Weight gain in smokers after quitting cigarettes: meta-analysis


CRD summary
Smoking cessation was associated with a mean increase of 4 to 5kg in body weight after 12 months of abstinence, which mainly occurred in the first three months of quitting. The authors' conclusions reflect the results of the synthesis but substantial clinical and statistical heterogeneity of the included studies should be considered.

Authors' objectives
To describe weight gain and its variation in smokers who achieve prolonged abstinence for up to 12 months, and who quit without treatment or use drugs to aid cessation.

Searching
The Cochrane Central Register of Controlled Trials (CENTRAL), The Cochrane Library and the Cochrane Tobacco Addiction Group specialist register to November, 2011.

Study selection
Eligible studies reported weight change from baseline to at least one follow-up in abstinent smokers.

Study populations were mainly recruited from North America, Europe or Australia. Mean participant age ranged from 28 to 57 years (where reported); most studies included both men and women, but seven included only women. Mean smoking intake at baseline ranged from 16 to 33 cigarettes per day. Most examined nicotine replacement therapy as a first line treatment and a smaller number examined varenicline and bupropion. All but two of the trials reported biochemical validation. Most measured weight at clinics (where reported).

The authors did not state how many reviewers selected studies for inclusion.

Assessment of study quality
Study quality assessment was based upon Altman's criteria for cohort studies; this included adequacy of descriptions for participant recruitment and sampling, follow-up periods, outcome measurements, statistical analyses and treatment/s received.

The authors did not state how many reviewers performed the quality assessment.

Data extraction
Mean weight (kg) changes and standard deviations from baseline (quitting start date) to specific follow-up time points (one, two, three, six and 12 months from baseline) were extracted; 95% confidence intervals for the mean changes were calculated. Data were extracted separately for treated quitters who had received cessation treatments (varenicline, bupropion or nicotine replacement therapy) and untreated quitters who had not (control groups from trials of cessation treatment and interventions that aimed to prevent concerns about post-cessation weight gain). Treatment groups who received more than one pharmacotherapy were excluded from analyses.

Three reviewers extracted the data overall, and data from each study were extracted independently by two reviewers. Discrepancies were resolved by a fourth reviewer extracting the data, and by consensus thereafter.

Methods of synthesis
For each of the follow-up points, data from the treated and untreated groups were pooled in random-effects inverse variance models to calculate summary mean weight changes and 95% confidence intervals (CIs). Statistical heterogeneity was assessed using $I^2$. To measure variation in weight change, a weighted mean of the standard deviations was calculated (according to the number of participants in a trial). Z scores were used to calculate the percentage of the quitting population expected to lose weight, remain stable, or gain weight (less than 5kg, 5 to 10kg, or more than 10kg over 12 months).
To identify subgroups with differing mean weight gain at 12 months follow-up, a random-effects meta-regression analysis was performed, using a binary predictor variable for weight concern.

Sensitivity analyses were performed according to location of weight measurement (clinic versus elsewhere) at each time point, and definition of abstinence (point prevalence versus prolonged or continuous). Funnel plots were constructed to assess publication bias.

**Results of the review**

Sixty-two trials (25,084 participants) were included in the review; the baseline number of participants per trial arm ranged from 20 to 2,861. Overall, studies were assessed as being high quality; fifty-one trials used the definition of prolonged or continuous abstinence from the quitting date, and all but one of these validated abstinence bio-chemically.

**Effect on weight gain**

In all groups, weight gain increased by approximately 1kg per month for the first three months, leading to an increase of approximately 4 to 5kg by 12 months follow-up.

At 12 months follow-up, 16-21% of untreated participants lost weight, 35-38% gained less than 5kg, 29-34% gained 5 to 10kg, and 13 to 14% gained more than 10kg. Proportions were similar for treated participants.

At 12 months follow-up, participants treated with nicotine replacement therapy had gained 4.86kg (95% CI 4.34 to 5.38, 19 studies), those treated with bupropion had gained 4.08kg (95% CI 3.44 to 4.71, five trials), and those treated with varenicline had gained 4.17kg (95% CI 1.64 to 6.71, three trials). This compared to an average weight gain of 4.67kg (95% CI 3.96 to 5.38, 25 trials) in untreated participants.

Significant statistical heterogeneity was shown in all of these analyses ($I^2$ range 69% to 91%), except for the one investigating weight change with bupropion.

**Subgroup analyses, publication bias and sensitivity analyses**

At 12 months follow-up, no clear difference in mean weight gain was observed between studies with weight concerned participants and those with general smoker populations (reported fully in paper). No evidence for publication bias was found (funnel plots not shown). Sensitivity analyses did not reveal any statistically significant differences between studies.

**Authors’ conclusions**

Smoking cessation was associated with a mean increase of 4 to 5kg in body weight after 12 months of abstinence, which mainly occurred in the first three months of quitting. Variation in weight change was large, with about 16% of quitters losing weight and 13% gaining more than 10kg.

**CRD commentary**

The review question was clear, inclusion criteria appeared sufficiently replicable and relevant electronic databases were searched. Efforts were made to reduce reviewer error and bias during data extraction, but this was unclear for the rest of the review process. Quality assessment criteria employed seemed suitable and suggested that the methodological quality of most included studies was high. Adequate study details were presented but the methods of synthesis did not appear appropriate, given the clinical and statistical differences shown between studies. The authors also suggested that populations of these studies may not have been representative of the general smoker population, but more relevant to smokers who consult clinicians about cessation.

The authors’ conclusions reflect the results of the synthesis but substantial clinical and statistical heterogeneity of the included studies should be considered.

**Implications of the review for practice and research**

**Practice:** The authors stated that doctors might discuss the range of expected weight gain with patients.

**Research:** The authors stated that further research was required to identify the subgroups at highest risk for gaining weight.
weight, and clarify the optimum content and timing of interventions that aimed to prevent post-cessation weight gain.

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