

Dietary energy density and energy intake in cancer patients

Akademisk avhandling

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The thesis is based on the following papers:

- I. Wallengren O, Lundholm K, Bosaeus I. Diet energy density and energy intake in palliative care cancer patients. *Clin Nutr.* 2005;24(2):266-73.
- II. Wallengren O, Bosaeus I, Lundholm K. Dietary energy density is associated with energy intake in palliative care cancer patients. *Support Care Cancer.* 2012;20(11):2851-2857.
- III. Wallengren O, Bosaeus I, Lundholm K. Dietary energy density, inflammation and energy balance in palliative care cancer patients. *Clin Nutr.* 2012. Epub 2012/06/26.
- IV. Wallengren O, Lundholm K, Bosaeus I. Diagnostic criteria of cancer cachexia: Relation to quality of life, exercise capacity and survival in patients with advanced cancer. Submitted



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ABSTRACT

Background & Aims: Cachexia is frequent in advanced cancer and is associated with adverse outcomes; however, definite diagnostic criteria for cachexia are not established. Diet energy density (ED) may affect energy intake (EI) and energy balance. Patient characteristics may also influence such associations. This potentially hampers cachexia treatment and dietary treatment in clinical practice.

The aim was to study associations between ED and EI in palliative cancer patients and whether ED or EI predict energy balance, and the influence of systemic inflammation and survival time. The prevalence of reduced quality of life (QoL), function and survival, in patients classified by different cachexia criteria were compared.

Methods: Dietary intake and ED was assessed by food records (n=251-322). Energy balance was calculated from the change in body energy content by repeated DXA scans in 107 patients for a total of 164 4-month periods. Linear regression and linear mixed model were used to investigate relationships between ED and EI with patient characteristics as covariates. In energy balance analysis systemic inflammation and survival were covariates. Quality of life (QoL) was assessed by questionnaire, physical function by treadmill test.

Results: Diet ED was associated with EI, explaining approximately 16-22 % of the variation in EI. Age, BMI, fatigue and survival were negatively associated and hypermetabolism was positively associated with EI. After covariate adjustment, ED was still positively associated with EI. In unadjusted models, the ED of solid food and EI were both positive predictors of energy balance ($P<0.03$). Survival was positively and systemic inflammation negatively associated with energy balance ($P<0.005$). After adjustment for inflammation, only EI remained a significant predictor. Adverse QoL, function and symptoms were associated with weight loss $>2\%$, BMI <20 , fatigue and CRP $>10\text{mg/L}$ ($P<0.05$). Short walking distance was associated with fatigue, low grip strength and inflammation ($P<0.05$). Short survival was associated with weight loss, fatigue, inflammation and S-albumin $< 32\text{g/L}$ ($P<0.05$). The prevalence of cachexia diagnosis varied from 12 to 85 % using different definitions.

Conclusions: Diet energy density and energy intake are positively associated. Age, BMI, fatigue, survival and hypermetabolism are associated with EI, but do not substantially influence the association between ED and EI. Diet EI and ED of solid food are positively associated with energy balance in patients with advanced cancer. Relations between EI, ED and energy balance are affected by systemic inflammation. Thus, targeting systemic inflammation may be important in nutritional interventions in this patient group.

Weight loss, fatigue and markers of systemic inflammation were consistently associated with adverse QoL, reduced function, more symptoms and shorter survival. The prevalence of cachexia using different definitions varied widely; indicating a need to further explore and validate diagnostic criteria for cancer cachexia.

Keywords: Cancer, cachexia, diagnostic criteria, quality of life, nutritional support, energy intake, energy balance, dietary energy density