



Review Article

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Do nutritional deficiencies lead to menstrual irregularities?

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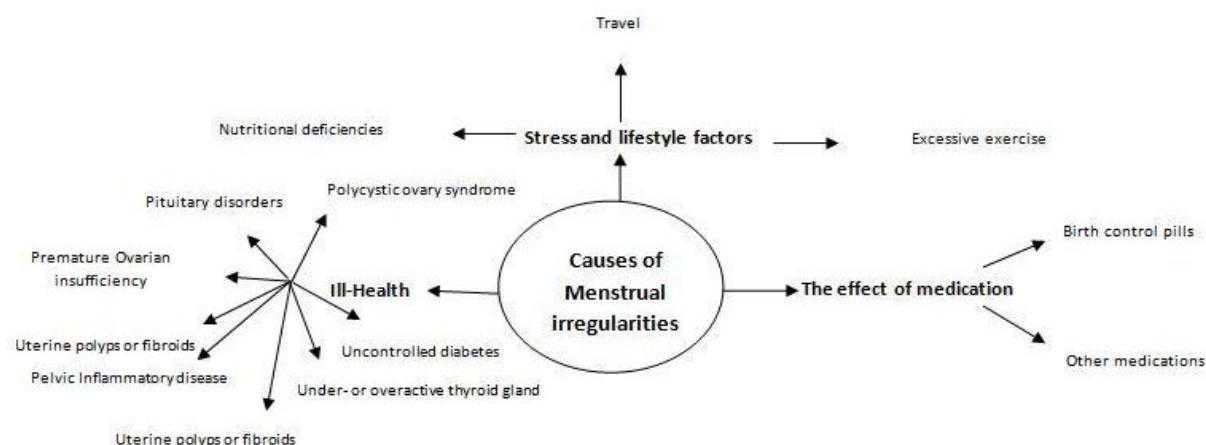
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Background:

Menstruation is a vital part of female reproductive health, and its irregularities could interfere in the normal life of menstruating women and girls⁽¹⁾. Despite the fact that menstrual irregularities are one of the most prevalent health disorders, they are not still considered as a public health concern especially in low and middle income countries (LMICs)^(2,3).

Generally, there are several causes leading to menstrual irregularities, which fall into three main categories: ill-health, the effect of medication, and stress and lifestyle factors (see diagram) ⁽⁴⁾. However, this review makes no claim regarding inclusion of all causes of menstrual irregularity; rather, we focus on the issue of nutritional deficiencies, which are assumed to be one of the underlying causes of menstrual irregularities. Studies have also indicated that nutritional deficiencies exert an influence over menstrual regularity; therefore, nutritional deficiencies are considered as one of the most significant factors result in menstrual irregularity in women and girls.

Keywords: Menstrual irregularity, menarche, nutritional status, BMI



This review was conducted due to the following reasons; whereas there are well-established studies that nutritional deficiencies (and particularly low Body Mass Index (BMI) lead to delayed onset of menarche for girls in high-income countries (HICs), for LMICs there is little comparable information on the age of menarche, let alone the effect that malnutrition may have on delayed menarche (5). This is all the more remarkable given that level of malnutrition is higher in LMICs, for example, in sub-Saharan Africa prevalence of stunted children under 5 is over 30%, and in Eastern Africa it is 36.7% (6).

Additionally, menstrual irregularities seem to be a concern for girls. In the field training of women and girls through WoMena our trainers were repeatedly asked about the reasons for irregularities, but none of the existing training tools seemed to give an answer.

In this review nutritional deficiencies and menstrual irregularities are defined as "essential nutrients are not received according to requirements", and "more than twenty days in individual cycle length over a period of one year" respectively (7,8). In this article early menarche is defined as "a girl experienced her first menstruation before the age of twelve years", and late menarche as "a girl experienced her first menstruation after the age of fourteen years" (27). To our knowledge, this present review is the first systematic review which has been carried out to assess a summary of studies that have been done regarding correlation between nutritional deficiencies and menstrual irregularity in LIMICs, and it provides suggestions for future studies in this area.

Objectives:

To assess correlation between nutritional deficiencies and menstrual irregularity in young girls.

Methods:

A systematic review of peer-reviewed studies available through PubMed, BioMed Central, ProQuest, and Google Scholar databases.

Results:

Fifteen studies were eligible for the inclusion criteria. The existing available evidence suggests that nutritional deficiencies result in menstrual irregularities and delayed menarche (first menstruation) in adolescent girls.

Therefore, BMI found to be an important indicator of nutritional status of girls, has been identified as a determining factor associated with the age at menarche, and has significant impact on the regularity of menstrual cycle.

Discussion and Conclusion:

Studies have established that nutritional deficiencies significantly contribute towards menstrual irregularities. Hence, consuming a well-balanced diet performs an essential role in having regulated menstrual cycle which determines the health of women. This means that women and girls need to know what balanced nutrition means and the impact of well-balanced diet on the onset of menarche as well as regularity of menstruation.

Introduction:

It is estimated that around 25% of the world population are females of reproductive age (aged 15-49) and they menstruate on average approximately 3,000 days during their lifetime (9). Menstrual irregularities impact on the quality life of menstruating girls and women (10). Therefore, it is deemed essential to find out the root of this problem and seek effective solutions for this issue.

Generally, menstrual problems range from menstrual cycle irregularities, hyper- or hypomenorrhoea, poly- or oligomenorrhoea, dysmenorrhoea, amenorrhoea, menorrhagia, and premenstrual syndrome (11). Genetic, socio-economic, and nutritional elements as well as psychosocial status, and reproductive problems determine the regularity of menstruation and menstrual issues (3).

Mainly because of lack of awareness and education, menstruating

girls and women who suffer from nutritional deficiencies often do not seek advice from health professionals which can lead to reproductive health issues (25). It is observed that menstrual irregularity is one of the main reasons for school absenteeism in adolescent girls (12). Although genetic indicators are primarily responsible for age at menarche; nutritional deficiencies have been shown to have a large impact on the start of menarche in girls (13). Moreover, mainly due to improvement in nutrition intake in developed countries compared to low-income countries, age at menarche has lowered in developed contexts (26).

Evidence suggests the indirect effect of nutritional deficiencies on start of menarche maybe because of the role of nutrients on the production of gonadotropin hormone (13, 14). It is also observed that nutrient deficient girls tend to attain menarche one year later than girls who do not have nutritional deficiencies (13).

Methods:

PubMed, BioMed Central, ProQuest, and Google Scholar databases were selected to identify conducted studies on connection between menstrual irregularities and nutritional deficiencies.

Searches were performed through employment of the following key words:

ProQuest:

Menarche, body composition
Menstrual disorders, BMI, anemia
Menstrual irregularity, nutritional status
Menstrual irregularity, BMI

From 75 identified studies, 6 articles met the inclusion criteria

BioMed Central

Malnutrition, menstrual dysfunction
Nutritional status, menstrual dysfunction
Menstrual irregularity, anemia

From 10 studies found to be relevant, none of them satisfied inclusion criteria

PubMed

Menstrual disorders, anemia, iron deficiency
Menstrual dysfunction, anemia, iron deficiency

From 45 studies recognised to be related to the review, 6 studies were included for the review

Google Scholar

Menstrual irregularity, BMI
Menstrual irregularity, nutritional deficiencies

Menstrual irregularity, malnutrition

From 7 selected studies, 3 of them followed the inclusion criteria

Inclusion criteria:

Chosen studies were required to be full text, conducted from the 2010s onwards, peer-reviewed, and carried out in English or translated into English, and assess the relationship among menstrual irregularities and nutritional deficiencies in both girls who had their menarche, and menstruating women.

Results:

1. Definition of terms variable by article

In selected articles, the terms of "menstrual irregularities", and "nutritional deficiencies" were variously defined as there is no solid definition for these two terms as well as early and late menarche especially for LMICs. Most of the participants in the studies reached menarche at age of between 11 and 14 years, and around 30-60% of them had Anemia ($Hb < 12 \text{ g/dL}$).

2. Deviation from normal range of BMI is associated with premature or delayed menarche

Studies showed that deviation from normal BMI is often associated with premature or delayed menarche, and menstrual irregularities (12, 13, 14, 15). Studies also revealed that girls with normal BMI had

regular menstruation (3, 15, 16, 17, 18, 21). Łagowska, Karolina, et al. reported important role of adequate nutrition intake on menstrual regularity as consumption of sufficient nutrition and availability of energy are key contributory factors on maintenance of regularity of menstruation since secretion of Luteinizing Hormone (LH) depends on energy availability. In accordance with Łagowska, Karolina, et al. findings from Belachew, Tefera, et al. depicted that adolescents who received insufficient amount of energy had delayed menarche which can be related to nutritional deficiencies. A study from Panat, A. V., et al. also indicated that girls who belonged to the low BMI category, as a result of chronic energy deficiency, had delayed age at menarche. Another study showed that BMI was greatly higher in early menarche in adolescent girls compared to mid and late menarche young girls; it also showed that the menarcheal age decreases when BMI increases (19), while a study in Northern Uganda showed no association between BMI and menarche. Another study done in Pakistan indicated that there is a statistically significant correlation between BMI and menstrual irregularities; it showed that attainment of menarche for overweight and obese girls is lowered (21).

3. Late onset of menarche associated with subsequent menstrual irregularities

Lee SE, et al. found that late menarcheal girls are more likely to experience menstrual irregularity in comparison with girls who reached menarche earlier (19). Two studies support the idea that normal BMI is strongly correlated with regular menstrual cycle; a study in Nepal showed that adolescent girls who had abnormal BMI, whether underweight or overweight, suffered from menstrual irregularity (16). The second study in Egypt indicated that obese adolescent girl students are inclined to have a higher level of blood flow, and long interval throughout the menstruation when compared with those who had normal BMI, whilst overweight students were very likely to have short interval within their period in comparison with student adolescent girls with normal BMI (15). Thus, it can be said that menstrual bleeding pattern for a girl with low BMI is different from a girl with high BMI. Mohite, R. V., et al. found out that low BMI is statistically correlated with dysmenorrheal, hypomenorrhea as well as premenstrual syndrome. A study in Indonesia found that participants who had abnormal nutrient (underweight, overweight, and obese) were 3.007 times more likely to experience abnormal menarche compared to those who had normal nutritional status, and the result from the study showed that the menarche age and BMI are highly correlated. It also showed that 14.8% of girls who reached menarche age earlier had nutritional status of obese categories ($BMI \geq 30$), and 13.6% of them who experienced late menarche had nutritional status with thin category ($BMI < 18.50$) (14); in accordance with the study in Indonesia, a study in Pakistan demonstrated that 89.9% of adolescent girls with normal weight, had regular menstruation, while 40% of girls in obese categories experienced menstrual irregularity, so it concluded that earlier onset of menarche can result from a higher gain in BMI since 75.51% girls in normal BMI category had normal menstruation (21).

4. Conclusion

Girls who suffer from nutritional deficiencies are very likely to experience late menarche compared to girls with normal nutritional status. That suggests that delayed menarche could be a sign of nutritional deficiencies because with better nutritional status girls would experience menarche at an earlier age (7). Studies also indicated that there is a substantial difference in menstrual blood loss between anemic and non-anemic women and girls, and frequency of consumption of legumes and nuts was more in non-anemic ones than anemic (17, 20). Thus, delayed menarche may be due to nutritional deficiencies seeing that when the status of nutrition becomes better,

menarche happens at lower age (14). From studies, it can also be concluded that having normal BMI is critical for regularity of menstrual cycle. Thus, having healthy and balanced nutrition helps women and girls, particularly adolescent girls, to maintain the normal BMI and as a result experience a more regular menstruation (15).

Discussion:

This review was carried out to identify and conduct a critical appraisal of articles on correlation between nutritional deficiencies and menstrual irregularity in any setting. Most of the studies in this review showed the leading role of nutritional status on the onset of menarche and irregularity of menstruation. They also established that problems related to menstrual irregularities are quite common and often lead to disturbance of the daily activities of women and girls. We can also see that in many low and middle income contexts food is not distributed equally among family members and male members are prioritized to eat first and then female members can eat after men; this traditional custom may cause

nutritional deficiencies in women and girls and as a result menstrual irregularities. Hence, addressing malnutrition alongside treatment of menstrual irregularities is important to ensure the well-being of women and girls. It is also thought that achieving Sustainable Development Goals (SDGs) 2, 3, 4 and 5 can act as determining factors in addressing this issue as they can pave the way for improvement of nutritional status and equal access of women and girls to reproductive health services, food as well as education because through implications of these SDGs, we can ensure that women and girls experience normal menarche and menstruation.

Conclusion:

Although, it is difficult to draw a definite conclusion merely based on these studies, this review revealed that high prevalence of nutritional deficiencies among women and girls can cause menstrual irregularities, and that girls who have nutritional deficiencies will experience menarche delay compared to girls with good nutritional status. Moreover, significant changes in diet have resulted in change in hormone production and consequently led to menstrual irregularity and early age at menarche²². This review has also indicated that regularity of menstruation which is a determinant of women's health can be achieved through maintenance of normal BMI by having balanced nutrition.

Regarding solutions to this issue, one suggestion is an appropriate health education which emphasizes on including a variety of nutritious food such as vegetables, fruits, and meat in the daily diet. Therefore, inclusion of nutrition education in school curriculum is highly recommended and it is thought that girls can be encouraged to follow a nutritional diet if school canteens supply and subsidize healthier foods and drinks. As young children spend majority of their time at school, it is important that they have access to healthier choices while they are at school. Although this course of action seems to be expensive, it can be beneficial in the long run because when young girls are well-nourished (neither thin nor obese), they reach menarche age at the right time and do not experience menstrual irregularities due to inaccessibility, and unavailability of foods. As a result they are not as likely to miss days of school and can focus their full attention on their studies, and act as active persons for the development of their country.

It is recommended that trainings emphasize on the importance of balance nutrition on regularity of menstruation, since nutrients that we take from food play an important role on the production of hormones that regulate menstruation. Essential nutrients that particularly help in this process are iron, and folic acid. So, women and girls need to

include iron, and folic acid-rich food in their daily diet.

Generally, this review found that good nutrition plays an important role in menstruation. In addition, this article revealed that both being underweight and obese can lead to deviation from regularity of menstruation which indicates the role of nutrition in reproductive health.

Recommendation:

It is important to mention that the number of studies carried out to assess the relationship between nutritional deficiencies and menstrual irregularities are very limited; thus, there is a need for further research about the extent to which nutritional improvement can regulate the menstrual cycle.

Definitions:

1. "Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2)"⁽²³⁾

BMI classification: Underweight ($\text{BMI} < 18.5$), normal weight ($18.5-24.9$), overweight ($25.0-29.9$), and obesity ($\text{BMI} \geq 30.0$)⁽²³⁾

2. WoMena is an NGO working towards addressing reproductive health issues in developing settings. Seeing that, menstrual irregularities is a reproductive health issue, and that one of the main reasons for this can be due to nutritional deficiencies, the author volunteers with Knowledge Management team at WoMena to systematically address this global issue and to identify research gaps in sexual and reproductive health.

3. A well-balanced diet includes adequate proportions of carbohydrates (such as rice, potatoes, bread, posho, etc.), fats (oil, nuts), proteins (such as beef, chicken, fish and beans), and vitamins and minerals that can mainly be obtained from fruits and vegetables. Therefore, we need to inform young children and their families about the vital role of good nutrition for our reproductive health.

4. "Premenstrual Syndrome (PMS), also called premenstrual tension (PMT) is a collection of emotional symptoms, with or without physical symptoms, related to a woman's menstrual cycle"⁽²⁴⁾

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