The effect of weight loss on hypothalamus structure and function in obese individuals: A systematic literature review and meta-analysis

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Introduction

- Obesity is the result of a chronic whole body positive energy balance leading to excessive body weight (BMI ≥ 30 kg/m^2) due to increased fat deposition. It can affect the structural organization and functional activity of the hypothalamus. Hypothalamic inflammation and dysfunction are the most presented abnormalities in obesity.
- However, it is unclear if weight loss could reduce hypothalamic inflammation, restore its responsivity and correct the altered hypothalamic activity to regulate the whole-body energy homeostasis.
- Hence, aimed to conduct a systematic review and meta-analysis to determine the effect of body-mass reduction in obese individuals on hypothalamic structure and function.

Methods

- Based on pre-specified selection criteria, obese individuals undergoing body-weight reduction either surgically or non-surgically and who have a change in either the structure or function of the hypothalamus were included in the study.
- The studies evaluating non-obese background, with no weight loss, and individuals with any underlying conditions that alter the activity in the hypothalamus were excluded from the study.
- PubMed, Embase, and Cochrane databases were searched from inception till Nov 2020 for studies that provided relevant information.
- Qualitative and Quantitative analyses were performed on the correlations between the radiological changes and biomarker changes.
- Mean differences between pre-and post-weight loss and 95% confidence intervals (CI) were pooled using random-effects models.
- Quality Assessment tool by the National Heart-Lung, and Blood Institute was used to assess the quality of pre-post studies on a scale of 12.

Results

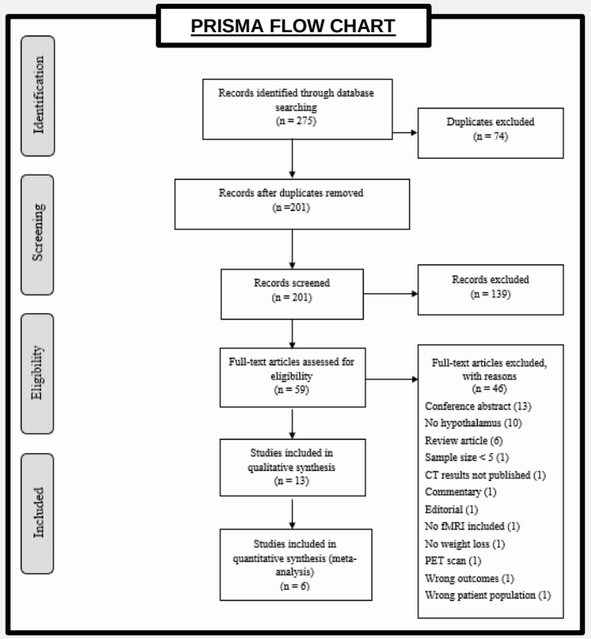
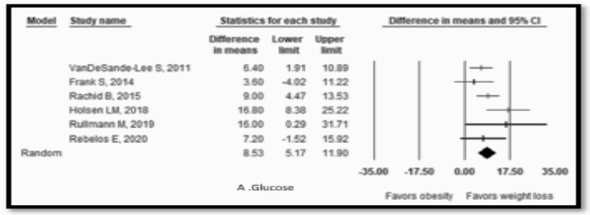
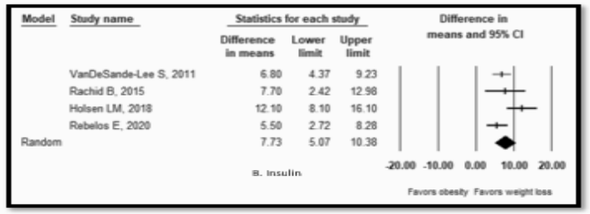
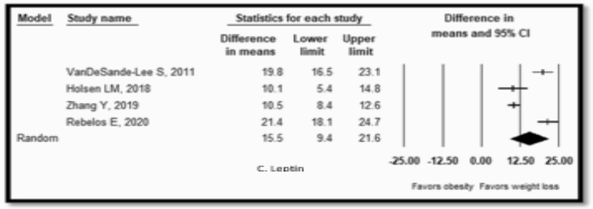


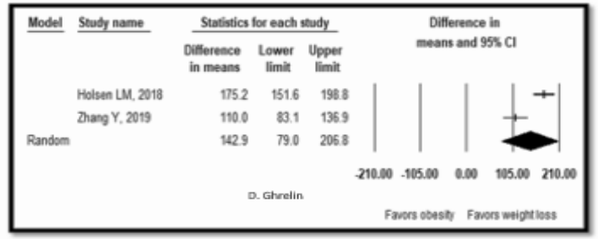
Figure1: PRISMA flow chart for study selection

- Studies showed a favorable decrease in the T2 relaxation time (n=1), beneficial change in the hypothalamic activity after weight loss on BOLD contrast (n=4), with higher peak activities after surgical weight loss (n=2).
- No difference was found in the gray matter density of the hypothalamus, on VBM, after surgical weight loss (n=1).
- Pooled mean differences between pre- and post-surgical weight loss revealed a decrease of 8.53 mg/dl (95%CI: 5.17, 11.9; six studies) in glucose, 7.73 pmol/l (95%CI: 5.07, 10.4; four studies) in insulin, 15.5 ng/ml (95%CI: 9.40, 21.6; four studies) in leptin, 142.9 pg/ml (95%CI: 79.0, 206.8; two studies) in ghrelin, and 9.43 pg/ml (95%CI: -6.89, 25.7; two studies) in IL-6.









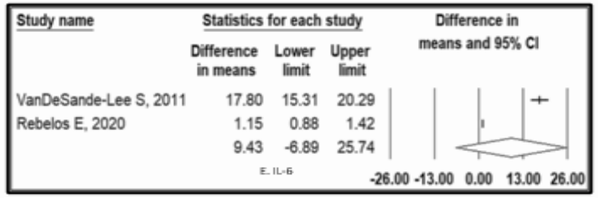


Figure 2-6: Forest plot showing the pooled mean differences between post vs pre weight loss in biomarkers: Glucose, Insulin, Leptin, Ghrelin, and IL-6

Conclusions

- The performed systematic review and meta-analysis found mixed evidence on structural changes in the hypothalamus after weight loss in obese individuals, as demonstrated by changes in peak hypothalamic activity on BOLD analysis and reduced T2-relaxation time.
- Functional hypothalamic changes in obese individuals were also reported after weight loss, as shown by the decreased plasma hormone levels of glucose, insulin, leptin, and ghrelin, and inflammatory markers of IL-6.

Future Insights

- Future studies should report the means and magnitude of weight loss as a relative change from baseline BMI or waist circumference according to the adopted means and duration of weight loss to understand the pathophysiology of hypothalamic mechanisms in obese individuals who underwent weight loss.
- Clinical studies can employ advanced diagnostic techniques to capture volumetric-microstructural changes, which could derive quantitative findings.

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