What effect does fat consumption have on children's brains?

It is safe to say that the majority of the population knows that consuming too much sugar and fat has negative effects on our bodies and our overall health in the long run. Defining what exactly is considered too much though is rather difficult, especially because every person’s body is different; the way they metabolize foods, and the way their body uses foods for certain processes, among many other factors. However, some people may not know that consuming fats is still necessary for our bodies to properly function. This paper seeks to explore the effect fat consumption has on the brain in kids specifically. It will explore the different kinds of fats and why they are necessary, what fat actually does to the brain once it is consumed, and the long term effects of too much fat consumption when young. Overall, the stance is that it is still important for kids to consume fats in a well-balanced diet as opposed to partaking in restricting diets, such as one in high protein/low carb or even a vegan diet.

Before it is discussed why fats are important for kids, we must first explore what fats are and the background information behind what they do for us. Fat is a lipid. The body does not produce lipids on its own so we have to consume them through food. An intake of fatty foods is necessary, especially for kids while they are still growing and their brains are still developing (Gómez-Pinilla 2008). However, the question is: What is considered a normal amount of fatty food intake? The recommended intake of fat per day is as much as 20-30% of your daily intake of calories (Fuentes et al., 2008). The recommended amount of calories for an average adult is 2, 000 a day and an average amount for a child ages 4-15 ranges from 1, 000-1, 500 calories a day (Gidding et al., 2006). There is discretion with this amount because

children who are more active can intake more calories due to the increased energy they expend.

Fat in foods can be broken up into saturated and unsaturated fats. Unsaturated fats usually come from plants and they are naturally liquids at room temperature, held together by strong carbon double bonds. They help reduce body fat by boosting your metabolism and ability to burn more calories (Fuentes et al., 2008) Some examples of unsaturated fats include vegetable oils, nuts, avocados, etc (Gómez-Pinilla 2008). Saturated fats usually come from animals and are solids at room temperatures, held together by carbon single bonds. They help reduce fat absorption from other foods (Fuentes et al., 2008). Saturated fats are found in red meat, eggs, yogurt, and milk (Gómez-Pinilla 2008). Saturated fats are still important to eat, but they should be limited in their intake because they are known for raising the level of cholesterol in your blood (Bellisle, 2004).

What is important to consider next is why fat is still necessary to consume. Fat helps to burn calories (when consumed in conjunction with protein). Fat also helps protect and run our immune system so that we have a better chance of staying healthy and fighting illnesses. Fat allows a good and solid production of testosterone and estrogen (which both sexes need). It also supplies essential fatty acids (EFA) that play an important role with nutrient absorption, such as being able to grab the necessary nutrients from daily vitamins (Gómez-Pinilla 2008). Finally, fat is especially important in infancy and early childhood. It is essential for proper neurological development and brain function. When children feed on their mother’s milk (or a formula

substitute), 40-50% of their energy comes from the fat in the milk (Fuentes et al., 2008).

Now that a proper background has been established on what fat is, the kinds of fats that exist, and why fats are necessary, it can properly be discussed what fat actually does to the brain once it is consumed. Fats can easily be divided to make them easier to understand; there are “ good fats” and there are “ bad fats.” “ Good fats” contain omega-3 fatty acids, a type of polyunsaturated fat. Some foods that contain omega-3 fatty acids are fish, canola oil, wild rice, soybeans, chia seeds, and walnuts. Omega-3 fatty acids help keep your brain running smoothly by preventing blood clots in the brain. A buildup of blood clots can lead to strokes, so it is important to have enough omega-3 fatty acids for protection. Omega-3 fatty acids can also help improve cognitive function (Gómez-Pinilla 2008). In addition to what you eat, when you eat is also important. Nutrient composition and meal pattern can have immediate or long-term benefits or adverse effects. A glucose load, for example, can actually facilitate improved mental performance on a task, particularly on demanding, long-duration tasks. The reason behind this is still not particularly clear, but findings from France Bellisle in a meta analysis study suggest that a breakfast rich in nutrients enhances cognition, such as in memory and concentration in school performance. An intelligence scale was one method used for assessment of performance in school’s correlation with how well and how often the children ate (details of the study will not be discussed in this paper, but can be reviewed from the References section) (Bellisle 2004).

“ Bad fats”, otherwise known as saturated fats, reduce the flexibility of synapses in our brains and increase the vulnerability of cells to damage by causing the formation of free radicals. “ Bad fats” can also cause oxidative damage to cellular proteins, lipids, and nucleic acids (Gómez-Pinilla 2008). What these “ bad fats” can do relate back to how they affect certain parts of the brain. For example, the prefrontal cortex can be dysregulated or hyperactivated from too many “ bad fats” consumed during adolescence. The prefrontal cortex undergoes a substantial amount of maturation during adolescence and any disruption to this can affect children in the long run. The prefrontal cortex is responsible for “ executive function”, that is reasoning, controlling emotions, among any other actions that involve making decisions (Kalat, 2012). When too much fat is consumed, the prefrontal cortex is less active than in people who consume the recommended amount of fat. The prefrontal cortex sends nerve fibers to the core appetite regulation area of the brain, the central orexigenic network. When the prefrontal cortex is fully active, it can reason with someone as to why he/she should not eat anymore. With people who consume too much fat, their prefrontal cortex does not regulate these decisions as well, so they can potentially continue to get more and more food with the inability to stop themselves. This finding is interesting, however there are mixed findings on whether or not obese humans start out with underactive prefrontal cortexes or if they have acquired them through excessive fat consumption at a young age (Le et al., 2006). “ Bad fats” are also associated with negatively impacting the amygdala in the brain. Children who eat too much of these “ bad fats” when younger are more susceptible to damage in the amygdala. Fear inhibition is affected along with an enhanced fear expression in these

types of individuals (details of this study will not be discussed, however the findings can be reviewed from the References) (Rollings & King 2000). Overall, too much of one kind of fat is not good, even if it is considered a “ good fat.” What matters most is the the quantity of the amount of food and fat eaten (Gidding et al., 2006).

Some of the long term negative effects of too much fat consumption will be discussed next. Habits typically develop in adolescence, so if a child does not eat well when they are young, these food choices are likely to continue into adulthood. Type II diabetes, metabolic syndrome, and heart disease can all arise. There are also studies that demonstrate a decline in cognitive function due to the role of inflammation and vascular alterations (Mühlhäuser, 2012). A study conducted by Borg showed the lipid consumption in the brains of mice on a low fat diet (LFD), high fat diet (HFD), and high fat diet with endurance exercise training (HFD-ex). This study looked to explore whether exercise can help return HFD mice to same levels of hypothalamic lipid accumulation as LFD mice. HFD-ex mice underwent 12 weeks of high-fat feeding with 6 weeks of treadmill exercise training (increasing from 30 to 70 min day). Hypothalamic lipids were assessed by mass spectrometry. The HFD mice increased body mass and hepatic lipid accumulation, and induced glucose intolerance, while the HFD-ex mice had reduced body weight and improved glucose tolerance. Lipids known to induce insulin resistance were increased in the hypothalamus of HFD vs. LFD mice. Hypothalamic lipids, however, were unaltered with exercise. This suggests that hypothalamic lipid accumulation is regulated by dietary lipid content and is resistant to change even with exercise (Borg et al., 2012).

Next we will look into alternative diets that lack fat consumption. Low-carb diets sound good in theory because they go along with intaking less fats, especially with childhood obesity being so high in America (Bellisle, 2004). However, children who participate in a low-carb, high protein diet are missing out on the intake of important nutrients. In low carb diets, only 10-20% of calories come from carbohydrates, while the remaining calories come from proteins. This higher intake of protein and other saturated fats puts children at risk for high cholesterol (Gidding et al., 2006). One of the more serious side effects of this diet is Ketosis. Severely restricting carbohydrates can result in this. Ketosis is when you do not have enough sugar for energy, so your body will turn to another source for energy. It will use stored fat for energy, which is alright every now and then. However, continuously depriving your body of sugars and fats will lead to ketones building up in your body, which could result in migraines, nausea, and mental and physical fatigue (Paoli et al., 2014). This can be even more detrimental for children who need sugars for their neurological development and as a source of energy.

Vegan diets are also not the best options for children. As discussed earlier, Omega 3 fatty acids are in the “ good fats”, the polyunsaturated fats. It is difficult for vegans to get enough fatty acids from their diets since the two essential omega-3 fatty acids, EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), are most available in fish oil and other animal sources. DHA is a very important one that keeps your nervous system functioning and provides anti-inflammatory benefits as well (Mangels & Messina, 2001). It is not impossible to obtain the essential nutrients needed,

it is just difficult and it is not recommended. There are too many extra considerations to be made in order to compensate for this change in diet. A parent would have to make sure their child is eating enough calories and protein from the healthy fats, as discussed earlier. It is also important to monitor their Vitamin B-12 intake. Animal foods are the main source of this, so it is easy for vegans to not get enough. Iron and calcium are also important to monitor for intake as well (Mangels & Messina, 2001). It is overall more difficult for parents and children to have accountability for the food the child has eaten. What also must be considered beforehand is planning for certain social situations that will make it difficult for the child. If a friend is having a sleepover and pizza is ordered for everyone, what will that child eat instead?

Overall, fat consumption has a major role on the development of adolescents' brains. There are both negative and positive side effects of fat consumption and its importance in our bodies. Fat is necessary to absorb essential vitamins, to help burn calories, and to help run our immune system. Too much of the wrong kinds of fat can negatively impact our brains with long term effects of Type II diabetes, metabolic syndrome, heart disease, and decline in cognitive functioning. The important takeaway is that there is no perfect diet, however knowing what kinds of food your body can benefit from is essential to prevention of negative long term health effects. A well balanced diet with more healthy fats is great for a child's development and growth. Other restricting diets depend too much on parents to make sure their child is making up for the deficits in one area of nutrition. It is very

risky and difficult to maintain long term, so it is best to just stick to a well balanced diet eating the appropriate fats.

References

- Bellisle, F. (2004). Effects of diet on behaviour and cognition in children. *British Journal of Nutrition, 92* (S2), 227-232. doi: 10. 1079/bjn20041171
- Borg, M. L., Omran, S. F., Weir, J., Meikle, P. J., & Watt, M. J. (2012). Consumption of a high-fat diet, but not regular endurance exercise training, regulates hypothalamic lipid accumulation in mice. *The Journal of Physiology, 590* (17), 4377-4389. doi: 10. 1113/jphysiol. 2012. 233288
- Fuentes, F., López-Miranda, J., Pérez-Martínez, P., Jiménez, Y., Marín, C., Gómez, P., . . . Pérez-Jiménez, F. (2008). Chronic effects of a high-fat diet enriched with virgin olive oil and a low-fat diet enriched with α-linolenic acid on postprandial endothelial function in healthy men. *British Journal of Nutrition, 100* (01), 159-165. doi: 10. 1017/s0007114508888708
- Gidding, S. S., Dennison, B. A., Birch, L. L., Daniels, S. R., Gilman, M. W., Lichtenstein, A. H., . . . Horn, L. V. (2006). Dietary Recommendations for Children and Adolescents: Aguide for practitioners. Pediatrics, 117(2), 544-559. doi: 10. 1542/peds. 2005-2374
- Gómez-Pinilla, F. (2008). Brain foods: the effects of nutrients on brain function. *Nature Reviews Neuroscience, 9* (7), 568-578. doi: 10. 1038/nrn2421

- Kalat, J. W. (2012). *Biological Psychology* (11th ed.). Australia: CENGAGE.
- Le, D. S., Pannacciulli, N., Chen, K., Parigi, A. D., Salbe, A. D., Reiman, E. M., & Krakoff, J. (2006). Less activation of the left dorsolateral prefrontal cortex in response to a meal: A feature of obesity. *The American Journal of Clinical Nutrition, 84* (4), 725-731. doi: 10. 1093/ajcn/84. 4. 725
- Mangels, A. R., & Messina, V. (2001). Considerations in planning vegan diets. *Journal of the American Dietetic Association, 101* (6), 670-677. Doi: 10. 1016/s0002-8223(01)00169-9
- Mühlhäusler, B. S. (2012). Fat on the brain. *The Journal of Physiology, 590* (17), 4121-4130. doi: 10. 1113/jphysiol. 2012. 239491
- Paoli, A., Rubini, A., Volek, J. S., & Grimaldi, K. A. (2014). Beyond weight loss: A review of the therapeutic uses of very-low carbohydrate (ketogenic) diets. *European Journal of Clinical Nutrition, 68* (5), 789-796. doi: 10. 1038/ejcn. 2014. 47
- Rollins, B. L., & King, B. M. (2000). Amygdala-lesion obesity: What is the role of the various amygdaloid nuclei? [Abstract]. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 279* (4). doi: 10. 1152/ajpregu. 2000. 279. 4. r1348