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Brain Fog among Perimenopausal Women: A Comparative Study

By S. Shrividya¹ and Molly Joy²

Abstract

Menarche is the beginning of a girl's ability to ovulate and reproduce. Visible menopause symptoms are absent with little hormonal changes during pre-menopause. Perimenopause is the transitional period which is a slow process from normal to no menstrual periods at all, which often takes up to 10 years. In menopause, ovarian development of estrogen decreases significantly, and this results in painful effects such as hot flashes, nausea, exhaustion, etc. Another common symptom is brain fog: a mostly temporary state of diminished mental capacity marked by an inability to concentrate or to think or reason. The study intends to analyze brain fog differences in perimenopausal women between the ages of 37 and 50 following two different diets. The sample consisted of 100 women; 50 were lacto-vegetarians and 50 were lacto-non-vegetarians, and in the same group 50 were homemakers and 50 were employed women. The tool used for this study was Mini-Mental State Exam (MMSE), and analyses were done using statistical techniques like descriptive statistics and independent sample t-test using SPSS software. Results revealed that there was no cognitive impairment and no brain fog between the sample of 50 lacto-vegetarian and 50 lacto-non-vegetarian perimenopausal women who were employed and homemakers. But lacto-vegetarians had better Mini-Mental State Exam (MMSE) scores than lacto-non-vegetarians, and employed women showed better Mini-Mental State Exam (MMSE) scores than homemakers. The study revealed this and other observations and findings that broaden scope for further research in this area.

Keywords: Menarche, Premenopause, Perimenopause, Menopause, Brain Fog, Lacto-vegetarian, Lacto-non-vegetarian, Employed women, Homemaker, MMSE

Introduction

Hormones are chemical messengers secreted by our glands in our body that travel in our blood to their target organs and give instructions on what must be done in order to regulate health and behavior (Hill, 2019). Menarche is an important indicator of both a woman's health and the health of the population. The average age of a girl's first menstruation is 12.4 years; in the beginning her menstrual cycles may be highly irregular in terms of number of days or the blood flow, and the cycle approximately occurs once every 28 days, or for some girls once every 21 to 45 days (Lacroix and Langaker, 2019). At birth, a girl has all the ova she will ever have in her entire life (i.e. around 4,000,000). These immature ova reside in her two ovaries with each ovum is in its own small sac or follicle. After menarche has taken place, ovulation (rupture of a mature follicle and expulsion of its ovum) occurs about once every 28 days until menopause. The

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girl stops menstruating once the ovum has been fertilized and resumes after the fetus or the baby is out of the uterus and continues again as long as the ovaries keep releasing eggs (Papalia *et al.*, 2007).

Perimenopause

Menopause occurs during middle-age, usually in the late forties or early fifties, when the menstrual periods of a woman cease completely. The life cycle of a woman has long been determined by her reproductive capacity. A few centuries or decades ago, the average life expectancy was only 50 years, which is shorter than the average age of menopause. Some things have not changed; the average age of menopause is still about 51 years old. However, with the improvement of health and hygiene conditions, medical care and lifestyle, current survival trends indicate that women's life expectancy is about 80 years. Therefore, after the transition to menopause, women have now lived for more than one-third of nearly 30 years (Kravitz and Joffe, 2011). There is however, a large variation in the age at which menopause begins (between the ages of 39 and 59). By the age of 60, almost all women are postmenopausal (Gosden, 2007). The premenopausal cycle does not contain any of the usual menopause signs or symptoms (such as night sweats, insomnia, or missed periods). An individual undergoing premenopause has cycles that may or may not be regular, and is still considered fertile or in their life phase of reproduction. There are no visible changes in the body during premenopause, but hormonal changes may begin to occur. In abstract terms, before they reach menopause, women are considered in the premenopause phase (Kristeen, 2020).

Perimenopause outlines the physical and physiological symptoms which are the direct results of massive hormonal changes taking place in a woman's body (Cabeca, 2019). It is a period when women should start making clear choices about medicinal and natural therapies to take care of themselves and focus on diet, sleep, and exercise. Perimenopause is a frightening period for many women; some of them are just ending their thirties and often just contemplating their life's goals when they enter perimenopause. Perimenopause is a transitional hormonal stage which can last up to many years before the actual menopause. In a recent scientific study, it was shown that the range of normal for the duration of perimenopause varies from four to fifteen years. Usually, women who have had an operational menopause are not addressed with a particular name because they can either be called postmenopausal (if the operation was performed after menopause) or because their condition could not be determined if surgery was performed before menopause (Green and Alvis, 2011).

Brain Fog

It's common for women going through perimenopause to complain of what researchers sometimes call "brain fog". Lexico (Oxford Dictionary) defines brain fog as "an impediment to thinking clearly; inability to concentrate and remember". Merriam Webster Dictionary defined Brain Fog as a temporary state of reduced mental ability and capacity which is marked by inability to concentrate or to think or reason clearly. An individual's diet, lifestyle, and circumstances play a major role in maintaining brain chemistry. The unavoidable result of this brain chemistry imbalance leads to cognitive and mood problems. Human schedules of eating, sleeping, everyday chores, and life styles are disrupting three vital encephalon neurotransmitters: serotonin, dopamine, and cortisol. And because of biological factors, perimenopausal women

face drastic changes in hormones level in their body, especially estrogen and progesterone levels. Lack of balance in these neurotransmitters makes women experience brain fog, absent-mindedness, mental confusion, exhaustion, uneasiness, and sadness (Dow, 2015).

Cognitive research shows that any field of professional achievement is important for progress. Here, we start with the description of three different dimensions of focus: the act of concentrating (or effortful awareness), limited perception, and attention division (or the ability to pay attention to more than one stimulus equally well as the first one). According to Shiffrin (1988), "Attention was used to refer to all those aspects of human cognition that can be regulated by the speaker, and to all aspects of cognition linked to limited resources or ability, and methods of coping with such limitations." Reasoning abilities of perimenopausal women is also found to be affected. Reason and logic (i.e., the ability to interpret reason) are related to learning, intellect, and knowledge. Problems with self-reported memory are common during midlife. These women between the ages of 33 and 55 who had been met about their psychological capacity, 60% had noticed an ominous change in memory "as of late." In this cross-sectional survey, women identified difficulties with word and number recall, disturbances in daily activity (e.g., loss of household items), trouble concentrating, need to use memory aids, and forgetting events (e.g. appointments). Variables related to apparent cognitive decline, work pressure, and different jobs, however, not a temporary time of perimenopause showing that the apparent memory issues were fundamentally a component of stress and various pressing factors bringing about diminished concentration and focus. The Study of Women's Health (SWAN) (Bromberger and Kravitz, 2011) likewise detailed a cross-sectional connection between self-revealed neglect and perimenopause and in this investigation of 12,425 women between the ages of 40–55, unadjusted for socio-segment factors, 31% premenopausal, 44% early or late perimenopausal, and 42% of normally menopausal women showed a tendency toward absentmindedness. Of 12,425 women between the ages of 40–55, unadjusted for socio-segment factors, 31% premenopausal, 44% early or late perimenopausal, and 42% of normally menopausal women indicated absent-mindedness. Perimenopausal women were 1.4 more likely to report distraction than premenopausal women after change for race/identity, age, business, financial difficulty, conjugal status, sex, body size, wellbeing propensities, and uneasiness side effects, despondency and helpless rest would be inconvenient to perception.

Diet

Based on the number diets and eating habits, it has been classified into lacto-vegetarian diet and lacto-non-vegetarian diet. A lacto-vegetarian diet includes plants-based foods like fruits, vegetables, nuts, whole grains, dairy products, etc., which is good for maintaining body weight and heart health. There are many vegetarians who chose this diet because of ethical reasons like the killing of animals. Some consume it for ecological reasons: the low efficiency of producing animal food from edible plants in relation to the world's food situation and also the growing population. Some consume it for health reasons, as excessive consumption of animal products high in saturated fats is associated with a wide variety of diseases. The presence of contaminants, additives and unwanted substances from animal products is another health reason. And lastly, some follow this diet simply because they dislike the taste of some animal products. The word vegetarian is often used as the synonym for the word "ovo-lacto vegetarian". Ovo-lacto vegetarians consume a diet composed of plants food, dairy, and eggs but do not consume meat, fish, or other seafood. But in this study, lacto-vegetarians will include those who consume plant

food and dairy products but do not consume eggs, meat, fish, or seafood. Vegetarian food certainly helps aid in weight loss without compromising on nutrients. According to the year 2014' data, *Expo* (2014) magazine reported in their lifestyle article that in the U.S., four percent of men and seven percent of women are vegetarians. Throughout India, where a cruel-free diet is driven by religious reasons, 31 percent of the population is vegetarian. In the whole world, the total calculated number of vegetarians is 375 million (Figus, 2014). According to recent research, (Sawe, 2019) India is ranked top in the world with 38% of the total population being vegetarians.

Significance and Need for the Study

The association between perimenopause and comprehension is centered on numerous systems. Changes in sex chemicals may influence the brain and the spinal cord. It is critical to consider both the circuitous and direct impacts of hormonal changes on the cerebrum while considering the systems by which perimenopause can impact psychological capacity. Roundabout impacts are the consequences for neuronal frameworks of hormonal changes related to menopause manifestations like mindset, unsettling influence in circadian rhythm, and hot flashes. Direct impacts are those that support psychological capacities on neural frameworks. High and low levels of estrogen and withdrawal have different consequences for the cerebrum and spinal cord, which can have an impact on psychomotor function and memory. It is hypothesized in this study that if brain fog exists in perimenopausal women, its level will be the same regardless of diet. A diet that includes fish, eggs, beef, vegetarian food, and dairy products etc. is called a lacto-non-vegetarian diet, and this diet is ideal for muscle development. It also assists in preserving hemoglobin and body endurance. A lacto-non-vegetarian diet is a good source of protein. Protein may also be present in food products like seeds, and pulses; however, these sources of protein are incomplete. Vitamin B12 and iron are found abundantly in fish, eggs, and milk. The production of red blood cells and nerve fibers is very important. When our bodies don't produce enough red blood cells, iron deficiency, known as anemia, will occur. A diet consisting of seafood such as fish and eggs sharpen our intellects and facilitate the smooth functioning of our brain according to the medical science.

The study also focuses on the occupations of the women. Types of occupations were categorized as either employed women or homemakers. Employed women are women who earn a salary, everyday wages, or any other income through regular employment somewhere outside home. In recent years, the employment rate of women, particularly within the service sector, has been going up, and at the same time researchers have become interested in the psycho-social consequences of women's employment especially on health (Dibaji *et al.*, 2017). While women have become more assimilated into the workplace in recent decades, they have made significant changes in their job environments that can lead to health issues and other negative outcomes such as marital distress and reduced employment status (Lennon, 1994). Heavy workloads can adversely affect women's health, especially in the presence of certain functional characteristics (e.g., clerical, administrative, technical, or executive, or child care). Heavy work obligations can also threaten marital satisfaction, particularly if the way couples manage household work is considered to be unequal. There are various theoretical models and specific work and health studies on women. A woman who manages the home and is not employed outside the home is referred to as a homemaker. The extent of housework involving independent thinking and judgment has similar psychological consequences. Researched have compared employed wives and full-time homemaker's qualities and their every-day work exercises and examined the results

of these work conditions for mental prosperity (Lennon, 1994; Mortimer, 2018; Schooler *et al.*, 1983). It was found that self-direction in housework is related to women's intellectual flexibility and a self-directed orientation. Similar relationships were not found among men, for whom housework generally is more discretionary. There was one study conducted to find the connection between fertility history and cognition in men and women (Read and Grundy, 2017), where, in his study he found that less and more parity compared to moderate or mid parity were linked with poorer cognitive functioning, as was an early age at entry to parenthood (<20 women/23 men). Many of these links vanished when socio-economic position and health were on their side. For women, however, adjusting for socio-economic place and social contacts made the links stronger between childlessness and poor cognition. Late motherhood (>35) was linked with improved cognitive function.

The need for this study arises because the majority of past studies focus mainly on severity of perimenopause symptoms and post menopause symptoms. It is essential to enhance awareness about dietary and nutritional guidelines and their influence on physical and mental health. Good nutrition based on healthy eating is an important factor which helps us to remain healthy and to be active. Today, both those who can afford nutritious food and those who cannot eat an imbalanced diet which can have adverse effects on their bodies. Individual dietary intake and nutritional status are important factors which affect mental health and the development of psychiatric disorders. Most scientific evidence on mental health centers on depression, cognitive function, and dementia. During perimenopause women undergo many changes in their bodies including the condition known as 'brain fog'. This is not a medical condition but refers to temporary, unclear thinking. It is a type of cognitive dysfunction involving memory problems, poor concentration, inability to focus, forgetfulness, or lack of mental clarity (Dow, 2015). Today, women are following different diets to maintain good health and in doing so they unknowingly fight brain fog by supplying enough nutrients to the brain. Yet there are many women who cannot afford and sustain special diets due to financial crisis. This study can find out whether a regular and/or day-to-day lacto-vegetarian diet or lacto-non-vegetarian diet, with few exceptions, can help to maintain cognitive functioning.

The objective of the present study is to achieve a more detailed understanding of brain fog with a focus on attention, concentration, and reasoning abilities in perimenopausal women. Further, this is investigated in perimenopausal women following two different diets with respect to their occupations, i.e., employed and homemakers. This means to compare the lacto-vegetarian perimenopausal homemakers and lacto-vegetarian perimenopausal employed women, the lacto-non-vegetarian perimenopausal homemakers and the lacto-non-vegetarian employed women, and finally to assess the level of brain fog and compare between both the groups as a whole i.e. lacto-vegetarian women and lacto-non-vegetarian women. There has not been any study that has taken all three categories (i.e. brain fog, lacto-vegetarians and lacto-non-vegetarians) with respect to employed women and homemakers. Hence, the objectives of the study are to assess the level of brain fog in perimenopausal women, to compare the lacto-vegetarian perimenopausal homemakers and lacto-vegetarian perimenopausal employed women, to compare the lacto-non-vegetarian perimenopausal homemakers and the lacto-non-vegetarian employed women, and finally to assess the level of brain fog and compare between the two groups, i.e., lacto-vegetarian women and lacto-non-vegetarian women. So, studying the peculiarities of this age group is also important because eating habits affect the brain fog in this stage. The study shows the difference in the level of brain fog in different groups by using the

Mini Mental State Exam (MMSE) questionnaire. It enables us to know the rate of cognitive decline.

Method

The method of this study was a comparative design using a quantitative approach to compare brain fog between perimenopausal women following two different diets and occupations.

Variables of the Study

- *Brain Fog*: Defined as a decline in cognitive abilities that is not permanent. Symptoms include scattered thinking, forgetfulness, memory loss, and inability to focus or complete multiple tasks.
- *Perimenopausal Women*: This is the period of changes before the final change which marks the end of the fertility of a woman, when a woman's menstrual periods completely cease, known as menopause.
- *Lacto-Vegetarian Diet (LV)*: It refers to a diet that includes plant-based foods like fruits, vegetables, nuts, whole grains, dairy products, etc., which are good for maintaining body weight and heart health.
- *Lacto-Non-Vegetarian Diet (LNV)*: It refers to a diet that includes fish, chicken, meat, and vegetarian and dairy products, etc. which are good for muscle development.
- *Employed Woman*: A woman who earns a salary, wages, or other income through regular employment or somewhere outside the home.
- *Homemaker*: A woman who manages the home and is not employed outside of it.

Objectives of the study

The main objectives of this study were to find the difference in brain fog level between lacto-vegetarian perimenopausal women and lacto-non-vegetarian perimenopausal women and the difference of brain fog level between lacto-vegetarian perimenopausal women and lacto-non-vegetarian perimenopausal women based on occupation (homemakers vs employed women). The null hypothesis was set to test the difference. Descriptive Statistics and Independent sample t-test to test the null hypothesis and SPSS (Statistical Package for the Social Sciences) 21 was employed to analyze the data.

Sample

Purposive sampling technique was used to select 50 lacto-vegetarians and 50 lacto-non-vegetarians of perimenopausal women between the ages of 37-50 years. This technique was used as the researcher wanted to access a particular subset of people; all participants of this study were selected because they fit a particular profile needed for the study. While performing this sampling method, 350 participants were interviewed and 250 individuals were rejected who did not fit the particular profile to create the sample. Only vegetarians and vegans weren't found in the required age group, i.e. 37-50 years, which is why lacto-vegetarians and lacto-non-vegetarians were selected for the study. 100 questionnaires were given out in total. The total

number of samples taken for the study was $n = 100$, where 50 of them were lacto-vegetarians and 50 of them were lacto-non-vegetarians. Out of the 50 women, 25 of them were employed and 25 of them were homemakers.

Tool Used for the Study

The Mini-Mental State Exam (MMSE) by Folstein *et al.* (1975) is employed in the study. The validity and reliability are .78 and .80 to .95 respectively. It is an 11-items questionnaire that explores functions such as registration, attention and estimation, recall, language, and the ability to follow commands and guidance. The higher the score, the lower the likelihood of brain fog. The scores are summed, and interpretation of MMSE is done based on norms which are based on severity levels, namely- 24-30: No cognitive impairment; 18-23: Mild cognitive impairment; and 0-17: Severe cognitive impairment. MMSE is also used to track an individual's progression of cognitive changes over time.

Ethical Guidelines Followed

The researcher gave an adequate explanation about the purpose of the study. The consent of the participant was taken before they filled out the questionnaire. Anonymity, confidentiality, and respect for the privacy of the participant were maintained. Also, researchers assured that the current study would be of no harm to the participants.

Results and Discussion

The mean for the variable brain fog among perimenopausal women is 27.21 with a standard deviation of 2.194. Based on the norms, MMSE scores interpret that there is no cognitive impairment among perimenopausal women in this study. Analysis revealed that the scores suggested no cognitive impairment in women but Attention and calculation (count backward), Recall (recall the three things told before), Language and praxis (copy the pentagon picture) were the Mini-Mental State Exam (MMSE) domains in which poor baseline performance was found.

Table 1: Mean and Standard Deviation of the Variable Brain-Fog among Perimenopausal Women between Lacto-vegetarian and Lacto Non-vegetarian Homemakers and Employed Women

Variable	Sample	N	Mean	S.D
Brain fog	Perimenopausal women	100	27.21	2.194

Table 2: Mean, SD, and Independent Sample t-test to Check Brain Fog among Perimenopausal Women between Lacto-vegetarian and Lacto non-vegetarian Homemakers and Employed Women

Groups	N	Mean	S.D	Standard Error Mean	t	df	p
LV Homemaker	25	25.72	2.509	0.502	-3.151**	48	.003
LV Employed	25	27.64	1.729	0.346			
LNV Homemaker	25	27.20	1.936	0.387	-2.059*	48	.045
LNV Employed	25	28.28	1.768	0.354			

**p<0.01 (2-tailed) *p<0.05 (2-tailed). LV: Lacto-Vegetarian; LNV: Lacto-Non-Vegetarian

Descriptive statistics of brain fog level between perimenopausal women was calculated, and based on Mini-Mental State Exam scores, there is no cognitive impairment in selected perimenopausal women in the study, suggesting a low level of brain fog, but Attention and calculation (count backward), Recall (recall the three things told before), Language and praxis (copy the pentagon picture) were MMSE domains in which poor baseline performance was found.

The t-test value for lacto-vegetarian perimenopausal homemakers and lacto-vegetarian perimenopausal employed women was found to be significant at 0.01 level, indicating that there is a significant difference in Mini-Mental State Exam scores of lacto-vegetarian perimenopausal homemakers and lacto-vegetarian employed perimenopausal women, wherein, lacto-vegetarian employed women have better cognition than lacto-vegetarian homemakers. The hypothesis that there will be no significant difference in brain fog level among lacto-vegetarian perimenopausal homemakers and lacto-vegetarian employed perimenopausal women is rejected. The t-test value for lacto-vegetarian perimenopausal women and lacto-non-vegetarian perimenopausal women were found to be significant at 0.05 levels, indicating that there is a significant difference in Mini-Mental State Exam scores of lacto-vegetarian perimenopausal women and lacto-non-vegetarian perimenopausal women, wherein, lacto-vegetarian perimenopausal women have better cognition than lacto-non-vegetarian perimenopausal women. The hypothesis stating that there will be no significant difference in brain fog level between lacto-vegetarian perimenopausal women and lacto-non-vegetarian perimenopausal women is rejected. The conclusion of this research was in line with the research conducted by Beezhold *et al.* (2018) wherein their objective was to investigate menopausal symptoms and dietary patterns in peri- and postmenopausal women. The findings of the study revealed that vegans have less bothersome vasomotor and physical symptoms than omnivores. More vegetables and less non-veg food were associated with decreased negative symptoms.

The t-test value for lacto-non-vegetarian perimenopausal homemakers and lacto-non-vegetarian perimenopausal employed women was found to be significant at 0.05 levels, indicating that there is a significant difference in Mini Mental State Exam scores of lacto-non-vegetarian perimenopausal homemakers and lacto-non-vegetarian working perimenopausal

women, wherein, lacto-non-vegetarian employed women have better cognition than lacto-non-vegetarian homemakers (Posel and Bruce-Brand, 2020). The hypothesis stating that there will be no significant difference in brain fog level between lacto-non-vegetarian perimenopausal homemakers and lacto-non-vegetarian employed perimenopausal women is rejected. Based on the Mini-Mental State Exam norms, it was found that there is no cognitive impairment between perimenopausal women, suggesting a low level of brain fog. These findings are similar to the previous longitudinal study on perimenopause and cognition conducted by Greendale *et al.* (2010). Perimenopause's effect on cognition tends to be marked by a lack of enhanced performance, rather than a decline. The crucial timing hypothesis is confirmed which states that estrogen improves cognitive function when introduced early, but not later. But, as perimenopause indicates the decline in the estrogen level in women, owing to worsening cardiovascular risk factors, the menopausal transition may also affect cognitive function in older age.

Conclusion

The findings of this study can be used to enhance and knowledge about perimenopause and brain fog, its effect on cognition, dietary and nutritional guidelines, and their influence on physical and mental health. The findings of the study can be used to enhance awareness that being employed and working or just keeping the brain active is important. The findings of this study will help future researchers who are interested in this area.

Limitations of the study

The study focused only on lacto-vegetarians and lacto-non-vegetarians and not on ovo-vegetarians, lacto-ovo-vegetarians, or non-vegetarians. The study focused mainly on women in Karnataka. Normality testing was not done. Psychological factors during the administration of the test would have affected the result.

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