Does Early Menarche Cause Greater Adiposity In Adulthood?

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Figure 1. Showing two females – on the left is a woman of healthy weight and on the right is an obese woman. (Reprinted from 'The Mother Nature Network').

The World Health Organisation (2000) defines obesity as having an abnormal or excessive amount of body fat to the extent that it may impair health. Body Mass Index is a measure of weight for height and is commonly used to identify whether an individual or population of individuals is obese. A BMI of 25-29.9Kg/m^2 defines a person as overweight and a BMI of 30Kg/m^2 or above defines obesity. Many studies use BMI as their main measure of fatness. BMI is not a very accurate measure of fatness in individuals as it does not account for the differences in percentage of lean body mass (muscle). A study by Wright and colleagues in 2001 suggests BMI may merely be indicative of body build as opposed to fatness. Despite this, BMI is a reasonably accurate measure of fatness when measured over populations, is simple, and convenient, and therefore has been used heavily in the studies included in this review.

Globally600 million people are obese. This includes 60% of people within the European Union. According to the World Health Organisation we are in the midst of an obesity epidemic – the main consequences being a rise in type 2 diabetes and cardiovascular disease. The increase in ill-health related to obesity is stretching NHS resources to their limit and the Department of Health (2011) are calling it a major public health concern.

Menarche is defined as the first menstrual bleeding within a woman's life. The general consensus amongst scientists such as Langley-Evans (2009) is that menarche is 'early' if it is before the age of 11.

In 2008 Kaplowitz showed strong and convincing evidence that childhood obesity can lead to early menarche. This probably accounts for the trend in reducing menarcheal age that has been seen through most of the 20th century. As more young children become obese the age at which they are attaining menarche is getting lower. Karapanou (2010) estimates that throughout most of the 20th century the average age at menarche has been falling by around three months each decade. In the 19th century the average age at menarche was between 17 and 18, by the 1990's this had dropped to between 12 and 13 and now it is not uncommon for girls as young as 8 to have menarche.

Furthermore, it may be the case that early menarche exacerbates adult adiposity. If so, it would provide an impetus for scientific investigations of obesity in girls and women, and the development of remedies. It would also mean that health care professionals such as dietitians would be better equipped to treat obesity and to target their interventions e.g. they might target

preventative obesity advice at adolescents who have had early menarche as they are more likely to be obese in later life.

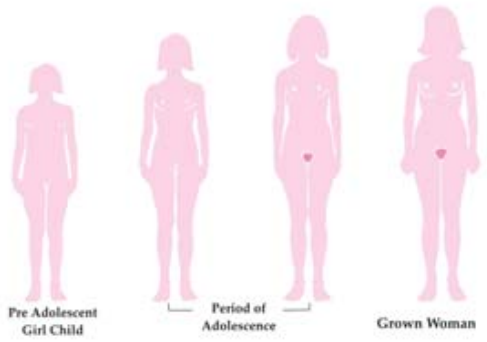

Figure 2. Showing the stages of change in body shape from a pre adolescent girl through to a grown woman. (Reprinted from 'Kotex.com').

Tracking of adiposity (body fat)

The proportion of fat an individual has as a child is likely to remain similar through to adulthood; this is referred to as 'tracking of adiposity'. Obese children are more likely to have early menarche. This review considers whether early menarche was a cause of greater adult obesity in-itself, over and above the affects of tracking of adiposity from childhood. To measure this it was vital that tracking of adiposity was measured and controlled for. This could be done by measuring the fat mass of participants when they were children, then adjusting their adult fat mass accordingly. This means the new value of adiposity in adulthood would not be due to tracking and therefore must be caused by a different factor i.e. menarcheal age.

Methods

This study was a systematic review, i.e. previous studies were collated and their results interpreted in a very planned and systematic way.

The PubMed and Web of Science databases were searched using a very precise set of criteria to choose the relevant studies e.g. the study must be about female humans, it must be a piece of primary research etc. Making such a strict set of criteria allows the systematic review to be replicated.

Once a list of studies that met the criteria was compiled they were analysed using a data extraction table and a quality assessment tool. The data extraction table was an aid to ensure all the same key information is collected from each study. The quality assessment tool was designed to assess how well each study has been carried out and to what extent their results can be relied upon. The tool asks questions about the study participants e.g. are they representative of the general UK population or have their measurements been adjusted for tracking of adiposity from childhood to adulthood? This assesses the reliability of the individual study and thus the impact upon the review.

Results

Seventeen studies were included in the review following the selection process. Twelve of these studies did not adjust for tracking of adiposity from childhood.

There were five studies which adjusted for tracking of adiposity from childhood. However, the age at which they measured childhood adiposity was variable and this produced differing results. Two studies (Kivimaki *et al*, 2008; Must *et al*, 2005) measured childhood adiposity from age 9-14 and used this to adjust the adulthood measurements for tracking. After adjustment the results showed that early menarche did not cause obesity. A study by Freedman and colleagues in 2003 measured childhood adiposity at age 9 only. They found that early menarche contributed 25-30% toward adult obesity. Two studies by Pierce and colleagues in 2005 and 2010 adjusted for tracking of childhood adiposity from age 4-7 years. Both studies found that early menarche did lead to an increase in adult obesity. They found that for each year menarche was delayed BMI was 0.57 - 0.52Kg/m^2 lower in adults.

The quality assessment tool showed that other variables that could affect both age at menarche and adult obesity were accounted for in some studies but these varied. For example the study by Kivimäki *et al* (2008) was awarded eight stars and accounted for tracking of adiposity from childhood. It accurately measured adiposity in adulthood and age at menarche was reported in adolescence. Its participants were representative of the contemporary western world as they are from Finland and any participants lost on follow-up were accounted for. All five studies which adjusted for childhood adiposity included between 448-3743 participants (9199 in total) so the results should have been reliable. All five studies also used participants from the western world only, which made them representative.

Discussion

Any relationship between adiposity and menarche depended upon the age at which childhood

obesity was assessed for tracking. If this was carried out before the age of 9 years the effect was seen, thereafter adiposity may well have been affected by the onset of puberty. This is supported by Wright and colleagues (2001) who found that BMI at age 9 (but not younger) was significantly correlated with BMI at age 50.

Three studies included in this review adjusted for tracking before age 9 years and in total they studied 7957 women. This indicates that early menarche is likely to cause greater adiposity in later life.

If early menarche causes adult obesity the physiological mechanism behind this finding has to be explained.
Langley-Evans (2009) considers that girls who reach puberty earlier (and have menarche earlier) enter into their pre-determined growth spurt at a shorter height and therefore are shorter as adults. If these shorter adults consume the same quantity of food and energy as their taller peers and thus have a similar amount of adiposity, then their BMI (which takes height into account) will be higher i.e. they will be more likely to be obese. This is supported by some of the studies included in the review such as that by Emaus and colleagues (2007) who demonstrated that women with early menarche also had a shorter stature.

Another suggestion by Van Lenthe and colleagues in 1996 and again supported by findings from Emaus in 2007 could be that girls who have early menarche may have higher circulating levels of certain pubertal hormones such as 17-Estradiol which is a type of Oestrogen and may contribute to girls' attaining early menarche but is also known to promote the accumulation of fat.

One other idea is more concerned with the psychological impact of early puberty and how this may lead to greater adiposity in later life. Puberty is an important time of change for adolescents and those who start puberty earlier that their peers may have more difficulty adjusting to the changes causing them to feel isolated from their peers. Gross (2005) demonstrates that it is an intrinsic need of humans to feel that they belong to a group and if they do not it could lead to the loss of a person's identity and a reduced feeling of wellbeing. This can make them more likely to partake in risk taking behaviours such as eating junk food, according to Grogan (2006).

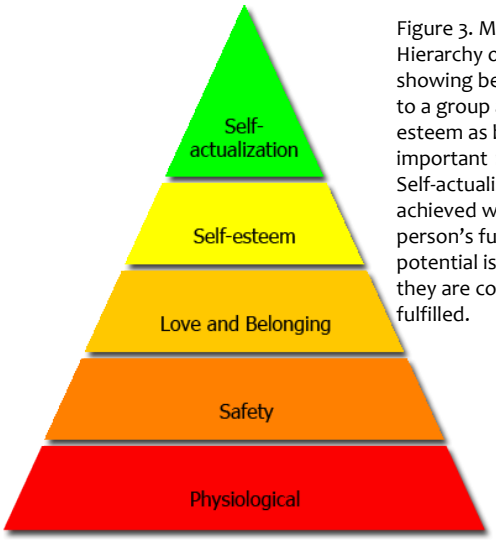

Figure 3. Maslow's Hierarchy of Needs showing belonging to a group and self-esteem as being important needs. Self-actualisation is achieved when a person's full potential is met and they are completely fulfilled.

The physical changes from puberty may make the woman more self-conscious and cause them to suffer body-dissatisfaction as their body shape moves away from the perceived ideal of thinness (Ogden, 2003). Together this could make them less likely to exercise and more likely to partake in sedentary activities which are often accompanied by the consumption of junk food. Tiggemann (2004) showed that these behaviours are likely to track into adulthood and increase the risk of obesity.

Limitations

The main limitation in this review was that most studies used BMI as their main measure of adiposity. Future studies should use not only BMI but more precise measures of adiposity such as dual-energy x-ray absorptiometry or simple measures like waist-height ratios to confirm the findings of this review. More studies are also needed which measure childhood adiposity before the effects of puberty to adjust for tracking of adiposity.

Conclusion

Two studies (involving 6778 participants in total) which adjusted for pre-pubertal adiposity suggest obesity in childhood can lead to earlier menarche. In turn, early menarche may cause both physical and psychological changes that lead to adult obesity over and above the effects of adiposity tracking from childhood. Future studies might concentrate on the physiological explanations for this relationship.

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Author Profile

Jessica is 22 years old and after completing her A-levels in 2008 and travelling in India and Kenya, she studied in the School of Bioscience graduating in 2012 with a first degree, MNutr. Nutrition and Dietetics. Jessica is going on to do an un-related six month placement at Sainsbury's in which she hopes to be involved in corporate responsibility. Ultimately she hopes to combine her knowledge of nutrition and health with her passion to help the wider community through policy making and public health initiatives.