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How Well Does Your Own Pillow Perform?

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OVERVIEW OF THE STUDIES

These two papers report on findings from congruent yet separate studies regarding the performance of people’s own pillow. Data for these papers was extracted from three previously published studies undertaken in the same South African adult-aged [18+ years] community by the same researchers:

1. Study 1: a telephone survey administering a standard questionnaire, and

2. 18 months later, two concurrent experimental studies using five test pillows compared with subjects’ “own” pillow:

   • Study 2: a pillow field trial of waking symptoms, pillow comfort and sleep quality, and
   • Study 3: a photographic study of changes in cervical posture in side lying.

All studies received ethics approvals from the University of South Australian Human Research Ethics Committee.

Study 1 was a telephone survey of 812 randomly-selected participants from the local telephone directory. This study described and correlated “own” pillow type, use, age and performance, subjects’ sleeping habits, waking symptoms, sleep quality, and pillow comfort. Subjects were asked to reflect on a “usual, recent” week when they provided this information. “Own” pillow use was associated with self-reported waking symptoms [headache, neck pain, stiff neck, and scapula-arm pain] for approximately 46 percent subjects. Five pillow types were commonly used [polyester, foam regular, foam contour, feather, and latex]. In the year preceding the survey, 26.2 percent subjects had purchased a new pillow. The mean age of pillows in this study was 58.9 months [standard deviation [SD] 74.4 months]. New pillows were purchased for many reasons including poor support and comfort, neck discomfort, and compromised hygiene. This study did not validate subjects’ self-report of “own” pillow type, shape, or age, nor measure waking symptom intensity.
Studies 2 and 3 were concurrent experimental studies, which conveniently age-cluster-sampled from the Study 1 sample, enhanced, as required, by volunteers responding to local newspaper advertisements. Age clusters were young [younger than 40 years], middle [40 to 59 years], and old [60 years or older] age groups. Subjects were eligible to participate in these experimental studies if they were healthy, generally slept on their side with one pillow, had not have suffered an injury to the neck in the previous twelve months, and were not actively seeking treatment for cervico-thoracic spine pain. The trial pillows were new versions of those most commonly reported in Study 1 [polyester, foam regular, foam contour, feather and latex]. Study 2, an experimental randomised controlled field trial, was undertaken with 106 subjects [comprising 61 subjects from the telephone survey and 45 recruits from advertisements] using a randomized controlled block-design. Differences were assessed in the effect of subjects’ “own” pillow, and the test pillows, on retiring and waking symptoms [pain, stiffness, headache, and scapula-arm pain]. Where possible, subject’s “own” pillow was inspected for shape, condition and content. Study 3 was a posture study in which 95 subjects [comprising 81 subjects from Study 2 and 14 additional recruits from advertisements] were photographed in a standardized side-lying position on each of the trial pillows, and “own” pillow, at 0 minutes and 10 minutes later. Short-term change in cervical spine posture on each pillow was compared. Cervico-thoracic posture was measured by digitising the x,y coordinates of five anatomical points [spinous processes of C2, C4, C7, and T3, and the external occipital protuberance], and calculating within- and between-point change in position over time. Subject’s “own” pillow depth and the depth of the trial pillows were measured, to allow consideration of pillow performance with respect to altered pillow depth, by placing the pillow on a horizontal table surface and putting a horizontally levelled piece of masonite on top of the pillow. A set square measured the depth of the pillow from the tabletop to the under-surface of the masonite, in millimetres.
The studies reported in this set of papers, study linkages, common subjects, the resultant papers and their objectives are outlined in Figure 1.

<<Figure 1 about here>>
Consistency of Reports of Sleep Quality, Pillow Comfort, and Cervico-Thoracic Waking Symptoms on “Own” Pillow of Known Type and Shape

ABSTRACT

Objectives: To examine the consistency of retrospective and prospective self-reports of “own” pillow comfort, sleep quality, and waking symptoms; to determine whether different pillow types perform differently over time; to identify the pillow types with longevity.

Methods: Sixty one subjects participated in two studies conducted 18 months apart, exploring sleep disruption, waking cervico-thoracic symptoms, sleep quality, and pillow comfort over a week. The first was a telephone survey about “own” pillow performance; the second was an experimental field trial. For 49 subjects, descriptions of “own” pillow provided during the survey were compared with the “own” pillow used during the field trial. “own” pillow performance over time and change in “own” pillow type between studies was reported.

Results: Reports of waking symptoms were consistent over time on the same pillow type. Thirty nine percent subjects changed their “own” pillow type between studies, varying from one-fifth of the polyester pillows to all feather pillows. For subjects who slept on the same pillow type in both studies, reports of waking symptoms and sleep disruption were lowest for polyester and latex pillows, and highest for feather pillows. Pillow comfort and sleep quality were variably reported for the “own” pillow types.

Conclusions: Self-reports of “own” pillow type are believable, and reports of waking symptoms, disrupted sleep, sleep quality, and pillow comfort are consistent. Polyester and latex pillows are generally associated with fewer waking symptoms, higher sleep quality, and least reports of disrupted sleep. Subjects sleeping on these pillow types were unlikely to change them over an 18 month period.

KEY WORDS: “Own” pillow, sleep quality, pillow comfort, waking cervico-thoracic symptoms, consistency of reporting
INTRODUCTION

Despite widely accepted evidence that a good night’s sleep is essential for good physical and mental health (1), the choice of a pillow to assist sleep is under-researched (2). There is a moderate body of evidence which reports preferred sleep position and the consistency of such positions (3-8). However there is very little information regarding the biomechanics of sleep posture on mattresses and pillows (9-12). There is a wide range of pillows on the market which are variably supported by limited research-based information at point of sale to assist purchasers to determine the best pillow for them, or to inform health practitioners so they can advise the purchaser. There is also little information about why some people choose one type of pillow over another, and why and when they decide to change pillows. As indicated in a recent media story, individuals make decisions on pillow purchase based on factors including price, previous experience with that pillow type, the feel and look of the pillow, as well as manufacturers’ claims; however the interplay of key decision-related factors is not well understood (12).

Patented methods for prescribing mattresses in relation to the level of support required by individual consumers are promoted in the marketplace (13). A similar patent has been lodged using a system to assist people to select their pillow (14).

A number of studies researching pillow performance have reported and investigated waking symptoms potentially related to poor performance of subjects’ pillow[s] (15-20) and subjects’ sleeping position (21). However little is known about the consistency, frequency, duration, and type of waking symptoms and whether changing pillow type changes waking symptoms. It is hypothesized that individuals choose to sleep on a particular pillow in order to optimize sleep quality and comfort and to minimize waking symptoms. Subjects who repeatedly suffer waking symptoms without any other known reasons, report changing their
pillow repeatedly in order to reduce symptom production (8). The role of a pillow is to fill the
gap between the sleeping surface and the cervical spine lordosis [curve] in supine or side-lying,
on the belief that a spine held in, or close to, neutral position will not be biomechanically
stressed (22-23).

This paper, the first of two, reports on findings from a subset of 49 subjects of the 61
subjects who participated in both the initial telephone survey (24) [Study 1] and 18 months
later in the experimental pillow field trial (25) [Study 2], and who agreed to have their “own”
pillow visually inspected during the experimental study. This inspection added context to
subjects’ self-reports of their “own” pillow shape and content at the time of the telephone
survey. The aims of the investigation reported in this paper were to:

- examine consistency of retrospective and prospective self-reports of “own” pillow
  comfort, sleep quality, and waking symptoms
- determine whether different pillow types perform differently over time, and
- identify the pillow types which remained in use the longest.

METHODS

Measurement Issues

Study Measurement Periods

Study 1 was a retrospective survey which asked subjects to reflect on a “usual” week.
The data collection process and a summary of the survey questions is reported elsewhere
(7,8,24). Study 2 collected data prospectively for a week on each trial pillow [five experimental
pillows and “own” pillow]. The data collection process and a summary of the prospective
sleep diary are reported elsewhere (25).

Disrupted Sleep

In Study 1, subjects indicated whether their sleep in a recent “usual” week was
consistently disrupted by known factors [illness, children, pets, alcohol, medications, etc]. In
Study 2, subjects could nominate any night’s sleep during the prospective study week which was disrupted for the same reasons. Information on waking symptoms reported after disrupted nights was reported; however, it was excluded from analysis of the effect of the trial pillows, so that analysis focused only on those nights where sleep quality and waking symptoms may have been influenced by the pillow type.

Waking Symptoms

Both studies collected information on waking symptoms [cervical pain, cervical stiffness, headache or scapula-arm pain]. Study 1 collected this as frequency of occurrence in a recent ‘usual’ week and usual duration [an hour or less, half a day, or all day]. Study 2 collected prospective daily information on waking symptoms, their duration [an hour or less, half a day, or all day], and their frequency. For this study, reports of frequency and duration were combined into categories of no problems, occasional short term problems [one to four times per week lasting a half a day or less], regular short term problems [five to seven times a week lasting a half a day or less], occasional longer term problems [one to four times a week lasting all day], and regular longer-term problems [five to seven times a week lasting all day]. Neither study quantified severity of waking symptoms.

Sleep Quality

Both studies collected information on sleep quality as “poor”, “fair” [grouped for analysis], or “good”, “excellent” [grouped for analysis].

Pillow Comfort

Both studies asked subjects to describe the comfort of their “own” pillow by choosing from the categories “perfectly comfortable”, “quite comfortable”, “barely comfortable”, or “uncomfortable”.

Analysis
Demographic, pillow, sleep and waking symptom data was compared for subjects who participated in both studies, and whose “own” pillow type was verified during Study 2. During Study 2, subjects were asked whether they had changed pillows since Study 1, and if so, to what type? Subject age in each study was reported as young [younger than 40 years], middle [40 to 59 years] or old [60+ years]. The data was treated categorically and described using percentages. Differences between categories were calculated using chi square tests, designating the Study 1 data as expected, and Study 2 data as actual. Significance was set at $P<0.05$.

RESULTS

Subjects

There were 61 common subjects from Studies 1 and 2. The “own” pillows of 49 of these 61 subjects [80.3 percent] were inspected. The remaining 12 subjects refused, or were unable to provide their pillow for inspection. This paper reports on data from the 49 subject subset. Gender-age classifications are reported in Table 1. Overall, 81 percent subjects were in the same age-group in both studies. Approximately 46 percent of subjects who were in the youngest age category during Study 1 were reclassified as middle-aged in Study 2, and approximately 12 percent subjects in the oldest age category during Study 2 had previously been classified as middle-aged in Study 1.

Reasons for Disturbed Sleep

In Study 1, approximately one-third subjects reported sleep disturbed for a known reason [68.5 percent women, 31.5 percent men]. In Study 2, 14 percent of the “own” pillow nights’ sleep was disturbed by known reasons [52.1 percent women, 36.4 percent men]. There were consistently more women reporting disturbed sleep in both studies, and similar reasons for sleep disturbance [mostly children and pets, illness, effects of medication, alcohol].

<<Table 1 about here>>
Waking Symptoms

In Study 1, waking in a recent ‘usual’ week with symptoms not associated with a sleep disturbance was reported by approximately 25 percent subjects. The frequency of each symptom report in the previous week, and the length of time these symptoms lasted are provided in Table 2. This finding was not significantly different to the frequency and length of waking symptoms reported prospectively in Study 2, where for ease of reporting, infrequent and regular occasional symptoms were grouped together as occasional, and infrequent and regular longer-term symptoms were grouped together as frequent [reported in the shaded columns]. Age was not significantly associated with any waking symptoms in either study [P>0.05], however, significant and consistent gender differences were observed across studies [P<0.05]. Significantly more men than women reported longer lasting waking neck stiffness, while women’s waking pain, headache, and scapula pain lasted significantly longer than for men.

<<Table 2 about here>>

“Own” Pillow

Study 1 established that subjects used a variety of pillows, with the most common being feather, foam [regular or contour shaped], polyester, and latex. Pillow age varied from a few months to over five years, with one in three pillows being older than five years. Inspection of the “own” pillows used in Study 2 fully confirmed not only subjects’ self-reports of their current pillow type, but also their Study 1 reports of “own” pillow. Table 3 outlines the frequency of “own” pillow use.

<<Table 3 about here>>

Approximately 39 percent subjects had changed pillow type between studies [Figure 3]. The polyester pillow had the lowest rate of change [20 percent] followed by the latex pillow
[25 percent], the foam pillows [54 percent], then the wool [67 percent], followed by the feather [100 percent].

The inspection of “own” pillows in Study 2 verified that subjects who had not changed pillows between studies were probably still using the same pillow, evidenced by pillow history, appearance, and compression [compared with new pillows of same type]. The estimated age of subjects’ “own” pillow had been collected during Study 1. Thus, for subjects who used the same pillow in Study 2, the reported pillow age was adjusted by the time difference between studies [18 months] and reported as clusters of average months of use. The clusters were approximately 18 months [i.e. new at Study 1], approximately 30 months, 56 months, and older [Figure 4]. No feather or wool pillows were consistently used in both studies.

Waking Symptoms

Despite being their regular pillow of choice, subjects’ “own” pillow did not always produce symptom-free waking. Using only the prospective data from Study 2 which provided daily reports of waking symptoms, the “own” pillows which consistently produced the lowest frequency of waking symptoms [across all symptom types] were filled with foam, polyester and latex [Table 4].

New Pillows and Waking Symptoms

Nineteen new “own” pillows were purchased between Studies 1 and 2 [18 months]. All feather pillows were in this category, as were 22 percent foam pillows, 37 percent polyester pillows, and 33 percent latex pillows. Using the Study 2 data only, no daily waking cervical pain was reported on any new pillow, however headache, cervical stiffness and scapula pain were reported [Table 5]. The combined findings of Tables 4 and 5 suggest that pillow age may
have little influence on the role of pillows in producing waking stiffness, headache, or scapula-arm pain.

<<Table 5 about here>>

**Sleep Quality**

Pillow type was consistently related to reports of good and/or excellent sleep quality in both studies [Table 6]. However, there was a discrepancy between study findings in reported sleep quality and waking symptoms for the feather and foam pillows. These pillow types produced the most frequent symptoms and were changed most readily, however they were rated as providing good/excellent sleep. The remaining pillow types provided consistent information.

<<Table 6>>

**Pillow Comfort**

Pillow type was related to reports of good and/or excellent comfort in both studies [Table 6]. Foam regular and the polyester pillows provided the most consistent information. There was inconsistent reports of pillow comfort between the studies for feather, latex, and wool pillows.

<<Table 6 about here>>

**DISCUSSION**

This paper reports new information on the consistency of “own” pillow use, based on a rare opportunity to compare data from the same subjects in two studies conducted 18 months apart. Waking symptoms occurred regularly and consistently on subjects’ “own” pillow in both studies, and thus self-reports of waking symptoms and sleep disruption on subjects’ “own” pillow are believable. Over one-third subjects changed their pillow between studies, with all feather pillows being changed over this time to another type. Reports of waking symptoms and sleep disruption were consistently low for polyester and latex pillows, and consistently
high for feather pillows. This mirrors the finding of Study 2 regarding waking cervical pain reported on the five new trial pillows (25). Pillow age and type variably influenced pillow comfort and sleep quality, which seemed to be independent of waking symptoms.

**Symptoms and “Own” Pillow Choice**

The consistency of waking symptoms related to subjects’ “own” pillow was concerning, as choice of “own” pillow should realistically be made on the basis that it produces the most satisfying sleep and the fewest waking symptoms compared with any other pillow. Even when known reasons for waking symptoms were excluded from analysis, there were consistent reports over 18 months of waking symptoms from otherwise healthy subjects using their “own” pillow. These findings indicate that subjects’ choice of “own” pillow may not be the most informed, subjects may “put up” with regular discomfort and waking symptoms, and their “own” pillow may not be the most helpful sleeping aid.

**Pillow Choice and Replacement**

Longevity of use was observed for polyester, latex, and foam contour “own” pillows, as over half the subjects used the same pillow in both studies. Moreover, if these pillow users had purchased another pillow in the intervening period, it was generally of the same type. Conversely, the rate of change to a pillow of another type for subjects originally using a foam regular pillow was over 50 percent, and all subjects using a feather pillow in Study 1 had changed to another pillow type by the time they participated in Study 2.

**Study Limitations**

This study examined only side sleepers with no recent history of injury or accident to the cervico-thoracic spine (8). No information was collected in either study on the type of mattress on which subjects slept, or the effect of sleeping with a partner, thus the “fit” of pillow to body shape on the mattress was not investigated. Thus there is a need for further research into pillow performance for individuals who regularly assume other sleep positions, and for
people with cervico-thoracic problems. Pillow-person-mattress “fit” also requires consideration. Research is required into how people choose their pillow, and how often, and why, they change it.

CONCLUSION

Waking symptoms and disrupted sleep were consistently and frequently reported on subjects’ “own” pillow. Polyester and latex pillows are generally associated with fewer waking symptoms, higher sleep quality, and least reports of disrupted sleep. Subjects sleeping on these pillows were less likely to change them over 18 months than subjects sleeping on foam or feather pillows.

REFERENCES


2. Shields N, Capper J, Polak T, Taylor N: Are cervical pillows effective in reducing


**Table 1.** Overall Percentage of Subjects by Age Groups and Gender in the Telephone Survey and in the Pillow Field Trial *italics*

<table>
<thead>
<tr>
<th></th>
<th>Age&lt;40</th>
<th>40-59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.2% [6.0%]</td>
<td>16.3% [10.0%]</td>
<td>12.2% [16.0%]</td>
</tr>
</tbody>
</table>
Table 2. Waking Symptoms and Frequency in a Recalled “Usual” Week [Telephone Survey] Compared with the Prospective Experimental Field Study

<table>
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<tr>
<th></th>
<th>None</th>
<th>None</th>
<th>Occasional [1-4 times per week]</th>
<th>Occasional</th>
<th>Frequent [5-7 times per week]</th>
<th>Frequent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TS</td>
<td>EFS</td>
<td>TS</td>
<td>EFS</td>
<td>TS</td>
<td>EFS</td>
</tr>
<tr>
<td>Pain</td>
<td>81.7%</td>
<td>84.9%</td>
<td>16.0%</td>
<td>9.1%</td>
<td>2.3%</td>
<td>6.0%</td>
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<tr>
<td>Stiffness</td>
<td>78.3%</td>
<td>63.7%</td>
<td>18.4%</td>
<td>27.8%</td>
<td>3.3%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Headache</td>
<td>72.7%</td>
<td>83.4%</td>
<td>25.6%</td>
<td>8.3%</td>
<td>1.7%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Scapula and arm pain</td>
<td>76.7%</td>
<td>80.6%</td>
<td>19.2%</td>
<td>13.8%</td>
<td>4.1%</td>
<td>5.6%</td>
</tr>
</tbody>
</table>

TS = telephone survey, EFS = experimental field study
Table 3. Pillow Types Used in the Comparison Studies [N=49]

<table>
<thead>
<tr>
<th>Pillow Type</th>
<th>Telephone survey</th>
<th>Pillow trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester</td>
<td>N=26 [53.1%]</td>
<td>N=27 [55.1%]</td>
</tr>
<tr>
<td>Foam regular</td>
<td>N=6 [12.2%]</td>
<td>N=2 [4.1%]</td>
</tr>
<tr>
<td>Foam contour</td>
<td>N=8 [16.3%]</td>
<td>N=8 [16.3%]</td>
</tr>
<tr>
<td>Feather</td>
<td>N=2 [4.1%]</td>
<td>N=2 [4.1%]</td>
</tr>
<tr>
<td>Latex</td>
<td>N=4 [8.2%]</td>
<td>N=9 [18.4%]</td>
</tr>
<tr>
<td>Wool</td>
<td>N=3 [6.1%]</td>
<td>N=1 [2.0%]</td>
</tr>
</tbody>
</table>
Table 4. Type of “Own” Pillow and Frequency of Waking Symptoms from the Experimental Study

<table>
<thead>
<tr>
<th>Waking symptoms</th>
<th>% cervical pain</th>
<th>% cervical stiffness</th>
<th>% headache</th>
<th>% scapula pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feather</td>
<td>0.0%</td>
<td>50.0%</td>
<td>0.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Foam Regular</td>
<td>0.0%</td>
<td>100.0%</td>
<td>0.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Foam Contour</td>
<td>33.3%</td>
<td>33.3%</td>
<td>0.0%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Polyester</td>
<td>10.0%</td>
<td>40.0%</td>
<td>20.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Latex</td>
<td>14.0%</td>
<td>43.0%</td>
<td>14.0%</td>
<td>29.0%</td>
</tr>
<tr>
<td>Wool</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Table 5. Symptom Production on “Own” Pillow Aged up to 18 Months

<table>
<thead>
<tr>
<th></th>
<th>% waking cervical pain</th>
<th>% waking cervical stiffness</th>
<th>% waking with headache</th>
<th>% waking with scapula pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feather</td>
<td>0.0%</td>
<td>100.0%</td>
<td>0.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Foam Regular</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Foam Contour</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Polyester</td>
<td>0.0%</td>
<td>50.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Latex</td>
<td>0.0%</td>
<td>33.3%</td>
<td>100.0%</td>
<td>50.0%</td>
</tr>
</tbody>
</table>
Table 6. Good or Excellent Quality of Sleep and Good or Excellent Pillow Comfort on Own Pillow [N=49]

<table>
<thead>
<tr>
<th></th>
<th>Good or excellent sleep quality</th>
<th>Good or excellent pillow comfort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Telephone survey</td>
<td>Pillow trial</td>
</tr>
<tr>
<td>Feather</td>
<td>50.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Foam</td>
<td>83.3%</td>
<td>50.0%</td>
</tr>
<tr>
<td>regular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam</td>
<td>100.0%</td>
<td>42.9%</td>
</tr>
<tr>
<td>contour</td>
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<tr>
<td>Polyester</td>
<td>65.4%</td>
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<tr>
<td>Latex</td>
<td>75.0%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Wool</td>
<td>33.3%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

FIGURE LEGEND
Figure 1: Consort diagram showing study subjects, studies and resultant papers in this set

Figure 2: Changes in pillow use between the two studies

Figure 3: The age of pillows [reported as a %] which were used consistently in both studies as determined at the time of experimental study.

Inclusion criteria

Studies

Telephone Survey

Experimental field trial

Experimental posture trial

18 months time difference

Concurrent studies
Figure 1.

Paper 1: To establish the consistency of self-reports of “own” pillow comfort, sleep

N=812 randomly selected

49 common

N=106 who met inclusion criteria [61 subjects from Study 1 & 45 responders]

Paper 2: To describe “own” pillow performance

81

N=95 [81 subjects from Study 2 and 14 additional responders to newspaper advertisement]

Paper 3: To establish whether use of a specific

N=812 randomly selected

N=81 randomly selected subjects from electoral roll

N=106 who met inclusion criteria [61 subjects from Study 1 & 45 responders]
Figure 2.
Figure 3.