

The Effect of Concentrating Carbohydrates to Dinner on Metabolic Syndrome: A Systematic Review of Randomised Controlled Trials

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BACKGROUND

Obesity, cardiovascular disease (CVD), and type 2 diabetes mellitus (T2DM) are reaching pandemic proportions. They lead to loss of life, disability and financial burden at the individual and public levels. An important precursor and link between them is metabolic syndrome (MetS).¹ It doubles CVD risk and increases all-cause mortality by a factor of 1.5.²

Diet can improve MetS, CVD and T2DM. Chrononutrition,³ the timing of food intake, and macronutrient intake more specifically affects MetS⁴ and other determinants of health.

Concentrating carbohydrates to dinner (CCtoD) (eating most daily carbohydrates at dinner)⁴ may improve several metabolic markers of disease risk⁵ and MetS.⁴

This effect was not previously systematically reviewed.

AIM

To systematically review the evidence on the effect of CCtoD on the components of MetS and other reported health outcomes and to elucidate potential pathways or mechanisms of action.

METHODS

MEDLINE, EMBASE, CENTRAL and CAB abstracts were searched for key search terms including: metabolic syndrome, insulin resistance, blood glucose, dietary carbohydrates, dinner and meal-timing.

Retrieved studies were screened against predefined inclusion and exclusion criteria published on the international prospective register of systematic reviews. Data was extracted and assessed for risk of bias using Cochrane criteria.

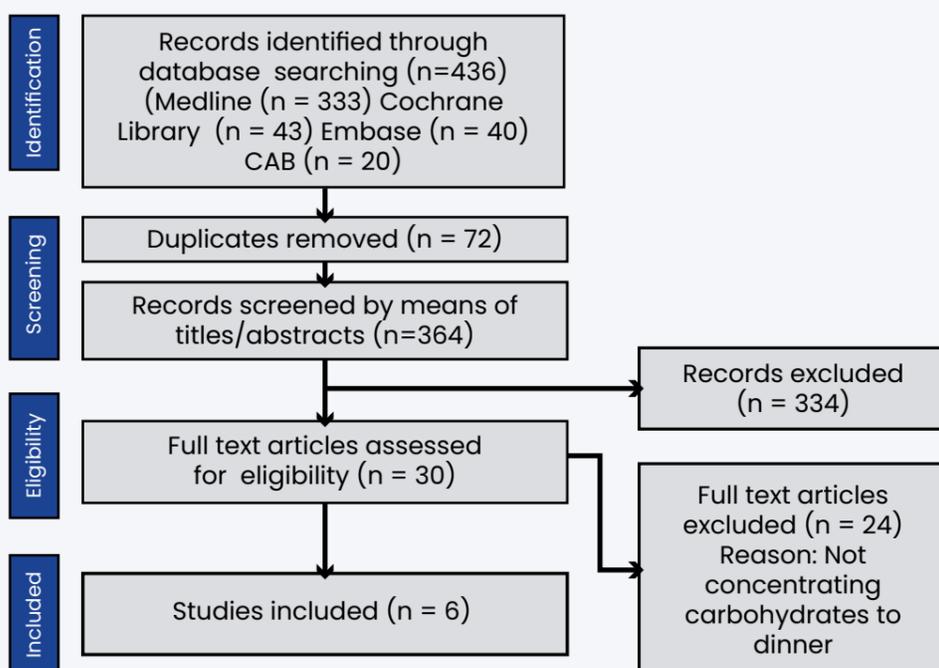
Results were presented in a narrative form, and a vote-counting⁶ procedure of effects was conducted (Table 1).

RESULTS

The search resulted in the inclusion of six articles representing five randomised controlled trials (RCT's) (See PRISMA Flow Chart). Two articles^{4,8} represented one RCT; therefore, they were handled as one study.

The included sample was 311 participants aged 44.6 ± 7.2 years.

PRISMA Flow Chart



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RESULTS

CCtoD had a positive effect on:

Fasting blood glucose, HOMA-IR and lipid profiles.

Table 1. Vote Counting of Effects of CCtoD

		Pearce et al. ⁷	Sofer et al. ^{4,8}	Alves et al. ⁵	Kessler et al. ⁹		Nouripour et al. ¹⁰
					NGT*	IGT/IFG**	
Metabolic Syndrome	Waist Circumference	-	↓	↓	-	-	↓
	Systolic blood pressure	-	-	↔	-	-	↓
	Diastolic blood pressure	-	-	↔	-	-	↓
	Fasting blood glucose	↔	↓	↓	↓	↑	↓
	Triglycerides	-	↓	↓	↔	↔	↓
	HDL cholesterol	-	↑	↔	↔	↔	↔
Other Health Effects	Inflammation (CRP, TNF-α, IL-6)	-	↓	-	-	-	-
	Hunger/Satiation	-	↓	-	-	-	-
	Diet satisfaction	-	-	-	-	-	↓
	BMI	-	↓	↓	↔	↔	↓
	HOMA-IR	-	↓	↓	↔	↔	↓
	HbA1c	-	-	-	-	-	↓
	Lipid Profile†	-	↓	↓	↓	↓	↓
	Postprandial Glucose Peaks	↓	-	-	↑	↑	-
	Energy Metabolism	-	-	↑	-	-	-

*NGT= Subjects with normal glucose tolerance; **IGT/IFG= Subjects with impaired glucose tolerance/impaired fasting glucose; † total cholesterol, LDL-Cholesterol, HDL-Cholesterol ↑= increase in marker; ↓= decrease in marker; ↔= non change in marker; -= Not measured or data not available Green = positive change in biomarker, Red = negative change in biomarker

However:

- Wide variation in definition of CCtoD (Figure 1).
- Wide diversity in study design and biomarkers measured.
- Risk of bias was high for all studies but this was in part due to the nature of nutrition research.

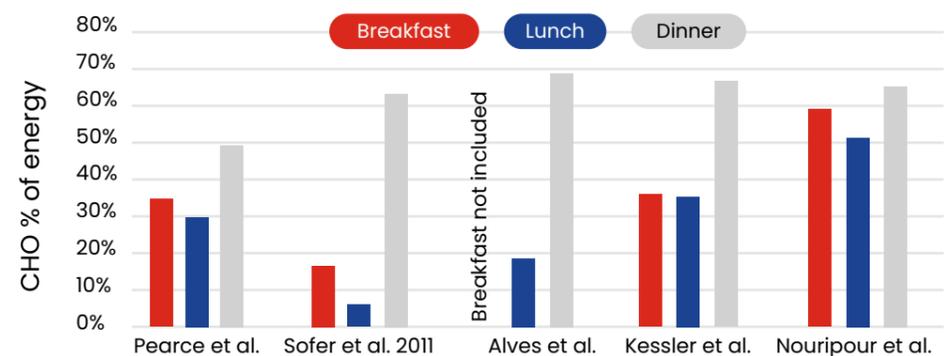


Figure 1 Variability of Carbohydrate Content as a Percentage of Energy for Intervention Meals

CONCLUSIONS

- Reaching clear conclusions regarding the effects of CCtoD was not possible. However, it is evident that it does lead to measurable biological effects.
- Further research is needed to understand the direction and importance of these effects.
- A clear definition of CCtoD is needed.
- While measuring the components of MetS, simultaneous consideration of several biomarkers and methods may be promising, including, measurement of:
 - Postprandial glucose peaks using continuous glucose monitoring.
 - Inflammatory markers, including CRP, TNF-α, IL-6.
 - Diet satisfaction, hunger and satiety, including through the analysis of leptin, ghrelin and adiponectin.
 - Energy-metabolism and energy-expenditure.
 - Effect of CCtoD on sleep.

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