiving dextenfluramine) groups was elevated premenstrually when compared to the mean postmenstrual intake. The placebo group premenstrual intake of energy and all macronutrients was significantly greater over all three menstrual cycles. For the treatment group premenstrual carbohydrate was significantly higher when compared to postmenstrual intake for
the first and third menstrual cycle. Energy and fat was significantly higher for the third menstrual cycle. Analysis of the data using the percent of energy contribution from protein, fat and carbohydrate found no consist difference between pre and post menses for the placebo and the treatment groups.

For both the placebo and treatment groups there was a preference for foods from the cake and dessert and high sugar food categories. This was consistent over the three cycles. Analysis of the food groups in terms of the percentage of each macronutrient and energy they contribute to the total diet, found that the high sugar foods consistently provided a greater proportion premenstrually for the placebo group. The pattern in the treatment group was similar but less consistent.

A commonly proposed theory is that women with PMS and other disorders such as Seasonal Affective Disorder have a specific desire or craving for high carbohydrate foods in response to low brain serotonin levels. This theory proposes that individuals with low brain serotonin levels are attempting to self medicate by consuming high carbohydrate foods.

The findings of this study do not support the theory that there is an overall preference for foods high in carbohydrates, but rather a preference for sweet tasting foods. Dexfenfluramine reduces overall food intake when comparing the placebo and treatment groups and reduces intake of sweet tasting foods.
Changes in the Steiner self-rated menstrual score did not significantly correlate to change in total nutrient intake over the three menstrual cycles. There was a correlation between the placebo nutrient intake from high sugar food category. This lack of correlation suggests that mood and other PMs symptoms are not linked directly with the observed changes in nutrient intake.
Contents

Premenstrual syndrome: Food preferences, increasing brain serotonin availability and mood in women.

Abstract .................................................................................................................................................. i
Statement of originality ....................................................................................................................... v
Statement of Ethics .............................................................................................................................. v
Acknowledgments ............................................................................................................................... vi
Publication ............................................................................................................................................. vi
Contents ............................................................................................................................................... vii
List of Abbreviations ............................................................................................................................ xiii
List of figures ......................................................................................................................................... xiii
List of graphs ......................................................................................................................................... xiii
List of tables ........................................................................................................................................... xiv

Chapter 1: Literature Review

1. Introduction ...................................................................................................................................... 2
1.1 The menstrual cycle ......................................................................................................................... 4
1.2 Premenstrual syndrome .................................................................................................................. 8
1.3 PMS and reproductive hormones .................................................................................................. 13
1.4 Appetite and Premenstrual Syndrome ......................................................................................... 15
  1.4.1 Energy and macronutrient intake over the menstrual cycle .................................................. 15
  1.4.2 Nutrient intake over the menstrual cycle in women with PMS ............................................. 19
  1.4.3 Food craving .............................................................................................................................. 20
1.5 Serotonin and appetite in premenstrual syndrome ................................................................. 23
  1.5.1 Serotonin and appetite ............................................................................................................. 23
  1.5.2 Serotonin in the central nervous system .............................................................................. 26
1.6 Oestrogen and progesterone influences on appetite .............................................................. 28
1.7 Dexfenfluramine: mode of action and influence on appetite .................................................. 29
1.8 Background to rationale for thesis ............................................................................................... 31
1.9 Research aims and Hypotheses ..................................................................................................... 33
  1.9.1 Aims ....................................................................................................................................... 33
1.9.2 Hypotheses ................................................................. 34

Chapter 2: Methods

Part 1: Screening methods
2. Introduction ........................................................................... 36
2.1 Subject recruitment into the screening phase ....................... 36
  2.1.2 Eligibility criteria for entry into the screening process .......... 37
2.2 The screening process ......................................................... 38
  2.2.1 Anthropometrics and other measures .......................... 38
  2.2.2 Administration of the Steiner self rated premenstrual syndrome .... 38
  2.2.3 Retrospective categorisation of premenstrual symptoms .......... 40
  2.2.4 Food intake documentation ........................................ 40
2.3 Nutritional analysis of food intake data ............................... 42
  2.3.1 Application of Goldberg’s cut off limit ......................... 44
  2.3.2 Analysis of food diaries according to food categories .......... 46
  2.3.3 Analysis of the frequency of food consumption ................ 48
2.4 Statistical analysis ............................................................ 49
  2.4.1 Subjects included in the statistical analysis ................... 49
  2.4.2 Creation of new variables ........................................... 49
    2.4.2.1 Calculation of percentage change in nutrient intake ........ 49
    2.4.2.2 Calculation of macronutrient intake as percentage of energy .... 50
    2.4.2.3 Calculation of the percentage that each food category
    Contributed to the total energy or macronutrient intake .......... 51
  2.4.3 Testing nutrient data for significance ............................ 51
  2.4.4 Relationship between energy, macronutrient intake and the Steiner
    Self rated PMS score .................................................. 52

Part 2: Randomised double blind placebo controlled study
2.5 Study design ..................................................................... 53
  2.5.1 Steiner self rated and Nottingham Health Profile questionnaires .... 55
  2.5.2 Administration of questionnaires .................................. 55
  2.5.3 Anthropometric measurements ...................................... 56
2.6 Food intake data collection ............................................... 56
  2.6.1 Returning and checking of food intake records ................ 37
  2.6.2 Food data input ...................................................... 57
Chapter 3: Results Part 1

Part 1: Findings from analysis of the screening data

3. Introduction

3.1 Hypothesis 1

3.2 Subject profiles

3.3 Retrospective perception of the severity of premenstrual symptoms

3.4 Additional data collected from women meeting the entry criteria

3.5 Macronutrient and energy intake

3.5.1 Data analysis prior to application of Goldberg's cut off limit

3.5.2 Data analysed according to food categories

3.5.3 Energy and macronutrient analysis after applying the Goldberg's cut-off limit

3.5.4 Analysis of nutrient data according to food categories after applying the Goldberg's cut off limit

3.6 The number of 'episodes of eating' in women with and without PMS symptoms

3.7 Relationship between the Steiner self rated score and nutrient intake

3.8 Summary of the screening data results
Chapter 4: Results

Part 2: Findings of the randomised double blind placebo controlled parallel group study

4. Introduction ........................................................................................................... 106

4.1 Hypotheses addressed in randomised double blind placebo study ............... 108

4.1.1 Hypothesis 2 .................................................................................................. 108

4.2 Participant profile and medication compliance ............................................... 110

4.3 Anthropometric measures over the study period ........................................... 112

4.4 Comparison of the energy and macronutrient intake between the placebo and
treatment groups .................................................................................................... 114

4.4.1 The macronutrient contribution to total energy consumption ................. 122

4.4.2 Variation of energy and macronutrient intake over the three cycles of
the study .................................................................................................................. 125

4.4.3 Analysis of data according to food categories .............................................. 127

4.4.3.1 The contribution to total energy intake by food categories ................. 127

4.4.3.2 The contribution of the food categories to protein intake .................. 129

4.4.3.3 Contribution of food categories to the total fat intake ....................... 130

4.4.3.4 Contribution of food categories to the total carbohydrates
intake ...................................................................................................................... 131

4.4.3.5 Contribution of food categories to the total simple sugars
intake ..................................................................................................................... 133

4.4.3.6 Contribution of food categories to the total complex
carbohydrate intake ............................................................................................. 135

4.4.4 Percentage of energy and macronutrients contributed by each food
category .................................................................................................................. 135

4.4.4.1 Percentage of energy contributed by food categories ......................... 135

4.4.4.2 Percentage of protein contributed by food categories ....................... 137

4.4.4.3 Percentage of fat contributed by each food group .............................. 138

4.4.4.4 Percentage of carbohydrate contributed by each food category ......... 139

4.4.4.5 Percent of simple sugars contributed by each food category .......... 140

4.4.4.6 Percent of complex carbohydrate contributed by food
categories ............................................................................................................... 140

4.5 Frequency of daily meal intake over three menstrual cycles ......................... 160
Chapter 5: Discussion

5. Introduction ........................................................................................................... 179

5.1 Premenstrual syndrome and food consumption .................................................. 180

5.1.1 Evidence for premenstrual increase in food consumption in women with PMS ........................................................................................................... 180

5.1.2 The effect of increasing brain serotonin availability using doxepin tartrate on food consumption ................................................................. 183

5.1.2.1 Doxepin tartrate influence on energy and macronutrient intake during the pre and post menstrual phases ......................................................... 183

5.1.3 The influence of doxepin tartrate on the types of food consumed over the menstrual cycle ................................................................. 186

5.1.3.1 Energy contribution by food categories .................................................. 187

5.1.3.2 Macronutrient contribution by food categories ..................................... 188

5.2 PMS and alleviation of symptoms by doxepin tartrate ....................................... 195

5.3 The relationship between PMS symptoms and food consumption ....................... 195

5.4 Future work ......................................................................................................... 198

Conclusion .................................................................................................................. 202

References .................................................................................................................. 203