3. Methodology

3.1. Participants.

The study was conducted at the Hollings Faculty, the food and clothing Faculty of Manchester Metropolitan University. All the participants were in full or part-time employment at the Faculty and occupied a variety of positions, including lecturers, administrators, technicians and researchers. Participants were selected from the Faculty telephone directory; if initially interested in taking part a meeting was arranged where they could be fully briefed regarding the requirements of the study. All participant data was collected between April and August 2008. A total of fifty-nine people were approached and fifty-one agreed to take part, (86% positive response). This comprised twenty-eight men and twenty-three women. The age of the participants ranged from twenty-three to sixty-six years and all were in apparent good health.

The ethics committee of The Faculty of Applied and Health Sciences, University of Chester approved the study protocol and Manchester Metropolitan University gave their approval for the research to be conducted. A completed consent form was obtained from each participant. (See Appendix 7.2.1.)
3.2 Study design.

A cross-sectional study was carried out with the primary aim of examining the relationship between Physical Activity and Happiness. Happiness was measured using a validated self completion questionnaire (Hills & Argyle, 2002).

Physical Activity levels were calculated using both a subjective method, i.e. physical activity diary (see Appendix 7.2.4.), and an objective method, i.e. a motion sensor armband, manufactured by BodyMedia ®, USA. and identified as a Sensewear Armband (SWA). The integration of two physical activity measurement methods fulfilled a secondary aim of the study which was to compare activity levels when assessed using either subjective or objective methods. Physical Activity diaries were completed by all participants and data collected from the SWA’s in a smaller subgroup (n=20, 14 males and 6 females). This was due to only three SWA’s being available during the study period. Participants in the subgroup wore the armband for the same three days as they kept the dairy allowing a comparison in data to be made.

Participants wearing the armbands were briefed how the armband worked, where it should be positioned on the arm and were instructed to wear it for three full days, including sleep and were only to take it off during bathing/showering.
Each participant was given a verbal explanation of the aims and requirements of the study. They were also assured of confidentiality of the investigation and provided with a study pack containing the following items:

- The Consent Form (Appendix 7.2.1.)
- Participant Information Sheet (Appendix 7.2.2.)
- Sensewear Armband and Instruction Sheet (Appendix 7.2.3.)
- Physical Activity Diary (See Appendix 7.2.4.)
- Oxford Happiness Questionnaire (see Appendix 7.2.5.)

Each document was fully explained with an opportunity to ask questions. The Participant Information Sheet provided the participant with written details regarding the aims and objectives of the study. It also provided step by step instructions as to what each participant was required to do, information regarding confidentiality and a contact address in case of complaint.

Prior to starting the Diary, all participants signed and returned the consent form and completed the front of the diary which requested information regarding gender, height, weight and date of birth. (Participants who were also wearing the SWA were asked whether they were a smoker or non-smoker and whether or not they were right handed as these were manufacturer’s requirements for energy expenditure calculation). Names were not required but participants were asked to number the pack, choosing a number between 1 and 1000. The number known only by the participant was written on the front of the pack. On completion the pack was sealed and returned to a ‘post-box’ in the faculty office. This procedure
allowed all participants to obtain feedback directly from the researcher by quoting their number should this be required.

3.3 Measures:

3.3.1. Physical Activity Diary:
Participants were asked to keep a Physical Activity Diary for three full days including two consecutive work days plus one weekend day. Work days had to be completed at the place of work (as opposed to working at home) and all three days must fall within the same 7-day week. The diary included guidance on completion together with an ‘example day’ for further clarification (Appendix 7.2.4.).
All study participants were asked to maintain their usual physical activity patterns. The requirement for two consecutive work days plus one weekend day aimed to provide an accurate representation of normal activity levels rather than participant selection of more active days.
The diary was divided into five domains of activity:

i. Occupational activity, incorporating all activity at the place of work, (completed Monday to Friday only)

ii. Non occupational household activity – this which included all household tasks.

iii. Non-occupational leisure activity – which included all recreational pursuits and hobbies.

iv. Transportation, including methods of travel.

v. Sleep
This division was based on validated diaries used in previous studies focusing on activity measurement (Ainsworth et al. 2000b, Hagströmer, Oja, & Sjöström, 2006). As occupational activity levels were a key measure, participants could not complete their diaries when they were on holiday or working away from the Faculty, thus the diary aimed to record a ‘typical’ working week.

Participants were asked to note the duration of all activities completed in each category in hours or minutes. Following the protocol in the Ainsworth study, participants were asked to record only activities with a duration of greater than 10 mins, however activities could be ‘rounded up’ over the day, e.g. climbing several flights of stairs 2 to 3 times. Participants were also asked to judge if each activity was light, moderate or vigorous and were provided with verbal and written guidance as to how to differentiate between the three. (Appendix 7.2.4.pge 2) These intensity guidelines were based on the DH Report for physical activity (2004) and were included to assist calculation of energy expenditure.

**3.3.1.1. Calculation of physical activity levels.**

Once the diary was completed and returned, the time spent on each activity in minutes per day was multiplied by its typical energy expenditure expressed as a MET value, derived from the Compendium of Physical Activities (Ainsworth, 2000b).
To calculate the energy expenditure for each activity (kcals/kg/per hour) the formula provided by Ainsworth which took into account each participant’s body weight was applied (Ainsworth, 1993). Therefore the MET values were multiplied by the length of time that each participant spent in that activity, For example,

If a person weighing 65kg jogged for 30 minutes, the number of kcal expended for this period of activity would be as follows:

\[(7 \text{ METs} \times 65\text{kg body weight}) \times (30\text{min}/60\text{min}) = 227.5\text{ kcals}\]

The total number of kcals expended for each activity in each domain was then calculated to provide energy expenditure for the three day period. This was then divided by three to obtain average daily energy expenditures. Using this method, average daily energy expenditure scores were also calculated for each domain. (N.B. average daily energy expenditure for occupational activity was divided by two as only two working days was recorded).

Where daily activities plus sleeping time did not summate to 24 hours, a baseline energy expenditure of 1.5 METs x remaining length of time was estimated, (Ainsworth, 1993).

To enable comparison with previous studies, activities were also grouped into light, moderate or vigorous activities according to their intensity level. Values were based on guidelines given by the DH (2004), the CDCP/ACSM (Pate et al.1995) and Ainsworth (2000b). Therefore, activities requiring less than 3 METs were classified as ‘low intensity’, those between 3 and 6 METs ‘moderate intensity’ and those requiring more than 6 METS were classified as vigorous intensity.
Once duration of activities was totalled and MET values calculated, energy expenditure was calculated using Microsoft Office Excel 2003. A spreadsheet was produced for each participant. Energy expenditures were cross tabulated for each day and for each domain and then manually checked to ensure accuracy. (See Appendix 7.4.1. for examples of participant spreadsheets)

### 3.3.2. Motion Sensor Armband.

The motion sensor armband used in the study is a relatively new device termed the Sensewear Armband (SWA) produced by BodyMedia Inc, USA. The armband uses a micro-electro-mechanical sensor to measure motion, and a heat flux sensor to measure the amount of heat being dissipated by the body which together capture data leading to the calculation of energy expenditure. Studies conducted so far indicate that the SWA has a very low level of error when measuring energy expenditure (Liden et al. 2002, Malavolti, Pietrobeli, Dugoni, Poli, Cristofaro, Battistini, 2005, Mignault, St-Onge, Karelis, Allison & Rambasa-Lhoret, 2005), although its accuracy when measuring certain types of exercise has been questioned, (HagstrÖmer, Oja & Sjöström, 2006) [See Appendix 7.6 for Comparative Report of PAD’s and SWA’s.].

As recommended by the manufacturer, the SWA must be worn on the upper right arm over the triceps muscle. This position was checked with all participants using the SWA and the arm band was fitted with new batteries for each participant use.
3.3.3 The Oxford Happiness Questionnaire.

The Oxford Happiness Inventory, a preliminary of the Oxford Happiness Questionnaire, was devised by Argyle, Martin and Crossland in 1989 and revised in 1995 by Argyle, Martin & Lu to provide a broad measure of personal happiness (Hills & Argyle, 2002). The inventory was found to produce consistent results, and Hills & Argyle cite positive reports of its use documented in studies in Spain, USA, Australia, Canada, Israel, China, Taiwan and the UK. However, concerned with the statistical elements of the Inventory, Hills and Argyle concluded that the document would be improved if respondents selected answers from a wider range. As a result the Oxford Happiness Questionnaire (OHQ) was developed in two formats, the full 29 statement questionnaire, plus a shorter eight statement version suitable for incorporation into multi-subject questionnaires. The OHQ is described as compact, easy to administer, less susceptible to respondent bias and the preferred instrument for measuring happiness (Hills and Argyle, 2002).

The content validity and reliability of the questionnaire was tested by several separate studies including Jayasvasti and Kanchanatawan (2005) who found it to be a reliable and valid measure, Maltby, Day and Barber (2005) who described it as "well established, reliable and valid" and a review by Bekhet, Zauszniewski and Nakhla (2008) comparing happiness measures for use in clinical research summarised the OHQ stating it was ‘a more comprehensive instrument, less susceptible to respondent bias than other scales’. 
Although there are a limited number of published papers detailing use of the OHQ in population groups, a summary of study details and outcomes are presented in Table 3.2. This illustrates that the OHQ was found to be a positive form of measurement by the authors of all the studies involving subject groups ranging from 3 to 438 participants.

The OHQ (see Appendix 7.2.5.) consists of twenty-nine single statements that can be answered on a 6-point Likert scale ranging from strongly disagree (Score = 1) to strongly agree (Score = 6). Total scores range from 29 to 174 with higher scores indicating a higher level of happiness. To reduce questionnaire and respondent bias, the statements are phrased both positively and negatively. Therefore, when calculating the overall score for each participant, scores for negative statements are reversed. An example of this is given in Table 3.1. below where Q3 is negative statement and therefore a reverse score is allocated by the researcher.

<table>
<thead>
<tr>
<th>Example Question:</th>
<th>Participant Score</th>
<th>Score Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am intensely interested in other people</td>
<td>( 5 )</td>
<td>5</td>
</tr>
<tr>
<td>2. I have very warm feelings towards almost everyone</td>
<td>( 4 )</td>
<td>4</td>
</tr>
<tr>
<td>3. I don’t feel particularly pleased with the way I am</td>
<td>( 2 )</td>
<td>5</td>
</tr>
</tbody>
</table>
### Table 3.2. Review of studies using the Oxford Happiness Questionnaire

<table>
<thead>
<tr>
<th>Research Study</th>
<th>Author and Year</th>
<th>Population Group</th>
<th>Questionnaire Format</th>
<th>Score</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxford Happiness Questionnaire - trial by authors</td>
<td>Hills &amp; Argyle. (2002)</td>
<td>U/graduates &amp; relations Age: 13 – 68 yrs (Mean 30.9 yrs)</td>
<td>Oxford Happiness Questionnaire (29 items)</td>
<td>Questionnaire assessed for statistical validity but scores not published</td>
<td>Strong construct validity established for use of OHQ.</td>
</tr>
<tr>
<td>Happiness &amp; related factors in pregnant women</td>
<td>Jayasvasti &amp; Kanchanatawan (2005)</td>
<td>Pregnant women, (n = 438) Mean age 27.89 yrs</td>
<td>Oxford Happiness Questionnaire (29 items)</td>
<td>Mean score = 128 (all females) Range: not given.</td>
<td>Positive correlation between happiness and certain factors E.g. age, status.</td>
</tr>
<tr>
<td>Self reported happiness &amp; substance use</td>
<td>Thalbourne, &amp; Houran. (2005)</td>
<td>Substance-users, (n = 200), 35% male 65% female Age: 17 – 46 yrs</td>
<td>Oxford Happiness Questionnaire (29 items)</td>
<td>Mean score = 123 Range: 50 - 161</td>
<td>Negative relationship in highly transliminal individuals only..</td>
</tr>
<tr>
<td>Cognitive behaviour therapy and vocational rehabilitation</td>
<td>Binnie (2008)</td>
<td>Clinical intervention trial: 3 individuals case studies</td>
<td>Oxford Happiness Questionnaire (29 items)</td>
<td>Mean score = 109 (all males) Range: 104 - 117</td>
<td>Intervention treatment found to have a positive effect on happiness</td>
</tr>
<tr>
<td>Prayer, personality and happiness.</td>
<td>Robbins, Francis, &amp; Edwards. (2008)</td>
<td>U/graduates (n= 131) Age 18 – 21+</td>
<td>Oxford Happiness Questionnaire (29 items)</td>
<td>Mean Score = 98* Range: not given * 5 point scale</td>
<td>No significant association between prayer and happiness</td>
</tr>
</tbody>
</table>
3.4 Data analysis:

Physical Activity Diaries were analysed using the Compendium of Physical Activities (Ainsworth, 2000b). An Excel spreadsheet was created for each participant incorporating all the data from the diaries plus the individual happiness scores (See Appendix 7.4.). Data was transferred into the Statistical Package for Social Sciences (SPSS, Version 14), and used to calculate parametric and non-parametric correlations between happiness scores and energy expenditures, and significant differences between variables using independent T-Tests and Analysis of Variance (ANOVA). The significance value applied for all analyses was 0.05. (Field, 2005)

Data from the SWA was downloaded from the Armband following each use using the BodyMedia data retrieval statistical software package.