



Prenatal Vitamins Deficient in Recommended Choline Intake for Pregnant Women

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Abstract

Objective: This study examines the choline content found in the top 25 prenatal multivitamins to see if they contain the daily-recommended intake of choline for a pregnant woman.

Methods: Using quantitative analysis done by an independent scientific company, the authors list the choline content found in the top 25 prenatal multivitamins

Results: None of the top 25 prenatal multivitamins contains the daily-recommended choline intake for a pregnant woman (450 mg/d). Only two of the top 25 prenatal multivitamins contain 50 mg and 55 mg of choline, respectively. Merely six others containing choline have 30 mg or less.

Conclusions: These findings indicate that currently pregnant women cannot get daily-recommended choline from prenatal vitamins. Accordingly, considering the general prevalence, and higher rates of fetal alcohol exposure in various communities, the authors suggest prenatal vitamin makers incorporate more choline into prenatal multivitamins in order to ensure unborn fetuses are guaranteed optimal development by preventing choline deficiency in pregnant women.

Keywords

Choline, Prenatal vitamins, Pregnancy, Prevention

Introduction

The current recommended choline intake for pregnant women is 450 mg/day [1]. High levels of choline are necessary to maintain a normal pregnancy including neural development of the fetus and reducing the incidence of birth defects [2]. In an exemplary review, Ziesel [2] underscores choline's role as a major component of cell walls that ensures cell wall integrity so cells can communicate with other cells. Importantly, during pregnancy, choline has a strong influence on fetal development by influencing stem-cell proliferation and apoptosis of midline structures in the fetus, and, like folate, choline has a strong influence on neural tube development [3]. To determine if the top 25 prenatal multivitamins provide pregnant women with the daily-recommended amount of choline-450 mg/day [1], this current study assessed these vitamins for their choline content.

The human body derives choline through various internal metabolic mechanisms [2] and external sources. There are several

internal pathways for choline to be manufactured in the body, including the phosphatidylethanolamine N-methyltransferase (PEMT) pathway [2]. The PEMT pathway involves estradiol, a type of estrogen hormone, that is elevated up to 60 times by the end of the pregnancy [2] indicating the significance of choline in pregnancy to meet the fetus's needs. Another major source of choline is dietary, and the daily-recommended amount of dietary choline is 450 mg/day as determined by the Institute of Medicine in 1998 [1]. It is important to obtain choline from food in the diet or from prenatal vitamins because choline deficient diets cause various illnesses. One of the leading causes of choline deficiency is generated by alcohol intake during pregnancy and the lack of choline is a major contributor to the pathology found in fetal alcohol spectrum disorders [2].

Yan, et al. [4] performed a double-blind randomized control trial (RCT) in which 26 third-trimester pregnant and 21 non-pregnant women were given doses of choline at 480 or 930 mg/day for 12 weeks. This study illustrated several major considerations: 1) Pregnant women require more d-3 betaine (an endogenous form of choline and methyl donors), and 2) Pregnancy requires a larger amount of choline-formed methyl groups for phosphatidylcholine production occurring in the PEMT pathway. This study also discovered that during pregnancy, more choline is diverted to the cytidine diphosphate-choline (CDP) pathway (responsible for the production of choline in cell membranes) and less diverted to betaine [4]. The increase in this pathway suggests that more choline is necessary in order to compensate for the lesser production of betaine [4]. Accordingly, choline may not be as available for methyl donation, an important mechanism to foster good outcomes from epigenetic mechanisms [5]. Yan, et al. RCT suggests the current choline intake recommendation for pregnant women may be too low, especially in the third trimester [4]. Clearly, the need for choline is high in pregnancy and maternal choline levels can be depleted because of the rapid transfer of choline from mother to fetus, may be depleted from alcohol use, or both. Accordingly, choline intake in a pregnant mother's diet needs supplementation using prenatal vitamins.

Throughout pregnancy, choline is involved in several neurodevelopment processes of the fetus. Firstly, choline is crucial for the necessary closure of the neural tube; afterward choline is involved in the development of the hippocampus (the primary center for memory) [2]. In 2007, Jensen, et al. [6] reported that 90% of

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Table 1: Choline content in top prenatal vitamins.

Prenatal Vitamin	Choline Content
1) Mega food Baby & Me Prenatal Multivitamin	None
2) Garden of Life Vitamin Code Raw Prenatal Multivitamin	None
3) Zahler Prenatal Vitamin and DHA	-None -Marteklife's DHA 250 mg (Other ingredients = Sunflower Lecithin)
4) Thorne Research Basic Prenatal Multivitamin	None
5) New Chapter Perfect Prenatal	-None -Breast support blend (sprouted seeds) 100 mg = organic broccoli and cauliflower
6) Rainbow Light Prenatal Petite Mini	Choline (as bitartrate) 10 mg
7) Deva Vegan Prenatal Vitamin	Choline (bitartrate) 50 mg
8) Nordic naturals Prenatal DHA	None
9) Rainbow Light Prenatal One	Choline (as bitartrate) 10 mg
10) Twinlab Prenatal Care	Choline (as Choline Bitartrate) 10 mg
11) The Honest Company Prenatal Multivitamin	Choline (as Bitartrate) 30 mg
12) New Chapters Wholemega Prenatal	None
13) Garden of Life Ocean's mom Prenatal DHA	None
14) Naturemade Prenatal Multi + DHA	None
15) Similac Prenatal Multivitamin	None
16) Naturemade Prenatal Multivitamin	None
17) Bellybar Chewable Prenatal Vitamin	None
18) Nature's Way Completia Prenatal Multivitamin	Choline (as choline bitartrate): serving = 2 mg / day = 4 mg
19) Spectrum Essentials Prenata; DHA	None (Other = Sunflower Lecithin)
20) One a Day Women's Prenatal Vitamin with DHA	None
21) Enfamil Expecta Prenatal Multivitamin	Choline (as choline bitartrate) 55 mg
22) Vitafusion Prenatal Gummy MV	Choline (as choline chloride) 10 mg
23) Centrum Specialist Prenatal Multivitamin	None
24) Spring Valley Prenatal Multivitamin	None
25) Happy Health Smart Prenatal Multivitamin	None

- Bold print was used to identify which prenatal multivitamins contained choline.

pregnant women do not meet daily-recommended intake of choline. Considering the sequelae of choline deficiency this is a major public health issue.

Method

The top 25 prenatal multivitamins for pregnant women were assessed for their nutritional content of choline. These rankings are according to Labdoor (<https://labdoor.com/rankings/prenatal-vitamins>), an independent online scientific company that is financially supported by the Mayo Clinic.

Results

Table 1 was constructed to display the choline content of the top 25 ranked prenatal multivitamins.

Firstly, none of the top 25 prenatal multivitamins contained the daily-recommended choline intake for a pregnant woman (450 mg/d). Additionally only two of the top 25 prenatal multivitamins contain any noteworthy amount of choline: Deva Vegan Prenatal Multivitamin (50 mg) and Enfamil Expecta Prenatal multivitamin (55 mg). Six others just have 30 mg or less.

Discussion

This study looked at the choline content of the top 25 rated prenatal multivitamins. The authors found all of the 25 products contained nowhere near the recommended-daily intake of choline for pregnant women (450 mg/d). Of course, a variable to consider is that pregnant women are obtaining their choline from exogenous sources in their diet, such as eggs, broccoli, cauliflower, chicken and milk (<https://ndb.nal.usda.gov/ndb/nutrients/report?nutrient1=421&nutrient2=&nutrient3=&fg=&max=25&subset=0&offset=25&sort=c&totCount=4681&measureby=m>). However, 90% of pregnant women do not consume the daily-recommended amount of choline [6] suggesting that pregnant women are deficient in obtaining necessary amounts of choline from their diet.

Only two of the top 25 prenatal multivitamins contain choline are worthy of attention (Deva Vegan and Enfamil) and these only include 11-12% of the daily-recommended choline intake. The

findings from the results warrant the need to increase the amount choline found in prenatal multivitamins.

Yan, et al. work [4] suggests choline requirements may be higher the third trimester when choline plays a key role in the development of the hippocampus. The finding that choline content found in current prenatal multivitamins is notably miniscule or absent causes grave concern that a fetus's neural development can be severely hindered, especially if the pregnant woman is drinking before or after she knows she is pregnant. This danger is even more prevalent in low-income communities where the social determinants of health, i.e., food deserts, limit choline dietary intake. Additionally, the plethora of liquor stores creating "food swamps" that facilitate social drinking in pregnant women who may not realize they are pregnant until 4-6 weeks after conception is a serious unrecognized public health problem [7,8].

It is clear that choline is significantly involved in pregnancy, from cell membrane integrity to proper neurogenesis. Unfortunately, choline intake may be below the necessary levels in a pregnant women's diet, especially if they are drinking socially or more heavily. The lack of choline in the top 25 prenatal vitamins compounds the problem of insufficient dietary choline intake in pregnant women.

In 2009, the National Research Council and the Institute of Medicine released its seminal report on Preventing mental, emotional, and behavioral disorders among young people: Progress and possibilities [8] but, unfortunately, the prevention of fetal alcohol exposure was not covered [9]. Drinking in pregnancy is a common problem in the US [10], a problem that lowers choline in pregnant women; and the implementation of preventive strategies to prevent choline deficiency in fetuses and newborn infants is of the utmost importance. Pregnant woman may get an adequate supply of choline from their diet, e.g., a Vietnamese medical student told the first author in her culture pregnant women were advised to eat two eggs per day (2 egg yolks contains about 400 mg of choline (<https://ndb.nal.usda.gov/ndb/nutrients/report?nutrient1=421&nutrient2=&nutrient3=&fg=&max=25&subset=0&offset=25&sort=c&totCount=4681&measureby=m>)). However, considering the finding 90% of pregnant women do not meet the dietary choline intake requirements, it is probably a good

public health strategy to be “better safe than sorry”. One sure way of being safe is to include the daily-recommended choline intake (450 mg) in prenatal vitamins.

Conclusions

None of the 25 top prenatal vitamins has the daily-recommended choline (450 mg/day) advised by the Institute of Medicine [1]. An easy universal prevention strategy [11] for choline deficiency in fetuses from various causes (poor dietary intake, multiple births, prenatal alcohol exposure) would be for prenatal vitamin manufacturers to increase the choline in their vitamins to at least 450 mg. Of course, then the challenge is to get pregnant women to take prenatal vitamins, but by putting the daily-recommended dose of choline in prenatal vitamins, we would be a step closer to solving a hidden public health problem [12].

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