

ORIGINAL ARTICLE

# A double blind, placebo controlled trial of inert cellulose powder for the relief of symptoms of hay fever in adults\*

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**Key words:** Hay fever – Inert cellulose powder – Seasonal allergic rhinitis

## ABSTRACT

**Objective:** An inert cellulose powder has been on sale in the UK since 1994 as a remedy for hay fever but no scientific trials have been conducted previously. It is applied to the inside of the nose where it forms a gelatinous coating. The principal aim was to determine if there is a significant difference in the amount and type of rescue medication required for adult hay fever sufferers to control their symptoms while using either the inert cellulose powder or a placebo. The second objective was to see whether the cellulose powder resulted in an improvement in symptom control.

**Research design:** A double blind, placebo controlled study was conducted of 97 adult hay fever sufferers, over the grass pollen season of 2004. Participants (selectively recruited to be living within the catchment area of a 50-km radius from Worcester, UK) were assigned randomly to two groups (A, Active and B, Placebo) matched by age by decades and gender. Of those completing the trial, group A had 19 males and 28 females and group B had 21 males and 29 females. There were no significant differences between the groups in age distributions, severity of symptoms over the last 2 years or in medication taken. They completed

daily symptom diary score cards and were allowed to take any medications they wished in addition to the inert cellulose powder or placebo because medication use was taken as an outcome measure. Results were analysed in relation to pollen counts.

**Results:** Significant differences were found in the amounts of rescue medication taken by the active and placebo groups ( $p < 0.05$ ). More people in the placebo group took rescue treatments than those in the active group.

No significant differences were found ( $p < 0.01$ ) between the active and placebo groups in Likert scores for any of the rhinitis nasal symptoms or in the total Likert symptom daily scores. No adverse events were reported during the study.

**Conclusions:** The amount of rescue medication taken by the placebo group was significantly more than that taken by the active group both overall, considering all types of medication, and also in the individual cases of antihistamines, nasal sprays and eye drops. These results provide evidence that the inert cellulose powder reduces the need to take rescue medication for the symptoms of hay fever.

## Introduction

Seasonal allergic rhinitis due to pollen allergy occurs in 15–35% of the population of Europe depending on

age group and region<sup>1–3</sup>. In the UK hay fever affects at least 10% of the general population<sup>4</sup> and in teenagers (12–14 year olds) lifetime prevalence increased from 34.8% in 1995 to 37.4% in 2002<sup>5</sup>, resulting in notable

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social and economic costs. A wide range of remedies and treatments is available both on prescription and for sale over the counter but many of these can have side effects and some sufferers are reluctant to take them. An inert cellulose powder (Nasalezet<sup>†</sup>) has been registered as a class one medical device with the Medical Devices Agency (MDA) since 1994 and is on sale in many countries, including the UK, as a remedy for hay fever. It is applied to the inside of the nose by a simple puffer device. The mechanism of action of the cellulose is unclear although it is likely that the cellulose reacts with moisture within the airway to produce a protective barrier over the nasal mucosa, preventing binding of inhaled allergen with receptors. Evidence for the efficacy of this device in the management of rhinitis has been almost entirely anecdotal as no scientific trials have been conducted previously. The popularity of the product has been increasing steadily over the last 10 years with numerous unsolicited testimonials being cited by the manufacturers.

In the UK, and the majority of Europe, the most important allergenic pollen type is grass, with approximately 95% of hay fever sufferers being allergic to this taxon, whereas only about 25% are allergic to tree pollen and about 20% to weed pollen<sup>6</sup>.

The UK grass pollen season typically starts in late May and continues through to mid-August, with the main peak occurring in June and a second smaller peak typically occurring in early July. This period overlaps with the flowering times for some weeds, such as Nettle (*Urtica* spp.), certain trees such as Lime (*Tilia* spp.) and pollen from some crops (such as Oil seed rape, *Brassica napus*).

A trial was conducted with the principal objective of determining if there is a significant difference in the amount of and type of rescue medication required for adult hay fever sufferers to control their symptoms in the main grass pollen season while using either the inert cellulose powder or a placebo. The secondary objective was to establish whether the inert cellulose powder has a significant effect in the control of the symptoms of hay fever in adults during the grass pollen season.

## Patients and methods

### Patients and their selection

Subjects were recruited via local general practitioners, leaflets in libraries and other public places and via the National Pollen and Aerobiology Research Unit (NPARU) web site. Informed consent was obtained from potential volunteers who then completed a baseline questionnaire which supplied the following types of information: age range, name and address

of doctor, occurrence and timing of hay fever in the previous two summers, qualitative assessment of symptoms (as none, slight, moderate or severe for frequent sneezing, itchy eyes, blocked nose, running eyes, headache/tiredness, itchy throat/mouth). Subjects were also asked if they took medication or other treatments (if so, were these bought over the counter or on prescription) and the generic types e.g. eye drops (choices to tick plus 'other'). They were also asked about asthma in the summer months and whether this required treatment with steroids.

The criteria for inclusion were as follows:

1. Subjects must be 18 years or over.
2. Subjects must have had symptoms of seasonal allergic rhinitis during June and July for at least the previous 2 years.
3. Subjects must have had symptoms sufficiently severe to need treatment by medication either from a pharmacy or on prescription.
4. Subjects must be residing and spending the majority of time within 50 km of Worcester during the trial period.

Criteria for exclusion were as follows:

1. Subjects who did not understand English clearly. This was because the relevant documents need to be completed in English.
2. Subjects with a history of severe grass pollen associated asthma who were likely to require steroid treatment for asthma symptoms during the hay fever season.
3. Subjects who were likely to be spending more than 2 weeks at a time away from the region during June and July.
4. Subjects who had rhinitis outside of the grass pollen season.

These criteria ensured that recruits were highly likely to suffer symptoms of seasonal allergic rhinitis due to grass pollen allergy. The baseline questionnaire specifically asked about the occurrence of symptoms in relation to calendar month. Only those people who had clear seasonal rhinitis during the grass pollen season were included. People who had symptoms at other times of the year were excluded. If people were sensitized to other allergens such as dogs, cats, house dust mites or mould, it is highly likely that they would have symptoms outside of the grass pollen season.

The catchment area was a 50-km radius from Worcester so that symptoms could be related to pollen count data at the National Network pollen-monitoring site at the National Pollen and Aerobiology Research

<sup>†</sup> Nasaleze is a registered trade mark, Kisska International Ltd, Keighley, UK

Unit, Worcester. Previous research has demonstrated that it is acceptable to use the results from a standard roof top pollen monitoring site to indicate the pollen counts prevailing in a region of about 50 km radius from the site<sup>7-9</sup>. Throughout the duration of the trial the daily average pollen counts for all allergenic pollen types were taken from the Worcester site which uses the standard techniques of the British Aerobiology Federation<sup>10</sup>.

Study design

A double blind, placebo controlled study was conducted on adult hay fever sufferers (aged 18 years and over) who had experienced symptoms of hay fever in June and July in the previous 2 years that were sufficiently severe to require treatment. A pilot study was conducted in the summer of 2003 in one GP practice in Worcester, which indicated a high efficacy for the inert cellulose powder. This indicated the power of the study and the sample size required. The pilot indicated that with 100 patients in this two treatment study, the probability is 90% that the study will detect a treatment difference at a two-sided 1.000% significance level, if the true difference between the treatments is 0.555 units. This is based on the assumption that the within patient standard deviation of the response variable is 1.000.

The trial was planned for the main grass pollen season (June and July) in 2004 with the intention of recruiting 120 hay fever sufferers (sample size of 100, plus 20% over-recruitment to allow for 'dropout').

Suitable volunteers were assigned randomly to two groups matched by gender and age within decades from 18 to 57 years, then to the groups as people 58 years and over to give stratified random samples (Table 1). Recruits were given a participant number and were grouped by gender and age range. Within these categories they were assigned to group A or B by alternate random draw of sealed shuffled envelopes. There were no significant differences at the 95% level

in the occurrence or severity of symptoms experienced by the people in the two groups over the previous 2 years (Table 2). Similarly there were no significant differences at the 95% level in the numbers taking different types of medication (Table 3). Participants who were recruited but did not complete the trial are not included in the tables.

Ethical considerations

Ethical approval was obtained from the Hereford and Worcestershire NHS Local Research Ethics Committee. The study complies with the Declaration of Helsinki.

Collection and analysis of data

In early June those recruited were given daily diary cards to cover 4 weeks together with detailed instructions, prepaid envelopes for returns and nasal powder type A or B. They were given the opportunity to discuss the project and to ask any questions. They were also given a phone number to contact if they had any questions during the trial period. The diary cards included reports on symptoms as Likert scores. These are widely used as a qualitative assessment of the severity of symptoms. The Likert technique presents a set of statements. Subjects are asked to express agreement or disagreement of a five-point scale (in relation to having symptoms). Each degree of agreement is

Table 1. The age and gender of participants completing the trial

| Age range           | Active group |        | Placebo group |        |
|---------------------|--------------|--------|---------------|--------|
|                     | Male         | Female | Male          | Female |
| 18-27 years         | 3            | 6      | 2             | 7      |
| 28-37 years         | 7            | 8      | 8             | 7      |
| 38-47 years         | 3            | 9      | 3             | 9      |
| 48-57 years         | 5            | 3      | 6             | 3      |
| 58+ years           | 1            | 2      | 2             | 3      |
| Totals for analysis | 19           | 28     | 21            | 29     |

Table 2. Results from the baseline questionnaire. Occurrence and severity of symptoms over the last 2 years

|               | Sneezing | Itchy eyes | Blocked nose | Running nose | Running eyes | Headaches/tiredness | Itchy throat/mouth |
|---------------|----------|------------|--------------|--------------|--------------|---------------------|--------------------|
| Active group  |          |            |              |              |              |                     |                    |
| Severe        | 19       | 21         | 15           | 23           | 14           | 11                  | 10                 |
| Moderate      | 25       | 19         | 16           | 15           | 15           | 16                  | 17                 |
| Slight        | 3        | 7          | 10           | 5            | 10           | 10                  | 10                 |
| None          |          |            | 5            | 4            | 8            | 8                   | 8                  |
| Placebo group |          |            |              |              |              |                     |                    |
| Severe        | 20       | 27         | 18           | 24           | 17           | 15                  | 10                 |
| Moderate      | 26       | 17         | 17           | 16           | 13           | 16                  | 16                 |
| Slight        | 4        | 6          | 8            | 9            | 11           | 9                   | 13                 |
| None          |          |            | 5            | 1            | 9            | 10                  | 9                  |

**Table 3.** Results from the baseline questionnaire. Medication taken regularly during grass pollen season over the last 2 years

|                                                                 | Active group | Placebo group |
|-----------------------------------------------------------------|--------------|---------------|
| Antihistamines only                                             | 20           | 21            |
| Antihistamines with nasal spray                                 | 4            | 4             |
| Antihistamines with eye drops                                   | 4            | 5             |
| Antihistamines with eye drops and nasal spray                   | 9            | 10            |
| Antihistamines with eye drops, nasal spray and steroids         | 1            | 1             |
| Nasal spray only                                                | 1            | 2             |
| Nasal spray and eye drops                                       | 2            | 3             |
| Eye drops only                                                  | 1            | 1             |
| Eye drops and herbal                                            | 1            | 0             |
| Eye drops, nasal spray and herbal                               | 1            | 0             |
| Steroids only                                                   | 1            | 0             |
| Herbal only                                                     | 2            | 0             |
| Antihistamines with nasal spray and herbal                      | 0            | 1             |
| Antihistamines with eye drops, nasal spray and herbal           | 0            | 1             |
| Antihistamines with eye drops, nasal spray, herbal and steroids | 0            | 1             |

given a numerical value from one to five. Thus a total numerical value can be calculated from all the responses.

The daily diary cards requested the following information:

- Likert scores for each of four individual categories of symptoms of hay fever over the last 24 h.
- How many times the nasal powder was used that day.
- Whether they had taken any hay fever medication or treatment today, if so what type and how much.
- Visits to GP or nurse related to allergy.
- Whether they had cold or flu like symptoms. If so what were these?
- If they had been away from the Worcester area (more than 50 km radius) during the day.

Subjects were told that they could use any hay fever treatments or remedies they felt they needed during the trial. This was done because use of medication was to be taken as an outcome measure. Also if it was overtly allowed and monitored it could be taken into account. Restrictions on the use of rescue remedies and medication in a field trial could have resulted in non-compliance. If this was not recorded it could have distorted the results considerably.

One group was given the active product and the other the placebo, which was a lactose powder with the same particle size and appearance as the inert cellulose powder and supplied in an identical container (the containers were labelled A and B). The codes for the active and placebo products were not revealed until the data had been analysed at the end of the study. The nasal powders were supplied in plastic containers which delivered the powder from a nozzle when squeezed. The exact amount delivered is not

standardized and the variation of patterns of deposition in the nose are not known. These are topics of ongoing product development and research.

In total 116 subjects were recruited to the study, but 19 did not complete the 4 weeks. The analysis of results has been based only on those subjects who completed the whole trial. Analysis was done anonymously and in accordance with the data protection act. After the study was completed all participants were informed whether they had taken the active or placebo product and they were sent a summary of the results.

### Statistical methodology

Diary card data have been analysed for differences between the active and placebo groups both for individual aspects and combinations taking only those days with grass pollen counts at moderate, high or very high levels. Non-parametric tests have been used as follows:  $\chi^2$  to test for differences in the distributions of the actual frequencies of scores, Mann-Whitney U-test of medians and correlations. Statistical significance was applied at the 95% level or above.

## Results

### Features of the two sample groups at the start of the study

The demographic features of age and gender showed no significant differences between the active and placebo groups at the start of the trial (Table 1). Similarly the occurrence and severity of individual hay fever symptoms (Table 2) reported from the previous 2 years also showed no significant differences between the groups. With 2 degrees of freedom, no values were within 1%, or 5% of significance levels. No significant differences were found between the active and placebo

groups in the use of different types of medication for hay fever in the previous two summers (at 1% significance level) (Table 3). Based on these results the two groups can be taken as being drawn from the same population for the study.

Diary card results

No significant differences were found at the 1% level in differences in the distribution frequencies of Likert scores for any of the individual symptoms. However, some significant differences were found at the 5% level (Table 4). These differences were such that symptom scores were higher in the placebo group than in the active group.

No significant differences occurred between the total Likert symptom daily scores for the active and placebo

groups (Figure 1 and Table 4), using a non parametric test of difference in central tendency.

The number of times that the inert cellulose powder was taken by the active group compared to the placebo group (Figure 2) was similar. On most days a few people in each of the groups forgot to take their powder, or did not take it for various other reasons such as having a cold.

Very few visits to GPs for allergy related symptoms were recorded for either group. No significant differences were detected in the number of people in each group reporting symptoms of colds or flu. No adverse reactions were reported by any of the participants in the study. Of the 19 people who did not complete the 4 weeks of trial, 4 said that they did not like the feel of powder in the nose, 1 went on holiday and 14 gave no reason for giving up.

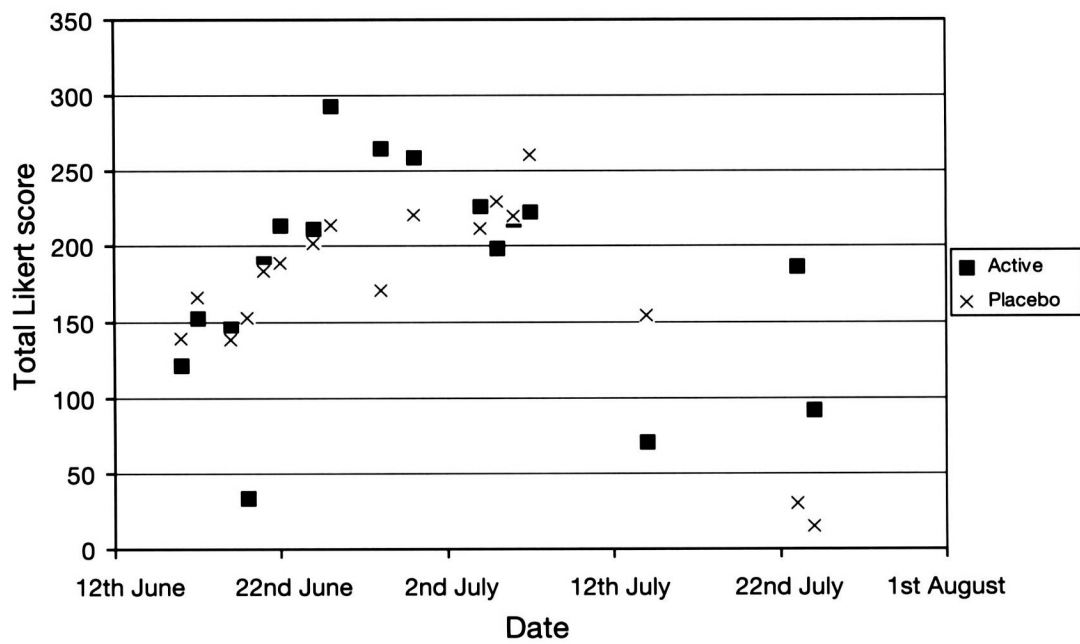


Figure 1. Total Likert scores for active and placebo groups on days with very high, high or moderate pollen counts

Table 4. The differences in symptom scores between active and placebo groups over the study period

|                                      | Chi <sup>2</sup> value | Significance      | Degrees of freedom (n – 1), based on number of classes for frequency |
|--------------------------------------|------------------------|-------------------|----------------------------------------------------------------------|
| Sneezing                             |                        |                   |                                                                      |
| Moderate pollen count days           | 6.31                   | Not significant   | 4                                                                    |
| Running nose                         |                        |                   |                                                                      |
| Moderate pollen count days           | 10.05                  | Significant at 5% | 5                                                                    |
| High and very high pollen count days | 8.04                   | Not significant   | 5                                                                    |
| Blocked nose                         |                        |                   |                                                                      |
| Moderate pollen count days           | 8.17                   | Not significant   | 5                                                                    |
| High and very high pollen count days | 12.16                  | Significant at 5% | 5                                                                    |
| Watery eyes                          |                        |                   |                                                                      |
| Moderate pollen count days           | 5.78                   | Not significant   | 4                                                                    |
| High and very high pollen count days | 5.92                   | Not significant   | 5                                                                    |

## Rescue medication

Significant differences were found in the overall amounts of rescue medication taken by the active and placebo groups (Figure 3 and Table 5). For simplicity, in Table 5, both the inert cellulose powder and the placebo are referred to as 'Nasal powder' as the subjects did not know what they were taking. Almost all of the treatments are 'once a day', the exceptions being some herbal remedies. The results are analysed on a daily basis so there is a measure of the amounts taken.

Considering individual types and combinations of remedies, the predominant pattern was such that more people in the placebo group took treatments than those in the active group. This was apparent for all the types and combinations with the exception of homeopathic remedies and a combination of nasal sprays and eye drops. Antihistamines were by far the most frequently used type of medication (Figure 3). In the active group, 29% of people took only antihistamines compared with 33% in the placebo group (Figure 4). There was no significant difference between these groups, but when

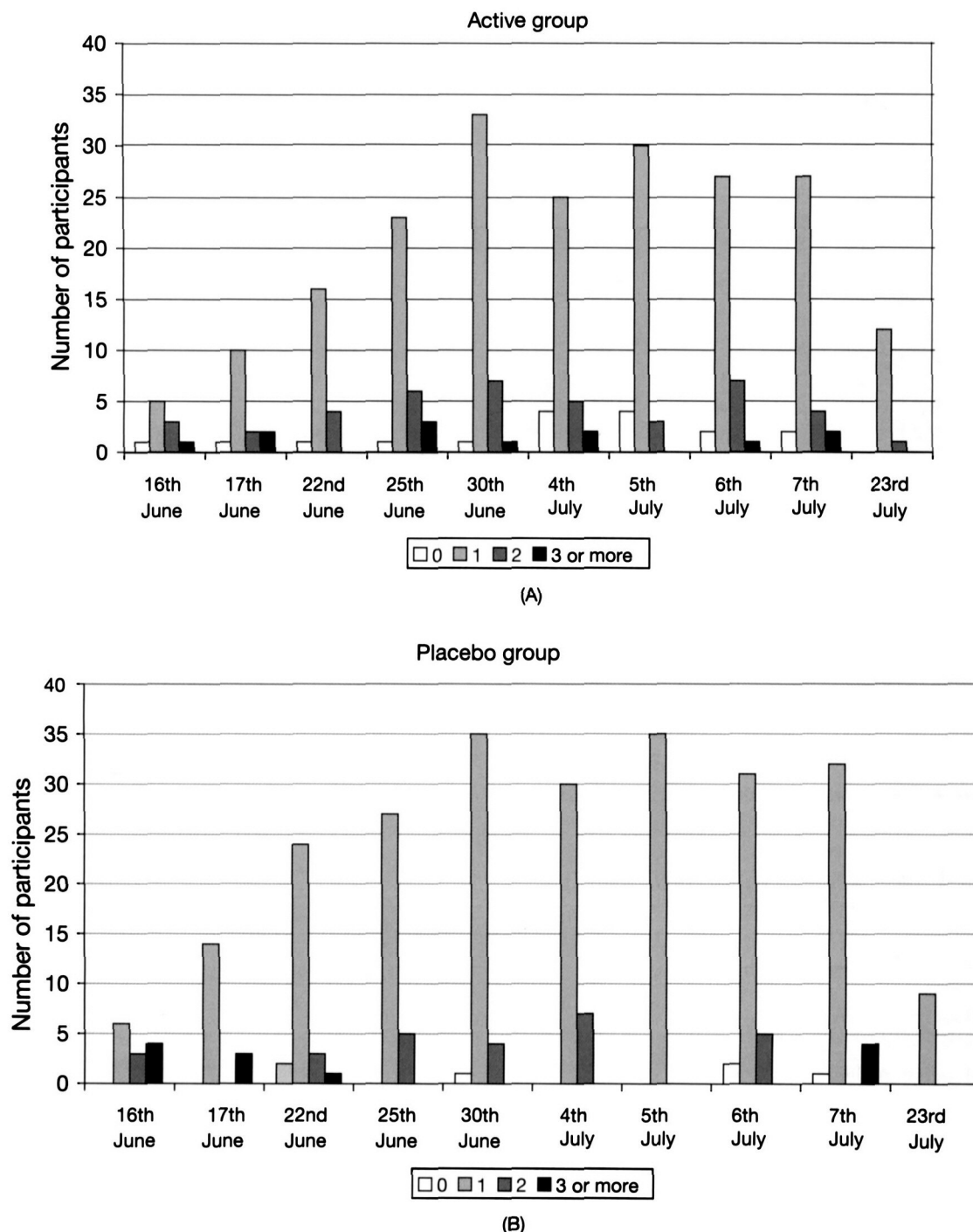


**Figure 2.** The number of times each day the nasal powder was taken by (A) the active and (B) placebo groups on days with high or very high pollen counts

overall use of antihistamines is considered (i.e. people using antihistamine whether or not it is in combination with other medication), the percentage in the active group was 34% compared with 48% in the placebo group (significantly different at  $p < 0.05$ ). Taking into

account all days with grass pollen counts at high or very high only, the figures are 34% for the active group and 45% for the placebo group (significantly different at  $p < 0.05$ ). The Mann–Whitney U-tests are reinforced by results from correlation (d.f. = 15, Rho statistic =

**Table 5.** Summary of statistical tests on medication taken by the active and placebo groups during the study period

| Overall medication taken                 | Chi <sup>2</sup> value significant at $p \leq 0.1$ | Degrees of freedom ( $n - 1$ ) |
|------------------------------------------|----------------------------------------------------|--------------------------------|
| Very high, high and moderate pollen days | 51.32                                              | –                              |
| Very high and high pollen days           | 20.73                                              | –                              |

| Mann–Whitney U-test results on medication categories           | $p$ values ( $< 0.05$ = significant) | Degrees of freedom ( $n - 1$ ) | Means |      | SD   |       |
|----------------------------------------------------------------|--------------------------------------|--------------------------------|-------|------|------|-------|
|                                                                |                                      |                                | A     | P    | A    | P     |
| High and very high pollen days, medication – nasal powder only | 0.288                                | 9                              | 15.6  | 13.7 | 7.62 | 6.2   |
| Combined pollen days, antihistamine (+ nasal powder)           | 0.000                                | 16                             | 8.23  | 31.4 | 3.9  | 12.1  |
| High and very high pollen days, antihistamine (+ nasal powder) | 0.048                                | 9                              | 9.4   | 33.2 | 4.17 | 12.32 |
| Combined pollen days, nasal spray (+ nasal powder)             | 0.037                                | 16                             | 2.47  | 4.06 | 1.66 | 2.19  |
| Very high and high pollen days, nasal spray (+ nasal powder)   | 0.179                                | 9                              | 3.2   | 4.5  | 1.33 | 2.17  |
| Combined pollen days, eye drops (+ nasal powder)               | 0.103                                | 16                             | 1.8   | 2.76 | 1.07 | 1.6   |
| Very high and high pollen days, eye drops (+ nasal powder)     | 0.050                                | 9                              | 2.1   | 3.1  | 0.88 | 1.85  |

Combined pollen days are those with very high, high or moderate grass pollen counts

A = active group

P = placebo group

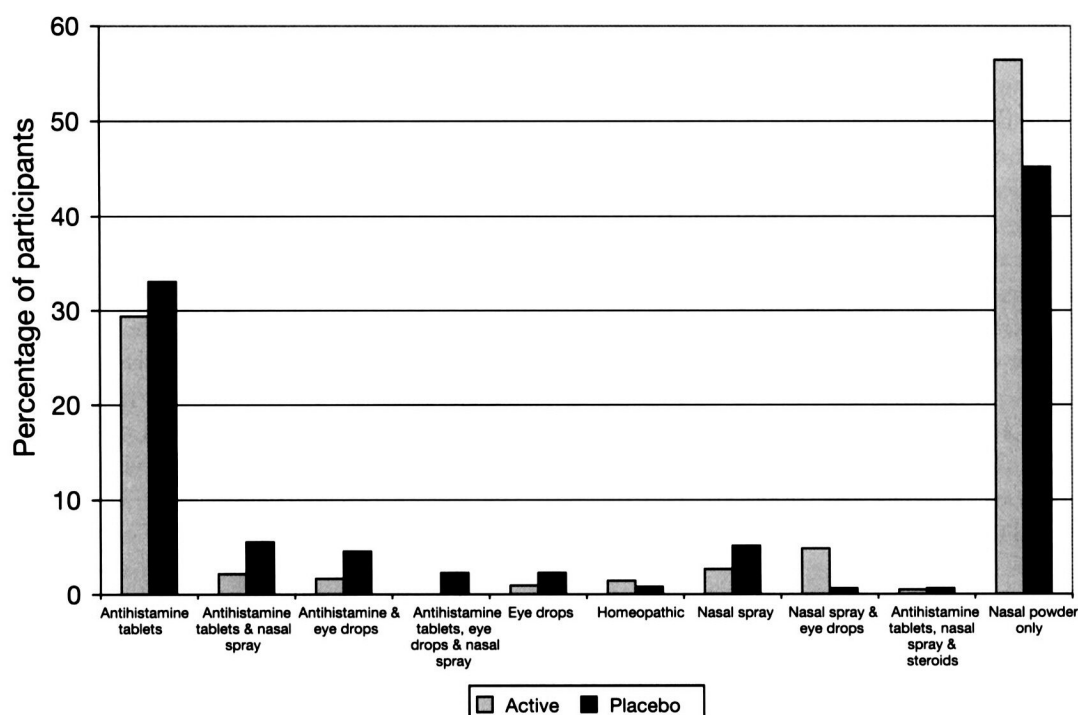


**Figure 3.** Percentage of participants in the active and placebo groups taking different types of hay fever treatments over the study period

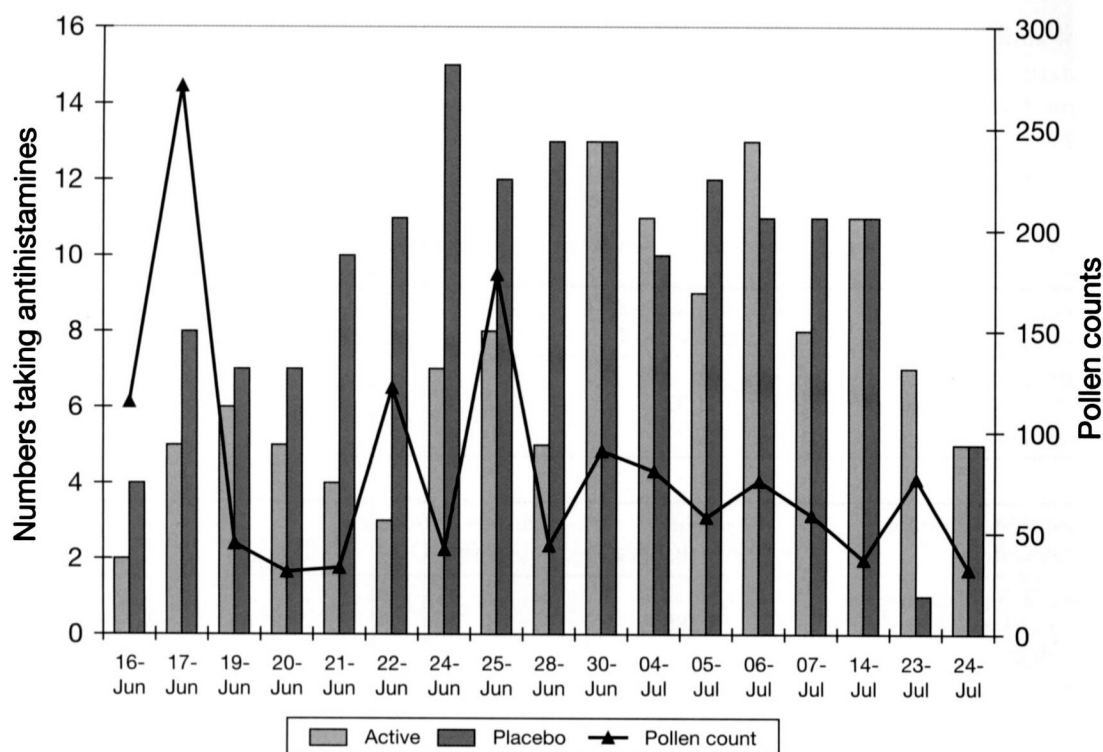


**Figure 4.** Numbers of people taking antihistamines in the active and placebo groups on days with very high, high or moderate pollen counts over the study period

1.91) which is not significant at 1% or 5% levels of probability. This indicated that there was no significant relationship between the data sets for the two groups and that they were different.

Nasal sprays were the second most frequent type of medication used. Taking all the days with grass pollen counts at moderate or above, 10% of the active group took nasal sprays compared to 14% of the placebo group (significantly different at  $p < 0.05$ ). In the case of eye drops, there is no significant difference between the results for the two groups in the data for days combined but considering only high and very high grass pollen count days, 7.5% of subjects in the active group used eye drops compared to 11.3% in the placebo group (significantly different at  $p < 0.05$ ).

The placebo group participants took a wider range of medication combinations than those in the active group. Very few subjects in either group took steroids or homeopathic remedies. Fifty-seven per cent of subjects in the active group took the inert cellulose powder only, with no rescue medication, on days with counts at moderate or over, compared with 44% in the placebo group (Figure 5).

## Discussion

The main differences in the results between the two groups occurred in the amounts of rescue medication taken. This measure is widely used in research on

allergy and related areas, for example by Rolinck-Werninghaus *et al.*<sup>11</sup>, Miller *et al.*<sup>12</sup> and Roefaro and Daryanari<sup>13</sup>. The overall significant difference in the amounts of medication taken is reinforced by the results of tests on individual types. The significantly different results in the amounts of medication taken by the active and placebo groups show similarities across three types of hay fever medication i.e. antihistamines, nasal sprays and eye drops. This constancy of outcome helps to confirm the results. The only case in which more rescue medication was taken by the active group than the placebo group, was in the group taking nasal sprays and eye drops without antihistamines. This suggests that the inert cellulose powder may not have an effect on eye symptoms but the sample size is small and this aspect would have to be investigated further.

The results show that there are few significant differences in the symptom scores during the trial for the two groups in the cases of individual symptoms (sneezing, runny nose, blocked nose, watering eyes). The subjects did not all experience each of the symptoms that were monitored. They were also taking medication if they wanted to. Consequently, the total Likert scores are not high and this is not unexpected.

The amount of rescue medication taken by the placebo group was significantly more than that taken by the active group, both overall considering all types of medication and also in the individual cases of antihistamines, nasal sprays and eye drops. There were no significant differences in the demographic profiles of

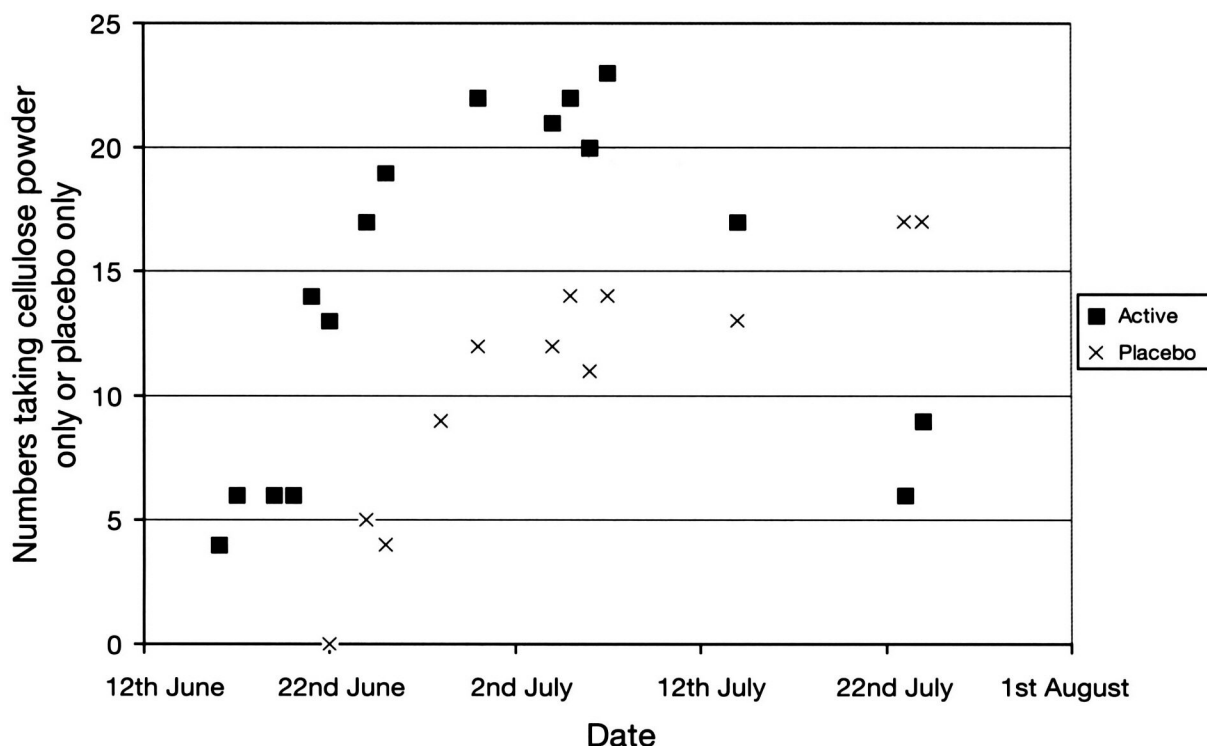


**Figure 5.** Numbers of people taking cellulose powder only or placebo powder only on days with very high, high or moderate pollen counts over the study period

the two sample groups or in the severity of their reported symptoms in previous grass pollen seasons. This indicates that the inert cellulose powder was operating to reduce the symptoms of hay fever in the active group.

### The 2004 grass pollen season

The 2004 Worcester grass pollen season was less severe than average. The first 2 weeks of June followed a typical pattern of many days with high counts but after this, rainfall was above average (108% of long term norm). Despite the unusually low severity of the grass pollen season overall, there were sufficient moderate, high and very high days during the trial to provide an adequate sample (pollen count categories for grass are moderate 30–49 grains per cubic metre, 50–149 high, 150 or over very high). Due to the season being below average severity, the results were analysed for those days with moderate, high or very high grass pollen counts only. Once inflammation is established some symptoms can persist on days when pollen counts are lower. However, in this study use of medication is an outcome measure and this is more likely to be related to the days with pollen counts above the threshold. In a season which is markedly below average severity the inclusion of substantial periods with low pollen counts could distort the results.

Apart from grass pollen, the other main pollen types in the air during the trial were Nettle (*Urtica* spp.), with minor amounts of oil seed rape (*Brassica napus*) and

weeds such as Plantain (*Plantago* spp.) and Mugwort (*Artemisia* spp.). The thresholds of response to these taxa are not well established due to lack of clinical evidence but the days when moderate, high or very high pollen counts occurred for these other types coincided with those for grass, due to the overriding influence of weather conditions on pollen release and dispersal.

### Discussion of results

The data generated from this study were from self reporting by volunteers who had been admitted to the trial on the basis of a baseline questionnaire. These aspects could produce some bias and subjectivity in the data which needs to be considered. For example, in some of the participants the diagnosis of hay fever in the peak grass pollen season was based on their description of the symptoms and the timing of them. However, the application of the exclusion and inclusion criteria was designed to eliminate those with perennial rhinitis which could be caused by indoor allergens or by non-allergic rhinitis.

The scale of severity of symptoms is relative and may be applied differently by individuals. However, the use of Likert scores is a well established and accepted methodology and the relatively large sample size would reduce any bias. The results from the baseline questionnaire have shown no significant differences in the severity of the symptoms reported by the two groups at the start of the study.

In the trial itself it is possible that the use of the placebo powder could have caused some 'wash out effect'. If this was the case, then the outcome would be to decrease the differences between the results for the two groups, whereas certain significant differences have been detected.

Towards the end of the season there are 2 days (July 6th and July 23rd) on which more people in the active group took antihistamines than those in the placebo group (Figure 4). Similarly there are 2 days (July 23rd and 24th) when the total Likert scores for the active group are higher than those for the placebo group (Figure 1). These differences are not statistically significant due to the small sample sizes (2 days in each case). The subjects did not report irritation from the powder. It is possible that the active group took less anti-inflammatory medication earlier in the season and may have suffered more nasal infiltration by inflammatory cells which will take longer to settle down.

It is reasonable to suppose that the few significant differences in the symptom scores shown between the two groups in the data from the diary cards, reflect a real difference due to the action of the cellulose powder combined with the amounts of rescue medication taken. Exposure to a large amount of grass pollen on days with very high counts would present a severe challenge to hay fever sufferers and could result in all hay fever sufferers, who are allergic to grass pollen, having some symptoms despite taking treatments<sup>14</sup>.

Although it is very likely that someone who had hay fever in June and July would be allergic to grass pollen, it is possible that they were allergic to other types such as weeds and summer flowering trees either in addition to grass or on their own. All types of pollen released in June and July tend to have high counts during the same sort of weather as grass pollen due to the influence of variables such as temperature, rainfall and wind. It is extremely unlikely that pollen counts for weeds and the few summer flowering trees would be low on days when the grass pollen count was moderate or high. This factor would tend to produce synchronisation of symptoms for hay fever sufferers at this time of year.

These results provide evidence that the inert cellulose powder reduces the need to take rescue medication for the symptoms of hay fever. Further research is needed to explore the effects of the cellulose powder in controlling symptoms of hay fever when the subject is not taking any medication and also to determine the degrees of protection conferred in different pollen concentrations (moderate through to very high). It would also be useful to run comparative studies between the cellulose powder and conventional medications. In addition, research is needed to investigate how the cellulose powder works because an

understanding of the mechanisms is likely to help in the development of the product and in the extension of its applications.

Both of these aspects will be addressed by challenge tests planned to take place outside of the pollen season. Known amounts of grass pollen allergen will be introduced to the noses of subjects under controlled conditions when they are not taking medication for hay fever and the response will be monitored both for expression of symptoms and physiological reactions. The outcome of these experiments will help the design of further trials. In particular, it would be useful to determine whether the inert cellulose powder can be employed to reduce or even eliminate the use of steroids in pollen allergy, including some cases of asthma.

Although the mechanism of action is unknown, the fact that cellulose is an inert substance which develops a gel-like consistency on contact with moisture indicates that it is likely that the primary mechanism of action of the product is to produce a simple mechanical barrier to the allergenic component of the pollen grains preventing them from triggering an inflammatory response on the mucosal membrane. The benefit of this product is that it has the potential ability to reduce the need for the use of other medication such as decongestants and intranasal steroids which are known to have significant side effects. There is also an economic benefit as the over the counter cost of the cellulose powder works out at less than 50% of the daily cost of antihistamines. It is about the same cost as or slightly less than the daily dose for most nasal sprays.

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