BSc (Hons) Osteopathy - Module: U49599

OXFORD BROOKES UNIVERSITY

Effectiveness of a Postural Awareness Software (PAS) for increasing the postural awareness on computer users

An exploratory study into PAS user's perception of changes to their posture for a better understanding of the potential of this tool to the Osteopathic profession

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1. Abstract

Background: The number of work days lost due to musculoskeletal disorders (MSD) makes the search for strategies to prevent them a priority. This study looked at the effectiveness of PAS on a potential precursor for MSD's: posture awareness.

Participants: Data was examined from 41 participants (26 female, 15 male) out of an initial 50, drop out rate of 18%. 68% of patients were aged between 20 and 40. 14 were osteopathy patients.

Methods: Participants installed PAS in their computer and used it for 2 weeks. It prompted the participant to perform previously shown exercises during the use of computer.
5-point Likert scales were used in 2 questionnaires to auto-assess posture awareness before and after the use of PAS. The patients' compliance with the exercises prescribed was also auto-assessed and compared with this result to understand its influence. Exploratory qualitative data was obtained through the use of a comment box to retrieve participants' opinions or remarks in their own words.

Results: Significant improvement in postural awareness could be demonstrated. The Wilcoxon signed-rank test showed $\rho < 0.05$. The progression of postural awareness found no correlation with the compliance of the participants or with any of the other variables used.

Conclusion: Using PAS may be an option for the Osteopathic profession to obtain better treatment outcomes for computer users. Its role on patients' posture awareness and compliance with prescribed exercises were identified as areas for future research.

2. Introduction

2.1. Aim

The aim of this study was to assess the effectiveness of a software tool (PAS) on the computer user's perception of posture.

PAS reminds computer users about their posture by providing regular on-screen prompts and displays stretching exercises that they can follow.

The lack of osteopathic literature targeted at understanding new strategies to intervene in the management and treatment of computer users led to an increasing interest in this area.

Research Question: Can PAS increase postural awareness in computer users?

Null-hypothesis: HO1: PAS does not increase postural awareness in computer users

2.2. Background and Justification

The UK Health and Safety Executive (HSE, 2006) has identified MSDs as a priority because they affect large numbers of people across most industries and occupations. In 2003-4 the HSE estimated that 4.7 million working days were lost through work-related MSDs, affecting the upper limbs or neck.

The majority of computer professionals were found to have computer-related health problems and the incidence of MSD increased with the amount of time spent working at a computer (Talwar *et al*., 2009; Klussmann, *et al*. 2008).

According to Edmondston, *et al*. (2007), more than one quarter of office computer users suffer from neck and shoulder girdle pain. Osteopathic philosophy asserts that environmental, social, mental and behavioural factors contribute to the aetiology of disease and illness and need to be addressed as part of any management plan. (Chila, 2010).

2.3. Posture Related Problems

Work related upper limb musculoskeletal disorders (WRMULSD) can occur as a result of spending time at the workstation in a relatively fixed posture without taking adequate breaks. The lack of movement affects the circulatory system with the reduced blood supply allowing the build up of metabolites, excitation of nociceptors (Larsson *et al*., 2007) and causing the body's tissues to undergo physiological changes due to their viscoelastic properties (Norkin and Levangie, 1992). A constant stretching load on muscle fibres can cause elongation or creep in the muscle tissue resulting in a remodelling of the fibres and a new increased length affecting the mechanism of proprioceptive control based on muscle spindle activity (Kumar 1993; Ming, *et al*. 2004). This can adversely affect muscle function causing other muscles to compensate for the loss of function resulting in repetitive strain and overuse problems (Chaitow, 2006; Szeto, *et al*. 2009).

2.4. Posture Awareness

There is no consensual definition for posture awareness. Most of the literature refers to its role in self-consciousness, some will approach a definition based on somatic proprioception and self-specifying information (Bermúdez, 2009).

Symptomatic subjects (postural neck pain) tend to have a different perception of what 'good posture' is, compared to asymptomatic subjects according to Edmondston, *et al*. (2007). He studied the clinical relevance of the perception of own posture on sitting subjects. The postural neck pain group understood 'good posture' as more cervico-thoracic extension; it was discussed that this maintained posture for long work hours would contribute to the symptoms.

The ability to maintain a previously taught posture also deteriorates with time (Kumar, 1993). The accuracy of repositioning the spine has been found to be reduced in those with a 'slouched'

posture. Posture awareness was indicated as one of the strategies to prevent injuries (Dolan and Green, 2006).

2.5. Exercises during work

The static loading posture, characteristic of computer users requires active breaks to encourage circulation, oxygenation, concentration, muscle stretching and a better balance of proprioceptive activity (Wilson, 2002).

Past research has shown that the use of regular breaks and exercises can reduce the impact of work-related upper limb musculoskeletal disorders (WRULMSD) (Monsey, *et al*. 2003; van den Heuvel *et al*., 2003; Trujillo and Zeng, 2006; Galinsky *et al*., 2000; Galinsky *et al*., 2007). None of the studies reported any adverse effects resulting from the addition of stretching exercises to the participants' daily routine. Taking regular breaks is recommended by the HSE (2006).

2.6. Software reminders

The use of computer software as a means to educate the patient and to facilitate the practitioner-patient collaboration has been tested and put into practice for over a decade. Problem-solving exercises, the ability to retrieve, organize and analyse the data and persuasion have been found to be very useful factors which can lead the way for new software tools to be developed (Skinner *et al*., 1993; Buchanan and Carenini, 1998; Fogg, 2003). This interaction concept is currently under study to provide counselling and reveal changes in cognitive and affective attitudes (Becker *et al*., 2010). This interaction towards physical activity was the topic of Monsey, *et al*. (2003) who looked at the use of computer reminder software to prevent repetitive strain injuries and suggested that it could have an impact on the number of stretch breaks. It was also concluded that using software to remind computer users to take breaks contributes to perceived recovery from MSDs (Van den Heuvel, 2003).

Significant reduction in symptoms in school children was found when on-screen reminders were used as a posture education tool in a study by Robbins, *et al*. (2009).

By taking short breaks and occasionally stretching, workers do more accurate work and as a result are more productive, according to a study by Lang (1999).

2.7. Compliance with exercises

Compliance is defined as the extent to which patients adopt the behaviours recommended by their practitioners. Non-compliance has been identified as one of the factors which have a negative impact on treatment outcomes (Bassett and Petrie, 1999).

In the field of osteopathy, concerns with compliance have been raised. Studies run by osteopaths in Australia suggest that positive attitude, more education, more positive health, sports and exercise experiences are more likely to increase compliance with prescribed exercises, which increases the probability of a successful treatment outcome (Wheller, *et al*., 2006; Howard and Gosling, 2008).

Compliance with treatment can be enhanced if patients understand the rationale and the importance of their role in recovery. The use of educational and behavioural modification methods such as treatment goals is assumed to be a probable way of improving this understanding (Sluijs and Knibbe 1991; Bassett and Petrie, 1999) as well as understanding what their bodies are doing and what the effects of the exercises are (Chila, 2010).

It is recommended that exercise is prescribed with accompanying written and illustrated instructions to increase compliance (Schneiders, 1998).

Motivation and compliance seem to be directly related (Friedrich, *et al*. 1998), therefore more strategies and tools are needed for osteopaths and other health professionals to achieve greater compliance from their patients.

3. Methodology

3.1 Study design

This study was designed to collect primary data from computer users by means of 2 questionnaires during a period of 2 weeks. This period of time was chosen based on practical limitations and the results of studies by Fenety and Walker (2002) and McLean, *et al*. (2001) which found that 10 to 14 days was sufficient time to identify musculoskeletal changes following exercises carried out by computer users.

This is one part of a study looking at the effectiveness of PAS on computer users and it shares the methodology and data collection with another part which will look into the effects of PAS on reported symptoms. This is a replicable study and was given clearance to be carried out by Oxford Brookes University Ethics committee - SH&SC REC Study no. 2009/30.

The project was structured in 3 phases (Appendix G):

1 – Develop the PAS and documentation.

2 – Run a pilot study to assess the software and procedures.

3 – Run this study, collect the data and analyse it.

Phase 1 – The development of the Postural Awareness Software, information sheet, installation information, consent form and supporting questionnaires.

a) Documented and tested the exercises that were incorporated into the PAS.

b) Designed an information sheet outlining the study.

c) Tested the software in different operating system environments.

d) Designed the questionnaires to meet our research questions and a few exploratory questions.

e) Produced a participant pack including an installation CD for the PAS and user installation instruction sheet.

Phase 2 – The pilot study included user acceptance testing (UAT) of the software and a questionnaire to highlight any problems.

a) Recruited participants for UAT which ran for 2 weeks. This involved a small number of friends and colleagues with the main aim of obtaining feedback prior to producing a final version of the software.
b) Logged and document any problems identified during the pilot.
c) Created a final version for the participant pack.

Phase 3 – Recruited volunteers, issued PAS package and collection of data.

a) Recruited participants that met the inclusion criteria for the study.
b) Carried out a short presentation of the PAS to familiarise the participant with the software, demonstrated how to safely perform the exercises and then obtained their written consent before issuing the PAS package.
c) Asked participants to fill in the first part of the questionnaire (Sections 1 and 2).
d) At the end of the trial period the participants were sent their participant codes by email and asked to complete the on-line part of the questionnaire (Sections 3 & 4), including feedback on the study itself.
e) Retrieved and analysed the data using Microsoft Excel for general demographics and correlations and PRISM for the Wilcoxon signed-rank test.

3.2 Software design

The PAS provides an on-screen prompt illustrating an exercise, instructions on how to execute it and an option to change the time period between prompts.

It was written by the author of this study and compiled in Microsoft Visual Basic 6.0. The software was originally designed for personal use, with a broader view that it could be a valid tool to osteopaths or other health care professionals.

The software was designed and tested on Windows compatible machines running on 32 or 64-bit versions of XP, Vista or 7 versions.

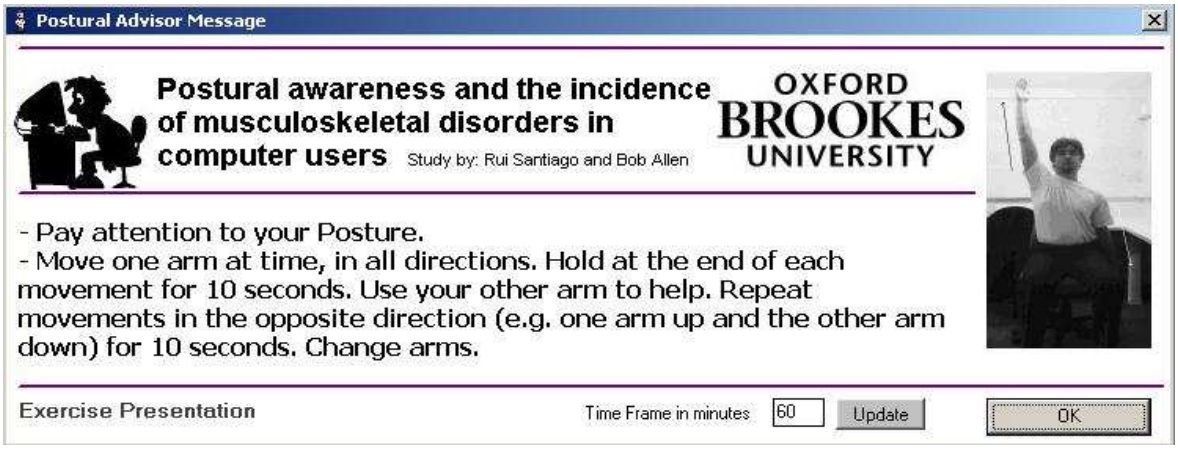


Fig 1. Screen-shot of PAS displaying a message with an exercise description and its corresponding image.

3.3 Questionnaire design

The questionnaire was based on one used by Mulligan (2009) and included demographics questions, questions relating to the direct aim of the research and 3 more questions for exploratory purposes. In all questions a comment box was added to retrieve participants' opinions or remarks in their own words.

In order to quantify posture awareness, the reference used was a study by Garmer, *et al*. (2002). A questionnaire using a simple subject rating scale (1-10) was used to validate the hand-strength kit through the perceived awareness of strength. Kumar (1993) states that self-assessment and

reporting of posture can be found to be a reliable and valid technique to quantify posture awareness.

Subjective posture awareness was compared before and after using PAS, retrospectively by means of 2 5-point Likert scale questions (Questions 17 and 18 – Appendix E). The reason for this was that any questions about posture and postural awareness asked before the use of PAS would immediately make the participant more aware of their posture and could create expectations which could potentially affect the outcome of the study.

Compliance could not be asked retrospectively or compared before and after the intervention, so it was decided to ask the same question in 2 different formats (Questions 15 and 16 – Appendix E), as 5-point Likert scale or percentage of use questions. The 5-point Likert scale method was previously used by Howard and Gosling (2008) and the percentage one by Schneiders. *et al*, (1998). Ideally the software would have been designed to retrieve user compliance data, but that was not possible.

All the questions were validated by the pilot study and were designed according to the Oxford Brookes University Ethical standards for research involving human participant's code of practice.

The decision to use a questionnaire was based on its growing use to assess the health of individuals following a medical or psychosocial intervention. Classically more often employed in clinical trials, they can be used to monitor individual patients with a clinical setting. Patient-reported measures are increasingly being used in routine evaluation of health care (Neale, 2009).

3.4 Recruitment

Participants were recruited from Oxford Brookes University and Mill Court Clinic using leaflets and posters. Sampling followed a mixed method using incidental sampling (through requests to colleagues), volunteer sampling (based on people responding to the leaflet) and snowball sampling (where key individuals were identified and asked to distribute the information sheet to people who meet the criteria of the sample).

There was no payment or incentive for participation in the study and no feedback was given to patients regarding their participation.

Potential participants that contacted the researchers were given a short presentation, with the following steps:

- Presentation of the study and what would be required from the participant (Appendix A)
- Demonstration of how to perform the exercises (Appendix B) and make sure participant can perform them safely and efficiently.
- Asked to sign the consent (Appendix F)
- Asked to fill in the questionnaire part 1 (Appendix D)

Once this was completed they were given the participant pack and an exercise hand-out. In addition they were given the start and end dates for their involvement in the study.

3.5. Subjects

There were no exclusions based on ethnic group, religion or gender, with the aim of recruiting computer using participants of all ages and from all occupations.

The target sample size was 75 participants with an estimated final sample size of 45 assuming there was a 40% drop out rate as found in a similar study by Mulligan (2009).

Table 1- Inclusion / Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Use of computer >=1h a day. Use a Windows Operative System (XP, Vista or 7). 32 or 64 bits. Either at home or workplace. Administration right to install PAS in the working computer.	Treated at Mill Court Clinic by the research students. Anyone under the age of consent i.e. < 18 years of age.

As an exploratory study, it was decided to keep open as many variables as possible so that any tendencies emerging from the data could be interpreted and potentially better designed studies could be created. No power calculations were performed.

3.6. Documents Used

These are the formats of the documents used during the study:

- Participant Information Sheet (both A4 and leaflet formats)
- Handout of the exercises (A4 format)
- PAS Installation Instructions (portable document format (PDF) and A4 formats)
- Initial Questionnaire (A4 format)
- Final Questionnaire (on-line – surveymonkey.com)
- Consent Form (A4 format)
- GANTT Project Plan (Excel spreadsheet)

4. Results

Although in this study a more quantitative approach to the data retrieved was used, participants were encouraged to provide comments and additional feedback. Not many took that opportunity, but some of those comments were taken into account in the discussion part of this paper. Out of a total of 50 participants recruited, 41 finished the study; the drop out rate was 18% - the reasons for the drop out were not asked or given. Data has been cleaned and anonymised prior to its analysis in Microsoft Excel and PRISM Software.

4.1. General Demographics

Table 2 - General demographics and type of computer use

Demographics characteristics	Description	n	%
Gender	Female	26	63.4
	Male	15	36.6
Age	18-20	2	4.9
	21-30	15	36.6
	31-40	13	31.7
	41-50	7	17.1
	51-60	4	9.7
	61-65	0	0
	Over 65	0	0
Type of computer used	Desktop	20	48.8
	Laptop	16	39
	Both	5	12.2
Hours spent at computer daily	Less than 1h	1	2.4
	Between 1 and 3h	11	26.8
	Between 3 and 6h	11	26.8
	Between 6 and 8h	15	36.6
	More than 8h	3	7.3
Longest before break at computer	Less than 1h	3	7.3
	Between 1 and 2h	25	61
	Between 2 and 3h	10	24.4
	More than 3h	3	7.3

4.2. Posture Awareness Data

In order to obtain a general overview of the posture awareness responses, we compared the results before and after the intervention. This visual distribution illustrates a quite marked difference in self-assessment of postural awareness after the use of PAS (chart 1 and 2).

Chart 1 - Postural Awareness, by scale, before and after usage of PAS.

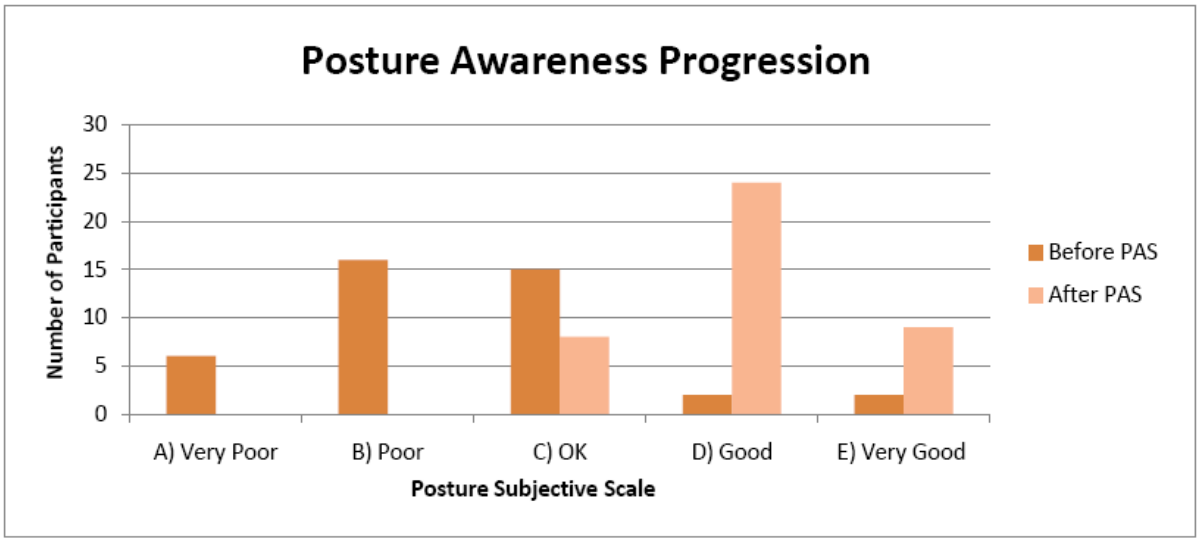
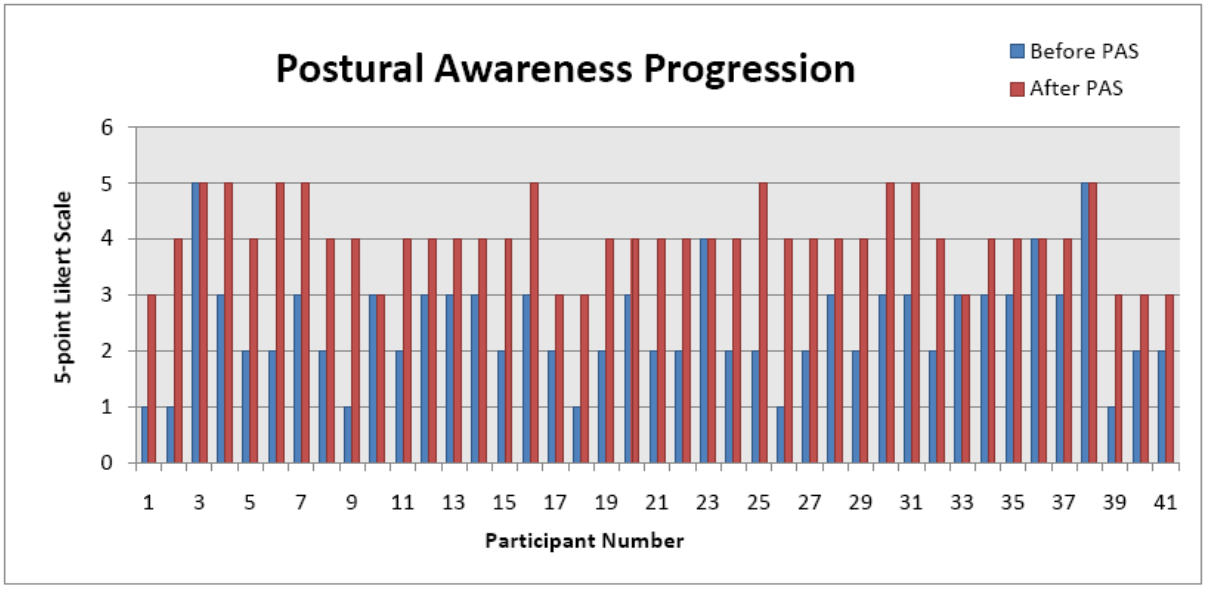


Chart 2 - Postural Awareness, by participant, before and after usage of PAS

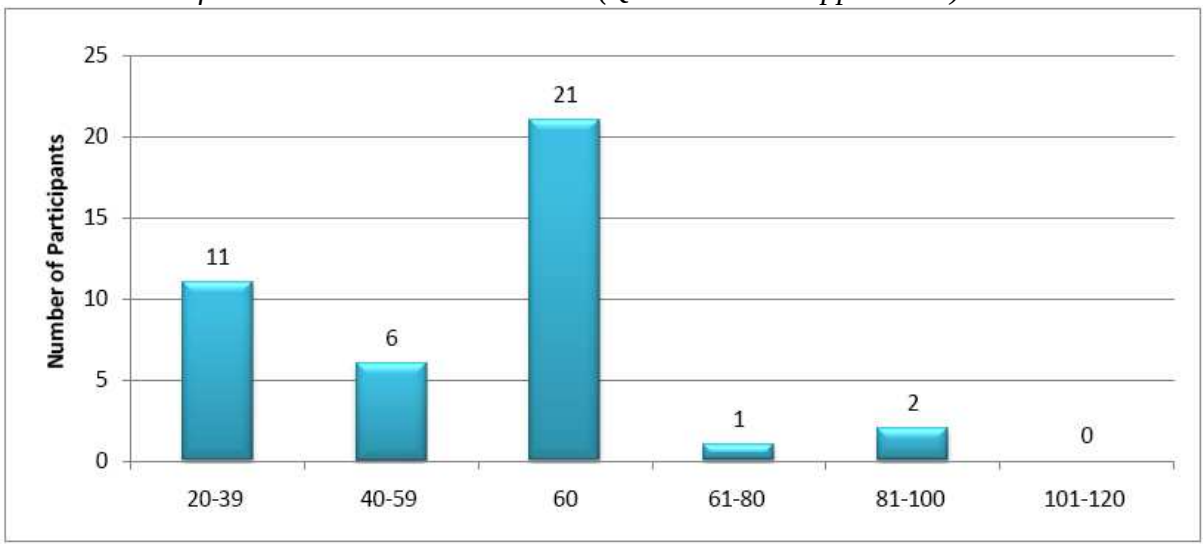


The visual analysis shows a clear quantitative difference after the use of PAS, but in order to understand if the differences between the answers can be attributed to the intervention or whether they could have occurred by chance alone, the non-parametric Wilcoxon signed-rank

test (non-Gaussian population for 2 paired groups) was performed, using PRISM Software, with a significance level of $\rho < 0.05$ (Fisher and Foreit, 2002) and two-tailed ρ value. The result was $\rho = 0.0028$ with pairing significantly effective (before and after measurement vary together) proving the null-hypothesis wrong.

4.3. Exploratory Data

Chart 3 - Time frame used between reminders (Question 14 in appendix E)



This chart show a clear predominance of shorter breaks between the on-screen reminders, the majority preferring 60 minutes.

Chart 4 – Percentage compliance with the PAS exercises (Question 15 in Appendix E)

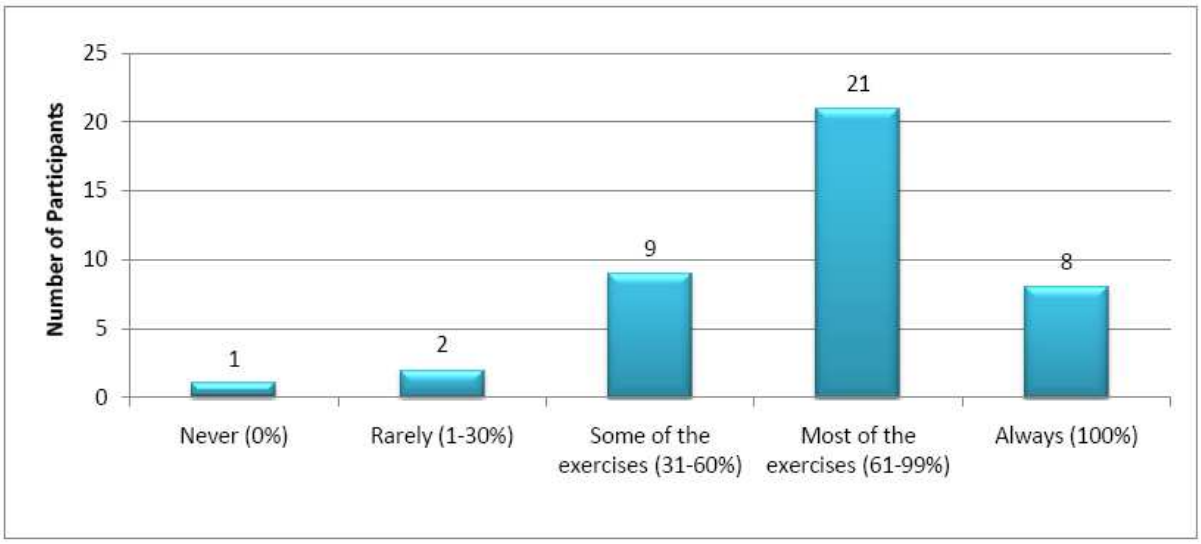
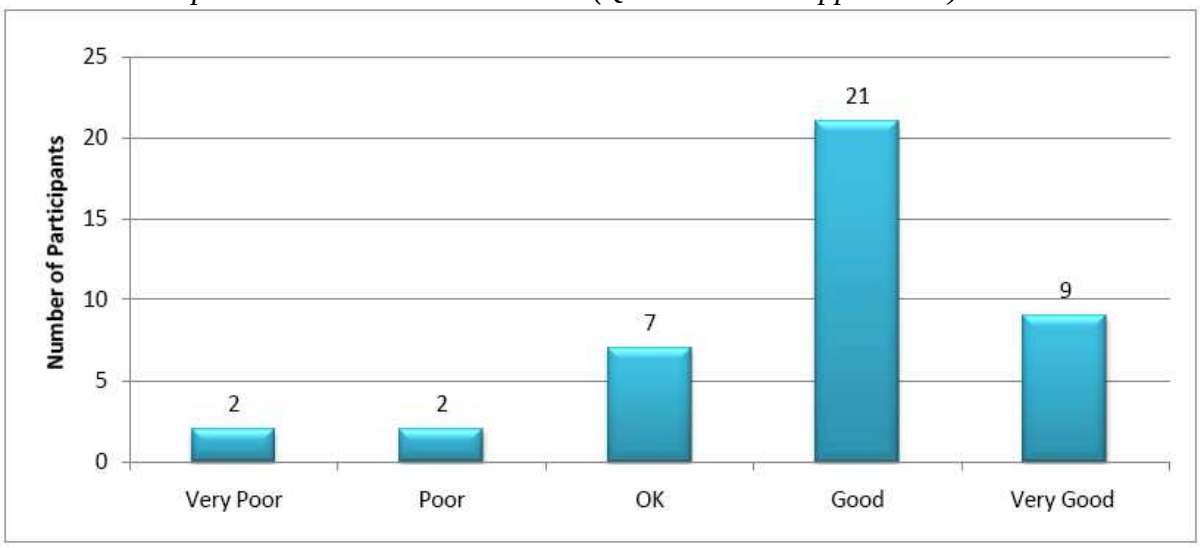


Chart 5 – Compliance with the PAS exercises (Question 16 in Appendix E)

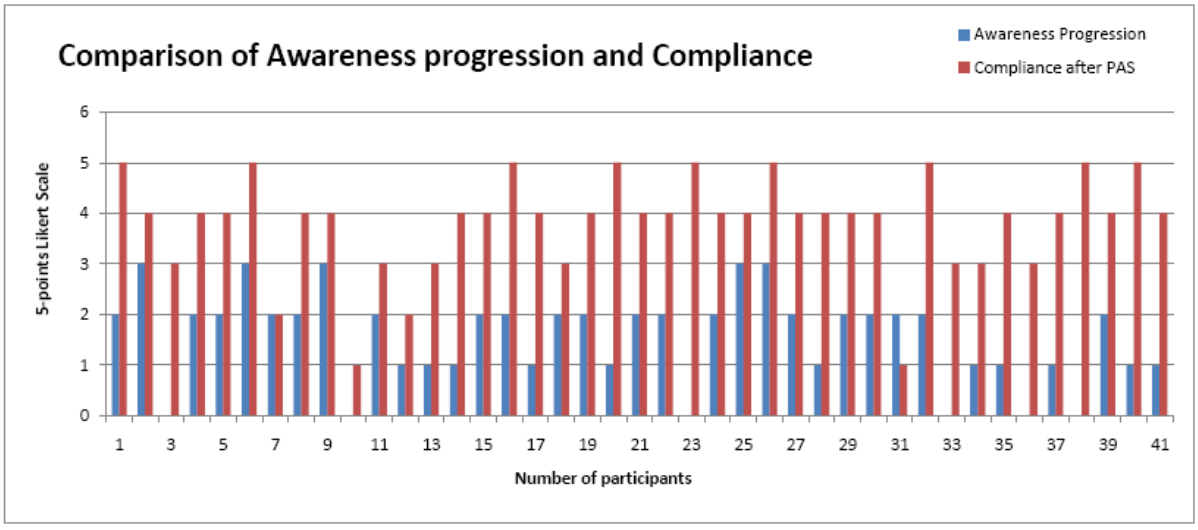


In order to understand if the compliance had an influence on the postural awareness results, we compared its progression with the compliance results. The compliance questions were compared and screened for possible discrepancies (chart 4 and 5).

It was concluded by a visual analysis that the participants' perception of compliance in terms of the percentage of times they did the exercises and their subjective assessment of compliance are highly related. 51% of the participants showed a good compliance with the use of PAS.

Progression of awareness was then compared with compliance (difference between results of questions 17 and 18 and question 16 in Appendix E) (Chart 6).

Chart 6 - Relation between compliance and prescribed exercises



The correlation function from Microsoft Excel Data Analysis tool was used to observe if there was a common variability. The value reached was 0.235, showing no strong relationship between the variables.

Other correlations, between the progress of awareness and other variables were analysed. None of these correlations showed a strong relationship (Table 3).

Table 3 – Correlation of Progress of Posture Awareness with other variables

Variable	Correlation Coefficient
Age	-0.023
Gender	0.149
Type of computer	0.136
Hours daily spent at computer	0.252
Length of breaks at the computer	0.027
Participant was osteopathy patient	0.227

5. Discussion

This study showed a significant increase in the reported awareness of posture among computer users after the use of PAS for 2 weeks.

5.1. Relationship between awareness and symptoms

In the other part of this study, which shares the same methodology and looked at symptoms, it was found that after the use of the PAS, there were more reported symptoms in some areas of the body and less in others. This is not a complete surprise. Coury (1998) found that, in a study of sedentary workers following a self-administered preventive programme concentrating on their perception of any MSD, the participants reported more symptoms. The likelihood that this was due to an increased awareness was discussed. On the other hand, when used on children, there was a significant reduction of MSD symptoms reported (Robbins *et al*., 2009). The fact that postural awareness may increase symptom awareness in adults is a new field to be studied.

5.2. Exploratory Questions

Some questions were designed to retrieve data which could help in formulating future research questions.

Postural Awareness

All the variables compared with the progression of awareness through the correlation function showed very low relationships. Correlation was higher in participants who spent more hours in front of a computer or were osteopathy patients. In future studies, narrowing of these variables may help to attain a clearer picture of which variables influence subjective postural awareness.

Compliance with exercise prescription

A correlation between the participants compliance and the progression of awareness, was not found (chart 6), showing that compliance might not have an influence on the postural awareness outcome. The present workload of the participants was the most commented dissuasive factor for their full compliance with the software.

Exercise breaks at work

Work breaks could be used in a way to promote health by means of exercise; it is an opportunity yet untapped to reduce unhealthy behaviours and promote healthy ones (Wendell, 2005). A systematic review by Brewer, *et al*. (2006) of the effect of office interventions on musculoskeletal and visual health concluded that rest breaks combined with exercise had no effect. This contrasts with studies by Henning, *et al*. (1997), Fenety and Walker (2002), Saltzman (2002) and Lacaze, *et al*. (2010) which found that regular rest breaks and exercise could reduce musculoskeletal discomfort. It is worth noting that the Brewer review found that the "evidence was insufficient" to draw conclusions about the benefits of rest breaks and exercise training rather than stating that the interventions were ineffective. 61% of the participants in this study, take breaks every 1-2 hours. PAS may have the potential to help introducing more exercise breaks during work.

Length of break

Analysis of the used time frame (chart 3) showed that most participants opted for 60 minutes. This was the value by default presented by the software; therefore it is not conclusive if it was always adjusted to personal needs.

Taking short breaks for at least every hour was highlighted (Ming *et al*., 2004) as one of the methods of preventing development of WRMULSD.

Continuous computer user discomfort can be moderated by short rest breaks at 10 to 15 minutes intervals for a period of 20 seconds and by continuous feedback about rest break behaviour with untoward effects on performance, well-being or acceptance (Henning *et al*., 1996; Henning *et al*., 1997).

Qualitative data

It showed very distinct user types revealing various difficulties, mostly concerning work load, tiredness and work station set-up preventing some exercises.

Compliance with the exercises seemed to be greater after long periods in front of the computer when compared with short ones.

Other comments acknowledged how surprised some participants were with their own posture when the reminder was presented, some even changed the prescribed exercises to others that worked better for them and used the reminder to do them, to just relax or as an opportunity to get up and walk around.

As participants spent more time thinking about their posture and the exercises they raised concerns about ergonomic factors.

Another observation was that more time using the software might be needed to feel the benefits to their postures.

5.3. Study limitations

These are the most relevant methodological limitations found in this study:

Control group

This approach was considered not viable for an undergraduate level project.

The use of a control group should however be considered as a requirement for any future studies, as it would reduce the risk of bias.

Blindness

Ideally, double blindness would have been used in this study, but the absence of a control group and the limited resources available made it not viable. It would have required that both the investigators and the participants were unaware of the group to which the patient was assigned to prevent being influenced by that knowledge.

It is particularly important to decrease the chance of bias in a study when the outcomes are subjective, as in this case (Neale, 2009).

Sample size

The sample size of 50 participants was considered appropriate for this study, nevertheless it is very small. Future studies should aim to a much bigger sample size, if possible from different geographic and cultural areas. When targeting a specific population and intervention, sample size should be calculated.

Participants who were patients

Some participants were receiving osteopathic treatment (39%), which could influence the results and reduce the chance that the intervention alone was causing the results.

As an exploratory variable, a correlation was not found between the postural awareness progression and the fact that those participants were patients.

Subjectivity

The information obtained from this study is completely dependent on the subjectivity of the participants' responses, therefore more objective means of evaluating patients postural awareness would have to be considered and introduced.

Computer user profile

Although not explicit in the questionnaire, some participants chose both options for the type of computer used. Another volunteered the option of using a laptop with desktop set-up. These are variables that need to be considered in further studies.

5.4. Clinical implications

From the qualitative data and the recruitment experience, the enthusiasm of the participants for using PAS was clear. Clinically, it would work as an extra tool available to the osteopath to address computer use as a maintaining factor.

PAS seems to have a good effect on patients' compliance with exercises or advice given by the clinician, opening doors to a treatment outside the treatment room paradigm.

It can be used preventively, as discussed before, through increased awareness, or by earlier interpretation of symptoms, preventing more severe conditions.

The idea is that it would be free to the patient and it would include general exercises / advice to the computer user or tailored to patient specific complaints / biomechanical factors / work type / work station limitations / periodic work load increase.

Following participation, when asked if they kept using PAS, out of a total of 39 answers, 69% declared that they are still using it and some even passed it on to family, friends and work colleagues.

5.5. Suggestions for future research

Future studies, using this technology (with the necessary alterations) should consider the following:

- Can PAS increase compliance with postural advice in asymptomatic computer users?
- Can PAS increase compliance with prescribed exercises in asymptomatic computer users?
- Study the effectiveness of stretches and exercises commonly prescribed by Osteopaths to computer users.
- Comparative study of optimal length of breaks for the computer user.
- Study of the optimal PAS use time to increase the awareness of posture.

For the reasons presented above, having a tool which may involve, help and motivate the patient in their own recovery, is present during the work time and makes the patient also responsible for their improvement could be a tool for osteopaths.

This study may represent the start of a process of validation of PAS as a therapeutic tool for osteopaths or other health care professions. There are several commercial packages available for office workers, but none as a tool that osteopathy or other health care professions could use to adapt to the patient's specific needs.

6. Conclusion

Posture associated problems are a very common precursor to WRMULSD in computer users.

This was the first study looking at postural awareness, completely developed and conducted by osteopathy students and using exercises commonly prescribed in an osteopathic clinic.

It was concluded that software reminders with exercises can be a useful tool for osteopaths to use in a clinical setting, involving the patients in their treatment and management. The scope of the study focused mostly on the awareness of posture, but the potential for more studies with this type of population, using this technology appears to be considerable and should be explored.

7. Acknowledgements

I would like to thank my supervisor, Philip von Hauenschild, for his advice and support throughout this study and for agreeing to be our supervisor when, at a critical time, we were left without one.

I would also like to thank Dona Williams for her precious help at Mill Court Clinic, setting up the interviews.

Many thanks to the participants, who gave their time generously; this study would not have been possible without them.

Also, my thanks to the Brookes University ethics committee team, for their guidance during the approval of the ethics application for this study.

Finally to my friend and colleague Bob Allen, for all his patience and perseverance during all the difficulties and the busier moments designing and running this study.

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Appendix A – Participant Information Sheet

Information Sheet

Title: A study of Postural Awareness and the incidence of musculoskeletal disorders in computer users.
Student investigators: Rui Santiago & Bob Allen
Research Supervisor: Philip Von Hauenschild
Academic institution: Oxford Brookes University
Date: 14th September, 2010

You are being invited to take part in a research project. Here is some information to help you decide whether to do so. Please take the time to read this information carefully and discuss it with friends or relatives if you wish. If there is anything you do not understand, or if you would like more information, please do not hesitate to contact us.

What is the purpose of the study?
The UK Health and Safety Executive (HSE) have identified musculoskeletal disorders (MSD) as a priority because they affect large numbers of people across most industries and occupations and more importantly it is possible to prevent or minimise their effects. A number of approaches have been used to reduce the incidence of work-related upper limb musculoskeletal disorders (WRULMSD) including the use of shoulder exercises, real-time visual feedback to improve posture and neural stretching of the upper limbs.
The postural awareness software (PAS), that has been developed for this study, will provide regular on-screen prompts to remind the computer user to check their posture and it will display stretching exercises that will help to reduce any muscular tension.
The study aims to consider:

- Whether Postural Awareness Software (PAS) can have an effect on the self-awareness of posture in computer users?
- Is compliance with prescribed exercises affected by the use of PAS?
- Can the use of PAS reduce the severity of WRULMSD in computer users?

This study will indicate whether PAS is a valid tool for increasing postural awareness in computer users and whether it can affect the incidence of WRULMSD.

Why have I been invited to participate?
We are looking for participants who currently use a computer on a daily basis and would be prepared to take part in our study. The PAS needs to be installed on a computer running a 32 or 64 bit, Windows-based operating system i.e XP, Vista or Windows 7.

Do I have to take part?
The decision to participate in this study is entirely voluntary. You will be asked to sign a consent form, however, as a volunteer you can opt out at any time without having to give a reason.

What would happen to me if I take part?
Anyone agreeing to take part in the study will be invited to attend a one-to-one meeting, either in Mill court Osteopathic Clinic or the School of Health and Social Care at Oxford Brookes University. The meeting, will not last more than 20 minutes, where you will be given a brief overview of the study together with an:

- explanation and demonstration of good posture with some exercises at the computer and a printed copy for you to take away.
- information pack containing a CD ROM of the PAS and installation instructions.

If you are happy with the information provided and wish to take part in the study you will be asked to sign a consent form and then to complete Part 1 of the questionnaire (Sections 1 & 2).

The study will last 2 weeks beginning with the installation of the software. After that period, you will be asked to complete Part 2 (Sections 3 & 4) of the questionnaire which will be on-line (we will email you a link allowing access after 2 weeks of software use).

What happens at the end of the study?
After the completion of Part 2 of the questionnaire, your participation ends. You will have the option to keep the software at no charge or you can easily remove it from your computer (details on uninstalling the software are included in the installation instructions handout).
We will still be available to be contacted if you have any questions and we will welcome your feedback about the study.

What are the possible benefits of taking part?
The use of the PAS is to encourage you to maintain good posture and to take regular rest breaks with exercise, during computer use. Your participation in this study will also contribute to additional knowledge in this field.

Risks and potential discomfort
To minimise the possibility of any discomfort during the study the initial meeting will be used as an opportunity to ensure participants can carry out the exercises safely and correctly. The PAS has been thoroughly tested for safety both to the user and their computer.

Would my taking part in the study be kept confidential?
All data will be collected and stored in accordance with the Data Protection Act 1998 and it will not be possible to identify any participant from any publication. The data will be held in a secure password-protected environment and will only be accessible to the students.

Who has approved the study?
Oxford Brookes University SH&SC Research Ethics Committee has reviewed the study – Project number: 2009/30.
Please note that if you have any concerns about the conduct of this research project you can contact the Chair of the SH&SC Research Ethics Committee at Oxford Brookes University at the following email address: heabbott@brookes.ac.uk

What will happen to the results of the research study?

The results of the study will be used for the dissertation project of the 2 students and may also be published in a related journal. Participants can contact the students directly if they would like a copy of the results.

Who can I contact if I have any further questions?

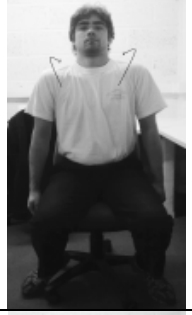
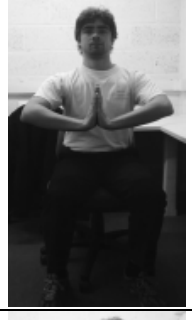
Research Students	**Rui Santiago** Telephone: 07748204081 Email: 06084852@brookes.ac.uk **Bob Allen** Telephone: 07515014308 Email: 06084177@brookes.ac.uk
Project supervisor	**Philip Von Hauenschild** Associate Lecturer in Osteopathy at Oxford Brookes University Telephone: 07590283720 Email p0016656@brookes.ac.uk

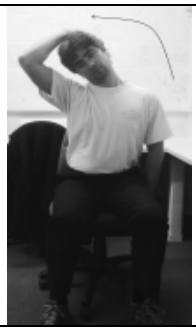
Appendix B – Exercises Handout

Exercises

The following exercises are provided as a printed reference covering the exercises that are included in the Postural Advice Software.

Very Important: Please note that you may feel a small degree of discomfort while performing these exercises as they will be stretching and moving muscles that are not used to this type of movement. *However,* if at any point you experience any pain then stop and note which exercise caused the discomfort. When you have the opportunity please contact one of the researchers who will be able to provide you with relevant information regarding what caused the discomfort and will advise you on what can be done to avoid it happening again.

Back • Move one arm at time, in all directions for 10 seconds. • Then, hold at the end of each movement for 10 seconds. • Move your arms in opposite directions i.e. one arm up and the other arm down and hold for 10 seconds. Change arms and repeat.	
Shoulders • Roll your shoulders slowly to the front and then to the back. • Draw both shoulders back for 10 seconds and then forward for another 10 seconds. • Link your fingers behind your neck, bring elbows together and slowly make a figure of 8. Do this 10 times in one direction then the other.	
Hands and Wrists • Put your palms together, elbows pointing to the sides, push together gently for 10 seconds. • Repeat with the backs of your hands together. • With your arms in front of your body open and close your fingers 10 times. • Interlock your fingers, keep wrists and forearms together, and make circles with your wrists.	
Shoulders and Back • Place your hands on your waist with your thumbs to the back, then move your elbows back, for a stretch in your shoulders. Hold for 10 seconds • Change your hand position so that thumbs are to the front and do it with the elbows to the front. Hold for 10 seconds	

Neck Tilt your head to the side taking your ear towards your shoulder and use the weight of your arm, to gently increase the stretch in your neck (do *not* pull as this could overstretch and damage your neck muscles). Do this for both sides holding the stretch for 10 seconds each time.	

Contacts

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Project supervisor	**Philip Von Hauenschild** Associate Lecturer in Osteopathy at Oxford Brookes University Telephone: 07590283720 Email p0016656@brookes.ac.uk

Appendix C – PAS installation instructions

Introduction

The Postural Awareness Software (PAS) used in this study was created to support the maintenance of good posture while using a computer and to provide stretching/ strengthening exercises to help reduce the incidence of work-related upper limb musculoskeletal disorders (WRULMSD). Once installed the software will provide the computer user with regular reminders to check that they are maintaining 'good posture' (refer to the information sheet for more details on what a good posture is). The computer user will also be given exercises to help relieve any existing muscular aches and pains and to reduce the incidence of any new problems.

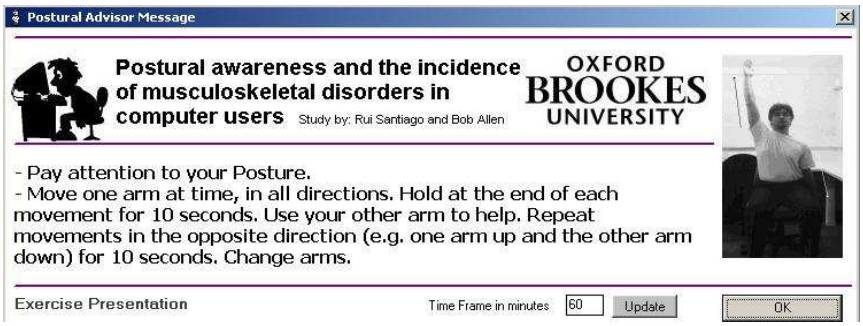

Fig 1. Screen-shot of the PAS software. Displaying a message with postural advice and an exercise description with its corresponding image.

Installation

The PAS can run on Windows based machines running 32 or 64-bit versions of either XP, Vista or Windows 7.
To install the software please find the file **'setup.exe'** inside the PAS V3.2 folder in the CD-ROM. Click twice on the file and the installation should start immediately.
If there is any difficulty or problems concerning the installation please contact one of the research students.

Running PAS for the first time

After the software is initially installed, the user should go to **Startup -> Programs -> PAS** and click on the face icon. You will only need to do this once then the program will load automatically each time you restart your computer. The PAS dialog box will be shown immediately, allowing you to set the time between reminder messages from the default period of 20 minutes up to a maximum of 120 minutes. Once you have selected the time interval that you want please click on the Update button to save the changes, if you don't click the Update button it will run on the previously selected interval.

Using PAS

The PAS is set to auto-run which means that it will automatically be running in the background each time you start your computer. The dialog box will be shown after the time period that you selected previously and when you have reviewed your posture and completed the exercise click on the OK button. The next exercise will appear after the pre-set time period.

Uninstalling PAS

To disable this software you need to start the Windows Task Manager using the keys [ctrl+alt+del] and on the Applications tab, choose PAS and click the 'Stop Task' button.

In the Windows Control Panel, accessible from the Start button, choose ‘Add/Remove’ programs. A list of programs will be shown, choose PAS and click ‘Change/Remove’ and the software will be uninstalled.

Final Note

Although the PAS has been thoroughly tested for compatibility with the Windows operating system if you have any concerns related to the running of the software, please contact one of the research students who will be happy to help.

Contacts

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Appendix D – Initial Questionnaire

Please note that Sections 1-2 of this questionnaire should be completed at the start of the study prior to installing and using the Postural Awareness Software.

If you have any questions or need any additional information regarding this request please do not hesitate to contact us.

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SECTION 1: General

This section asks about you, your job and your computer use.

 If you are completing the questionnaire by hand, please circle your response(s)

 Where a COMMENT space is provided please add any additional information which you feel may be relevant or which allows you to explain your response more fully.

1. Name: _____

2. Email address: _____

3. Gender
a) Female
b) Male

4. Age
a) 18-20
b) 21-30
c) 31-40
d) 41-50
e) 51-60
f) 61-65
g) Over 65

5. What type of computer do you use?
a) Desktop computer
b) Laptop computer (Notebook, Netbook etc.)

6. How long do you spend at your work computer during a typical day?
a) Less than one hour
b) Between one and three hours
c) Between three and six hours
d) Between six and eight hours
e) More than eight hours

7. What might be the longest time you spend working at your computer before taking a break, e.g. short break away from the computer for telephone calls, paperwork, filing, photocopying, comfort break?

a) Less than one hour
b) Between one and two hours
c) Between two and three hours
d) Three hours or more

COMMENT:

8. Do you have any upper body symptoms which you attribute to or which you believe may be aggravated by computer use in the last 6 months?
(For the purpose of this study symptoms refers to upper body related problems which might include: headaches, eyestrain, muscle aches, joint pain, pins and needles etc.)

a) Yes
b) No
c) Prefer not to answer

If you answered (b) "No" or (c) "Prefer not to answer" to Question 8 you have now completed Part1 of the survey.
A link to allow completion of Part2 of the survey will be emailed to you 2 weeks after installation and use of the PAS software. Thank you for your time.

SECTION 2: Symptoms

This section asks about any symptoms that you believe may have been caused or aggravated by computer use.

9. Which of the following statements describe(s) your symptoms. ….
(Please select all that apply)

a) Chronic (the discomfort/ pain is long-lasting, recurrent in nature)
b) Acute (the discomfort/ pain started recently, rapid onset, short-lasting)
c) Severe (the discomfort/ pain is intense, debilitating)
d) The discomfort/ pain is episodic (triggered by certain activities, postures, types of work, amount of work)
e) The discomfort/ pain generally wears off overnight or across a weekend
f) The discomfort/ pain wears off only with rest, e.g. when on a holiday
g) The discomfort/ pain is permanent: may change in intensity, but does not wear off

10. Please indicate which area(s) bother you (Please select all that apply)

a) Head (e.g. headache, migraine)
b) Eyes (e.g. hot, sore, tired, stinging, dry, weeping eyes; eyestrain)

c) Neck
d) Shoulder(s)
e) Middle of back
f) Lower back
g) Upper arm(s)
h) Forearm(s)
i) Wrist(s)
j) Hand/ Finger(s)

11. Please indicate which area bothers you the *MOST* (Please select just ONE)

a) Head (e.g. headache, migraine)
b) Eyes (e.g. hot, sore, tired, stinging, dry, weeping eyes; eyestrain)
c) Neck
d) Shoulder(s)
e) Middle of back
f) Lower back
g) Upper arm(s)
h) Forearm(s)
i) Wrist(s)
j) Hand/ Finger(s)
k) Other…. Please explain:

12. For the area which bothers you *MOST*, which of the following describe(s) your symptoms (Please select all that apply)**:**

a) Dull ache
b) Burning
c) Cramping/ tight muscles
d) General discomfort
e) Numbness/ loss of feeling
f) Sharp pain
g) Joint stiffness
h) Swelling
i) Tingling/ pins and needles
j) Muscle weakness
k) Other…. Please explain:

YOU HAVE REACHED THE END OF PART 1 OF THE QUESTIONNAIRE.
THANK YOU VERY MUCH FOR YOUR TIME

If you have any questions or need any additional information regarding this questionnaire please do not hesitate to contact us.

Research Students	**Rui Santiago** Telephone: 07748204081 Email: 06084852@brookes.ac.uk **Bob Allen** Telephone: 07515014308 Email: 06084177@brookes.ac.uk
Project supervisor	**Philip Von Hauenschild** Senior lecturer in Osteopathy at Oxford Brookes University Telephone: 07590283720 Email: p0016656@brookes.ac.uk

Appendix E – Final Questionnaire

SECTION 3: Postural awareness and compliance

Sections 2 asked for some information about your symptoms.
Sections 3 & 4 will help us to identify any changes to your posture and compliance that may have taken place since using the PAS.

13. Code: _____

(This unique code will be sent to the participant by email, after 2 weeks of PAS use. It was created to allow the linking of data from each participant before and after the use of the PAS without them having to input personal data on the internet.)

14. Which timings between on-screen reminders did you use most often?

a) 20-39
b) 40-59
c) 60
d) 61-80
e) 81-100
f) 101-120

COMMENT:

15. Did you check your posture and perform the exercises completely when prompted to by the software?

a) 1 - Never (0%)
b) 2 - Rarely (1-30%)
c) 3 - Some of the exercises (31-60%)
d) 4 - Most of the exercises (61-99%)
e) 5 - Always (100%)

COMMENT:

16. How do you rate your compliance with the on-screen postural advice and exercises given by the software?

a) 1 - Very Poor
b) 2 - Poor
c) 3 - OK
d) 4 - Good

e) 5 - Very Good

COMMENT:

17. How do you rate your awareness of your posture at the computer before using the software?

a) 1 - Very Poor
b) 2 - Poor
c) 3 - OK
d) 4 - Good
e) 5 - Very Good

COMMENT:

18. How do you rate your awareness of your posture at the computer after using the software?

a) 1 - Very Poor
b) 2 - Poor
c) 3 - OK
d) 4 - Good
e) 5 - Very Good

COMMENT:

SECTION 4: Symptoms update

Section 2 asked for some information about any symptoms which you attribute to or you believe may be aggravated by computer use.
Section 4 will help to identify any changes to your symptoms since using the PAS.

19. Which of the following statements describe(s) your current symptoms ….
(Please select all that apply)

a) Chronic (the discomfort/ pain is long-lasting, recurrent in nature)
b) Acute (the discomfort/ pain started recently, rapid onset, short-lasting)
c) Severe (the discomfort/ pain is intense, debilitating)
d) The discomfort/ pain is episodic (triggered by certain activities, postures, types of work, amount of work)
e) The discomfort/ pain generally wears off overnight or across a weekend
f) The discomfort/ pain wears off only with rest, e.g. when on a holiday
g) The discomfort/ pain is permanent: may change in intensity, but does not wear off

20. Please indicate which area(s) bother you (Please select all that apply)

a) Head (e.g. headache, migraine)
b) Eyes (e.g. hot, sore, tired, stinging, dry, weeping eyes; eyestrain)
c) Neck
d) Shoulder(s)
e) Middle of back
f) Lower back
g) Upper arm(s)
h) Forearm(s)
i) Wrist(s)
j) Hand/ Finger(s)

21. Please indicate which area bothers you the <u>MOST</u> (Please select just ONE)

a) Head (e.g. headache, migraine)
b) Eyes (e.g. hot, sore, tired, stinging, dry, weeping eyes; eyestrain)
c) Neck
d) Shoulder(s)
e) Middle of back
f) Lower back
g) Upper arm(s)
h) Forearm(s)
i) Wrist(s)
j) Hand/ Finger(s)
k) Other…. Please explain:

22. For the area which bothers you *<u>MOST</u>*, which of the following describe(s) your symptoms (Please select all that apply)**:**

a) Dull ache
b) Burning
c) Cramping
d) Discomfort
e) Numbness

f) Sharp pain
g) Stiffness
h) Swelling
i) Tingling / pins and needles
j) Weakness
k) Other…. Please explain:

YOU HAVE REACHED THE END OF THE QUESTIONNAIRE.
THANK YOU VERY MUCH FOR YOUR TIME

If you have any questions or need any additional information regarding this questionnaire please do not hesitate to contact us.

Research Students	**Rui Santiago** Telephone: 07748204081 Email: 06084852@brookes.ac.uk **Bob Allen** Telephone: 07515014308 Email: 06084177@brookes.ac.uk
Project supervisor	**Philip Von Hauenschild** Senior lecturer in Osteopathy at Oxford Brookes University Telephone: 07590283720 Email: p0016656@brookes.ac.uk

Appendix F – Consent Form

CONSENT FORM

Postural awareness and the incidence of musculoskeletal disorders in computer users
(SH&SC REC Study no. 2009/30)

		Please initial box	
1.	I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions.	☐	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.	☐	
3.	I agree to take part in the above study.	☐	
		Please tick box **Yes**	**No**
4.	I understand that my participation will not affect any current or future treatment or programme of studies at OBU.	☐	☐
5	I have the authority (or can obtain permission) to install the Postural Awareness Software on my computer.	☐	☐
6	I understood the postural advice given and how to safely perform the exercises.	☐	☐
7	I understand that the information I submit during the study may be published in the study report and that, on request, I will be sent a copy. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.	☐	☐
8	I agree that I can be contacted if the researchers require clarification on any of the information collected during this study.	☐	☐

Name of Participant	Date	Signature
Name of Researcher	Date	Signature

Contacts

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Appendix G – GANTT Project Plan