Human Evidence for Choline Intake Promotion Across Lifespan

Siraphat Taesuwan[1,2], Phachara Jindasereekul[1], Paradee Thammapichai[3],
Ariel B. Ganz[4], Wachira, Jirarattanarangsri[1],
Julaluk Khemacheewakul[1,2], & Noppol Leksawasdi[1,2]

Faculty of Agro-Industry, Chiang Mai University, Chiang Mai, Thailand[1],
Cluster of Agro Bio-Circular-Green Industry, Chiang Mai University, Chiang Mai,
Thailand[2], Faculty of Agriculture, Chiang Mai University,
Chiang Mai, Thailand[3], Department of Genetics,
Stanford University School of Medicine, Stanford, CA, USA[4]
E-mail: siraphat.t@cmu.ac.th

I. Introduction / or Background

Choline is an essential nutrient found in several components of a healthy diet. Choline is concentrated in animal-sourced foods (e.g., eggs, beef, poultry and fish), grains (e.g., wheat germs and soybeans), nuts, seeds, and some vegetables (Patterson et al., 2008). Choline can also be made within the body, though endogenous production is not sufficient to meet metabolic needs (S H Zeisel et al., 1991). Both dietary and endogenous choline are metabolized to compounds that function in the production of membrane phospholipids, lipoproteins, the methyl-group donor S-adenosylmethionine, and the neurotransmitter acetylcholine (Steven H Zeisel, 2006). Acetylcholine has been implicated in the reduction of blood pressure (BP) and heart rates, and this response to acetylcholine declines with age (Fischer, da Costa, Kwock, Galanko, & Zeisel, 2010; Resseguie et al., 2007). Therefore, older adults rely on dietary choline to meet their metabolic needs.

Several populations across the world are at a high risk of choline insufficiency. Adequate Intake levels of choline are 425 mg/day for adult women and 550 mg/day for adult men. However, average choline intake in the U.S. was 279 mg/day for women and 421 mg/day for men (Wallace & Fulgoni, 2017). In Japan, the averages were 416 and 484 mg/day for women and men respectively (Nagata et al., 2015), while in Taiwan women and men consumed on average 265 and 372 mg/day of choline (Chu, Wahlqvist, Chang, Yeh, & Lee, 2012). Currently, there are no estimates of choline intake situation in Thailand.

The essential roles of choline across lifespan, along with the high degree of choline insufficiency in several populations across the world, make choline a potential target nutrient for nutritional intervention. The objectives of the current study are to 1) investigate the relationships between total choline intake and hypertension and BP among U.S. adults aged ≥ 65 years, and 2) survey the current choline intake level in a Thai university student population.

II. Methods

A cross-sectional analysis was conducted to investigate the association between total choline intake and hypertension prevalence using 2,113 U.S. adult population aged ≥ 65 years in the

National Health and Examination Survey 2011–2014. Choline intake information was obtained from 24-hour dietary recalls. Hypertension status was determined using BP measurements, self-reported diagnosis and/or antihypertensive medication use. Complex-survey design logistic and linear regression models were used to analyze the association of choline intake with hypertension and BP respectively. Effect modification by sex, race, body mass index (BMI) and comorbidity status were separately investigated using an interaction term.

In another cross-sectional study, dietary choline intake data were collected in 412 Chiang Mai University students. Questionnaires were used to collect social and health information. Anthropometric measurements (weight, height, and waist and hip circumferences) as well as one to two 24-hour dietary recall interviews were performed by trained personnel. Food choline contents were obtained from the USDA food composition database following the International Network of Food Data Systems guideline (Food and Agriculture Organization). Usual intake distribution of dietary choline was calculated using the the Multiple Source Method (the German Institute of Human Nutrition Potsdam-Rehbrücke).

III. Results & Discussion

In the U.S. older adult population, choline intake interacted with BMI (P-interaction=0.04) such that choline intake tended to be associated with lower odds of hypertension among people with BMI <18.5 kg/m^2 (Odds ratio [95% CI]: 0.64 [0.4,1.00]; P=0.052). Choline intake was not associated with systolic BP (mean ± SEM change per 100 mg of choline: -1.03 ± 0.74 mmHg; P=0.16). In contrast, its relation to diastolic BP differed by cardiovascular comorbidity (P-interaction=0.03) with a non-significant (P=0.13) negative direction of association observed among those who were free of comorbidities and a non-significant (P=0.26) positive direction observed among those with comorbidities. Collectively, these results suggested that the associations of choline intake with BP levels and hypertension risk among older adults are dependent on other risk factors.

Preliminary results of the cross-sectional survey in Thailand were based on 114 students. The usual intake of choline in the total population was (mean ± SD) 366 ± 65 mg/day, with 350 ± 62 mg/day observed in women (n=72) and 392 ± 59 mg/day observed in men (n=42). At least 75% of women and 95% of men were estimated to not meet the Adequate Intake level for choline. Choline intake tended to be correlated with BMI in women only (Pearson's r = 0.21; P=0.09) and not with waist-to-hip ratios, a measure of abdominal obesity, in either sex (P>0.05). These preliminary results show for the first time the estimates of usual choline intake in a Thai population and reveal that most of the population are at risk of choline inadequacy.

IV. References

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