Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk through Lifestyle Behaviours and Well-Being

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Submitted in partial fulfillment of the requirements for the degree of

Master of Arts in Applied Health Sciences

(Nursing)

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I would like to dedicate my Master's Thesis to my parents.

Their ongoing love, support, encouragement, and belief in my capabilities never goes unnoticed and is always appreciated.

I would not be where I am today, with the aspirations that I have, if it was not for you.

Therefore, with thanks, this is for you Mom and Dad.

Abstract

The primary objective of this non-experimental study was to examine the differences based on obesity-related health risk in terms of physical activity, sedentary behaviour and well-being in adults. Participants (N = 50; M_{age} = 38.50, SD_{age} = 14.21) were asked to wear a SenseWear Armband (SWA) across a seven day monitoring period followed by a questionnaire package. Using the National Institute of Health's (1998) criteria, participants were classified as either least, increased, or high risk based on waist circumference and Body Mass Index scores. Differences between these classifications were found in the amount of time spent in active energy expenditure for bouts of ten minutes or more (p = .002); specifically between least and high risk (p < .05). No other differences (p > .05) emerged. Participants' also perceived the SWA as a practical and worthwhile device. Overall, these findings provide practical applications and future directions for health promotional research.

Keywords: obesity, activity behaviour, well-being, SenseWear Armband, perceptions

Acknowledgement

I would like to first acknowledge my supervisor, Dr. Diane Mack, who has assisted me, supported me, challenged me, and encouraged me throughout my graduate degree. No words can describe nor capture the amount of gratitude I have for all that you have done. My growth as a researcher, teacher, and professional is all due to you. Therefore, if I have not said it enough, I would like to thank you Diane for being the supervisor that you are, and for helping me make the most of my graduate journey – not to mention surviving my first journey away from home. I will always be appreciative and hope to make you proud of my future endeavors.

I would also like to acknowledge and thank my committee members, Dr. Philip Wilson and Dr. Phil Sullivan. I would like to thank Dr. Philip Wilson for his ongoing commitment, time, and efforts into my thesis development. No edit nor question was overlooked and I am utterly grateful for each and every one as it has allowed me to further strengthen my research. As for Dr. Phil Sullivan, I would like to thank you for your thought-provoking questions. Whether it was statistics-related or real life applications, they have assisted my growth as a researcher in more ways than one. Lastly, I would like to say a special thank you to my external examiner, Dr. Heather Lee Kilty, for not only agreeing to be a part of my committee, but also for offering such remarkable insight on my thesis topic. Your interest in obesity and well-being allowed me to reflect back on my thesis and acknowledge a job well done. I honestly could not have asked for a more insightful and supportive committee to share my thesis and graduate experience with.

On a final note, I would also like to thank all the individuals who voluntarily participated in my research. My thesis would not have been successful if it was not for each and every one of you.

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Abbreviation Table

Abbreviation	Meaning
AD ACL	Activation Deactivation Adjective Checklist
AEE	Active Energy Expenditure (≥ 3.0 METs)
AEE-10	Active Energy Expenditure (≥ 3.0 METs) in bouts of 10 minutes or more
BMI	Body Mass Index
EE	Energy Expenditure
GLTEQ	Godin Leisure Time Exercise Questionnaire
MANOVA	Multivariate Analysis of Variance
METs	Metabolic Equivalent Units
MVPA	Moderate-to-Vigorous Physical Activity (≥ 3.0 METs)
PA	Physical Activity
PANAS	Positive Affect Negative Affect Schedule
SB	Sedentary Behaviour
SWA	SenseWear Armband
WB	Well-Being
WC	Waist Circumference

Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk through Lifestyle Behaviours and Well-Being

Overweight and obesity is defined as a physical illness due to an abnormal and excessive accumulation of fat leading to a detrimental effect on one's health (Lawrence, Hazlett, & Hightower, 2010; World Health Organization [WHO], 2013). According to Callahan (2013), "Obesity may be the most difficult and elusive public health problem this country has ever encountered" (p. 34). Most recently, the American Medical Association [AMA] has classified obesity as a disease rather than an illness, hoping to attract more serious attention towards prevention, treatment, and costs related to this epidemic (Giovannetti, 2013; Ryan, 2013). According to the AMA, obesity is not just a consequence of poor health habits, it is now named a "multimetabolic and hormonal disease state" that leads to multiple comorbidities (Pollack, 2013; Ryan, 2013). This controversial change brings about a debate in Canada as to whether to classify obesity as a disease similar to what has been done in the Unites States (Giovannetti, 2013). Therefore, obesity continues to be a major concern in healthcare today; affecting both our present and future generations (Gibson-Moore, 2012; Tran, Nair, Kuhle, Ohinmaa, & Veugelers, 2013).

Literature Review

Anthropometric Assessment

Anthropometry involves the measurement of body dimensions for the purpose of understanding physical variation in humans. Numerous proxy measures have been developed to measure adiposity including Body Mass Index (BMI), waist circumference (WC), waist-to-hip ratio, and dual-energy X-ray absorptiometry. Canadian and

international definitions of overweight and obesity for adults are grounded in BMI estimates calculated from weight and height ([weight (kg)/height^2 (m)] as they are relatively simple to measure and easily interpreted (Centers for Disease Control & Prevention [CDC], 2011; Health Canada, 2003a; WHO, 2000). For example, those who are overweight have a BMI between 25.00-29.99 kg/m^2, while those who are classified as obese have a BMI equal or greater than 30.00 kg/m^2 (Public Health Agency of Canada [PHAC], 2011b). However, concerns have been raised with the use of BMI scores as they do not measure fat mass (Lavie, Milani, & Ventura, 2009; Lavie, Milani, Ventura, & Romero-Corral, 2010; Thibault & Pichard, 2012) and individuals classified as overweight/obese, based on BMI scores, have been shown to exhibit favourable outcomes (e.g., lower risk for myocardial infarction and mortality) in some studies (Romero-Corral et al., 2006; Yusuf et al., 2005). As such, researchers have turned to assess the utility of other measures of adiposity that are relatively simple to assess and demonstrate their utility to predict relevant health outcomes (Statistics Canada, 2012a; Yusuf et al., 2005).

It is now widely recognized that body fat distribution is an important risk factor for both morbidity and mortality, above and beyond total excess body weight (Janssen, Katzmarzyk, & Ross, 2002; Yusuf et al., 2005). WC is one way to measure body fat distribution in association to health risk whereby individuals who have a moderate WC (for men, 94.00-101.99 cm; for women, 80.00-87.99 cm) or high WC (for men, ≥102.00 cm; for women, ≥88.00 cm) tend to have a greater risk of being overweight/obese (Lean, Han, & Morrison, 1995; Janssen et al., 2002; National Heart, Lung & Blood Institute, 2014). Consequently, current national and international guidelines advocate for the routine measurement of WC in the assessment of obesity-related health risks (Health

Canada, 2003b; National Institutes of Health [NIH], 1998; WHO, 2000). Researchers have also shown that WC, compared to BMI, is a better predictor in explaining obesity-related health risks (Ardern, Katzmarzyk, Janssen, & Ross, 2003; Cheng, 2005; Janssen et al., 2004; Zhu, Wang, Heshka, Heo, Faith, & Heymsfield, 2002).

Moreover, measuring an individual's WC has shown to further identify obesity-related health risks, in conjunction with BMI, and has become a more reliable way to measure body composition in both children and adults (Patry-Parisien et al., 2012). Based on evidence that increased BMI and centrally patterned obesity as assessed through WC have been linked to mortality and cardiovascular/metabolic risk factors (Elobeid, Desmond, Thomas, Keith, & Allison, 2007; Li, Ford, McGuire, & Mokdad, 2007; Walls et al., 2011; Zhu et al., 2002), Canadian and international health agencies recommend the combined measurement of both BMI and WC for the assessment of obesity-related health risk (Health Canada, 2003b; NIH, 1998; WHO, 2000). With an eye towards informing individuals and health professionals about possible health concerns, a graded relative health risk classification system (Table 1) has been established.

Prevalence of Overweight and Obesity in Canadian Adults

According to recent measured BMI data, it is estimated that one in four adults (aged 20-69) are obese in Canada (PHAC, 2011b). With the inclusion of measured values within the overweight range, this figure increased to 62.10% of Canadians in 2008 (PHAC, 2011b). Recent WC data has displayed an even more growing concern (Statistics Canada, 2012b). Normal weight women, who exhibited high health risk based on WC scores, have tripled over the last two decades while both overweight and obese adults with a high health risk have more than doubled in numbers (Statistics Canada,

2012b). Therefore, the combination of the increasing prevalence in overweight/obesity as well as the rise in obesity-related health risks is a vital concern to all Canadian adults.

Consequences Associated with Overweight/Obesity

Being classified as overweight or obese affects one's physical and mental health (Rabbitt & Coyne, 2012). Being overweight/obese may lead to the development of multiple comorbidities, such as type II diabetes, cardiovascular disease, disability, various types of cancer, as well as having an increased risk of mortality (Callahan, 2013; Hawley, Beckman, & Bishop, 2006; International Obesity Taskforce, 2010). With respect to psychological functioning, being overweight/obese has been associated with higher levels of depression (Zhao et al., 2011), greater anxiety (Zhao et al., 2009), lower levels of health-related quality of life (Ghorbani, Ziaee, Oveisi, & Afaghi, 2013), negative affect (Carr, Friedman, Jaffe, 2007), and impaired functioning (Corica et al., 2008).

With the additional health consequences that accompany adults who are overweight or obese, extensive economic burden on healthcare services ensues (Katzmarzyk & Janssen, 2004; Withrow & Alter, 2011). In 2009, Canada's estimated direct and indirect costs, strictly associated with overweight and obesity, were $4.5 billion per annum (Ministry of Health and Long-Term Care, 2012; PHAC, 2011b). Total costs rose to $7.1 billion when examining the added expenses of secondary diseases that develop primarily due to individuals' overweight or obese status (PHAC, 2011b). Overall, the consequences of overweight and obesity contribute a projected 12% of total healthcare costs in Canada (Trans et al., 2013) and as high as 30% of costs worldwide when compared to those who are of normal weight (Withrow & Alter, 2011). Even with

these related high costs, Trans and colleagues' (2013) identified that obesity prevention programs in Canada are underfunded. Therefore, with the increased prevalence rates of overweight and obesity, combined with the increased risk of comorbidities and the associated costs, the importance of public health initiatives that are needed to target both prevention and treatment of overweight and obesity in Canada are highlighted (PHAC, 2011b; Trans et al., 2013).

Physical Activity

Interventions that target social and behavioural determinants are most appropriate when preventing or reducing obesity because they are the most effective (PHAC, 2011b). These determinants include physical activity, nutritional intake, socio-economic status, ethnicity and environmental factors (PHAC, 2011b). While recognizing the numerous factors associated with overweight/obesity and how they are interconnected, the present study will focus exclusively on physical activity and sedentary behaviour.

As defined by WHO (2013), physical activity (PA) is any movement performed by the muscles of the body that expend energy and, therefore, is not in a relaxed state. Regular PA is important to maintain a healthy weight and assists in reaching optimal health outcomes, such as reducing the development of chronic diseases (i.e., hypertension, osteoporosis, and stroke; Canadian Society for Exercise Physiology [CSEP], 2013; Kruk, 2007). It is recommended that adults aged 18-64 years participate in 150 minutes of moderate-to-vigorous physical activity (MVPA) per week in bouts of ten minutes or more for health benefits (CSEP, 2013; PHAC, 2011a). PA that fails to meet these public health guidelines are typically characterized as incidental physical activity, which consists primarily of mild intensity PA and sporadic (i.e., bouts lasting

<10 min) MVPA accrued through activities of daily living (Tremblay, Esliger, Tremblay, & Colley, 2007).

A focus on physical activity and anthropometric measurements. Results from cross-sectional and prospective cohort studies have generally demonstrated an inverse association between PA and obesity (cf. Ross & Janssen, 2007). Further, the role of PA toward the prevention of weight gain has been deemed convincing by the World Cancer Research Fund and American Institute for Cancer (2007). However, in a systematic review, Summerbell and colleagues (2009) were less supportive of the role of PA toward the prevention of weight gain and obesity. More specifically, these researchers state that the epidemiologic evidence attesting to the association between PA and weight gain have "either no effect or a small negative association" (p. s80). Not discounting the benefits of small effects, especially at a population level (Prentice & Miller, 1992), the bulk of support for the influence of PA on reductions in obesity and optimal health benefits has been linked with vigorous leisure-time activities (Abu-Omar & Rutton, 2008; Ekelund et al., 2011; Oppert et al., 2006).

When it comes to PA in relation to body composition as assessed through BMI, researchers have demonstrated that individuals who are overweight/obese do not engage in the recommended levels of MVPA (Scheers, Philippaerts, & Lefevre, 2012a; Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010), and that they report lower levels of PA when compared to individuals classified as normal weight (Bond et al., 2012; Gibson-Moore, 2012). Further, there is evidence to support that PA and WC generally have an inverse association (Du et al., 2013).

Sedentary Behaviour

Sedentary behaviour (SB), defined as any waking activity spent expending low levels of energy from < 1.5 metabolic equivalent units (METs) and in a sitting or reclined posture (Sedentary Behaviour Research Network [SBRN], 2012; Thorp, Owen, Neuhaus, & Dunstan, 2011) has been gaining increased focus in health research (Duncan, Vandelanotte, Caperchione, Hanley, & Mummery, 2012; Owen, 2012b). Common SBs include screen time activities (e.g., TV viewing, video game playing computer use), driving and reading (Marshall & Ramirez, 2011; Owen, Sparling, Healy, Dunstan, & Matthews, 2010). Traditionally, SB has been used to describe limited participation in MVPA (Ainsworth et al., 2000; Owen, Healy, Matthews, & Dunstan, 2010). However, SB is not simply the counterpart of PA (Lord et al., 2011; Owen, 2012), since an individual can be considered active based on scores from PA instruments or EE, while simultaneously being classified as sedentary.

Researchers have linked prolonged SB to adverse health outcomes, while controlling for MVPA, suggesting that SB is an independent construct of interest when predicting one's health risk (Biddle, 2012; Healy et al., 2008; Marshall & Ramirez, 2011; Thorp et al., 2011). In particular, SB or proxy measures such as television viewing have been shown to be associated with an increased risk of cancer (Howard et al., 2008; Moore, Gierach, Schatzkin, & Matthews, 2010), metabolic syndrome (Saunders et al., 2013; Wijndaele et al., 2010), type 2 diabetes (Wilmot et al., 2012), and all-cause mortality (Saunders et al., 2013; Wilmot et al., 2012) in various populations. With that being said, SB continues to be a concern and the need for further SB research remains a focus (Lynch, Dunstan, Vallance, & Owen, 2013).

A focus on sedentary behaviour and anthropometric measurements. Levels of SB are increasing in all classes of weight and body compositions (Scheers et al., 2012b). Time spent sitting and high levels of screen time, whether for occupational or leisure purposes, have been associated with a greater likelihood of being overweight or obese (Healy, Matthews, Dunstan, Winkler, & Owen, 2011). Researchers have further demonstrated that SB has a greater likelihood of influencing an individual's weight status compared to examining their lack of MVPA (Rhodes, Mark, & Temmel, 2012; Sugiyama, Healy, Dunstan, Salmon, & Owen, 2008). SB has also been found to predict added variance in BMI and WC than PA alone (Stewart-Knox et al., 2012). Therefore, SB and its unique relationship with overweight/obesity continues to be an emergent health concern to understand. As a result, further research is required to support existing relationships, as well as to increase public health awareness regarding the effects of SB (Owen, 2012b).

Psychological Well-Being

Despite the prevalent focus towards psychological well-being (WB) research (Keyes, Schmotkin, & Ryff, 2002; Seligman, 2011), the challenge of having an accepted universal definition remains (Dodge, Daly, Huyton, & Sanders, 2012; Thomas, 2009). WB is typically used interchangeably with the concept of health-related quality of life (Swencionis et al., 2013), which is an assessment about one's physical and mental health status (CDC, 2012). In a more encompassing approach, WB can be explained as a multifaceted construct (Diener, 2009) whereby an individual flourishes towards optimal functioning, happiness, and meaning (Rogers, 1961; Seligman, 2011).

A focus on psychological well-being and anthropometric measurements. Focusing strictly on BMI and WC values, those who are of normal weight are more likely to report greater levels of WB and health-related quality of life than those who are overweight or obese (Fontaine & Barofsk, 2001; Han, Tijhuis, Lean, & Seidell, 1998; Kolotkin, Meter, & Williams, 2001; Vieira et al., 2012) suggestive of a dose-response relationship (Fontaine & Barofsk, 2001). A change in weight status (i.e., from overweight to normal weight) has also been associated with having greater levels of WB, which has been linked to an increased level of vitality associated with actual weight change (Swencionis et al., 2013). Further, individuals with greater WC and BMI classifications (i.e., different stages of obesity) tend to express lower levels of health-related quality of life (Han et al., 1998; Kolotkin et al., 2001). However, the nature of the relationship between weight status and WB may be more complex than initially believed as researchers have also reported no (or inconsistent) associations between these constructs (de Zwaan et al., 2009; Katsaiti, 2012). Differences in measurement (i.e., how WB is operationalized) and characteristics of the samples may also be implicated in the differing findings.

Physical activity and psychological well-being. A consistent link has been noted between greater engagement in PA and higher levels in various dimensions of WB (Bize, Johnson, & Plotnikoff, 2007; Hamer, Stamatakis, & Mishra, 2012; Kruger, Bowles, Jones, Ainsworth, & Kohl, 2007; Penedo & Dahn, 2005; Wendel-Vos, Schuit, Tijhuis, & Kromhout, 2004). PA is associated with increased mood (Hoffman & Hoffman, 2008), positive affect (Parfitt, Markland & Holmes, 1994; Reed, 2005), and reductions in fatigue (Hoffman & Hoffman, 2008). Engagement in leisure-time PA has

been uniquely associated with WB (Bize et al., 2007; Cerin, Leslie, Sugiyama, & Owen, 2009), while the other domains (i.e., occupational, commuting) are either unrelated or negatively correlated (Cerin et al., 2009). As researchers have begun to examine the dose-response relationship (Ekkekakis, Hall, & Petruzzello, 2008), and individual differences in response to PA (Ekkekakis, Hall, & Petruzzello, 2005a), it appears as though the PA – WB relationship may be more complex than has originally been noted (Ekkekakis et al., 2013; Warburton, Katzmarzyk, Rhodes, & Shephard, 2007).

Recognizing that WB can be examined from many diverse perspectives (Ryan & Deci, 2001), the affective domain of WB will be explored for the purposes of this paper. As such, current research has advocated towards the importance of studying differences with affect in relation to PA (Ekkekakis, Hargreaves, & Parfitt, 2013). Feeling pleasant after PA has been recognized as a benefit in sustaining PA over time (American College of Sports Medicine [ACSM], 2011; Guiraud, Labrunee, Gayda, Juneau, & Gremeaux, 2012). Understanding the PA – affect relationship is vital in understanding why people choose to exercise or opt out (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007; de Geus & de Moor, 2008). With research moving into this direction, various affective components (i.e., self-efficacy, attitude) have shown to better predict exercise behaviour than cognitive constructs (i.e., memory, perception) (Calitri, Lowe, Eves, & Bennett, 2009; Gellert, Ziegelmann, & Schwarzer, 2012; Lawton, Conner, & McEachan, 2009; Nasuti & Rhodes, 2013). However, confusion still exists when examining affect in the context of PA (Ekkekakis & Petruzzello, 2000). Because of this, the relationship between affect and PA continues to be criticized due to the lack of research placed on both measurement and conceptualization of affective responses, thus emphasizing the

continued need for such evidence (Byrne & Byrne, 1993; Ekkekakis & Petruzzello, 1999; 2002; Gauvin & Spence, 1998). Once we can identify how to sustain PA behaviour over time, this will help contribute to greater WB and successful weight management (Guérin & Fortier, 2012).

A number of researchers (e.g., Cerin et al., 2009; Molina-García, Castillo, & Queralt, 2011; Netz, Wu, Becker, & Tenenbaum, 2005; Sylvester, Mack, Wilson, Busseri, & Beauchamp, 2012) have noted that the intensity of PA may play a unique role in predicting markers of WB, especially when the strenuous nature of engagement is selected by the individual (i.e., volitional) as opposed to being imposed by others (Ekkekakis, Parfitt, & Petruzzello, 2011; Vazou-Ekkekakis & Ekkekakis, 2009; Williams, 2008). As such, the intensity of PA (as opposed to frequency or duration) may be uniquely implicated in the promotion of WB. Even low intensity PA has been associated with higher levels of positive-activated affect (ACSM, 2013; Reed & Buck, 2009; Reed & Ones, 2006). This relationship may be associated with individuals experiencing less fatigue and negative affect after the activity as opposed to those participating in high intensity PA (ACSM, 2013). However, due to insufficient empirical evidence, more research is required to expand on the knowledge regarding the dose-response relationship between PA and affect (Ekkekakis & Petruzzello, 1999; Guérin & Fortier, 2012).

Sedentary behaviour and psychological well-being. A dearth of literature exists examining the SB – WB relationship when contrasted against what is known about PA and its association with markers of WB (Hamer, Stamatakis, & Mishra, 2010). Typically, SB has been associated with lower levels of WB or health-related quality of

life (Davies, Vandelanotte, Duncan, & van Uffelen, 2012; Gopinath, Hardy, Baur, Burlutsky, & Mitchell, 2012). An independent relationship was also identified between leisure-time SB (i.e., TV & screen-based viewing) and WB, apart from PA or an individual's level of functioning (Hamer et al., 2010). Furthermore, it has been identified that a high level of screen time in combination with not participating in PA has the greatest negative impact on an individual's health-related quality of life (Davies et al., 2012). Even though PA alone had a significant impact on an individual's psychological health, incorporating SB into the equation exacerbates the relationship (Davies et al., 2012; Wrosch & Sabiston, 2013). However, when it comes to reviewing the effects of weight status with the SB – WB relationship alone, research has lagged behind (Tremblay, Colley, Saunders, Healy, & Owen, 2010). Researchers operationalize PA and SB inconsistently (Scheers et al., 2012b; 2013b; Tremblay et al., 2010), such that SB can be defined as being 'not physically active' (Merriam-Webster's online dictionary, 2014) or classified based on varying MET level criteria (e.g., ≤ 1.8 METs; Scheers et al., 2012b). As a consequence to further unpack the SB and WB relationship, the measurement of SB should follow current advocated guidelines (i.e., < 1.5 METs; SBRN, 2012; Thorp et al., 2011) in an effort to act as a distinct variable from PA (Tremblay et al., 2010).

Measurement of Outcome Variables Linked to Obesity-Related Health Risk

The measurement of study variables comprising this investigation, which include PA, SB, and WB, can be assessed in various ways. However, it is recognized that there is no gold standard for PA, (Johannsen et al., 2010), SB (Atkin et al., 2012) and WB (McDowell, 2010). The following section will examine various approaches to measuring

these study variables as well as briefly outline associated strengths and weaknesses.

Measurement of physical activity. The measurement of PA is challenging and complex (Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012; Welk, 2002). Given the importance of PA on a varied health outcomes, such as healthy aging (Manini & Pahor, 2009), diabetes prevention (Roumen, Blaak, & Corpeleijn, 2008), and reducing one's risk for falls (Sherrington et al., 2008), assessments of PA should document: (a) frequency, (b) duration and intensity of PA, (c) evaluate the prevalence of individuals meeting health recommendations, and (d) be suitable for use in populations with diverse characteristics (Wareham & Rennie, 1998). It should also be noted that all PA scores have some level of measurement error, which can result in uncertainty and potentially erroroneous conclusions (Welk, 2002). Measurement error (either random or systematic) can lead to biased estimates of PA leading to the attenuation of the PA – health relationship. If the magnitude of attenuation is severe enough, actual relationships may be obfuscated. Therefore, it is important to understand the relative strengths and weakness of PA instruments and possibly identify ways to reduce or correct for measurement error.

A comprehensive review of PA instrumentation is outside the scope of this thesis. Greater detail will be provided on self-report questionnaires and technology-based devices given their use in the present investigation. A variety of self-report questionnaires have been developed for measuring levels of PA as well as gathering data on the characteristics of the activity (Janz, 2006; Prince et al., 2008; Wilcox & Ainsworth, 2009). It is the most cost-effective and convenient method, especially when administering to large samples (Kowalski, Rhodes, Naylor, Tuokko & MacDonald,

2012). As such, on-going investigations to compare the strengths and weaknesses of current self-report questionnaires – including the method of administration, instructional stems, and the reliability and validity of test scores is of import. In an effort to guide researchers, recommendations have been advanced to aid in the selection of self-report questionnaire to match research objectives (Ainsworth et al., 2012). However, the risk of social desirability and misinterpretation is higher when using self-report questionnaires leading to its biggest limitation (Wilcox & Ainsworth, 2009).

Technology-based devices (e.g., heart rate monitors, pedometers and accelerometers) typically measure, but are not limited to, either PA levels or EE, while some have the capabilities to measure both (Wilcox & Ainsworth, 2009). Heart rate monitors give information about PA patterns and are generally inexpensive and non-invasive. While it is recognized that there are many different models of pedometers and accelerators available with different features depending on cost, accelerometers generally measure the intensity of an activity, while pedometers measure the number of steps taken (Bassett, 2012). The use of these devices may eliminate some of the biases noted earlier by the use of self-report questionnaires (Prince et al., 2008; Wilcox & Ainsworth, 2009). However, in contrast to self-report questionnaires, the use of these devices are more expensive, time-consuming, and complex for both participants and researchers (Prince et al., 2008), which can limit their use in PA research. For example, the use of heart rate monitors has been associated with reduced accuracy with low-intensity activities, differing age and fitness levels, and improper EE estimates (Welk, 2002). Pedometers are also limited as they do not describe the intensity, mode, or pattern of PA (Berlin, Storti, & Brach, 2006). However, the overall relative merits of self-report and

technology-based devices have lead researchers to recommend their combined use (where feasible) in PA research (Bassett, 2012; Haskell & Kiernan, 2000).

Multi-sensor monitors. Most recently, the SenseWear Pro Armband (SWA; BodyMedia, Inc., Pittsburgh, PA) has emerged as an instrument to measure both PA and EE. This instrument has also gained interest due to its level of accuracy (Andre et al., 2006) and its ability to address some of the limitations inherent to other technology-based monitors. "The SWA is a multisensor body monitor, worn over the triceps muscle of the left arm" (Scheers et al., 2012b, p. 757). This device measures a variety of physical activities and provides a more accurate measurement of EE than that of accelerometry (Dudley, Bassett, John, & Crouter, 2009). Along with measuring total EE and movement data, the SWA measures multiple physiological components (Elbelt et al., 2010). As a result, not only does this device have its own pedometer and a two-axis accelerometer within the armband, but SWAs also gains data from a variety of other parameters, such as galvanic skin response, heat flux, skin and near-body temperature, as well as collects demographic characteristics about the individual when programmed (BodyMedia, 2013; Elbelt et al., 2010; Papazoglou et al., 2006).

SWAs have the advantage of measuring wear time allowing researchers to quantify participant compliance (Johannsen et al., 2010). The sophistication of SWAs also allows for a more advanced approach to measuring EE when compared to other PA devices (Papazoglou et al., 2006). In addition to SWAs having the capability to not detect any false motion, researchers are able to more accurately measure non-ambulatory PA (Papazoglou et al., 2006). However, like any PA device, limitations still exist. One major disadvantage of the SWA is the cost, which potentially limits the usage

(Papazoglou et al., 2006). Its measurement of resting EE is also not as accurate as indirect calorimetry in obese individuals; therefore, requiring additional investigation (Papazoglou et al., 2006). However, overall SWAs have been viewed as practical, user-friendly, and effective in measuring any 'free living' movement (Papazoglou et al., 2006).

Researchers have supported the utility of scores from the SWA in laboratory studies when compared against other PA measures, such as indirect calorimetry (Fruin et al. 2004), doubly-labelled water (St-Onge, Mignault, Allison, & Rabasa-Lhoret, 2007), across five treadmill speeds (King et al. 2004), as well as compares favourably against other types of accelerometers (Malavolti et al., 2007; Welk et al., 2007). The SWA has also shown construct validity of scores for use in clinical populations when compared to doubly-labelled water in individuals living with Type II diabetes (Mignault et al., 2005) and with indirect calorimetry (Papazoglou et al., 2006) in obese individuals. This literature demonstrates the ability of the SWA in the clinical population to assist in monitoring appropriate levels of daily EE, which is important to prevent future complications related to weight gain.

Though not afforded the stringent conditions of lab-based studies, the results of field-based studies offer more applicability to everyday living and activity. For scores assessing EE, its validity is equally important in both lab and real world settings. Unfortunately, field-based studies or those with activities resembling daily life are underrepresented in SWA validation studies (Johannsen et al., 2010; St-Onge et al., 2007). SWAs alone have shown underestimations of EE in both healthy (Johannsen et al., 2010) and obese (Papazoglou et al., 2006) individuals. However, researchers have

provided preliminary information on scores from SWA during lifestyle activity in children (Arvidsson et al., 2007) and adults (Bersten et al., 2010; Galvani, et al., 2007; Welk et al., 2007). Overall, SWAs have shown promise for accurately measuring daily EE in real world settings, but further construct validation has been recommended (Johannsen et al., 2010).

Measurement of sedentary behaviour. SB can be measured through a variety of instruments spanning self-report questionnaires to technology-based devices (Atkin et al., 2012; Owen, 2012a). The most common subjective measurement for SB is self-report questionnaires (Clark et al., 2009) that are typically designed to measure a variety of items or activities during the time in which a person is in a relaxed state, such as TV viewing, computer use, time spent in a vehicle, and reading (Atkin et al., 2012; Gardiner et al., 2011). These self-report questionnaires have been known to contribute to the characterization of the amount and types of activities an adult takes part in (Clark et al., 2009; Owen, 2012a). However, using these measures as single items should be approached with caution (Atkin et al., 2012). Self-report methods that look at the combination of duration, mode, context and breaks of SB are preferred, with recognizing the limitations, such as social desirability and the challenge of having conceptual equivalence (Atkin et al., 2012).

Accelerometry has been the most common technology-based device used to measure SB. However, the main weakness outlined for the use of accelerometry is that it measures the intensity of movement and, therefore, is not able to distinguish between different postures, such as sitting and standing, which are important distinctions to make when it comes to measuring SB (Atkin et al., 2012; SBRN, 2012). In an effort to

overcome this limitation of accelerometry, the use of the SWAs to measure SB is gaining favour in literature (Bond et al., 2012; Scheers et al., 2012b). SWAs are able to classify different body postures (i.e., sitting, laying; Scheers et al., 2012b), examine the time spent in a MET-value of less than or equal to 1.5 as outlined by Ainsworth and colleagues (2000), as well as measure small fluctuations in EE (Johannsen et al., 2010). Scores from SWAs have also demonstrated their utility for measuring bouts of SB and reductions in sitting time (Kozey-Keadle, Libertine, Lyden, Staudenmayer, & Freedson, 2011; Scheers, Philippaerts, & Lefevre, 2013). However, SWAs have mostly been examined in the clinical setting, which leaves more to be known when measuring SB in field settings (Atkin et al., 2012). The ability to note differences between SB and light activity continues to be a concern due to inconsistencies with cut-points and various devices being used to measure SB, including the SWA (Scheer et al., 2012). Further, measuring total sedentary time should be approached with caution as smaller distinctions (i.e., breaks) in SB cannot be fully expressed, which has shown differences when examined separately (Scheers et al., 2012b; 2013b). Therefore, even though SWAs can assess different PA intensities (Scheers et al., 2013b), scores of SB from this device still require further exploring and development to strengthen future evidence (Atkin et al., 2012; Duncan et al., 2012; Owen, 2012a).

Measurement of well-being. The reliance on self-report methods to assess WB is common with the limitations inherent to any self-report instrument recognized (McDowell, 2010). While a number of other measures exist (i.e., informant reports, implicit association tests) that have been found to correlate at least moderately with self-report assessments (Kim, 2004; Schimmack, 2008), there use has been limited. It is

important to note that no gold standard exists for measuring WB, but there has been considerable growth in instruments based on the increasing interest in academia. However, the challenge in measuring WB has stemmed from the diversity of theoretical underpinnings of the instruments (e.g., self-determination theory), elements (e.g., autonomy, pleasure, relationships, etc.), and traditions (e.g., hedonic vs. eudemonic vs. health-related quality of life; Huppert & So, 2013; McDowell, 2010). As Diener and Seligman (2004) state, ‘‘…current measurement of well-being is haphazard, with different studies assessing different concepts in different ways, and therefore that a more systematic approach is needed’’ (p. 2). Further, measuring the affective domain of WB has recently gained considerable amount of attention, especially when studying PA (Ekkekakis et al., 2013), and will be the focus for this study.

The affective phenomenon is complex and made up of three closely-related constructs that are commonly used interchangeably; affect, emotion, and mood (Ekkekakis, 2012). These multiple constructs, as well as the theories and measures that accompany each, attests to the challenges researchers face when studying the affective domain (Ekkekakis, 2012). Therefore, differences between these constructs need to be made clear for proper consideration in the context of this study. First, core affect is described as an individual’s constant, non-reflective state of emotion or mood (i.e. either positive or negative) as a result of their varying experiences (Ekkekakis, 2012; Ekkekakis & Petruzzello, 2002; Russell & Fledman Barrett, 2009), which follows a specific pattern of cognitive assessments (Ekkekakis & Petruzzello, 2002). Second, emotion is a “prototypical emotional episode” (Russell & Fledman Barrett, 1999), specific to one type of core affect (i.e. anger, pride, love) based on the transaction between a person and

someone/something (Ekkekakis, 2012). Third, a mood is a longer state of emotion or affective states that do not follow a specific transaction making it more difficult to identify the actual cause (Ekkekakis, 2012; Fridja, 2009). Therefore, researchers can either measure a specific well-defined state (i.e., emotion) or examine various states from a more global context (i.e. mood or affect; Ekkekakis, 2012).

Most recently, Ekkekakis and colleagues (2013) have advocated for measuring WB using affective components, especially in relation to PA. Concerns have been expressed over not capturing essential aspects within the affective domain (Ekkekakis, 2008). Self-report instruments that either focus on specific affective states (i.e., anxiety) or those that examine a finite combination of affective responses that specifically occur during PA (i.e. exercise-related affect) have typically been used (Ekkekakis, 2008). Overall, selecting a scale will come down to which scale is most suitable for the researcher based on study objectives (Ekkekakis, 2008; McDowell, 2010).

The Affect Circumplex Model (Russell, 1980; see Figure 1) has been the proposed solution to this problem for measuring affective WB in its entirety (Ekkekakis & Petruzzello, 2002). The model was developed to examine both the differences and similarities in affective states through two basic dimensions (i.e., affective valence and perceived activation) in a parsimonious effort (Ekkekakis & Petruzzello, 2002). Affective valence refers to feelings of pleasure vs. displeasure and perceived activation refers to one's level of arousal (i.e., low or high; Ekkekakis & Petruzzello, 2002). This model is not only viewed as a conceptual model, but has also been identified as a measurement model (Larsen & Diener, 1992), and has since been utilized by other researchers in a constructive manner (Backhouse, Ali, Biddle, & Williams, 2007; Rose &

Parfitt, 2007; Welch, Hulley, Ferguson, & Beauchamp, 2007). Some researchers suggest that selecting a model over various scales for measuring the affect – PA relationship is best in order to describe the basic affective responses to PA in a balanced manner (Ekkekakis & Petruzzello, 2002). This study was informed by the Affect Circumplex Model such that all four dimensions of affect are considered as opposed to the two dimension (i.e., PANAS) that are typically used in the literature (Ekkekakis, 2008; Ekkekakis et al., 2013).

Participants' Perceptions of Physical Activity/Health-Related Technology

Similar to understanding adult's affective responses when participating in PA, understanding adult's perceptions when using a PA/health-related technology (e.g., accelerometers, pedometers, armbands, electronic diaries, etc.) is also not fully capturing in the literature. Having a positive perception about wearing and using these technologies is important in reducing dropout rates (Perry et al., 2010). However, perceptions are seemingly low when it comes to wearing such devices, especially if the device itself is inconvenient to use on a daily basis (Perry et al., 2010). For example, in adults, the main reasons for not complying to wear accelerometers are due to occupational barriers and/or feelings of discomfort (Perry et al., 2010). While in young adults, wearing an accelerometer is either viewed as negative due to feelings of embarrassment and having unwanted attention, or viewed as positive if it was well-received by others (Kirby et al., 2012). Common recommendations, regarding accelerometers, are to make the device more appealing for use, more personalized, and to be able to receive feedback of PA levels (Kirby et al., 2012). Other devices, such as pedometers, have been conveyed as beneficial to health, convenient to wear, and motivating because participants can view the number of steps they have taken daily (De

Cocker, De Bourdeaudhuij, & Cardon, 2008). However, if the use of any of these devices are not explained properly to the individuals using them, their perception and willingness to use the device longer than the required time will be low (De Cocker et al., 2008). Even though individuals' perceptions are based on the specific device being used, many of the factors involved may have the same impact on other existing PA technologies.

As of today, minimal research exists on participant's perceptions to wearing SWAs. According to Almeida, Wasko, Jeong, Moore, and Piva's (2011) research, the overall evaluation of SWAs was affirming due to detecting only minor criticisms with the device as well as displaying a high rate of adherence, which is comparable, if not better, to other studies using portable activity devices (Nguyen, Steele, & Benditt, 2006; Tudor-Locke & Bassett, 2004). SWAs have also been described as comfortable, unobtrusive, and have been shown to be highly practical as many individuals have positively expressed their satisfaction in regards to health monitoring in the home setting (Tierney, Fraser, & Kennedy, 2013). This evidence displays an overall positive review of the SWAs and is suggestive that the armband is a feasible device to use (Almeida et al., 2011; Tierney et al., 2013). However, additional research is still needed to further our understanding of participants' varied perceptions (e.g., instrumental and affective perceptions) with regards to using the SWA.

Study Purposes and Hypotheses

The purpose of this study was twofold: (1) To examine differences based on obesity-related health risk status in terms of PA, SB, and WB in adults; and (2) To explore participants' perceptions of using a multi-sensor monitoring device to measure

PA and SB levels. The following research hypotheses are advanced and are reflective of previous research (Han et al., 1998; Scheers et al., 2012b; Tierney et al., 2013).

H_1: It was hypothesized that differences would be found on measures of PA and SB by health risk classification. More specifically, participants would display lower levels of PA and higher levels of SB the greater their health risk classification. This hypothesis draws from findings by Scheers and colleagues' (2012a) that demonstrated a decrease in PA levels and an increase in SB levels in relation to participant's increasing BMI status.

H_2: It was hypothesized that differences would be found on WB by health risk classification. Aligned with Han and colleagues (1998), lower psychological WB would be reported by those classified at increased or high risk when compared to those at least risk.

H_3: Participants would report an overall positive experience with the use of a multi-sensor monitoring device. This hypothesis builds on Tierney and colleagues' (2013) research, which reported that participants had a positive experience when using the SWAs due to its comfort, convenience, and practicality in their daily lives.

Significance of the Study

This study contributes to research by examining behaviours and WB in individuals living at a greater (as opposed to a lesser) risk of obesity-related health concerns. First, SWAs are a fairly new device for measuring individual's PA levels which means there is still room for additional research to be completed, especially in field studies that are currently limited in the literature when compared to laboratory studies (Atkin et al., 2012; Johannsen et al., 2010; St.-Onge et al., 2007). Further, no known published research has examined SWA scores that are consistent with Canada's PA

guidelines and related to individual's obesity-related health risk. While most often used to monitor PA, the utility of the SWAs to measure SB has been understudied (Atkin et al., 2012; Duncan et al., 2012). Unlike other popular monitoring devices (i.e., pedometers, accelerometers), SWAs have the ability to classify different body postures (Scheers et al., 2012b), which can provide SB data in terms of how much time an individual spends sitting or lying down each day. Clarifying that the primary intent of this investigation was not to validate SWA scores, data from this research will help elucidate differences in PA and SB in individuals classified at varied risks for obesity-related health concerns in a natural setting.

Second, in response to using SWAs with individuals of different body compositions, this study uses both BMI and WC measurements to further expand Scheers and colleagues' (2012b; 2013b) findings based solely on BMI scores. These measurements also helped categorize participants into different health risk classifications, which further extends what is currently known about PA, SB, and obesity (Scheers et al., 2012b; 2013b). The combination of BMI and WC has demonstrated to be a more accurate way in calculating the level of obesity health-related risks as a consequence of weight status (Health Canada, 2003b; Lau et al., 2007; WHO, 2000; Ying, Song, Zhao, & Jiang, 2010) than BMI alone.

Third, this study also examined participants' psychological WB from the affective domain advocated by Ekkekakis and colleagues (2013). In an effort to provide a more comprehensive understanding of the PA – affect relationship, both affective valence and perceived activation were examined (Ekkekakis & Petruzzello, 2002; Russell, 1980). Through use of these two dimensions consistent with the Affect Circumplex Model

(Russell, 1980), greater insight was gained rather than an exclusive reliance on one (i.e., affective valence). Through adding WB as the third variable under study enhances current research in relation to individual's obesity-related health risk status.

Finally, this study explored participants' perceptions in regards to using the SWAs. Due to the minimal research that exists in this area, further investigation was warranted to help fully understand individuals' thoughts and feelings towards using the SWA. Generally, SWAs have received positive reviews by users (Almeida et al., 2011; Tierney et al., 2013). However, the present study has further replicated and extended current research specific to participant's perceptions about the SWA, such as their attitudes, instrumental and affective perspectives, if the feedback was effective, and the barriers. If individuals do not like wearing the armband, it may lose its effectiveness as an instrument that is designed to promote weight loss through increasing PA and/or decreasing SB (Barry et al., 2011; Shugar et al., 2011). This emphasizes the importance of perceptions for the continued use of PA technologies (Perry et al., 2010), especially for self-monitoring purposes or intervention-based programs.

Methods

Participants

Participants were 18-64 years of age consistent with ranges for adults as outlined in PHAC guidelines (2011a). Recruitment was conducted through the use of non-probability snowball sampling. A sample of 21 participants in each of the three different obesity-related health risk classifications based on BMI and WC scores was targeted (i.e., least risk, increased risk, and high risk). This sample size was determined using a large effect size (d = .80), a conservative power estimate (β = .80), and a fixed alpha level (α = .05; Cohen, 1992), which resulted in a total targeted sample of 63 participants. This

targeted sample size was also consistent with other investigators who have used the SWAs (Almeida et al., 2011; Johannsen et al., 2010; Papazoglou et al., 2006).

Inclusion criteria were: (a) between the ages of 18-64 years, (b) willing to commit to the full length of study, (c) can speak and write in English, (d) currently free of any ambulatory restrictions that may restrict them from their full participation, and (e) have a valid email account.

Instrumentation

Demographics. Demographic variables, including age, gender, ethnicity, education, and employment status were collected in order to provide a description of the sample.

Anthropometrics. Two anthropometric measures were taken to identify obesity-related health risk.

Body Mass Index. Each participant's weight (kg) was measured using a Seca scale calibrated to standard, and their height (m) was measured using a Gulick tape measure affixed to a wall. Each participant's BMI was then calculated using the formula: BMI = weight (kg)/height $(m)^2$ (CDC, 2011) and was rounded to the nearest 0.10 kg/m^2. Normal weight was defined as 18.50-24.99 km/m^2, overweight was defined as 25.00-29.99 kg/m^2, and obese was defined as $\geq$ 30.00 kg/m^2 (PHAC, 2011b). Further, BMI scores have been identified as a fairly strong reliable indicator for detecting the correlation between BMI and body fatness in adults (CDC, 2011). However, it is also recognized for its limitations when it comes to sex, race, and age (CDC, 2011).

Waist circumference. A non-stretchable tape measure (Seca 201 tape measure; Seca, Hamburg, Germany) was used to determine participant's WC measurement (cm),

while in a standing position. The measurement of WC was assessed at the point located halfway between the uppermost border of the iliac crest and lower border of the costal margin (i.e., the tenth rib) (CSEP, 2013; National Obesity Forum, 2006). The average of two measurements, during which the participant breathes in and out, was reported (CSEP, 2013; Heart and Stroke Foundation, 2010) and rounded to the nearest 0.10 cm.

Physical activity and sedentary behaviours. The SWA (BodyMedia, Inc., Pittsburgh, PA) was used to provide both PA and SB data. The SWA is a small ((l) 85.3 mm x (w) 53.4 mm x (h) 19.5 mm, wt = 79 g) body monitoring system designed to measure PA and EE throughout daily living. The SWA armband is worn on the back of the left arm midway between the acromion and olecranon processes. The SWA is secured to the body by an adjustable Velcro strap. The SWA does not require calibration and is battery operated (CR-2032 coin cell battery) that is charged through the computer. Before the monitoring period, the armband was configured for each participant using a USB port and cable with the accompanying BodyMedia software (version 6.1). Configuration uses the individual's gender, birth date, height, weight, handedness, and smoking status. During the configuration, the armband was synchronized with the computer clock and the portable digital clock (stopwatch) used during testing to time activities. This device is a multi-sensor monitoring system and is capable of measuring various metrics, including participants' METs, steps taken, temperature, heart rate, as well as provides minute-by-minute estimates of time spent in different levels of PA intensities (Bond et al., 2012; Jakicic et al., 2004; Johannsen et al., 2010; Scheers, Philippaerts, & Lefevre, 2012b; St-Onge et al., 2007). Raw data collection by the SWA occurs in 1-minute periods by five different sensors (e.g., temperature, heart rate) on the

armband including a biaxial accelerometer (transverse and longitudinal planes). To test study objectives, PA was classified as active energy expenditure (AEE; ≥ 3.0 METs) which is also classified as MVPA, and by step count. SB, on the other hand, was expressed as the time spent sleeping, laying down, and any minute-by-minute activities spent throughout the day at < 1.5 METs.

Leisure-time physical activity. Participants were asked to complete the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985) as a global estimate of their PA behaviour. This questionnaire is a three-item instrument that measures the frequency of mild, moderate, and vigorous PA that each individual participates in. The activity must last a minimum of fifteen minutes in duration and will recall activity across the span of seven days. A total PA score was calculated by estimating METs by multiplying the weekly frequencies of mild, moderate, and strenuous activity by three, five, and nine respectively, and then summing the scores. Support for the test-retest reliability of the overall scores generated from the GLTEQ over a one month period as well as convergent validity based on related indices of physical fitness have been demonstrated (Jacobs, Ainsworth, Hartman, & Leon, 1993).

Subjective sedentary behaviour. Consistent with the Canadian Community Health Survey – Health Aging (CCHS-HA), participants were asked to complete two single item measures of SB (Statistics Canada, 2010). Both self-report items estimated the total amount of sitting time or sitting-related activities (i.e., reading) a participant engages in across a period of seven days. Using Dogra and Stathokostas' (2012) criteria, a daily mean score of SB was then calculated to classify participants as either sedentary (i.e., ≥ 4 hours/day), moderately sedentary (i.e., 2-4 hours/day), or least sedentary (i.e., <

2 hours/day). Construct validity support from scores from the CCHS-HA SB instrument have been demonstrated (Dogra & Stathokostas, 2012).

Well-being. Two instruments were used to capture qualities of the affective domain of WB.

Perceived activation of affect. The Activation Deactivation Adjective Checklist (AD ACL; Thayer, 1989) was used to assess the dimensional qualities of affective responses. The short form AD ACL is a self-report questionnaire consisting of four subscales that measure various dimensions of arousal. In total, the questionnaire includes a 20-item adjective list, with five adjectives per arousal state, including Energy (sample item: "active"), Tiredness (sample item: "sleepy"), Tension (sample item: "intense"), and Calmness (sample item: "placid"). Using a 4-point Likert scale, with 1 = "definitely do not feel" to 4 = "definitely feel", participant's rated each adjective based on their level of affect in regard to engaging in PA, with higher scores reflecting a higher state of affect (i.e. high activation and energy).

Previous research has supported the validity and reliability of AD ACL scores in multiple investigations (Thayer, 1967; 1978; 1986). More specifically, test-retest reliability have repeatedly shown acceptable estimates for scores from all four subscales in various factor analyses (Thayer, 1967; 1978). AD ACL scores have also demonstrated adequacy in terms of measuring affective responses to PA as well as reflects the orthogonal dimensions of the Affect Circumplex Model (Ekkekakis, Hall, & Petruzzello, 2005b).

Positive and Negative Affect. The short form Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegren, 1988) was used secondary to the AD

ACL (Thayer, 1989) and assesses both positive and negative affect. It is a ten-item questionnaire that reflects upon participants' affective experience when engaging in PA. Using a 5-point Likert scale, with 1 = "very slightly or not at all" to 5 = "extremely", participants rated how they generally feel towards the five positive affect items (sample item: "excited") and the five negative affect items (sample item: "nervous") in relation to engaging in PA. Thus, higher scores are reflective of higher levels of positive or negative affect. Scores from each subscale were then computed to achieve an overall mean value for each affective dimension.

Support for construct validity using the short term PANAS scores have been well-documented (Crawford & Henry, 2004; Kercher, 1995). Scores from the PANAS have shown internal consistency (Cronbach's α, Cronbach, 1951) in the general adult population (Crawford & Henry, 2004), including PA research (Mack et al., 2012; Wilson, Mack, Blanchard, & Gray, 2009). Scores from the PANAS have also demonstrated their acceptability in assessing the high activation poles of the Affect Circumplex Model (Larsen & Diener, 1992; Nemanick & Munz, 1994).

Perceptions of self-monitoring device. Participants were asked to evaluate the SWAs at the end of wear time. This evaluation examined multiple aspects in regards to participants' perceptions (i.e., attitudes, instrumental and affective dimensions, feedback, and barriers) based on the lack of research that exists in today's literature. This questionnaire was adapted from various items used in previous research that have assessed portable PA monitoring technologies (Fukuoka, Lindgren, & Jong, 2012; Kirby et al., 2012; Perry et al., 2012; Shaw et al., 2011; Tierney et al., 2013) as well as other monitoring devices of various natures (Burns et al., 2013; McCluskey, Ada, Dean, &

Vargas, 2012; Ware et al., 2008). In total, it consisted of 39 items and was composed of dichotomous (i.e., Yes or No) and 5-item Likert scale type questions.

More specifically, this questionnaire evaluates various domains of perceptions, such as views about the instrument as a whole (sample item: "good vs. bad"), participants' attitudes towards the device (sample item: "fun vs. boring"), stigma attached to the device (sample item: "How embarrassed did you feel with wearing the device?"), the personalized results they received (sample item: "Do you think you will use the feedback to guide future physical activities?"), as well as assesses barriers associated with the device (sample item: "comfort of the device"). Four exploratory items were also developed and added within the questionnaire to enhance the overall findings about participants' perceptions. These sample items included: (a) "How willing would you be to wear the device long-term?", (b) "How interested would you be in purchasing this device in the future?", (c) "Have you ever used another physical activity monitoring device (i.e., pedometer, accelerometer, fitness apps)?" and (d) "If yes, how would you rate this device compared to other physical activity monitoring devices that you have used?".

Procedures

This study is a non-experimental, cross-sectional design using non-probability snowball sampling. However, it was noted that the SWA monitoring data was not classified as cross-sectional, since these devices gathered data across a period of time (e.g., 7 days). The data collection commenced in December 2013 and ended in February 2014; with three rounds of recruitment. Ethical clearance was granted prior to participant recruitment from Brock's Bioscience Research Ethics Board (see Appendix A).

The nature of the study was presented to participants through posters (see Appendix B) to promote interest in the research study as well as by word of mouth through a short verbal presentations (see Appendix C). Participants, who were interested, were also encouraged to recruit potential participants through word of mouth. Each participant was provided with information about the study as well as be given a Letter of Invitation (see Appendix D) to further explain all the components that are involved. Once informed, each participant was given a consent form (see Appendix E). Those participants who agreed to participate had their anthropometric measures taken and were given an orientation to the SWA regarding the use and wear of the device. Participants were then given a SWA each that they proceeded to wear at this time.

Participants were asked to wear the SWA for a total of seven days, which is consistent with other literature (Almeida, et al., 2011; Bond et al., 2012; Scheers et al., 2012b; 2012c). This timeline allows data to be collected for not only five weekdays, but also for a full weekend where the most variability in activity exists, which will assist in providing habitual PA scores that are most reliable (Buchowski, Acra, Majchrzak, Sun, & Chen, 2004; Scheers et al., 2012c; Tudor-Locke et al., 2004). Participants who wore the SWA for a minimum of five days with at least three being week days were retained for inclusion (Scheers et al., 2012c).[1] Participants were asked to wear the SWA for at least 23 hours across the course of each day, including sleeping, and only to be removed during water-based activities (i.e. showers, swimming, etc.) and for battery charging purposes (Scheers et al., 2012b; 2012c).[2] A ‘Participant Binder’ was distributed to all participants for any additional information they require about the function and wear of the

SWAs (e.g., checklists, FAQs) and to provide further support during the duration of the study (see Appendix F).

Participants were also be given an email consent form (see Appendix G) where they will be able to provide a valid email address that will be used throughout the seven day monitoring period. A total of two email reminders (see Appendix H) were sent throughout the week to each participant. The first email was sent on the participant's fourth day of wearing the SWA, being that it is approximately halfway through the week. The purpose of this email was to encourage participants' continued use of the armband, as well as to remind them to charge the device sometime that evening. The charging was only required for one solid hour just as a precaution to reduce the likelihood of data loss. The second email reminded participants about attending their final appointment to wrap up the study. This email was sent 24 hours prior to the final meeting.

Upon conclusion of the data collection period, participants were instructed to take off the device and give the armband back to the researcher who immediately uploaded the data onto a laptop. Participants were then given a questionnaire package (see Appendix I) to complete during this time. Upon completion, participants had the option to view their SWA report (see Appendix J) from the uploaded data, which was interpreted to them by the researcher. A second questionnaire was then administered in order to evaluate their perceptions about the SWA (see Appendix K). If participants did not want to view their results, they were still given the opportunity to complete the perception questionnaire. All participants were also provided a Debriefing Form (see Appendix L) where they could provide contact information if they wish to receive their SWA summary

report and/or the overall results of the study via mail or electronically. Participants did not receive any form of financial incentive for participation.

Data Analysis

Data analyses were proceeded sequentially. First, to examine adherence to study protocol for scores from the SWA, participant data was examined to determine if the monitoring device was worn for at least 23 hours per day for five days across the monitoring period (Scheers et al., 2012b; 2012c). For individuals meeting inclusion criteria, self-report data was then screened using frequency tables to examine for data entry errors as well as to detect the presence of missing values for self-report instruments. Missing data for self-report instruments was replaced using an expectation maximization algorithm.

Second, descriptive statistics were calculated to analyze participant demographics, anthropometric measures, and self-report data. BMI and WC values were used to classify individuals into different health risk groups (i.e., low, moderate, and high) consistent with NIH (1998) guidelines. AEE ($\geq$ 3.0 METs) and the number of steps taken across the monitoring period were calculated using the information contained in the SWA summary report. Further, AEE consistent with Canada's Public Health Guidelines was generated from the minute-by-minute data downloaded to the BodyMedia Professional Software. Data retained to document AEE consistent with guidelines was included if activities were engaged in at least 3.0 METs and for at least a continual 10 minute bout. This variable is known as AEE-10. The SWA records multiple forms of data that could be linked with SB, including time spent sleeping and activities engaged at an intensity less than 3.0 METs. In an effort to be consistent with recommendation from the SBRN (2012), SB

was calculated as the sum of "Sleeping" and "Laying down" from the SenseWear report and any minute-by-minute activities spent throughout the day at < 1.5 METs.

Third, pattern of association between AEE, AEE-10, and number of steps were examined with those from the GLTEQ (Godin & Shepard, 1985) using a Pearson bivariate correlation. Pattern of association was also examined between SWA and self-report SB scores, as well as scores from the AD-ACL and PANAS using a Pearson bivariate correlation. These analyses were conducted regardless of obesity-related health risk classification.

Fourth, with study variables created, hypotheses 1 – 2 were tested using a One-Way Multivariate Analysis of Variance (MANOVA) to examine differences on PA (i.e., AEE-10 and number of steps taken) and SB by obesity-related health risk classification, as well as WB markers by obesity-related health risk classification. Pillai's criteria was used instead of Wilk's lambda, since it is more robust when small or unequal sample sizes are present (Hair, Black, Babin, & Anderson, 2009). Where there were significant model differences ($p < .05$), post hoc analyses were conducted to determine differences between groups. Prior to running the MANOVA models, all required statistical assumptions were examined. Eta-squared and partial eta-squared effect sizes were also calculated to examine information complementary to null hypothesis significance testing (Harlow et al., 1997). Interpretation of effect sizes for small ($n^2 = .09$), moderate ($n^2 = .14$), and large ($n^2 = .22$) effects were based on eta-squared values (Fay & Boyd, 2010). However, both estimates of effect sizes were reported as a supplement to each other based on the recommendations of Levine and Hullett (2002; 2010) considering the

limitations that exist if only reporting partial eta-squared values (e.g., lack of research/knowledge), which serves as the default in SPSS.

Finally, descriptive analyses were calculated to answer the third hypothesis regarding participant perception data. Means and percentages were compared and reported for each item within the questionnaire; dependant on the level of measurement. This allows for a general overview of how participant's viewed the device during wear on a few different levels (i.e., attitudes, instrumental and affective perceptions, SWA feedback, and barriers to the device).

Results

Preliminary Data Screening

While participants were asked to wear the SWA for 23 hours/day across the monitoring period, the determination of adherence to study protocol was based on Scheers and colleagues' (2012b) recommendations (i.e., five days) along with at least 85% (i.e., 20.40 hours) of wear per day. Of those individuals providing data (N = 52), 3.85% (n = 2) did not wear the SWAs long enough, based on the cut-off criteria. These individuals were classified as non-adherers and were removed from further consideration. Therefore, the final sample under analysis totalled 50 participants.

Initial inspection of the GLTEQ indicated the presence of one individual outlier (z = |3.29|). This individual was deleted for any analysis involving the GLTEQ. Further inspection of the WB data indicated the presence of minimal non-response error as one participant did not response to any item of the AD ACL. Consequently, any analysis involving the AD ACL was based on a sample size totalling 49. Inspection of individual items across the AD ACL demonstrated that no more than 2.00 percent (n = 1) of data was missing. More specifically, the only other missing data point was for the item 'still'.

This was deemed to be missing completely at random and expectation maximization (EM) likelihood was used for this missing case whereby a value of 1.59 was inputted. The percent of missing data for scores from the PANAS ranged from 0 – 2.00 percent, with one individual not responding to the item "enthusiastic". This data point was also deemed to be missing completely at random and replaced using the EM likelihood method, which inputted a value of 3.21.

Inspection of the SWA perception data indicated the presence of minimal non-response error as one participant did not response to any item of the SWA attitudinal scale. Consequently, any analysis involving attitudinal variables linked to the use of the SWA was based on a sample size totalling 49.

Participant Characteristics

Participants were 50 men and women (n_{men} = 19, n_{women} = 31; M_{age} = 38.50 years, SD_{age} = 14.21 years). The majority of participants indicated their marital status was "Married/Common Law" (n = 29; 58.00%), self-identified as being "Caucasian" (n = 45; 90.00%), and that their employment status was "Employed" (n = 39; 78.00%). The majority of participants also indicated that their highest level of education was either a "College Diploma or Certificate or Trade" (n = 16; 32.00%) or "University Degree" (n = 17; 34.00%). On average, participant BMI values based on objective measures were classified as "overweight" (M_{BMI} = 27.32kg/m2; SD_{BMI} = 5.28; PHAC, 2011b) and WC values were classified as "moderate" for both men (M_{WC} = 94.27; SD_{WC} = 12.31) and women (M_{WC} = 83.22; SD_{WC} = 12.76; Lean et al., 1995; Janssen et al., 2002; National Heart, Lung & Blood Institute, 2014).

Participants were classified as "Least Risk" (n = 16; 32.00%), "Increased Risk" (n = 21; 42.00%), or "High Risk" (n = 13; 26.00%) based on BMI and WC scores to

determine their obesity-related health risk status. Differences based on obesity-related health risk status across demographic variables were examined (see Table 2). Results of appropriate parametric and non-parametric tests revealed no significant differences (p > .05) across groups with the notable exception of gender. Interpretation of the Kruskal-Wallis H test indicated that more participants in "Least Risk" and "High Risk" were female (n = 13; n = 9 respectively), while those in "Increased Risk" were more likely to be male (n = 12).

Descriptive Statistics and Estimates of Internal Consistency

Descriptive statistics across study variables can be found in Table 3. Inspection of the descriptive statistics demonstrated that the sample, on average, engaged in 7539.38 steps per day, and participated in 54.55 minutes of MVPA in ten minute bouts or more per week (i.e., AEE-10). According to the SWA data, participants also participated in large amounts of SB (e.g., sitting, sleeping) compared to their time spent in MVPA (M_{SB} = 1044.29 minutes; M_{AEE} = 135.52 minutes). Interpretation of the GLTEQ scores suggested that participants in this study engaged in more physical activity compared to normative values (M_{METS} = 45.80; Godin & Shephard, 1985). Based on self-report data, participants reported sedentary (or sitting) activities on average 3-4 days per week for about 2-4 hours per day. Participants also scored above the theoretical midpoint on indices of energy and positive affect while their scores fell below the theoretical midpoint on indices of tiredness, tension, calmness, and negative affect.

Reliability coefficients were estimates using Cronbach's coefficient alpha (Cronbach's α; Cronbach, 1951) are reported in Table 3. Estimates of internal consistency Coefficient alpha for test scores derived from affective measures of WB ranged from .72 to .90.

Bivariate Correlations between Study Variables

Patterns of association were examined between the three anthropomorphic variables and remaining study variables to determine whether different conclusions could be generated depending on measure of body composition employed. When obesity related health risk was adopted, Spearman rank order correlations were run. Pearson bivariate correlations were conducted between BMI or WC and study variables. In general no differences in statistical conclusions were made with two exceptions (Table 4). Specifically, AD ADL Tiredness showed a statistically significant relationship with obesity related health risk classification (r_{12} = .26), while SB was not statistically significantly related to obesity-related health risk classification (r_{12} = .13).

Pearson bivariate correlations were conducted to explore pattern of relationships between PA variables regardless of obesity-related health risk classification (r_{12s} =.34 – .94; p < .05; Table 5). In brief, a strong, positive relationship was found between AEE and AEE-10 (r_{12} = .94, p = .00). Step count data derived from the SWAs demonstrated a more moderate association with AEE (r_{12} = .65) and AEE-10 (r_{12} = .62) scores. A small-to-moderate and statistically significant association between PA scores derived from the SWA and scores from the self-report instrument (i.e., GLTEQ; r_{12s} = .34 - .45).

Spearman rank order correlation coefficients between SB variables collected either via SWA or the single item indicator of hours of SB were calculated[3]. The average amount of hours spent in sitting activities demonstrated a moderate positive relationship with the average amount of time spent in SB based on SWA data (r_{12} = .34, p = .01).

Moreover, scores from the AD ACL (Thayer, 1989) were compared to the scores of the PANAS (Watson et al., 1988) instrument designed to assess individuals' affective state in the context of PA (see Table 6). An examination of the pattern of relationships

revealed a moderate, positive relationship between negative affect and both tiredness and tension subscales. Scores for positive affect demonstrated a moderate, positive relationship with energy (r_{12} = .44, p = .00), while a moderate-to-strong, negative relationship was evident when examining scores between subscales energy and tiredness (r_{12} = -.68, p = .00). The two high activation subscales (i.e., energy and tension), as well as PANAS subscales (i.e., positive and negative affect) were unrelated (p > .05).

Main Analysis: PA and SB by Obesity-Related Health Risk Classification

Prior to running statistical assumptions for the main analysis, decisions as to the number of dependent variables to include were considered. When examining the pattern of relationships between dependent variables, high correlations were detected between AEE and AEE-10 (r_{12} = .94), as well as AEE and SB (r_{12} = -.82). As a consequence the likelihood of multicollinearity was high (Grice & Iwasaki, 2007) and AEE was identified as statistically redundant based on its near-linear combination of the other dependent variables (e.g., specifically AEE-10; Grice & Iwasaki, 2007). As a result, AEE was then removed from the main analysis in support of MANOVA assumptions (Grice & Iwasaki, 2007; Stevens, 2002; Tabachnick & Fidell, 2007). Therefore, hypothesis 1 was tested using a MANOVA to examine differences on PA (i.e., AEE – 10 and number of steps taken) and SB by obesity-related health risk classification. Before this main analysis was run, the appropriate assumptions were examined.

Assumptions. First, the assumption of independence was met on the basis of the study design. Participants were classified into one of three obesity-related health risk classifications based on BMI and WC scores. The use of this criteria for classifications excluded those from one group (e.g., least risk) from other groups (e.g., increased risk), which renders each participant and their scores were independent from another.

Second, the assumption of univariate and multivariate normality of the data was tested. Skewness and kurtosis values (see Table 3) demonstrated some departure from univariate normality in the data and as such departure from multivariate normality can be assumed. Multivariate normality was examined using Mahalanobis distances. Three outliers were detected as potentially problematic with a value of 12.14, 12.33, and 16.84 based on the chi-squared critical values table ($p < .001$). These cases removed from further analysis in an effort to uphold the assumption of multivariate normality.

Third, Bartlett's Test of Sphericity was used to test for the assumption of linearity among the dependent variables. For PA and SB variables, the Bartlett's test was statistically significant ($\chi^2 = 572.19$, $p < .0001$). Therefore, the assumption of linearity was upheld.

Fourth, the assumption of homogeneity of variance-covariance matrices was tested using Box's *M* Test of Equality of Covariance Matrices. After running the Box's *M* Test, it was determined that this assumption has been violated (*Box M* = 53.32, $p < .0001$). However, the Box's *M* Test should be interpreted with caution as this is a sensitive test whereby significant results can occur even when the departure of homoscedasticity between groups are minimal (Hair, Black, Babin, Anderson, & Tatham, 2006; Tabachnick & Fidell, 2007).

MANOVA. One-way MANOVA was conducted to examine the effect of obesity-related health risk (least risk, increased risk, and high risk) on PA and SB variables (see Table 7). Results revealed a significant multivariate effect of obesity-related health risk on the combination of PA and SB levels, Pillai's = .40, F (6, 86) =

3.60, $p = .003$, $\eta_p^2 = .20$, observed power = .94. Estimates of effect size were interpreted as moderate-to-large.

Given the significance of the multivariate test, the univariate main effects were examined. Significant univariate main effects for were obtained only for AEE-10, F (2, 44) = 7.02, $p = .002$, $n^2 = .12$, $\eta_p^2 = .24$. Both steps (F (2, 44) = .83, $p = .44$, $n^2 = .00$, $\eta_p^2 = .04$) and SB (F (2, 44) = 1.37, $p = .27$, $n^2 = .00$, $\eta_p^2 = .06$) showed non-significant univariate main effects. These results suggested that individuals differed in terms of AEE-10 depending on obesity-related health risk classification, but not for steps or SB.

Post-hoc comparisons were completed to examine the pairwise comparisons among obesity-related health risk classifications when examining AEE-10 with statistically significant differences between least and high risk ($p < .05$). There were non-significant differences between least and increased risk ($p = .32$) and differences between increased and high risk approached significance ($p = .06$). In sum, those at least risk participate in a significantly higher amount of AEE-10 than those in high risk.

Main Analysis: WB by Obesity-Related Health Risk Classification

Study hypothesis 2 was also tested using a MANOVA to examine WB by obesity-related health risk classification. Given the magnitude of correlations between AD ACL constructs (see Table 6), multicollinearity of dependent variables were not deemed problematic (Grice & Iwasaki, 2007). Before this analysis was run, the appropriate assumptions were examined.

Assumptions. First, the assumption of independence was met on the basis of the study design as described in the previous MANOVA analysis. Participants were classified into one of three obesity-related health risk classifications based on BMI and WC scores. The use of this criteria for classifications excluded those from one group

(e.g., least risk) from other groups (e.g., increased risk), which renders each participant and their scores were independent from another.

Second, skewness and kurtosis values (see Table 3) demonstrated some departure from univariate normality. Multivariate normality was tested using Mahalanobis distances. One possible outlier was detected with a value of 20.73 based on the chi-squared critical values table ($p < .001$). Therefore, this case was removed from further analysis in an effort to uphold the assumption of multivariate normality for this analysis.

Third, Bartlett's Test of Sphericity was used amongst dependent variables to test for the assumption of linearity. The Bartlett's test for WB variables showed to be significant ($\chi^2 = 110.49$, $p < .0001$) and therefore, it can be concluded that the assumption of linearity was met.

Fourth, the assumption of homogeneity of variance-covariance matrices was tested using Box's *M* Test of Equality of Covariance Matrices. Since the Box's *M* Test showed significance (*Box M* = 61.46, $p = .22$), it is concluded that the assumption of homogeneity has been upheld.

MANOVA. One-way MANOVA was conducted to examine the effect of obesity-related health risk on WB (see Table 8). Results revealed a non-significant multivariate effect of obesity-related health risk on WB levels, Pillai's = .36, F (12, 82) = 1.49, $p = .147$, $\eta_p^2 = .18$, observed power = $.75^4$. Estimates of effect size were interpreted as moderate. Therefore, given the non-statistically significant findings, no additional interpretation was conducted in this section.

Exploratory Analysis on SWA Perceptions

Attitudes. Based on participant's perceptions, the majority of the participants had a positive attitude to wearing the SWA based on their responses to various attitudinal

items ($M_{attitude}$ = 4.05, $SD_{attitude}$ = 0.70; see Table 8). More specifically, the two individual attitudinal items that were endorsed most highly were the items "worthwhile" and "good" (*n* = 30; 61.20%). Comparatively, very few rated the individual attitudinal items negatively. For example, only 4.10% (*n* = 2) of participants considered using the SWA "boring".

Instrumental and affective perceptions. According to participant responses, very few participants rated the instrumental or affective items negatively (see Table 9). Most participants scored above midpoint when asked about the device's practicality (*n* = 33; 66.00%), and only 2.00% (*n* = 1) of participants reported having a very low confidence level when wearing the device in public.

Additional instrumental data (not included in Table 9) demonstrated that most participants did not know that the device was commercially available to them (*n* = 38; 76.00%). However, when asked if they would purchase the device, now knowing that it is available in stores, the majority of participants were either "Somewhat" interested (*n* = 16; 32.00%), or "Not at all" interested (*n* = 14; 28.00%). Those participants who identified that they have used another PA monitoring device in the past favourably scored the SWA as being "Moderately" to "Very High" (*n* = 21; 42.00%) when compared to the other devices.

SWA feedback. After participants viewed their SWA summary report, the majority of participants found the information "Extremely" worthwhile (*n* = 29; 58.00%) and would use the feedback to guide future physical activities (*n* = 39; 78.00%). More specifically, almost all participants found the feedback for EE as well as the graphs useful when understanding their PA behaviour (*n* = 48; 96.00%). Prior to receiving feedback,

the majority of participants were "Somewhat" aware of their PA behaviour (*n* = 27; 54.00%). However, after viewing their SWA summary report, most participants were now more aware (*n* = 45; 90.00%). Finally, the majority of participants scored above midpoint when asked how much they liked having their health monitored at home rather than a clinical setting (*n* = 42; 84.00%). However, participants willingness to wear the device long-term was varied in response, with just over two thirds of participants feeling anywhere from "Somewhat" to "Extremely" willing (*n* = 34; 68.00%).

Barriers. Scores across all barrier items were relatively low (see Table 9). More specifically, the two individual barrier items that were perceived as the most unproblematic were the "weight of the device" (*n* = 46; 92.00%) and "your occupation" (*n* = 39; 78.00%). Very few of the items were rated negatively, with the exception of the "comfort of the device", which only 18.00% (*n* = 9) rated as not a problem.

Discussion

Obesity continues to be a major public health concern in society leading to the development of multiple comorbidities (Callahan, 2013; Pollack, 2013; Ryan, 2013) and affecting individuals physical and psychological health (Rabbitt & Coyne, 2012). Based on previous evidence, researchers have explored BMI and WC measures to the incidence of disease and have demonstrated additional variance, specifically with mortality, and cardiovascular/metabolic risk factors (Elobeid et al., 2007; Li et al., 2007; Walls et al., 2011; Zhu et al., 2002). As a result, Canadian and international health agencies have recommended the combined measurement of both BMI and WC for the assessment of obesity-related health risk (Health Canada, 2003b; NIH, 1998; WHO, 2000). However, to the best of my knowledge, researchers have not explored lifestyle behaviours (e.g., PA and SB) and WB in relation to obesity-related health risk based on BMI and WC

measures. Therefore, extending beyond what is known will help individuals understand a broader array of health-related constructs across the three levels of obesity-related health risk, which may be a potential contributor to their own risk status. Consequently, the primary purpose of this study was to examine the differences based on health risk status in terms of PA, SB, and WB in adults.

Comparing the present sample's obesity characteristics to the Canadian population will help identify how reflective my sample is to normative statistics. Recognizing that my sample is relatively small, one in six adults would be considered obese based on the present study's BMI values. This statistic is slightly lower than the Canadian adult population (i.e., one in four adults; PHAC, 2011b). However, the percentage of both overweight and obese participants (i.e., 68.00%) is slightly higher than the general population according to 2008 measured data (62.10%; PHAC, 2011b). Despite these slight differences, the average BMI value (M = 27.32) is almost an exact reflection of Canadian adults (M = 27.20; Statistics Canada, 2012b). Further, based on WC values, the present study generally had a lower WC (M = 87.42cm) than the adult population (M = 91.40cm; Statistics Canada, 2012b). There was also triple the amount of females who had a high WC when compared to males, which is consistent with the growing trend for the female population having higher WC values (Statistics Canada, 2012b).

Interpretation of descriptive statistics assist the general understanding of lifestyle behaviours and WB examined in the present investigation. Among study participants, approximately 66.00% met the public health recommendations of participating in 150 minutes of MVPA per week, in bouts of ten minutes or more (CSEP, 2013; PHAC, 2011a). The percentage of individuals meeting the Canadian PA guidelines in this

sample may be deemed somewhat atypical. According to Colley and colleagues (2011) 15.4% of adults aged 20-79 years meet Canadian PA guidelines. Data reported by Colley and colleagues (2011) may actually overestimate PA levels as AEE in continuous bouts of eight minutes or more was adopted as the criterion. However, even with this considerable difference, my sample seems to be more active than the norm and, therefore, may not be fully representative of the Canadian population (Colley et al., 2011).

Although public health guidelines have not been identified for the minimum number of steps per day needed for health benefits in adults, Tudor-Locke and Bassett (2004) have suggested that at least 10000 steps should be targeted. When using step count as the index of PA, participants on average did not reach this recommended level (M_{steps} = 7539.38). In fact, only 18.00% (n = 9) of participants had an average of more than 10000 steps per day across the monitoring period. When compared to Colley and colleagues' (2011) population health data, participants in the present study reported significantly fewer steps across the seven day monitoring period ($t(49) = -3.61$, $p < .00$). This suggests that participate step count may not be fully representative of the Canadian population.

Extending beyond PA levels, SB is increasingly becoming a concern (Lynch et al., 2013; Owen, 2012b) as it encompasses a broad range of activities (e.g., TV watching, eating, driving) that occur intermittently throughout the day (SBRN, 2012; Thorp et al., 2011). Researchers have also demonstrated that SB has an emergent impact on health and subsequently deserves attention; independent from PA (Katzmarzyk, 2010; Rhodes et al., 2012; Sugiyama et al., 2008). Participants in the present investigation engaged in approximately 17 hours and 40 minutes SB per day, which was very similar to that of

Scheers and colleagues' (2012a) findings based on their SWA scores (i.e., 17.41 hours/day of SB, on average). Even though SB included both waking and non-waking activities, participants engaged in an average of 9 hours per day in sedentary pursuits (assuming 8 hours of sleep per night). These findings are typical of Canadian adults according to Colley and colleagues (2011) research, which reported that Canadians spend about 9.5 of their daily waking hours being sedentary. Therefore, since SB accounts for a large portion of an adult's day, ongoing monitoring of this behaviour and how it will continue to impact the population is required (Colley et al., 2011; Shields & Tremblay, 2008).

In additional to the lifestyle behaviours, examining markers of WB as experienced within the context of PA and, ultimately obesity-related health risk, is important to understanding how people feel and why they choose to be active or not (Backhouse et al., 2007; de Geus & de Moor, 2008). Guided by the Affect Circumplex Model (Russell, 1980), varied dimensions of WB were considered in the present investigation. Interpretation of participant scores demonstrated that individuals generally reported feelings of positive affect and energy when engaging in PA, which is consistent with previous research (Ekkekakis et al., 2000; Parfitt, Markland, & Holmes, 1994; Reed, 2005). Affective responses linked to "tiredness" and "calmness" were on average rated relatively low in response when individuals engage in PA. Overall, these findings were reflective of the Affect Circumplex Model as shifts towards higher activated states and improved valence were shown to have the most impact when engaging in PA (i.e., energy; Thayer 1987; Ekkekakis et al., 2000).

Lastly, both lifestyle behaviours and WB scores were examined to test for construct validity of scores. The GLTEQ and SWA measures for PA were all significantly ($p <$. 05) correlated with each other. SB results from both self-report and SWA also demonstrated similar results, which strengthens my overall findings for validity of scores of SB. When comparing findings from the AD ACL and PANAS, both Energy and Positive Affect showed to be significantly correlated as was seen between all the negative dimensions of affect. This demonstrates that the AD ACL instrument, in the context of PA, relatively supports aspects of the PANAS, which is the instrument most often used in the literature (Ekkekakis, 2008; Ekkekakis et al., 2013). Within the AD ACL instrument alone, results showed how strongly contrasted the feelings of Energy and Tiredness are experienced during PA consistent with the Affect Circumplex Model (Ekkekakis, Hall, & Petruzzello, 2005b; Ekkekakis & Petruzzello, 2001). Therefore, all study variables and their various measurements showed no significant differences to what you would typically expect.

Activity Behaviour and Obesity-Related Health Risk Classification

Using BMI scores, researchers have consistently found that those who are more likely to be overweight or obese tend to engage in less PA and report higher SB (Bond et al., 2012; Colley et al., 2011; Gibson-Moore, 2012; Healy et al., 2011; Scheers et al., 2012b; Tudor-Locke et al., 2010). With the concerns over exclusive reliance on BMI as an anthropometric measure well documented (Lavie et al., 2009; 2010; Thibault & Pichard, 2012), a somewhat novel classification system was used in the present investigation based on BMI and WC scores. In general, individual's activity behaviour when examining AEE-10, steps taken, and SB, showed significant differences ($p < .05$) and a moderate-to-large effect ($\eta_p^2 = .20$) based on their obesity-related health risk

classification. While these variables have been examined in previous literature, overall findings show inconsistencies possibly due to the variations in PA measurements and constructs at study (e.g., overall PA, MVPA, light activity; Bond et al., 2012; Colley et al., 2011; Scheers et al., 2013b; 2012a; Tudor-Locke et al., 2004). When each dependent variable was examined separately, significant differences corresponding to small-to-moderate effect sizes existed for the variable AEE-10. More specifically, those who were at least risk for obesity-related health complications participated in more MVPA in bouts of at least ten minutes than those classified as high risk. Differences across classifications were not found for those at increased risk ($p > .05$). This can be further generalized as AEE-10 alone has shown to have a small-to-moderate effect ($\eta^2 = .12$, $\eta_p^2 = .24$; Fay & Boyd, 2010) when considering markers of practical significance based on obesity-related health risk.

Furthermore, steps taken and SB have also produced discrete findings. My study's findings suggest that there are no differences, based on null hypothesis significance testing, in obesity-related health risk classifications when examining how many steps individuals take per day or how much they participate in SBs. The interpretation of effect size also displayed a similar finding. Both steps and SB displayed a small to null effect (η^2 ranged from .00 - .06; Fay & Boyd, 2010). For steps, my findings differed from that of Colley and colleagues' (2011), which found that those individuals who were obese accumulated significantly fewer steps than those who were of normal weight. Colley and colleagues' (2011) also noted that the older the adult and the higher their weight status, the less steps they were likely to take. This was not the case for this study as no significant differences existed between steps and one's obesity-

related health risk. However, it was noted that those at increased risk accumulated approximately 1000 more steps per day than those in the other classifications. Nonetheless, on average, my findings suggest that adults are not reaching the recommended amount of steps to achieve health benefits (Tudor-Locke & Bassett, 2004) regardless of their weight status.

Further, the study's findings support the trend found in Scheers and colleagues' (2012a) research that shows SB is increasing in all classes of weight and body compositions. Since there were insignificant results across classifications of obesity-related health risk and SB, this may mean that Canadian adults are experiencing high levels of SB regardless of weight status. However, my findings contrast Healy and colleagues' (2011), which showed that time spent sitting and higher levels of screen time were associated with a greater likelihood of being overweight or obese; recognizing that these researchers conceptualized SB differently. However, Colley and colleagues' (2011) also differed in their instrumentation for PA (i.e., accelerometer-based) and criteria for what they considered a valid week/day (i.e., $\geq$ 10 hours; $\geq$ 4 days/week) as well as a bout of AEE (i.e., 8 to 10 minutes), which could account for some of the differences noted. Therefore, based on the inconsistencies in results, instrumentation, and criteria between my study and previous studies, future researchers need to continue to explore obesity-related health risk in relation to behavioural factors.

WB and Obesity-Related Health Risk Classification

As the bulk of existing literature has looked at chronic conditions and biomedical outcomes linked with obesity or obesity-related health outcomes (Elobeid et al., 2007; Li et al., 2007; Walls et al., 2011; Zhu et al., 2002), examining psychological outcomes also

holds utility. With regards to WB levels, previous researchers have shown inconsistencies in findings as some suggest that those who are overweight or obese are more likely to have lower levels of WB (Fontaine & Barofsk, 2001; Vieira et al., 2012), while other researchers recently have demonstrated no difference in ill-being in relation to obesity (Henriksen, Mather, Mackenzie, Bienvenu, & Sareen, 2014). In the present study, differences among obesity-related health risk classifications with multiple markers of affect were examined. Despite previous literature where researchers have demonstrated a dose-response relationship between WB and weight status (Fontaine & Barofsk, 2001; Han et al., 1998; Kolotkin et al., 2001; Vieira et al., 2012), there were no differences ($p > .05$) detected in the present investigation between scores on WB and obesity-related health risk. Although a moderate effect size was noted in the overall model, each predictor showed very small to null effects (η^2 ranged from .00 - .01; Fay & Boyd, 2010) when examined further, which supports the notion that individuals' affective responses in the context of PA are similar regardless of weight status. With that being said, my results further support the complex nature of the relationship between WB and weight status as researchers have reported both similar or differing associations between these constructs (de Zwaan et al., 2009; Katsaiti, 2012). With respect to those researchers who have used the Affect Circumplex Model, most have looked at an acute bout of exercise compared to activities of daily living and sampled healthy, young adults, which resulted in differences in the high-activating dimensions of affect (Ekkekakis & Petruzzello, 1999; Ekkekakis et al., 2005b; 2011). However, the present investigation taps into the affective dimension of WB as it is typically experienced during PA, which may have accounted for the differing outcome.

Moreover, continuing to explore the PA – affect relationship is vital to understanding why people choose to exercise or opt out (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007; de Geus & de Moor, 2008) as a potential contributor to their current weight status. Since the current study examined affective responses with engaging in PA, the present findings suggest that the association between PA and WB may exist apart from examining one's weight status -- a finding consistent with previous research (Bize, Johnson, & Plotnikoff, 2007; Hamer, Stamatakis, & Mishra, 2012; Kruger, Bowles, Jones, Ainsworth, & Kohl, 2007; Penedo & Dahn, 2005; Wendel-Vos, Schuit, Tijhuis, & Kromhout, 2004). The intensity of PA (as opposed to frequency or duration) may have influenced the promotion of WB as well (Ekkekakis, Parfitt, & Petruzzello, 2011; Vazou-Ekkekakis & Ekkekakis, 2009; Williams, 2008). While the present study examined MVPA, examining PA of mild intensity (e.g., light activity) may have shown higher levels of affect as previously shown (ACSM, 2013; Reed & Buck, 2009; Reed & Ones, 2006). However, based on the lack of research on affective responses with PA and/or weight status, further evidence is still needed (Byrne & Byrne, 1993; Ekkekakis & Petruzzello, 1999; 2002; Gauvin & Spence, 1998).

Perceptions of SWA

As a secondary purpose to this study, participants' perceptions were also explored in regards to using a multi-sensor monitoring device to measure PA and SB levels. Understanding participant's perceptions in relation to wearing the SWA may be important in determining whether individuals will actually use the device to monitor their PA levels. Based on previous research (Almeida et al., 2011; Tierney et al., 2013), individuals have generally perceived the SWA as a positive and practical device. These

favourable perceptions are reinforced in the present study. However, going beyond Tierney and colleagues' (2013) findings specific to the affective value (e.g., high personal satisfaction) of using the SWA, the present investigation also included additional instrumental benefits. Using the SWA allowed participants to become more aware of their own activity behaviour among other factors, which potentially increases its functional value. However, the challenge of maintaining compliance was still a concern with SWAs. Mixed reviews were reported by participants when asked about long-term use of the device, which based on previous literature was identified as a main concern when using any PA monitoring device (Perry et al., 2010).

Participants in the present study also identified the main barrier with wearing the SWA to be comfort. This was in contrast to what Tierney and colleagues (2013) found. However, what we do know from this present investigation was that the feedback (e.g., graphs) provided by the SWA summary report was perceived as an asset, since participants' awareness about their activity behaviours changed after use. This novel feature showed to have influence over guiding their future physical activities. As a result, ongoing evaluation of the SWA and other self-monitoring devices will continue to help broaden our understanding of participants' perceptions and overcome compliance concerns.

Limitations

In order to advance this line of research, it is important to acknowledge the limitations of the current study. First, the present study only included participants who had worn the device for at least five days (Scheers et al., 2012b; 2012c) with 85% compliance per day (equal to 20.40 hours/day). Criteria for what is considered a valid

day for wearing the SWA varies from study to study and appears to be a personalized decision for the researchers involved. For the present study, having at least 20.40 hours of data maximizes my sample size and is higher minimum than that of previous research using the SWA (Almeida et al., 2011; Chen, Kim, & Gao, 2014; Sabia et al., 2014; Unick et al., 2012). However, in contrast to these studies, Scheers and colleagues (2012a; 2012b) used a compliance rate of 95% given their larger sample size and their definition of what a valid day should be. Therefore, it is acknowledged that results may be slightly inflated/overestimated based on inclusion criteria in comparison to Scheers and colleagues' (2012a) criteria. However, when it comes to selecting the number of monitoring days required, my inclusion criteria followed Scheers and colleagues' (2012b) recommendations for producing acceptable validity and reliability scores when using the SWAs.

Moreover, the final sample size for the present study was 50 participants, which is below what was targeted in my apriori analyses based on Cohen's (1992) recommendations. Furthermore, based on the classification system for obesity-related health risk, unequal group sizes were also present. Efforts were made to account for these limitations, such as extending the recruitment/data collection phase in order to gain more participants. However, with that being said, the smaller than targeted sample size was addressed through Philai's criterion and the interpretation of effect sizes which may offset concerns with lack of power and unequal sample sizes (Hair et al., 2009).

Third, not all statistical assumptions for conducting MANOVAs were upheld (e.g., normality, homogeneity). These violations were recognized and the required changes were made where necessary before analyses were conducted. However, the

results of the present study based on inferential statistics should still be interpreted with caution. Again, the use of effect size estimates somewhat offset any concerns linked with the violation of statistical assumptions. With recognizing that eta- and partial eta-squared statistics have their own limitations (e.g., commonly miscommunicated and misinterpreted), it is recommended that both effect sizes should be reported for additional clarity based on the lack of research and knowledge about partial-eta squared (Levine & Hullett, 2002; 2010).

Fourth, data collection procedures used various types of measurements. Even though Canadian and International agencies recommend the use of BMI and WC measurements to determine individual's obesity-related health risk classification (Health Canada, 2003b; NIH, 1998; WHO, 2000), they are not without limitations. BMI does not account for differences in sex, race, and age (CDC, 2011) and WC requires precision with its measurement and may be over- or underestimated based on the training of the individual(s). While other instruments to measure anthropometric values that may be more accurate (Prince et al., 2008), they were not available for use. Despite the benefits of using the SWA, it is also not without limitations including its inability to capture all forms of movements (e.g., swimming; Prince et al., 2008; Scheers et al., 2012a) and participants altering their normal PA over the monitoring period (i.e., Hawthorne effect; Johanssen et al., 2013; Scheers et al., 2013a). Therefore, because the device does not allow us to capture mode of activity, this could underestimate the magnitude of certain types of activities and could deflate EE values (Johannsen et al., 2010; Papazoglou et al., 2006); affecting the accuracy of the results. Furthermore, the assessment of WB is also highly reliant on self-report methods, which makes this data susceptible to the limitations

that are inherent with any self-report (McDowell, 2010). While a number of other WB measures exist (i.e., informant reports, implicit association tests) that have been found to correlate at least moderately with subjective assessments (Kim, 2004; Schimmack, 2008), there use has been limited. However, regardless of which mode of assessment used, it is important to note that no gold standard exists when measuring PA (Johannsen et al., 2010), SB (Atkin et al., 2012) or WB (McDowell, 2010).

Finally, my SB variable included sleep, which may have influenced findings. Sleep is essential for health and has been associated with obesity, which is reason for its inclusion (Beccuti & Pannain, 2011). However, sleep could have over- or underestimated the amount of time spent in SB based on how many hours sleep a participant had per day (Scheers et al., 2012b). This limitation was consistent with the work of Scheers and colleagues' (2012a) as SB during 'waking' hours was not examined to determine whether there may have been differences.

Future Implications

Because of the novelty of the current investigation, a number of opportunities exist for future research. While this study was the first to test differences in PA, SB, and WB by obesity-related health risk classifications, it is probable that other behavioural (e.g., diet) and psychological (e.g., motivation) aspects may also be of import to these classifications being that they too impact weight status. In the present investigation, the main significant difference in relation to obesity-related health risk was based on AEE (or MVPA) in bouts of ten minutes or more suggesting that other lifestyle or psychological mechanisms may provide better insight into detecting potential differences across classifications. This can also be supported through interpretation of effect size since a

small-to-moderate effect was only present for AEE-10 and obesity-related health risk; with all other variables having a very small to null effect. It is also recognized that the current study was underpowered. With that being said, future research may want to continue to examine behavioural and WB variables in additional to other lifestyle variables in an effort to explore associations related to obesity-related health risk. Future research may also want to explore the feasibility and effectiveness of the commercially available SWA that allows you to input data about diet, mode of activity, etc., which could further enhance findings in relation to obesity-related health risk.

Second, if you were to look at descriptive statistics, steps did differ based on obesity-related health risk classification even though there was no statistical significance; specifically with increased risk individuals. Although the study's findings were based on a limited sample size, having almost a 1000 step count difference than least risk may suggest that increased risk individuals choose to engage in more ambulatory activities. In contrast, those who are least risk may choose a balance of ambulatory and non-ambulatory activities as part of the PA regime. Further, those in high risk actually had a similar step count to those in least risk, but also participate in the least amount of AEE-10 and the most in SB suggesting that they require more activity. However, since the SWA device does not provide data on mode of activity (Johannsen et al., 2010; Papazoglou et al., 2006; Prince et al., 2008; Scheers et al., 2012a), this could not be further explored. Therefore, as a future direction, one should consider collecting data on mode of activity for further explanation regarding the differences between these classifications.

Third, this study assessed PA, SB, and WB over a seven day period. The assessment of PA and SB during one week may not have reflected seasonal variability in

PA as it would have over several months or a year (Almeida et al., 2011; Scheers et al., 2013b). As a result, future studies adopting a longer monitoring period may help unpack the true nature of such differences in relation to obesity-related health risk. Moreover, the possibility of showing significant differences with SB, WB, and other markers of PA may be present. Furthermore, the bulk of the researchers using the SWA has examined validity/reliability of scores (Elbelt et al., 2010; Dudley et al., 2009; Johannsen et al., 2010; Papazoglou et al., 2006; Tierney, Fraser, Purtill, & Kennedy, 2013), monitored weight loss/lifestyle interventions (Barry et al., 2011; Shugar et al., 2011), or simply described PA levels among different populations (Almeida et al., 2011; Bond et al., 2012; Scheers et al., 2012b). Because this study was one of few to link SWA scores to health or health outcomes (e.g., metabolic syndrome outcomes; Scheers et al., 2013b), continued investigation into this association will help reduce such gaps in the literature.

Fourth, while WB is commonly assessed through self-report (McDowell, 2010), future research may explore other forms of assessing WB, such as through informant reports. Using other self-report measures than what was used in this study (i.e., AD ACL), may also contribute to findings. Reporting results from various instruments, both self-report and other measures, provides a more complete description and will help reduce some biases with interpretation (Pedhauzer & Schmelkin, 1991). For example, obesity-related health risk may be linked more to markers of ill-being or quality of life than markers of WB.

Fifth, participants' WB levels in relation to their obesity-related health risk classification showed no statistical differences, which adds to the inconsistencies from previous studies (de Zwaan et al., 2009; Katsaiti, 2012). One reason might be that most

of the existing research looks at global measures of WB (generally how enthusiastic you are) or health-related quality of life (Huppert & So, 2013). However, future implications should proceed to explore the association between WB and weight status based on the current study being underpowered. Further, due to the complexity and advocacy with using the Affect Circumplex Model (Ekkekakis & Petruzzello, 1999; 2002; Ekkekakis et al., 2013), both dimensions of affect should continue to be examined in relation to PA. Other markers or tools to measure WB should also be explored in order to replicate or extend findings based on the fact that no gold standard exists when it comes to measuring WB (McDowell, 2010).

Practical Applications

The present investigation has demonstrated that participation in AEE-10 (or MVPA) in bouts of ten minutes or more, should be promoted as a parameter for influencing obesity-related health risk. Although other activities can be performed intermittently throughout the day, adults should try to accumulate PA in sustained bouts to achieve optimal health benefits (Scheers et al., 2013b). As a result, following the Canadian PA guidelines should be one of many ways for adults to reduce their obesity-related health risk. Also, because SB showed to be similar across all classifications of obesity-related health risk, it is important to still reduce time spent in SB in addition to increasing PA levels regardless of risk status. Therefore, such findings should be considered when developing interventions to reduce the prevalence of obesity and its associated health risks (Scheers et al., 2013b).

When it comes to examining individual's WB from an affective perspective, there were no statistically significant differences to be noted in relation to obesity-related

health risk. However, this does not mean psychological factors are not important towards reaching optimal health outcomes (Rogers, 1961; Seligman, 2011). On one level, it might be good that people can experience positive well-being outcomes associated with PA regardless of weight status. Based on descriptive statistics, positive affective responses were more favorably rated (i.e., above midpoint on the scale) compared to negative responses within the context of PA. Therefore, participation in any PA (i.e., specific to the individual) should be encouraged and promoted regardless of weight status in an effort to elicit those positive feelings of affect, which is also consistent with previous research (de Zwaan et al., 2009; Katsaiti, 2012).

Moreover, the present findings also offer an attempt at examining participants' perceptions with regards to wearing the SWA. Because the SWA is a self-monitoring device that measures an individual's activity behaviour, the use of this device has been promoted for PA and/or weight loss interventions (Barry et al., 2011; Shugar et al., 2011). However, perceptions by those who have used this device have been examined minimally in the literature. As a reflection of this present investigation, the device overall received positive reviews from participants – namely for its practicality and usefulness. Therefore, these findings emphasize reasons why the SWA should be used in future practical applications in an effort for higher participant compliance (Perry et al., 2010). Using the SWA in more practical settings will also attempt to bring more awareness to individuals about their own PA and SB levels.

Conclusion

The present study provides a unique insight into adults' patterns of PA and SB, as well as WB levels based on obesity-related health risk. Understanding these

classifications of obesity-related health risk in relation to different lifestyle behaviours and WB are important to help promote ways in which individuals can reduce their own risks. Individuals' weight and body compositions have been associated with differences in PA and SB (Bond et al., 2012; Gibson-Moore, 2012; Healy et al., 2011; Scheers et al., 2012b; Tudor-Locke et al., 2010). However, when it came to examining obesity-related health risk, the major difference was based on the amount of time spent in MVPA, in bouts of ten minutes or more, and not necessarily the amount of SB. Therefore, future research should continue to explore the PA and SB relationship, and extend to include other lifestyle behaviours that may be associated with obesity and obesity-related diseases. Further, despite the inconsistency of whether WB is associated with different weight and body compositions (de Zwaan et al., 2009; Katsaiti, 2012), there were no differences detected in WB based on individuals' obesity-related health risk classification. Therefore, the need to establish more consistency in research when examining WB and weight status is also supported. Moreover, participants' perceptions with regards to wearing the SWA also lend a hand towards future research for PA and weight loss interventions, since this device was highly rated for its practicality and usefulness. Overall, although this study extends well to current research, this is only a fraction of what may be numerous differences that exist in relation to understanding obesity-related health risks.

Footnotes

Different criterions exist in identifying what a valid day should be in terms of number of hours of wear per day (Scheers et al., 2012c).

[2] The wear time will drop to 22 hours on the day participants charge the device for one hour.

[3] Frequency item for SB was not used during analysis due to the similar nature of both self-report questions. Dogra and Stathokostas' (2012) criteria used only the SB (hours) item to categorize individuals as sedentary.

[4] Given the non-significance of the multivariate test, the univariate main effects were still explored. Significant univariate main effects for were obtained only for Energy, F (2, 45) = 4.53, p = .02, η_p^2 = .17, observed power = .74. The remaining markers of WB (Tension, Calmness, Positive Affect, and Negative Affect) showed non-significant univariate main effects at $p > .05$, except for Tiredness which was non-significant at p = .052. Post-hoc comparisons were then completed to examine the pairwise comparisons among obesity-related health risk classifications when examining Energy. There were significant differences between least risk and high risk ($p < .05$) and between increased risk and high risk ($p < .05$). There were non-significant differences between least risk and increased risk (p = 1.00). These results suggested that those in least risk and increased risk have a significantly higher level of Energy when engaging in PA than those in high risk.

References

Abu-Omar, K., & Rutten, A. (2008). Relation of leisure time, occupational, domestic, and commuting physical activity to health indicators in Europe. *Preventive Medicine, 47*, 319-323. doi: 10.1016/j.ypmed.2008.03.012

Ainsworth, B. E., Haskell, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., … Leon, A. S. (2000). Compendium of physical activities: An update of activity codes and MET intensities. *Medicine & Science in Sports & Exercise, 32*, S498-504.

Ainsworth, B. E., Caspersen, C. J., Matthews, C. E., Mâsse, L. C., Baranowski, T., & Zhu, W. (2012). Recommendations to improve the accuracy of estimates of physical activity derived from self report. *Journal of Physical Activity & Health,* 9, S76-84.

Almeida, G. M., Wasko, M. M., Jeong, K., Moore, C. G., & Piva, S. R. (2011). Physical activity measured by the sensewear armband in women with rheumatoid arthritis. *Physical Therapy, 91*, 1367-1376. doi: 10.2522/ptj.20100291

American College of Sports Medicine. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine & Science in Sports & Exercise, 43*, 1334-1359. doi: 10.1249/MSS.0b013e318213fefb

American College of Sports Medicine. (2013). *ACSM's guidelines for exercise testing and prescription* (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Andre, D., Pelletier, R., Farringdon, J., Safier, S., Talbott, W., Stone, R., … Teller, A.

(2006). *The development of the sensewear armband, a revolutionary energy assessment device to assess physical activity and lifestyle*. Body Media, Inc.

Ardern, C. I., Katzmarzyk, P. T., Janssen, I., & Ross, R. (2003). Discrimination of health risk by combined body mass index and waist circumference. *Obesity Research, 11*, 135-142. doi: 10.1038/oby.2003.22

Atkin, A., Gorely, T., Clemes, S., Yates, T., Edwardson, C., Brage, S., … Biddle, S. (2012). Methods of measurement in epidemiology: Sedentary behaviour. *International Journal of Epidemiology*, *41*, 1460-1471. doi: 10.1093/ije/dys118

Backhouse, S. H., Ali, A., Biddle, S. J. H., & Williams, C. (2007). Carbohydrate ingestion during prolonged high-intensity intermittent exercise: Impact on affect and perceived exertion. *Scandinavian Journal of Medicine & Science in Sports, 17*, 605-610. doi: 10.1111/j.1600-0838.2006.00613.x

Backhouse, S. H., Ekkekakis, P., Biddle, S. J. H., Foskett, A., & Williams, C. (2007). Exercise makes people feel better but people are inactive: Paradox or artifact? *Journal of Sport & Exercise Psychology, 29*, 498-517.

Barry, V. W., McClain, A. C., Shuger, S., Sui, X., Hardin, J. W., Hand, G. A., … Blair, S. N. (2011). Using a technology-based intervention to promote weight loss in sedentary overweight or obese adults: A randomized controlled trial study design. *Diabetes, Metabolic Syndrome & Obesity: Targets & Therapy*, *4*, 67-77. doi: 10.2147/DMSO.S14526

Bassett, D. R. (2012). Device-based monitoring in physical activity and public health research. *Physiological Measurement, 33*, 1769-1783. doi: 10.1088/0967-3334/33/11/1769

Beccuti, G., & Pannain, S. (2011). Sleep and obesity. *Current Opinion in Clinical Nutrition & Metabolic Care, 14*, 402-412. doi:10.1097/MCO.0b013e3283479109

Berlin, J. E., Storti, K. L., & Brach, J. S. (2006). Using activity monitors to measure physical activity in free-living conditions. *Physical Therapy, 86*, 1137-1145.

Biddle, S. J. H. (2011). Fit or sit? Is there a psychology to sedentary behaviour. *Sport & Exercise Psychology Review, 7*, 5-10.

Birnbaum, H. G., Kessler, R. C., Kelley, D., Ben-Hamadi, R., Joish, V. N., & Greenberg, P. E. (2010). Employer burden of mild, moderate, and severe major depressive disorder: mental health services utilization and costs, and work performance. *Depression & Anxiety, 27*, 78-89. doi: 10.1002/da.20580

Bize, R., Johnson, J., & Plotnikoff, R. (2007). Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine, 45*, 401-415. doi: 10.1016/j.ypmed.2007.07.017

BodyMedia. (2013). *The science*. http://www.bodymedia.com/the_science.html

Bond, D., Unick, J., Jakicic, J., Vithiananthan, S., Trautvetter, J., CO'Leary, K., & Wing, R. (2012). Physical activity and quality of life in severely obese individuals seeking bariatric surgery or lifestyle intervention. *Health & Quality of Life Outcomes, 10*, 86-90. doi: 10.1186/1477-7525-10-86

Brage, S., Brage, N., Franks, P. W., Ekelund, U., Wong, M. Y., Andersen, L. B., … Wareham, N. J. (2004). Branched equation modeling of simultaneous accelerometry and heart rate monitoring improves estimate of directly measured physical activity energy expenditure. *Journal of Applied Physiology, 96*, 343-351.

Buchowski, M. S., Acra, S., Majchrzak, K. M., Sun, M., & Chen, K. Y. (2004). Patterns

of physical activity in free-living adults in the southern United States. *European Journal of Clinical Nutrition, 58,* 828-837. doi: 10.1038/sj.ejcn.1601928

Burns, M. J., Wilson, P. M., Mack, D. E., Gilchrist, J. D., Meldrum, L. S., & Blanchard, C. M. (2013, March). Evaluation of a portable device to record dietary intake in women using commercial weight-loss programs. Paper presented at the 34th annual meeting and scientific sessions of the Society of Behavioural Medicine on Rapid Communications, San Francisco, California. Abstract retrieved from http://www.sbm.org//UserFiles/file/RapidHandout2013FINAL.pdf

Byrne, A., & Byrne, D. G. (1993). The effect of exercise on depression, anxiety, and other mood states: A review. *Journal of Psychosomatic Research, 37,* 565-574.

Callahan, D. (2013). Obesity: Chasing an elusive epidemic. *Hastings Centre Report, 43,* 34-40. doi: 10.1002/hast.114

Calabro, M. A., Welk, G. J., & Eisenmann, J. C. (2009). Validation of the sensewear pro armband algorithms in children. *Medicine & Science in Sports & Exercise, 41,* 1714-1720. doi: 10.1249/MSS.0b013e3181a071cf

Calitri, R., Lowe, R., Eves, F. F., & Bennett, P. (2009). Associations between visual attention, implicit and explicit attitude and behaviour for physical activity. *Psychology & Health, 24,* 1105-1123. doi: 10.1080/08870440802245306

Canadian Society for Exercise Physiology. (2013). *Canadian physical activity guidelines for adults 18-64 years*. Ottawa, ON.

Canadian Society for Exercise Physiology. (2013). *The revision of the measurement of waist circumference in the CPAFLA*. Ottawa, ON.

Carr, D., Friedman, M. A., & Jaffe, K. (2007). Understanding the relationship between

obesity and positive and negative affect: The role of psychosocial mechanisms. *Body Image, 4,* 165-177. doi: 10.1016/j.bodyim.2007.02.004

Centres for Disease Control and Prevention. (2011). *About BMI for adults*. http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/

Centres for Disease Control & Prevention. (2012). *Health-related quality of life (HRQOL).* http://www.cdc.gov/hrqol/

Cerin, E., Leslie, E., Sugiyama, T., & Owen, N. (2009). Associations of multiple physical activity domains with mental well-being. *Mental Health & Physical Activity, 2,* 55-64. doi: 10.1016/j.mhpa.2009.09.004

Chen, S., Kim, Y., & Gao, Z. (2014). The contributing role of physical education in youth's daily physical activity and sedentary behavior. *BioMed Central Public Health, 14,* 1-7. doi: 10.1186/1471-2458-14-110

Cheng, T. O. (2005). Waist circumference is a better predictor of obesity-related health risk than body mass index in the Chinese including children. *Southern Medical Journal, 98,* 124.

Clark, B. K., Sugiyama, T., Healy, G., Salmon, J., Dunstan, D., & Owen, N. (2009). Validity and reliability of measures of television viewing time and other non-occupational sedentary behaviour of adults: A review. *Obesity Reviews, 10,* 7–16. doi: 10.1111/j.1467-789X.2008.00508.x

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155-159. doi: 10.1037/0033-2909.112.1.155

Colley, R. C., Garriguet, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). Physical activity of canadian adults: Accelerometer results from the 2007

to 2009 Canadian health measures survey. *Health Report, 22*, 7-14.

Corica, F., Corsonello, A., Apolone, G., Mannucci, E., Lucchetti, M., Bonfiglio, C., … Marchesini, G. (2008). Metabolic syndrome, psychological status and quality of life in obesity: The QUOVADIS study. *International Journal of Obesity, 32*, 185-191. doi: 10.1038/sj.ijo.0803687

Crawford, J. R., & Henry, J. D. (2004). The positive and negative affect schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 43*, 245-265. doi: 10.1348/0144665031752934

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.

Davies, C. A., Vandelanotte, C., Duncan, M. J., & van Uffelen, J. G. Z. (2012). Associations of physical activity and screen-time on health related quality of life in adults. *Preventive Medicine, 55*, 46-49. doi: 10.1016/j.ypmed.2012.05.003

De Cocker, K. A., De Bourdeaudhuij, I. M., & Cardon, G. M. (2008). The effect of pedometer use in combination with cognitive and behavioural support materials to promote physical activity. *Patient Education & Counselling, 70*, 209-214. doi: 10.1016/j.pec.2007.10.008

de Geus, E. J. C., & de Moor, M. H. M. (2008). A genetic perspective on the association between exercise and mental health. *Mental Health & Physical Activity, 1*, 53-61. doi: 10.1016/j.mhpa.2008.09.005

de Zwaan, M., Petersen, I., Kaerber, M., Burgmer, R., Nolting, B., Legenbauer, T., … Herpertz, S. (2009). Obesity and quality of life: A controlled study of normal-

weight and obese individuals. *Psychosomatics, 50,* 474-482. doi: 10.1016/S0033-3182(09)70840-0

Diener, E. (2009). Subjective well-being. In E. Diener (Ed.), *The science of well-being* (pp.11–58). New York: Spring.

Dodge, R., Daly, A., Huyton, J., & Sanders, L. (2012). The challenge of defining wellbeing. *International Journal of Wellbeing, 2,* 222-235. doi: 10.5502/ijw.v2i3.4

Dogra, S., & Stathokostas, L. (2012). Sedentary behavior and physical activity are independent predictors of successful aging in middle-aged and older adults. *Journal of Aging Research, 2012,* 1-8. doi: 10.1155/2012/190654

Du, H., Bennett, D., Li, L., Whitlock, G., Guo, Y., Collins, R., … Chen, Z. (2013). Physical activity and sedentary leisure time and their associations with BMI, waist circumference, and percentage body fat in 0.5 million adults: The China Kadoorie Biobank study. *The American Journal of Clinical Nutrition, 97,* 487-496. doi: 10.3945/ajcn.112.046854

Dudley, P., Bassett, D. R., John, D. & Crouter, S. E. (2009). Validity of an armband physical activity monitor in measuring energy expenditure during eighteen different activities. *Medicine & Science in Sports & Exercise, 41,* 1-7. doi: 10.4172/2165-7904.1000146

Duncan, M., Vandelanotte, C., Caperchione, C., Hanley, C., & Mummery, W. (2012). Temporal trends in and relationships between screen time, physical activity, overweight and obesity. *BioMed Central Public Health, 12,* 1060-1068. doi: 10.1186/1471-2458-12-1060

Ekelund, U., Besson, H., Luan, J., May, A. M., Sharp, S. J., Brage, S., … Peeters, P. H.

(2011). Physical activity and gain in abdominal adiposity and body weight: prospective cohort study in 288,498 men and women. *American Journal of Clinical Nutrition, 93*, 826-835. doi: 10.3945/ajcn.110.006593

Ekkekakis, P. (2008). Affect circumplex redux: The discussion on its utility as a measurement framework in exercise psychology continues. *International Review of Sport & Exercise Psychology, 1*, 139-159. doi: 10.1080/17509840802287200

Ekkekakis, P. (2012). Affect, mood, and emotion. In G. Tenenbaum, R. C. Eklund, & A. Kamata (Eds.), *Measurement in sport & exercise psychology* (pp. 321-332). Champaign: IL.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005a). Some like it vigorous: Individual differences in the preference for and tolerance of exercise intensity. *Journal of Sport & Exercise Psychology, 27*, 350-374.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005b). Evaluation of the circumplex structure of the activation deactivation adjective check list before and after a short walk. *Psychology of Sport and Exercise, 6*, 83-101. doi: 10.1016/j.psychsport.2003.10.005

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2008). The relationship between exercise intensity and affective responses demystified: To crack the forty-year-old nut, replace the forty-year-old nutcracker! *Annals of Behavioral Medicine, 35*, 136-149. doi: 10.1007/s12160-008-9025-z

Ekkekakis, P., Hall, E. E., VanLanduyt, L. M., & Petruzzello, S. J. (2000). Walking in (affective) circles: Can short walks enhance affect? *Journal of Behavioural Medicine, 23*, 245-275.

Ekkekakis, P., Hargreaves, E. A., & Parfitt, G. (2013). Invited guest editorial: Envisioning the next fifty years of research on the exercise - affect relationship. *Psychology of Sport & Exercise,* 751-758. doi: 10.1016/j.psychsport.2013.04.007

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities. *Sports Medicine, 41*, 641-671. doi: 10.2165/11590680-000000000-00000

Ekkekakis, P., & Petruzzello, S. J. (1999). Acute aerobic exercise and affect: Current status, problems, and prospects regarding dose-response. *Sports Medicine, 28*, 337-374.

Ekkekakis, P., & Petruzzello, S. J. (2000). Analysis of the affect measurement conundrum in exercise psychology: I. Fundamental issues. *Psychology of Sport & Exercise, 1*, 71-88. doi: 10.1016/S1469-0292(00)00010-8

Ekkekakis, P., & Petruzzello, S. J. (2002). Analysis of the affect measurement conundrum in exercise psychology: IV. A conceptual case for the affect circumplex. *Psychology of Sport & Exercise, 3,* 35-63. doi: 10.1016/S1469-0292(01)00028-0

Elbelt, U., Schuetz, T., Hoffmann, I., Pirlich, M., Strasburger, C. J., & Lochs, H. (2010). Differences of energy expenditure and physical activity patterns in subjects with various degrees of obesity. *Clinical Nutrition, 29*, 766-772. doi: 10.1016/j.clnu.2010.05.003

Elobeid, M. A., Desmond, R. A., Thomas, O., Keith, S. W., & Allison, D. B. (2007). Waist circumference values are increasing beyond those expected from BMI increases. *Obesity (Silver Spring), 15*, 2380-2383. doi: 10.1038/oby.2007.282

Fay, K., & Boyd, M. (2010). Eta-squared. In N. Salkind (Ed.), *Encyclopedia of research design*. (pp. 423-426). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288.n13

Fontaine, K. R., & Barofsky I. (2001). Obesity and health-related quality of life. *Obesity Reviews, 2,* 173-182.

Frijda, N.H. (2009). Mood. In D. Sander & K. R. Scherer (Eds.), *The Oxford companion to emotion and the affective sciences* (pp. 258-259). New York: Oxford University Press.

Fukuoka, Y., Lindgren, T., & Jong, S. (2012). Qualitative exploration of the acceptability of a mobile phone and pedometer-based physical activity program in a diverse sample of sedentary women. *Public Health Nursing, 29,* 232-240. doi: 10.1111/j.1525-1446.2011.00997.x

Gardiner, P. A., Clark, B. K., Healy, G. N., Eakin, E. G., Winkler, E. A. H., & Owen, N. (2011). Measuring older adults' sedentary time: Reliability, validity, and responsiveness. *Medicine & Science in Sports & Exercise, 43*, 2127-2133. doi: 10.1249/MSS.0b013e31821b94f7

Gauvin, L., & Spence, J. C. (1998). Measurement of exercise-induced changes in feeling states, affect, mood, and emotions. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 325-336). Morgantown, WV: Fitness Information Technology

Gellert, P., Ziegelmann, J. P., & Schwarzer, R. (2012). Affective and health-related outcome expectancies for physical activity in older adults. *Psychology & Health, 27*, 816-828. doi: 10.1080/08870446.2011.607236

Ghorbani, A., Ziaee, A., Oveisi, S., & Afaghi, A. (2013). A comparison of health-related quality of life among normal-weight, overweight and obese adults in Qazvin metabolic diseases study (QMDS), Iran. *Global Journal of Health Science, 5*, 156-162. doi: 10.5539/gjhs.v5n3p156

Gibson-Moore, H. (2012). Can physical activity improve the health of the overweight without weight loss? *Nutrition Bulletin, 37*, 148-151. doi: 10.1111/j.1467-3010.2012.01963.x

Giovannetti, J. (2013, June 19). Designation of obesity as disease spurs Canadian debate. *The Globe and Mail.* Retrieved from http://www.theglobeandmail.com

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Sciences, 10*, 142-146.

Gopinath, B., Hardy, L. L., Baur, L. A., Burlutsky, G., & Mitchell, P. (2012). Physical activity and sedentary behaviours and health-related quality of life in adolescents. *Pediatrics, 130*, 167-174. doi: 10.1542/peds.2011-3637.

Grice, J. W., & Iwasaki, M. (2007). A truly multivariate approach to MANOVA. *Applied Multivariate Research, 12*, 199-226.

Guérin, E., & Fortier, M. (2012). Situational motivation and perceived intensity: their interaction in predicting changes in positive affect from physical activity. *Journal of Obesity, 2012*, 1-7. doi: 10.1155/2012/269320

Guiraud, T., Labrunee, M., Gayda, M., Juneau, M., & Gremeaux, V. (2012). Non-pharmacological strategies in cardiovascular prevention: 2011 highlights. *Annals of Physical & Rehabilitation Medicine, 55*, 342-374. doi: 10.1016/j.rehab.2012.03.005

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Hair, J. F. Jr., Black, B., Babin, B., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Hamer, M., Stamatakis, E., & Mishra, G. D. (2010). Television- and screen-based activity and mental well-being in adults. *American Journal of Preventive Medicine, 38*, 375-380. doi: 10.1016/j.amepre.2009.12.030

Han, T. S., Tijhuis, M. A., Lean, M. E., & Seidell, J. C. (1998). Quality of life in relation to overweight and body fat distribution. *American Journal of Public Health, 88,* 1814-1820. doi: 10.2105/AJPH.88.12.1814l

Harlow, L. L., Mulaik, S. A., & Steiger, J. H. (1997). *What if there were no significance tests?* Mahwah, NJ: Erlbaum.

Haskell, W. L., & Kiernan, M. (2000). Methodological issues in measuring physical activity and physical fitness when evaluating the role of dietary supplements for physically active people. *The American Journal of Clinical Nutrition, 72*, 541-550.

Hawley, S., Beckman, H., & Bishop, T. (2006). Development of an obesity prevention and management program for children and adolescents in a rural setting. *Journal of Community Health Nursing, 23*, 69-80. doi: 10.1207/s15327655jchn2302_1

Health Canada. (2003a). *Canadian guidelines for body weight classification in adults*. Ottawa, ON: Author

Health Canada. (2003b). *Office of nutrition policy and promotion: Canadian guidelines for body weight classification in adults*. Ottawa, ON: Author.

Healy, G., N., Matthews, C. E., Dunstan, D. W., Winkler, E. A. H., & Owen, N. (2011). Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06. *European Heart Journal, 32*, 590-597.

Healy, G. N., Wijndaele, K., Dunstan, D. W., Shaw, J. E., Salmon, J., Zimmet, P. Z., & Owen, N. (2008). Objectively measured sedentary time, physical activity, and metabolic risk: The Australian diabetes, obesity and lifestyle study. *Diabetes Care, 31*, 369-371. doi: 10.2337/dc07-1795

Heart and Stroke Foundation. (2010). *Healthy waists*. Ottawa, ON.

Henriksen, C. A., Mather, A. A., Mackenzie, C. S., Bienvenu, O. J., & Sareen, J. (2014). Longitudinal associations of obesity with affective disorders and suicidality in the Baltimore epidemiologic catchment area follow-up study. *Journal of Nervous & Mental Disease, 202*(5), 379-385. doi: 10.1097/NMD.0000000000000135

Hoffman, M.D., & Hoffman, D.R. (2008). Exercisers achieve greater acute exercise-induced mood enhancement than nonexercisers. *Archives of Physical Medicine and Rehabilitation, 89*, 358-363. doi: 10.1016/j.apmr.2007.09.026

Howard, R., Freedman, D., Park, Y., Hollenbeck, A., Schatzkin, A., & Leitzmann, M. (2008). Physical activity, sedentary behavior, and the risk of colon and rectal cancer in the NIH-AARP diet and health study. *Cancer Causes & Control, 19*, 939-953. doi: 10.1007/s10552-008-9159-0

Huppert, F. A., & Timothy, T. C. (2013). Flourishing across Europe: Application of a new conceptual framework for defining well-being. *Social Indicators Research, 110*, 837-861. doi: 10.1007/s11205-011-9966-7

International Obesity Taskforce. (2010). *Estimating the association between overweight*

and risk of disease. http://www.iaso.org/iotf/obesity/heathimpactobesity/

Jacobs, D. R. Jr., Ainsworth, B. E., Hartman, T. J., & Leon, A. S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine & Science in Sports & Exercise, 25*, 81-91.

Jakicic, J. M., Marcus, M., Gallagher, K. I., Randall, C., Thomas, E., Goss, F. L., & Robertson, R. J. (2004). Evaluation of the sensewear pro armband to assess energy expenditure during exercise. *Medicine & Science in Sports & Exercise, 36*, 897-904.

Janssen, I., Katzmarzyk, P. T., & Ross, R. (2002). Body mass index, waist circumference, and health risk: Evidence in support of current national institutes of health guidelines. *Archives of Internal Medicine, 162*, 2074-2079. doi: 10.1001/archinte.162.18.2074

Janz, K. F. (2006). Physical activity in epidemiology: Moving from questionnaires to objective measurement. *British Journal of Sports Medicine, 40*, 191-192.

Johannsen, D. L., Calabro, M. A., Stewart, J., Franke, W., Rood, J. C., & Welk, G. J. (2010). Accuracy of armband monitors for measuring daily energy expenditure in healthy adults. *Medicine & Science in Sports & Exercise, 42*, 2134-2140. doi: 10.1249/MSS.0b013e3181e0b3ff

Katsaiti, M. (2012). Obesity and happiness. *Applied Economics, 44*, 4101-4114. doi: 10.1080/00036846.2011.587779

Katzmarzyk, P. T. (2010). Physical activity, sedentary behaviour, and health: Paradigm paralysis or paradigm shift? *Diabetes, 59*, 2717-2725. doi: 10.2337/db10-0822

Katzmarzyk, P. T., & Janssen, I. (2004). The economic costs associated with physical

inactivity and obesity in Canada: An update. *Canadian Journal of Applied Physiology, 29*, 90-115.

Kercher, K. (1995). Assessing subjective well-being in the old-old. *Research on Aging, 14*, 131-168.

Keyes, C. L. M., Shmotkin, D., & Ryff, C. D. (2002). Optimizing well-being: The empirical encounter of two traditions. *Journal of Personality and Social Psychology, 82*, 1007-1022. doi: 10.1037/0022-3514.82.6.1007

Kirby, J., Tibbins, C., Callens, C., Lang, B., Thorogood, M., Tigbe, W., & Robertson, W. (2012). Young people's views on accelerometer use in physical activity research: Findings from a user involvement investigation. *International Scholarly Research Network Obesity, 2012*, 1-7. doi: 10.5402/2012/948504

Kolotkin, R. L., Meter, K., & Williams, G. R. (2001). Quality of life and obesity. *Obesity Reviews, 2*, 219-229.

Kowalski, K., Rhodes, R., Naylor, P., Tuokko, H., & MacDonald, S. (2012). Direct and indirect measurement of physical activity in older adults: A systematic review of the literature. *International Journal of Behavioral Nutrition & Physical Activity, 9*, 148-168. doi: 10.1186/1479-5868-9-148

Kozey-Keadle, S., Libertine, A., Lyden, K., Staudenmayer, J., & Freedson, P. S. (2011). Validation of wearable monitors for assessing sedentary behavior. *Medicine & Science in Sports & Exercise, 43*, 1561-1567. doi: 10.1249/MSS.0b013e31820ce174

Kruger, J., Bowles, H. R., Jones, D. A., Ainsworth, B. E., & Kohl, H. W. (2007). Health-related quality of life, BMI and physical activity among US adults (18 years):

National physical activity and weight loss survey. *International Journal of Obesity, 31*, 321-327. doi: 10.1038/sj.ijo.0803386

Kruk, J. (2007). Physical activity in the prevention of the most frequent chronic diseases: An analysis of the recent evidence. *Asian Pacific Journal of Cancer Prevention, 8,* 325-338.

Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In M. S. Clark (Ed.), *Review of personality and social psychology* (pp. 25-59). Newbury Park, CA: Sage.

Lau, D. C. W., Douketis, J. D., Morrison, K. M., Hramiak, I. M., Sharma, A. M., Ur, E., & Obesity Canada Clinical Practice Guidelines Expert Panel. (2007). 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. *Canadian Medical Association Journal, 176*, 1-13. doi: 10.1503/cmaj.061409

Lavie, C. J., Milani, R. V., & Ventura, H. O. (2009). Obesity and cardiovascular disease: Risk factors, paradox, and impact of weight loss. *Journal of the American College of Cardiology, 53*, 1925-1932. doi: 10.1016/j.jacc.2008.12.068

Lavie, C. J., Milani, R. V., Ventura, H. O., & Romero-Corral, A. (2010). Body composition and heart failure prevalence and prognosis: Getting to the fat of the matter in the "obesity paradox". *Mayo Clinic Proceedings, 85*, 605-608.

Lawrence, S., Hazlett, R., & Hightower, P. (2010). Understanding and acting on the growing childhood and adolescent weight crisis: A role for social work. *Health & Social Work, 35*, 147-153.

Lawton, R., Conner, M., & McEachan, R. (2009). Desire or reason: Predicting health

behaviors from affective and cognitive attitudes. *Health Psychology, 28*, 56-65. doi: 10.1037/a0013424

Lean, M. E., Han, T. S., & Morrison, C. E. (1995). Waist circumference as a measure for indicating need for weight management. *British Medical Journal, 311*, 158-161. doi: 10.1136/bmj.311.6998.158.

Levine, T. R., & Hullett, C. R. (2002). Eta squared, partial eta squared, and misreporting of effect size in communication research. *Human Communication Research, 28*, 612-625.

Levine, T. R., & Hullett, C. R. (2010). Partial eta-squared. In N. Salkind (Ed.), *Encyclopedia of research design*. (pp. 1007-1009). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288.n13

Li, C., Ford, E. S., McGuire, L. C., & Mokdad, A. H. (2007). Increasing trends in waist circumference and abdominal obesity among US adults. *Obesity (Silver Spring), 15*, 216-222.

Lord, S., Chastin, S. F., McInnes, L., Little, L., Briggs, P., & Rochester, L. (2011). Exploring patterns of daily physical and sedentary behaviour in community-dwelling older adults. *Age Ageing, 40*, 205-210. doi: 10.1093/ageing/afq166

Lynch, B. M., Dunstan, D. W., Vallance, J. K., & Owen, N. (2013). Don't take cancer sitting down: A new survivorship research agenda. *Cancer, 119*, 1928-1935. doi: 10.1002/cncr.28028.

Mack, D. E., Wilson, P. M., Gunnell, K. E., Gilchrist, J. D., Kowalski, K. C., & Crocker, P. R. E. (2012). Health-enhancing physical activity: Associations with markers of well-being. *Applied Psychology: Health and Well-Being, 4*, 127-150. doi:

10.1111/j.1758-0854.2012.01065.x

Manini, T. M., & Pahor, M. (2009). Physical activity and maintaining physical function in older adults. *British Journal of Sports Medicine, 43*, 28-31. doi: 10.1136/bjsm.2008.053736

Marshall, S. J., & Ramirez, E. (2011). Reducing sedentary behavior: A new paradigm in physical activity promotion. *American Journal of Lifestyle Medicine, 5*, 518-530. doi: 10.1177/1559827610395487

McCluskey, A., Ada, L., Dean, C. M., & Vargas, J. (2012). Feasibility and validity of a wearable GPS device for measuring outings after stroke. *International Scholarly Research Network: Rehabilitation, 2012*, 1-8. doi: 10.5402/2012/823180

McDowell, I. (2010). Measures of self-perceived well-being. *Journal of Psychosomatic Research, 69*, 69-79. doi: 10.1016/j.jpsychores.2009.07.002

Ministry of Health and Long-Term Care. (2012). *Healthy kids panel to help reduce childhood obesity: McGuinty government keeping Ontario kids healthy.* Toronto, ON: Author

Molina-García, J., Castillo, I., & Queralt, A. (2011). Leisure-time physical activity and psychological well-being in university students. *Psychological Reports, 109*, 453-460. doi: 10.2466/06.10.13.PRO.109.5.453-460

Moore, S. C., Gierach, G. L., Schatzkin, A. A., & Matthews, C. E. (2010). Physical activity, sedentary behaviours, and the prevention of endometrial cancer. *British Journal of Cancer*, *103*, 933-938. doi: 10.1038/sj.bjc.6605902

Nasuti, G., & Rhodes, R. E. (2013). Affective judgment and physical activity in youth: Review and meta-analyses. *Annals of Behavioral Medicine, 45*, 357-376. doi:

10.1007/s12160-012-9462-6

National Heart, Lung and Blood Institute. (2014). *Assessing your weight and health risk*. Bethesda, MD.

National Institutes of Health. (1998). *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report*. Bethesda, MD.

National Obesity Forum. (2006). *Waist circumference*. http://www.nationalobesityforum.org.uk/healthcare-professionals-mainmenu-155/assessment-mainmenu-168/171-waist-circumference.html

Nemanick, R. C., & Munz, D. C. (1994). Measuring the poles of positive and negative mood using the positive affect negative affect schedule and activation deactivation adjective check list. *Psychological Reports*, *74*, 195–199.

Netz, Y., Wu, M. J., Becker, B. J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychology & Aging, 20,* 272-284. doi: 10.1037/0882-7974.20.2.272

Nguyen, H. Q., Steele, B., & Benditt, J. O. (2006). Use of accelerometers to characterize physical activity patterns with COPD exacerbations. *International Journal of Chronic Obstructive Pulmonary Disease, 1*, 455-460.

Oppert, J. M., Thomas, F., Charles, M. A., Benetos, A., Basdevant, A., & Simon, C. (2006). Leisure-time and occupational physical activity in relation to cardiovascular risk factors and eating habits in French adults. *Public Health Nutrition, 9*, 746-754. doi: 10.1079/PHN2005882

Owen, N. (2012a). Ambulatory monitoring and sedentary behaviour: A population-

health perspective. *Physiological Measurement, 33*, 1801-1810. doi: 10.1088/0967-3334/33/11/1801

Owen, N. (2012b). Sedentary behavior: Understanding and influencing adults' prolonged sitting time. *Preventive Medicine, 55*, 535-539. doi: 10.1016/j.ypmed.2012.08.024

Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W. (2010). Too much sitting: The population-health science of sedentary behaviour. *Exercise & Sport Sciences Reviews, 38*, 105-113. doi: 10.1097/JES.0b013e3181e373a2

Owen, N., Sparling, P. B., Healy, G. N., Dunstan, D. W., & Matthews, C. E. (2010). Sedentary behavior: Emerging evidence for a new health risk. *Mayo Clinic Proceedings, 85*, 1138-1141. doi: 10.4065/mcp.2010.0444

Papazoglou, D., Augello, G., Tagliaferri, M., Savia, G., Marzullo, P., Maltezos, E., & Liuzzi, A. (2006). Evaluation of a multisensor armband in estimating energy expenditure in obese individuals. *Obesity, 14*, 2217-2223. doi: 10.1038/oby.2006.260

Parfitt, G., Markland, D., & Holmes, C. (1994). Responses to physical exertion in active and inactive males and females. *Journal of Sport & Exercise Psychology, 16*, 178-186.

Pedhauzer, E., & Schmelkin, L. (1991). *Measurement, design, and analysis: An integrated approach.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*, 189-193.

Perry, M. A., Hendrick, P. A., Hale, L., Baxter, G. D., Milosavljevic, S., Dean, S. G., …

Hurley, D. A. (2010). Utility of the RT3 triaxial accelerometer in free living: An investigation of adherence and data loss. *Applied Ergonomics, 41,* 469-476. doi: 10.1016/j.apergo.2009.10.001

Pollack, A. (2013, June 18). A.M.A. recognizes obesity as a disease. *The New York Times.* Retrieved from http://www.nytimes.com

Prentice, D. A., & Miller, D. T. (1992). When small effects are impressive. *Psychological Bulletin, 112,* 160-164. doi: 10.1037/0033-2909.112.1.160

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Gorber, S. C., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *International Journal of Behavioural Nutrition & Physical Activity, 5,* 1-24. doi: 10.1186/1479-5868-5-56

Public Health Agency of Canada. (2011a). *Benefits of physical activity*. Ottawa, ON.

Public Health Agency of Canada. (2011b). *Obesity in Canada*. Ottawa, ON.

Rabbitt, A., & Coyne, I. (2012). Childhood obesity: Nurses' role in addressing the epidemic. *British Journal of Nursing, 21,* 731-735.

Reed, J. (2005). Acute physical activity and self-reported affect: A review. In A.V. Clark (Ed.), *Causes, role, and influence of mood states* (pp. 91–113). Hauppauge, NY: Nova Science.

Reed, J., & Buck, S. (2009). The effect of regular aerobic exercise on positive-activated affect: A meta-analysis. *Psychology of Sport & Exercise, 10,* 581-594. doi: 10.1016/j.psychsport.2009.05.009

Reed, J., & Ones, D. S. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport & Exercise, 7,* 477-514. doi:

10.1016/j.psychsport.2005.11.003

Rhodes, R., Mark, R., & Temmel, C. (2012). Review and special article: Adult sedentary behaviour. A systematic review. *American Journal of Preventative Medicine, 42*, 3-28. doi: 10.1016/j.amepre.2011.10.020

Rogers, C. (1961). *On becoming a person*. Boston: Houghton Mifflin.

Romero-Corral, A., Montori, V. M., Somers, V. K., Korinek, J., Thomas, R. J., Allison, T. G., Mookadam, F., & Lopez-Jimenez, F. (2006). Association of bodyweight with total mortality and with cardiovascular events in coronary artery disease: A systematic review of cohort studies. *Lancet, 368*, 666-678. doi: 10.1016/S0140-6736(06)69251-9

Rose, E. A., & Parfitt, G. (2007). A quantitative analysis and qualitative explanation of the individual differences in affective responses to prescribed and self-selected exercise intensities. *Journal of Sport & Exercise Psychology*, *29*, 281-309.

Ross, R., & Janssen, I. (2007). Physical activity, fitness, & obesity. In C. Bouchard, S. N. Blair, & W. L. Haskell (Eds.), *Physical activity and health* (pp. 173-190). Champaign, IL: Human Kinetics.

Roumen, C., Blaak, E. E., & Corpeleijn, E. (2008). Lifestyle intervention for prevention of diabetes: Determinants of success for future implementation. *Nutrition Reviews, 67*, 132-146. doi: 10.1111/j.1753-4887.2009.00181.x

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality & Social Psychology, 39*, 1161-1178.

Russell, J.A, & Feldman Barrett, L. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality &*

Social Psychology, *76*, 805-819.

Russell, J.A, & Feldman Barrett, L. (2009). Core affect. In D. Sander & KR Scherer (Eds.), *The Oxford companion to emotion and the affective sciences* (p. 104). New York: Oxford University Press.

Ryan, A. (2013, June 19). Did the American medical association make a mistake in classifying obesity a disease? *The Globe and Mail*. Retrieved from http://www.theglobeandmail.com/

Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology, 52,* 141-166. http://proxy.library.brocku.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=4445599&site=eds-live&scope=site

Sabia, S., van Hees, V. T., Shipley, M. J., Trenell, M. I., Hagger-Johnson, G., Elbaz, A., Kivimaki, M., & Singh-Manoux, A. (2014). Association between questionnaire- and accelerometer-assessed physical activity: The role of sociodemographic factors. *American Journal of Epidemiology*, *179*, 781-790. doi: 10.1093/aje/kwt330

Saunders, T. J., Tremblay, M. S., Després, J., Bouchard, C., Tremblay, A., & Chaput, J. (2013). Sedentary behaviour, visceral fat accumulation and cardiometabolic risk in adults: A 6-year longitudinal study from the Quebec family study. *Public Library of Science ONE*, *8*, 1-8. doi: 10.1371/journal.pone.0054225

Scheers, T., Philippaerts, R., & Lefevre, J. (2012a). Assessment of physical activity and inactivity in multiple domains of daily life: a comparison between a computerized questionnaire and the SenseWear Armband complemented with an electronic diary.

International Journal of Behavioral Nutrition and Physical Activity, 9, 1-16. doi: 10.1186/1479-5868-9-71

Scheers, T., Philippaerts, R., & Lefevre, J. (2012b). Patterns of physical activity and sedentary behaviour in normal-weight, overweight and obese adults, as measured with a portable armband device and an electronic diary. *Clinical Nutrition, 31*, 756-764. doi: 10.1016/j.clnu.2012.04.011

Scheers, T., Philippaerts, R., & Lefevre, J. (2012c). Variability in physical activity patterns as measured by the sensewear armband: How many days are needed? *European Journal of Applied Physiology, 112*, 1653-1662. doi: 10.1007/s00421-011-2131-9

Scheers, T., Philippaerts, R., & Lefevre, J. (2013a). Compliance with different physical activity recommendations and its associations with socio-demographic characteristics using an objective measure. *BioMed Central Public Health, 13*, 1-10. doi: 10.1186/1471-2458-13-136

Scheers, T., Philippaerts, R., & Lefevre, J. (2013b). Sensewear-determined physical activity and sedentary behaviour and metabolic syndrome. *Medicine & Science in Sports & Exercise, 45*, 481-489. doi: 10.1249/MSS.0b013e31827563ba

Sedentary. (2014). In *Merriam-Webster's online dictionary.* http://www.m-w.com/dictionary/

Sedentary Behaviour Research Network. (2012). Standardized use of the terms "sedentary" and "sedentary behaviours". *Applied Physiology, Nutrition, & Metabolism, 37*, 540–542. doi: 10.1139/H2012-024

Seligman, M. E. P. (2011). *Flourish: A new understanding of happiness and well-being*

and how to achieve them. London: Nicholas Brealey Publishing.

Shaw, R., Fenwick, E., Baker, G., McAdam, C., Fitzsimons, C., & Mutrie, N. (2011). Pedometers cost buttons: The feasibility of implementing a pedometer based walking programme within the community. *BioMed Central Public Health, 11*, 1-9. doi: 10.1186/1471-2458-11-200

Shields, M., & Tremblay, M. S. (2008). Screen time among Canadian adults: A profile. *Health Reports (Statistics Canada), 19*, 31-43.

Sherrington, C., Whitney, J. C., Lord, S. R., Herbert, R. D., Cumming, R. G., & Close, J. C. (2008). Effective exercise for the prevention of falls: A systematic review and meta-analysis. *Journal of American Geriatric Society, 56*, 2234–2243. doi: 10.1111/j.1532-5415.2008.02014.x

Shuger, S. L., Barry, V. W., Sui, X., McClain, A., Hand, G. A., Wilcox, S., … Blair, S. N. (2011). Electronic feedback in a diet and physical activity-based lifestyle intervention for weight loss: Randomized controlled trial. *International Journal of Behavioral Nutrition & Physical Activity, 8*, 1-8. doi: 10.1186/1479-5868-8-41

St-Onge, M., Mignault, D., Allison, D. B., & Rabasa-Lhoret, R. (2007). Evaluation of a portable device to measure daily energy expenditure in free-living adults. *The American Journal of Clinical Nutrition, 85*, 742–749.

Statistics Canada. (2010). *Canadian community health survey – health aging*. http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5146&Item_Id=47962&lang=en

Statistics Canada. (2012a). Comparison of waist circumference using the world health organization and national institutes of health protocols. *Health Reports, 23*, 1-10.

Statistics Canada. (2012b). Measures of abdominal obesity within body mass index categories, 1981 and 2007-2009. *Health Reports, 43,* 1-7.

Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences* (4th ed.). Mahwah, NJ: Lawrence Erlbaum.

Stewart-Knox, B., Duffy, M., Bunting, B., Parr, H., Vas de Almeida, M., & Gibney, M. (2012). Associations between obesity (BMI and waist circumference) and socio-demographic factors, physical activity, dietary habits, life events, resilience, mood, perceived stress, and hopelessness in healthy older Europeans. *BioMed Central Public Health, 12,* 424-435. doi: 10.1186/1471-2458-12-424

Sugiyama, T., Healy, G., Dunstan, D., Salmon, J., & Owen, N. (2008). Joint associations of multiple leisure-time sedentary behaviours and physical activity with obesity in Australian adults. *International Journal of Behavioural Nutrition & Physical Activity, 5,* 1-6. doi: 10.1186/1479-5868-5-35

Summerbell, C. D., Douthwaite, W., Whittaker, V., Ells, L. J., Hillier, F., Smith, S., … Macdonald, I. (2009). The association between diet and physical activity and subsequent excess weight gain and obesity assessed at 5 years of age or older: A systematic review of the epidemiological evidence. *International Journal of Obesity, 33,* S1–92. doi: 10.1038/ijo.2009.80

Swencionis, C., Wylie-Rosett, J., Lent, M. R., Ginsberg, M., Cimino, C., Wassertheil-Smoller, S., … Segal-Isaacson, C. J. (2013). Weight change, psychological well-being, and vitality in adults participating in a cognitive–behavioral weight loss program. *Health Psychology, 32,* 439-446. doi: 10.1037/a0029186

Sylvester, B. D., Mack, D. E., Wilson, P. M., Busseri, M.A., & Beauchamp, M. R.

(2012). Health-enhancing physical activity and well-being: Is it how often, how long, or how much effort that matters? *Mental Health & Physical Activity, 5*, 141-147. doi: 10.1016/j.mhpa.2012.10.004

Tabachnick, G. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). New York: Allyn & Bacon.

Thayer, R. E. (1967). Measurement of activation through self-report. *Psychological Reports, 20*, 663-678.

Thayer, R. E. (1978). Factor analytic and reliability studies on the activation-deactivation adjective check list. *Psychological Reports, 42*, 747-756.

Thayer, R. E. (1986). Activation-deactivation adjective check list: Current overview and structural analysis. *Psychological Reports, 58*, 607-614.

Thayer, R. E. (1987). Problem perception, optimism, and related states as a function of time of day (diurnal rhythm) and moderate exercise: Two arousal systems in interaction. *Motivation & Emotion, 11*, 19-36.

Thayer, R. E. (1989). *The biopsychology of mood and arousal*. New York: Oxford University Press.

Thibault, R., & Pichard, C. (2012). The evaluation of body composition: A useful tool for clinical practice. *Nutrition & Metabolism, 60*, 6-16. doi: 10.1159/000334879

Thomas, J. (2009). *Working paper: Current measures and the challenges of measuring children's wellbeing.* Newport: Office for National Statistics.

Thorp, A. A., Owen, N., Neuhaus, M., & Dunstan, D. W. (2011). Sedentary behaviours and subsequent health outcomes in adults: A systematic review of longitudinal studies, 1996-2011. *American Journal of Preventative Medicine, 41*, 207-215. doi:

10.1016/j.amepre.2011.05.004

Tierney, M., Fraser, A., & Kennedy, N. (2013). Users' experience of physical activity monitoring technology in rheumatoid arthritis. *Musculoskeletal Care, 11*, 83-92. doi: 10.1002/msc.1034

Tierney, M., Fraser, A., Purtill, H., & Kennedy, N. (2013). Study to determine the criterion validity of the sensewear armband as a measure of physical activity in people with rheumatoid arthritis. *Arthritis Care & Research, 65*, 888-895. doi: 10.1002/acr.21914

Tran, B. X., Nair, A. V., Kuhle, S., Ohinmaa, A., & Veugelers, P. J. (2013). Cost analyses of obesity in Canada: Scope, quality, and implications. *Cost Effectiveness and Resource Allocation, 11*, 1-9. doi: 10.1186/1478-7547-11-3.

Tremblay, M. S., Esliger, D. W., Tremblay, A., & Colley, R. (2007). Incidental movement, lifestyle-embedded activity and sleep: New frontiers in physical activity assessment. *Canadian Journal of Public Health, 98*, S208–217. doi: 10.1139/H07-130

Tudor-Locke, C., & Bassett, D. R. Jr. (2004). How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine, 34*, 1-8.

Tudor-Locke, C., Brashear, M. M., Johnson, W. D., & Katzmarzyk, P. T. (2010). Accelerometer profiles of physical activity and inactivity in normal weight, overweight, and obese U.S. men and women. *International Journal of Behavioural Nutrition & Physical Activity, 7*, 1-11. doi: 10.1186/1479-5868-7-60.

Tudor-Locke, C., Ham, S.A., Macera, C. A., Ainsworth, B. E., Kirtland, K. A., Reis, J. P., & Kimsey, C. D. Jr. (2004). Descriptive epidemiology of pedometer-determined

physical activity. *Medicine & Science in Sports & Exercise, 36,* 1567-1573.

Unick, J. L., Bond, D. S., Jakicic, J. M., Vithiananthan, S., Ryder, B. A., Roye, G. D., Pohl, D., Trautvetter, J., & Wing, R. R. (2012). Comparison of two objective monitors for assessing physical activity and sedentary behaviors in bariatric surgery patients. *Obesity Surgery, 22*, 347-352. doi: 10.1007/s11695-011-0491-1

Vazou-Ekkekakis, S., & Ekkekakis, P. (2009). Affective consequences of imposing the intensity of physical activity: Does the loss of perceived autonomy matter. *Hellenic Journal of Psychology, 6*, 125-144.

Vieira, P. N., Palmeira, A. L., Mata, J., Kolotkin, R. L., Silva, M. N., Sardinha, L. B., & Teixeira, P. J. (2012). Usefulness of standard BMI cut-offs for quality of life and psychological well-being in women. *Obesity Facts, 5,* 795-805. doi: 10.1159/000345778

Walls, H. L., Stevenson, C. E., Mannan, H. R., Abdullah, A., Reid, C. M., McNeil, J. J., & Peeters, A. (2011). Comparing trends in BMI and waist circumference. *Obesity, 19*, 216-219. doi: 10.1038/oby.2010.149

Ware, L. J., Hurling, R., Bataveljic, O., Fairley, B. W., Hurst, T. L., Murray, P., … Foreyt, J. P. (2008). Rates and determinants of uptake and use of an internet physical activity and weight management program in office and manufacturing work sites in England: Cohort study. *Journal of Medical Internet Research, 10*, e56. doi: 10.2196/jmir.1108

Warburton, D. E., Katzmarzyk, P. T., Rhodes, R. E., & Shephard, R. J. (2007). Evidence-based guidelines for physical activity of adult Canadians. *Applied Physiology, Nutrition, & Metabolism, 32,* S17-74. doi: 10.1139/H07-168

Wareham, N. J., & Rennie, K. L. (1998). The assessment of physical activity in individuals and populations: Why try to be more precise about how physical activity is assessed? *International Journal of Obesity, 22*, S30-38.

Watson, D., Clark, L. A., & Tellegren, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality & Social Psychology, 54*, 1063-1070.

Welch, A. S., Hulley, A., Ferguson, C., & Beauchamp, M. R. (2007). Affective responses of inactive women to a maximal incremental exercise test: A test of the dual-mode model. *Psychology of Sport & Exercise, 8*, 401-423. doi: 10.1016/j.psychsport.2006.09.002

Welk, J. G. (2002). *Physical activity assessments for health-related research*. Champaign, IL: Human Kinetics.

Wendel-Vos, C.G., Schuit, A.J., Tijhuis, M.A., & Kromhout, D. (2004). Leisure-time physical activity and health-related quality of life: Cross-sectional and longitudinal associations. *Quality of Life Research, 13*, 667–677. doi: 10.1023/B:QURE.0000021313.51397.33

Wilcox, S., & Ainsworth, B. E. (2009). The measurement of physical activity. In S. A. Shumaker, JK Ockene, & KA Riekert (Eds.), *The Handbook of Health Behavior Change* (3rd ed., pp. 327-346). New York, NY: Springer Publshing Company, LLC.

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J., … Biddle, S. J. H. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis.

Diabetologia, *55*, 2896-2905. doi: 10.1007/s00125-012-2677-z

Wijndaele, K., Healy, G. N., Dunstan, D. W., Barnett, A. G., Salmon, J., Shaw, J. E., … Owen, N. (2010). Increased cardiometabolic risk is associated with increased TV viewing time. *Medicine & Science in Sports & Exercise, 42*, 1511-1518. doi: 10.1249/MSS.0b013e3181d322ac

Williams, D. M. (2008). Exercise, affect, and adherence: An integrated model and a case for self-paced exercise. *Journal of Sport and Exercise Psychology, 30*, 471-496.

Wilson, P. M., Mack, D. E., Blanchard, C. M., & Gray, C. E. (2009). The role of perceived psychological need satisfaction in exercise-related affect. *Hellenic Journal of Psychology, 6*, 183-206.

Withrow, D., & Alter, D. A. (2011). The economic burden of obesity worldwide: A systematic review of direct costs of obesity. *Obesity Reviews, 12*, 131-141. doi: 10.1111/j.1467-789X.2009.00712.x

World Cancer Research Fund & American Institute for Cancer Research. (2007). *Food, nutrition, physical activity and the prevention of cancer: A global perspective*. Washington, DC: American Institute for Cancer Research

World Health Organization. (2000). Obesity: Preventing and managing the global epidemic. Report of a WHO consultation. *Technical Report Series, 894*, 1-253.

World Health Organisation. (2009). *Global health risks: Mortality and burden of disease attributable to selected major risks.* Geneva, Switzerland: Author.

World Health Organisation. (2012). *Controlling the global obesity epidemic.* http://www.who.int/nutrition/topics/obesity/en/

World Health Organization. (2013). *Media centre: Obesity and overweight*.

http://www.who.int/mediacentre/factsheets/fs311/en/index.html

World Health Organization. (2013). *Physical activity*. http://www.who.int/topics/physical_activity/en/

Wrosch, C., & Sabiston, C. M. (2013). Goal adjustment, physical and sedentary activity, and well-being and health among breast cancer survivors. *Psycho-Oncology, 22*, 581-589. doi: 10.1002/pon.3037

Ying, X., Song, Z., Zhao, C., & Jiang, Y. (2010). Body mass index, waist circumference, and cardiometabolic risk factors in young and middle-aged Chinese women. *Journal of Zhejiang University Science B, 11*, 639-646. doi: 10.1631/jzus.B1000105

Yusuf, S., Hawken, S., Ounpuu, S., Bautista, L., Franzosi, M. G., Commerford, P., … Anand, S. S. (2005). Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: A case-control study. *Lancet, 366*, 1640-1649. doi: 10.1016/S0140-6736(05)67663-5

Zhao, G., Ford, E. S., Dhingra, S., Li, C., Strine, T. W., Mokdad, A. H. (2009). Depression and anxiety among U.S. adults: Associations with body mass index. *International Journal of Obesity, 33*, 257-266. doi: 10.1038/ijo.2008.268

Zhao, G., Ford, E. S., Li, C., Tsai, J., Dhingra, S., & Balluz, L. S. (2011). Waist circumference, abdominal obesity, and depression among overweight and obese U.S. adults: National health and nutrition examination survey 2005-2006. *BioMed Central Psychiatry, 11*, 130-138. doi: 10.1186/1471-244X-11-130

Zhu, S., Wang, Z., Heshka, S., Heo, M., Faith, M. S., & Heymsfield, S. B. (2002). Waist circumference and obesity-associated risk factors among whites in the third national

health and nutrition examination survey: Clinical action thresholds. *American Journal of Clinical Nutrition, 76*, 743-749.

Table 1

Obesity-Related Health Risk Classifications

Waist Circumference	BMI		
	Normal	Overweight	Obese class 1
< 102 cm (Males) < 88 cm (Females)	Least Risk	Increased Risk	High Risk
≥ 102 cm (Males) ≥ 88 cm (Females)	Increased Risk	High Risk	Very High Risk

Note: BMI = Body Mass Index. WC = Waist Circumference.

Note. This table is adapted from the National Institutes of Health (1998) Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report. It is used to help classify individuals, based on their body mass index and waist circumference measurements, into different health risk categories. However, this classification tool only extends to "Obesity class 1" as there are no changes noted beyond this stage, specifically in relation to waist circumference values.

Table 2

Inferential Statistics between Demographic Variables based on Obesity-Related Health Risk

	Demographic	*F*	χ^2	*P*
1.	Age	1.83		.17
2.	Gender		5.95	.05
3.	Marital Status		2.54	.28
4.	Ethnicity		1.72	.42
5.	Employment		2.03	.36
6.	Education		0.25	.88

Note: *F* = ANOVA model statistic. χ^2 = Chi-squares statistic. *p* = p-value or significance value.

Table 3

Descriptive Statistics and Internal Consistency Reliability Estimates

	Variable	*M*	*SD*	*Range*	*Skew.*	*Kurt.*	*α*
1.	AEE	135.52	89.46	0-∞	1.53	3.02	--
2.	AEE-10	54.55	62.53	0-∞	2.13	5.59	--
3.	Steps	7539.38	2795.63	0-∞	0.21	-0.05	--
4.	SB (SWA)	1044.29	109.00	0-∞	-0.87	1.81	--
5.	GLTEQ	65.14	23.26	0-∞	0.35	-0.56	--
6.	SB (frequency)	3.66	0.52	1-4	-1.15	0.26	--
7.	SB (hours)	4.22	0.89	1-5	-1.37	2.51	--
8.	AD ACL Energy	2.85	0.73	1-4	-0.38	-0.35	0.90
9.	AD ACL Tiredness	1.95	0.66	1-4	0.70	0.13	0.86
10.	AD ACL Tension	1.79	0.57	1-4	1.13	1.86	0.72
11.	AD ACL Calmness	1.92	0.52	1-4	0.45	0.18	0.72
12.	Positive Affect	3.29	0.81	1-5	-0.32	0.25	0.83
13.	Negative Affect	1.36	0.52	1-5	2.08	5.72	0.76

Note: *M* = Mean. *SD* = Standard deviation. *Skew*. = Univariate Skewness. *Kurt*. = Univariate Kurtosis. α = Cronbach's (1951) internal consistency reliability coefficient. AEE = Active Energy Expenditure (≥ 3.0 METs reported in minutes). AEE-10 = Active Energy Expenditure in bouts of 10 minutes or more (≥ 3.0 METs reported in minutes). SB = Sedentary Behaviour. SWA = SenseWear Armband. GLTEQ = Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985). AD ACL: Activation Deactivation Adjective Checklist (Thayer, 1989).

Table 4

Bivariate Correlations between Weight Status Measurements and Other Study Variables

Variable	*BMI*	*WC*	*Obesity-Related Health Risk*
1. AEE	-.46	-.37	-.53
2. AEE-10	-.43	-.35	-.54
3. Steps	-.23	-.19	-.09
4. SB	.39	.28	.13
5. AD ACL Energy	-.36	-.26	-.30
6. AD ACL Tiredness	.21	.17	.26
7. AD ACL Tension	-.01	.05	.12
8. AD ACL Calmness	-.12	-.13	-.03

Note: BMI = Body mass index. WC = Waist circumference. AEE-10 = Active Energy Expenditure in bouts of 10 minutes or more (≥ 3.0 METs reported in minutes). SB = Sedentary Behaviour. AD ACL: Activation Deactivation Adjective Checklist (Thayer, 1989). All *r*'s greater than |.24| significant at $p < .05$ (one-tailed) and |.33| significant at $p < .01$ (one-tailed).

Table 5

Bivariate Correlations between PA study variables

Variable		1	2	3	4
1.	AEE	--	.94	.65	.45
2.	AEE-10		--	.62	.34
3.	Steps			--	.41
4.	GLTEQ				--

Note: AEE = Active Energy Expenditure (≥ 3.0 METs reported in minutes). AEE-10 = Active Energy Expenditure in bouts of 10 minutes or more (≥ 3.0 METs reported in minutes). GLTEQ = Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985). Sample size (N = 50) is consistent across all SenseWear Armband data, while a sample size of 49 participants is consistent for analyses involving the GLTEQ. All r's greater than |.24| significant at $p < .05$ (one-tailed) and |.33| significant at $p < .01$ (one-tailed).

Table 6

Bivariate Correlations between WB study variables

Variable		1	2	3	4	5	6
1.	AD ACL Energy	--	-.68	.22	-.23	.44	-.00
2.	AD ACL Tiredness		--	.33	.32	-.11	.37
3.	AD ACL Tension			--	-.09	.17	.35
4.	AD ACL Calmness				--	.15	-.04
5.	Positive Affect					--	-.06
6.	Negative Affect						--

Note: AD ACL: Activation Deactivation Adjective Checklist (Thayer, 1989). Sample size (N = 50) is consistent for Positive Affect and Negative Affect, while sample size (n = 49) is consistent with all four AD ACL subscales. All r's greater than |.24| significant at $p < .05$ (one-tailed) and |.33| significant at $p < .01$ (one-tailed).

Table 7

Means and Standard Deviations for Activity Behaviours based on Obesity-Related Health Risk

	Obesity-Related Health Risk Classification	*M*	*SD*	*n*
AEE-10	Least Risk	68.83	51.99	14
	Increased Risk	46.90	37.70	20
	High Risk	13.82	14.36	13
Steps	Least Risk	6879.28	2473.15	14
	Increased Risk	7745.21	2515.52	20
	High Risk	6719.15	2514.32	13
SB	Least Risk	1056.60	90.18	14
	Increased Risk	1036.26	82.12	20
	High Risk	1088.99	99.59	13

Note: *M* = Mean. *SD* = Standard deviation. *n* = number of participants. AEE-10 = Active Energy Expenditure in bouts of 10 minutes or more (≥ 3.0 METs reported in minutes). SB = Sedentary behaviour (in minutes).

Table 8

Means and Standard Deviations for WB based on Obesity-Related Health Risk

	Obesity-Related Health Risk Classification	*M*	*SD*	*N*
Energy	Least Risk	3.04	0.58	16
	Increased Risk	3.00	0.64	20
	High Risk	2.33	0.86	12
Tiredness	Least Risk	1.84	0.69	16
	Increased Risk	1.78	0.49	20
	High Risk	2.33	0.77	12
Tension	Least Risk	1.75	0.57	16
	Increased Risk	1.67	0.43	20
	High Risk	2.00	0.74	12
Calmness	Least Risk	1.91	0.47	16
	Increased Risk	2.01	0.58	20
	High Risk	1.83	0.48	12
Positive Affect	Least Risk	3.39	0.69	16
	Increased Risk	3.36	0.91	20
	High Risk	3.08	0.85	12
Negative Affect	Least Risk	1.30	0.39	16
	Increased Risk	1.32	0.45	20
	High Risk	1.28	0.41	12

Note: *M* = Mean. *SD* = Standard deviation. *n* = number of participants.

Table 9

Descriptive Statistics based on SWA Perception Questionnaire

Perception	*M*	*SD*	*Range*	*%*	*n*
1. Attitudes Overall Score	4.05	0.70	1-5		
Worthwhile	4.53	0.65	3-5		
Good	4.33	1.05	1-5		
Wise	4.16	1.01	1-5		
Useful	4.37	0.91	1-5		
Beneficial	4.33	0.94	1-5		
Interesting	4.37	0.78	3-5		
Calming	3.50	1.02	1-5		
Pleasant	3.39	0.98	1-5		
Invigorating	3.69	0.89	1-5		
Fun	3.61	1.13	1-5		
Motivating	4.24	0.95	1-5		
2. Instrumental Values					
Change in daily PA	1.78	1.02	1-5		
Practicality	3.78	1.00	1-5		
3. Affective Values					
Embarrassed	1.43	0.84	1-4		
Confidence	3.92	1.10	1-5		
4. Perceptions of Others					
Notice device				66.00	33
Ask about device				100.00	33
Well-received	3.95	0.75	3-5		
Used for something other than PA if noticed by others				57.58	19
5. Barriers					
Wearing device on arm	1.92	1.05	1-5		
Comfort of device	2.54	1.13	1-5		
Visibility to others	1.96	1.04	1-4		
Clothing worn each day	1.90	1.13	1-5		
Charging of device	1.38	0.75	1-4		
Weight of device	1.12	0.44	1-3		
Occupation	1.36	0.75	1-4		

Note: SWA = SenseWear Armband. *M* = Mean. *SD* = Standard deviation. *%* = Percent of "yes". *n* = number of sample that responded "yes". PA = Physical Activity.

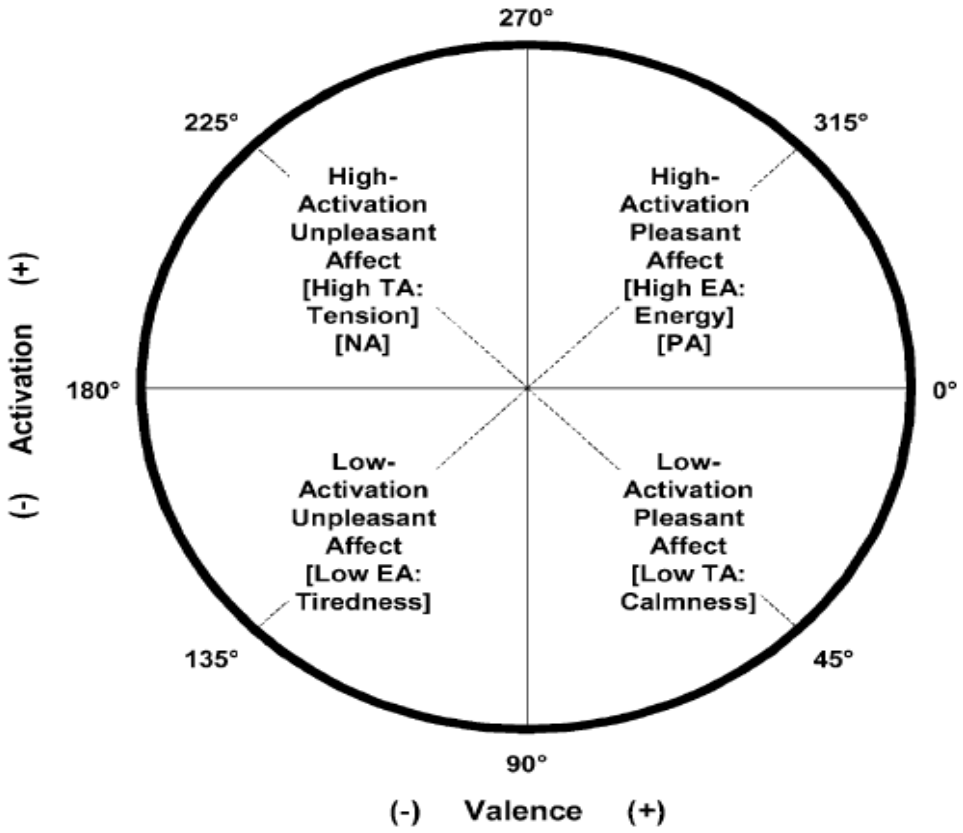

Figure 1: The Affect Circumplex Model. This model is designed to measure bipolar and orthogonal dimensions of affect (Ekkekakis & Petruzzello, 2002). The vertical axis represents affective valence (positive and negative), while the horizontal axis represents perceived activation (low and high) (Ekkekakis & Petruzzello, 2002). When you rotate the axes 45 degrees, you get dimensions that extend from low activation unpleasant (characterized by tiredness) to low activation pleasant (characterized by calmness), and high activation unpleasant (characterized by tension) to high activation pleasant (characterized by energy) (Ekkekakis & Petruzzello, 2002). NA means Negative Activation and the PA means Positive Activation (Watson et al., 1988), while the TA means Tense Arousal and the EA means Energetic Arousal (Thayer, 1989). Both are represented within each quadrant of the model.

Appendix A

Ethics Clearance Certificate

Brock University
Research Ethics Office
Tel: 905-688-5550 ext. 3035
Email: reb@brocku.ca

Bioscience Research Ethics Board

Certificate of Ethics Clearance for Human Participant Research

DATE:	12/13/2013		
PRINCIPAL INVESTIGATOR:	MACK, Diane - Kinesiology		
FILE:	13-096 - MACK		
TYPE:	Masters Thesis/Project	STUDENT:	Kimberly Brooks
		SUPERVISOR:	Diane Mack

TITLE: Understanding Obesity-Related Health Risk Classifications among Adults: A Focus on Behavioural and Well-Being Differences in a Field Setting

ETHICS CLEARANCE GRANTED

Type of Clearance: NEW Expiry Date: 12/31/2014

The Brock University Bioscience Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from 12/13/2013 to 12/31/2014.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before 12/31/2014. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms.

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved:

Note: Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

Appendix B

Sample of Recruitment Poster

RESEARCH PROJECT

WE NEED YOU!

Purposes:

1) To examine the differences that exist, based on an individual's health risk status, in terms of physical activity, sedentary behaviour and well-being in adults

2) To explore participants' perceptions of using a multi-sensor monitoring device, such as the SenseWear Armband, to measure physical activity and sedentary behaviour levels.

Study Requirements: Complete a total of two short questionnaires and wear a SenseWear Armband to measure physical activities over a 7-day period.

Eligibility: The following inclusion/exclusion data will be used to guide participant recruitment for this study: (a) between the ages of 18-64, (b) willing to commit to the full length of study, (c) can speak and write in English, (d) currently free of any ambulatory restrictions that may restrict them from their full participation, and (e) have a valid email account.

Find out more about your own level of activity, health risk status, and well-being!
Also, help us further health promotional research for the general population!

This study has been granted ethics clearance by the REB at Brock University. Feel free to email the investigators if you have any questions regarding the study and/or its findings.

RESEARCH TEAM

KIMBERLY BROOKS, RN BSCN
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BROCK UNIVERSITY
FACULTY OF APPLIED HEALTH SCIENCES
Graduate Studies

Appendix C

Verbal Presentation Scripts

This is a sample overview of the verbal script that will be used to guide in any in-person recruitment efforts within this study. This script would be used to guide the verbal presentation/conversations in order to recruit participants for this study.

Good Morning/Afternoon/Evening,

My name is <*insert researcher name here or research assistant*> and I am a Masters Student in the Behavioural Health Sciences Research Lab in the Faculty of Applied Health Sciences at Brock University. I am here today to present to you the details of an ongoing research project we are currently doing that may be of interest to you. The study is designed to address two issues. The first issue concerns what the role of physical activity, sedentary behaviour, and well-being have on affecting an individuals' obesity-related health risk classification. The second issue concerns the perceptions and use of the SenseWear Armband, which is self-monitoring device that measures body movements in everyday physical activity contexts.

We are currently recruiting participants for this project. If you are interested, the following criteria must be met prior to becoming involved in the study. You must be: (a) between the ages of 18-64, (b) willing to commit to the full length of study, (c) can speak and write in English, (d) currently free of any ambulatory restrictions that may restrict them from their full participation, (e) have no implanted device such as a pacemaker and (f) have a valid email account.

Your involvement in this project, in brief, would request you to complete two short questionnaires immediately following one-week of using the SenseWear Armband to monitor your movement. Full details about what is being requested of participants who enrol in this study can be obtained by contacting one of the members of the research team.

Please see Kimberly Brooks or Dr. Diane Mack if you would like our contact information to discuss the study more privately.

Thank you for your time and I would be happy to answer any questions you may have right now regarding our research program at Brock University or this research project in particular.

Appendix D

Letter of Invitation

Brock University, Faculty of Applied Health Sciences
Letter of Invitation
Title of Study:
Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk through Lifestyle Behaviours & Well-Being
Principal Student Researcher:
Kimberly Brooks (RN, BScN), MA Candidate, Faculty of Applied Health Sciences, Brock University
Faculty Supervisor:
Dr. Diane E. Mack, Associate Professor, Department of Kinesiology, Faculty of Applied Health Sciences, Brock University
Research Assistant:
Meghan Crouch, Undergraduate Student, Bachelor of Kinesiology, Brock University

Dear Participant,

Introduction: The research project that you are being invited to participate in is entitled, "Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk through Lifestyle Behaviours and Well-Being". The investigators are members of the Behavioural Health Sciences Research Lab at Brock University with an interest physical activity behaviour and well-being.

Purpose: The purpose of this study is to examine the differences that exist, based on an adult's health risk classification, in terms of their physical activity, sedentary behaviour, and well-being. The second aim is to explore participants' perceptions of using a multi-sensor monitoring device, such as the SenseWear Armband, to measure physical activity and sedentary behaviour levels.

Involvement: Your involvement would be greatly appreciated and will help to further our understanding of how an individual's obesity-related health risk status is affected by physical activity, sedentary behaviour, and well-being, as well as understand what people like/dislike about the SenseWear Armband and how they feel about wearing the device. I will meet with you on the first day of the study and then again a week later. Should you choose to participate, you will be asked to wear the SenseWear Armband for those seven consecutive days. The SenseWear Armband is a portable device that is worn on the upper left arm in direct contact with the skin to measure human movement. It is noted the SenseWear Armband measures not only physical activity and sedentary behaviour, but other information such as heart rate and galvanic skin response. Please note, that for the purposes of this study we are only interested in your physical activity and sedentary behaviour data. As such, other information gathered by this device (e.g., heart rate) will not be accessed or analyzed. On this day, your height, weight, and waist circumference will be taken by a trained professional. During the seven days you will also receive two email reminders that will inform you about (a) when to charge the device, and (b) when your last

appointment for the study will be. Then, after the seven days, you will meet the principal student researcher and will be able to remove the armband at approximately the same time you put it on. At this time, you will be given a survey that will ask you questions regarding your demographics (i.e. age, sex), level of well-being, as well as a few questions about your physical activity and sedentary behaviour, which should take no longer than fifteen minutes. After this is complete, you will be provided the option of reviewing your results from the SenseWear Armband. Then you will be given a second questionnaire that will ask you questions about your personal perceptions with using the device. This should take you no longer than five minutes. The information provided in both surveys will be used in conjunction with the data from the armband to gauge accuracy and potential uses of monitoring technology in health promotion contexts.

Benefits: There are a number of benefits associated with participating in this study. First, participation in this research study may translate into increased knowledge regarding proper physical activity and sedentary behaviour as well as how these variables may relate to your level well-being. You will also gain knowledge about the use and function of the SenseWear Armbands. Second, it is likely that through participation in this research project you will become more aware of your obesity-related health risk status, provided that you also view your personal results. This will in turn make you more aware of your own level of physical activity and how much time you spend being sedentary. You will also become more aware about your own level of well-being based on your activity behaviour. Third, information gained may benefit the larger community by providing information that will likely be used in health promotion strategies as well as for additional research. For example, based on participants' perceptions of using the armband, this could help promote the use of this device in weight loss programs and/or physical activity interventions in the general population.

Feedback: A written summary of our results from this study will be made available to you at your request. Should you wish to receive a summary of your personalized data and/or about the results of the study, please complete the Debriefing Form located at the end of the questionnaire. Our findings will also be disseminated in academic journals and conference presentations; however, the specific identity of the participants in the study will not be disclosed.

Confidentiality: Any information that is provided from participants will be treated with confidentiality, and access to all information that might identify participants will be limited to members of the research team named above. All data provided are not anonymous in nature, but will be treated with the utmost confidentiality. All participant data will be de-identified within 7 days of the monitoring period. Participant de-identification involves assigning your data a unique alpha-numeric code (e.g., aa01). Once the data that any participant submits as a function of their involvement in this study has been de-identified, they can no longer be removed from the database upon request. All recorded data will be kept in a locked cabinet accessible only to members of the research team. Consistent with guidelines that control the collection and storage of scientific information in Canada, all data collected for this study will be destroyed five years following the completion of the investigation.

Participation: Participation in this study is voluntary and individuals may decline answering any question(s) that you choose. Participant risk is minimal and no greater than you could encounter in everyday life. There are no foreseeable physical risks, social risks, or risks associated with deception directly associated with study participation. According to the manufacturer less than 1% of users experience mild to severe skin irritation. Any irritation is often the consequence of improper wear or cleaning. Wear and cleaning instructions can be found in the Participant Binder. Should you experience persistent irritation, please discontinue wearing the SenseWear and contact members of the research team. While not an intended consequence, some participants may experience some psychological risks (feeling demeaned, embarrassed, worried or upset, emotional stress) based on the feedback offered as a result of your involvement. You may choose to decline or withdraw your participation at any time throughout the course of the study. If this is to occur, please inform one of the members of the research team immediately of your decision. However, your participation is needed and would be appreciated as it will improve the conclusions derived from this investigation. All summary reports emanating from this study will use de-identified (i.e., all identifying information will be removed) data only. The following inclusion/exclusion criteria will be used guide participant recruitment for this study: (a) between the ages of 18-64, (b) willing to commit to the full length of study, (c) can speak and write in English, (d) currently free of any ambulatory restrictions that may restrict them from their full participation, (e) have no implanted device such as a pacemaker, and (f) have a valid email account.

Sponsorship: The study has been reviewed and has received ethics clearance through the Bioscience Research Ethics Board at Brock University.

Should you have any further questions concerning the study in general, please feel free to contact members of the research team. Kimberly Brooks can be reached at by email kb12pt@brocku.ca. Diane Mack can be reached at: (905) 688-5550 extension 4360 or by e-mail at dmack@brocku.ca. Additionally, concerns about your involvement in the study may also be directed to the Research Ethics Officer in the Office of Research Services at (905) 688-5550 extension 3035.

Thank you for your interest and involvement in this study.

Sincerely,

Diane Mack, Ph.D.
Associate Professor

Kimberly Brooks, RN BScN,
MA Candidate

Meghan Crouch, BKin,
Undergraduate Student

This project has been reviewed and cleared by the Office of Research Services Ethics Board at Brock University (File# 13-096). Any questions pertaining to your rights as a participant in research at Brock University can be directed to the Research Ethics Officer (reb@brocku.ca or 905 688 5550 Ext. 3035).

Appendix E

Informed Consent

Title of Study: Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk though Lifestyle Behaviours & Well-Being

Principal Student Researcher: Kimberly Brooks (RN, BScN), MA Candidate, Faculty of Applied Health Sciences, Brock University; kb12pt@brocku.ca

Faculty Supervisor: Dr. Diane E. Mack, Associate Professor, Department of Kinesiology, Faculty of Applied Health Sciences, Brock University; dmack@brocku.ca

Research Assistant: Meghan Crouch, Undergraduate Student, Bachelor of Kinesiology, Brock University; mc11de@brocku.ca

You have been invited to participate in a research study.

- The two purposes of this study are: 1) To examine the differences in health risk status in terms of physical activity, sedentary behaviour, and well-being in adults, and 2) To explore participants' perceptions of using a multi-sensor monitoring device (i.e., SenseWear Armband) to measure physical activity and sedentary behaviour levels.

I understand that:

- I have received and read the Letter of Invitation provided to me through members of the research team conducting this study.
- My height and weight measurements will be taken in order to calculate my body mass index. I also understand that my waist circumference measurement will be taken to further identify my obesity-related health risk classification. I am aware that all physical measurements will be taken by a trained professional.
- My email will only be used for the purposes of sending two reminders during the seven days of the study regarding (a) when to charge the SenseWear Armband, and (b) informing me of the time to meet on the last day of the study.
- My participation will involve wearing a SenseWear Armband to measure my physical movements for seven consecutive days. I am aware that this device is a small device that is worn on the upper arm directly on the skin. After the seven days, I will hand in the SenseWear Armband at a mutually convenient time and then will receive a questionnaire that will take approximately 10-15 minutes to complete. This questionnaire will gather data about my demographics (i.e., age, sex), physical activity and sedentary behaviour, as well as my level of well-being. Immediately following completion of this questionnaire, I will have the opportunity to view my SenseWear armband results. A second questionnaire will follow which will take an additional five minutes to complete. This questionnaire will gather data based on my perceptions about the use and wear of the device.
- I am aware that the armband is a multifaceted device that collects data on skin temperature, galvanic skin response, motion using dual-axis accelerometer technology, step count, and heat flux simultaneously on a minute-by-minute basis.

However, for the purposes of this study my data will only be used to calculate my physical activity and sedentary behaviour data.

- The risks of participation in this study are minimal and no greater than I could encounter in everyday life.
- If skin irritation occurs, please consult the Participant Binder for proper wear and cleaning instructions. Should you experience persistent irritation, please discontinue wearing the SenseWear and contact members of the research team.
- While not an intended consequence, some participants may experience some psychological risks (feeling demeaned, embarrassed, worried or upset, emotional stress) based on the feedback offered as a result of your involvement.
- There are no additional foreseeable physical risks (e.g., bodily contact, physical stress, administration of any substance), social risks (e.g., loss of status, privacy, and/or reputation), or risks associated with deception. The following procedures have been included in this study to minimize the likelihood of this risk occurring: (a) Clear statement of study purpose; (b) Voluntary participation; (c) Confidentiality of any and all data provided by study participants; (d) Assurance that the participant has the right to revoke their involvement (and data if identifiable) in this study at any time; (e) Assurance that each participant has the right to refuse to answer any question asked of them for the duration of this study. Any personal identifiers used throughout the duration of this study will be removed once the data have been stored such that identification is no longer possible.
- I can choose to decline participation at any point in time throughout the study.
- Background information requires the disclosure of personal information.
- There is no obligation to answer any question that I do not wish to answer.
- Members of the research team have secured procedures to ensure participant confidentiality.
- All personal information will be kept strictly confidential and that all information will be assigned a unique alphanumeric code so that the name of individual participants will not be associated with their specific answers.
- My participation in this study is voluntary and that I may withdraw from the study at any time and for any reason without penalty. If I decide to withdraw, I understand that I will have to contact one of the members of the research team immediately and inform them of my decision.
- Only members of the research team named above will have access to the data.
- Data will be destroyed five years following completion of the study.
- Participants may gain a better understanding of their own physical activity behaviour and well-being, as well as insight into varied approaches to conducting research at the university level, which may assist in informing future research endeavours that you may wish to pursue.
- Following the seven day monitoring period any data I have provided will be de-identified in such a way that it is no longer identifiable to anyone including members of the research team. Participant de-identification involves assigning your data a unique alpha-numeric code (e.g., aa01). At this point, since my data can no longer be identified by any member of the research team, it cannot be removed even at my request.

- The following inclusion/exclusion criteria are being used in this research study to guide participant recruitment: (a) between the ages of 18-64, (b) willing to commit to the full length of study, (c) can speak and write in English, (d) currently free of any ambulatory restrictions that may restrict them from their full participation, (e) have no implanted monitoring device (e.g., pacemaker) and (f) have a valid email account.
- The results of this study will be distributed in academic journal articles and conference presentations, and a summary of the results will be made available to the participants in the study at their request.
- As indicated by my consent below, I acknowledge that I am participating freely and willingly.

I agree to participate in this study described above. I have made this decision based on the information I have read in the Informed Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time. Please retain a copy of this form for your own records.

	I consent to participate in this study by checking this box.	DATE:
If you have any questions about this study or require further information, please contact the Principle Student Investigator or the Principle Investigator using the contact information provided above. This study has been reviewed and received ethics clearance by through the Research Ethics Board at Brock University (FILE # 13-096). If you have any comments or concerns regarding your rights as a participant, please contact the Research Ethics Office at (905) 688-5550.		

Appendix F

Participant Binder

Participant Binder

"Unpacking Pieces of the Puzzle: Understanding Obesity-Related Health Risk"

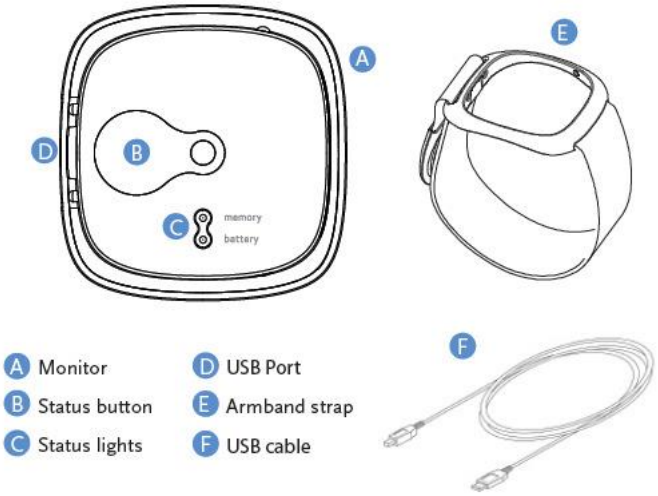
Research Project

ember & February 2013/14

"A Guide to the SenseWear Armbands"

Brock University

SenseWear Armband



Wearing the Armband

1. Make sure your upper left arm is clean and dry of any lotion or body oil on your skin.
2. Slide the Armband on the upper back of your left arm with the sensors touching the skin.
3. Adjust the strap so that it fits the arm comfortably, and then secure the Velcro tab. Make sure the sensors maintain continuous contact with your skin and that the Armband doesn't slide off your arm.
4. The Armband will turn itself on and begin gathering data within 10 minutes.

The Armband is designed to be worn high up on the back of the left arm (triceps area), touching the skin. The "right way up" has the logo closer to your shoulder and the lights closer to your elbow.

We recommend wearing the Armband for a maximum of 23 hours each day.
Do not immerse the Armband in water. The monitor is splash resistant, but it is not designed to be used underwater or to come in continuous contact with water.
If you experience a skin irritation please follow proper wear and cleaning instructions and this often resolves the issue. If irritation continues, discontinue use and consult a physician.

Follow all instructions regarding how to properly wear and clean the Armband to minimize the chance of irritation. If you have a known metal allergy consult your physician prior to using the product.

The Armband is designed to be worn comfortably loose rather than tight. You should be able to easily place two fingers underneath the strap.

If you experience visible impression marks on the arm that remain after a few hours you should adjust the strap to fit more comfortably. Once you have adjusted the strap to fit comfortably, it is best to slide the armband off by stretching the strap rather than adjusting each time you wear.

Turning the Armband On and Off

The Armband does not have a power button; it will power on automatically within 10 minutes of putting it on. To turn the Armband off, slide it off of your arm. Within a few minutes the Armband will power off.

To verify the Armband is "on" and gathering data while you are wearing it, press the status button located on the front of the Armband. When pressed, you will hear the "A-OK" sound indicating it is "on". If no sounds are heard then the Armband is off.

Frequently Asked Questions

How does the Armband measure my calories, activity, and sleep?

The Armband contains multiple sensors that measure motion, body heat, skin temperature, and conductivity. A proprietary algorithm "crunches" the collected information and the users' personal body parameters to deliver accurate information on calories, activity levels, steps, lying down, and sleep time.

How do I know the Armband is collecting data?

If you're wearing the Armband correctly, it's probably collecting data. To check that the Armband is on, press the status button once and release. You should hear an "A OK" sound; this sound confirms the Armband is collecting data.

How long will it take to charge my Armband?

The armband is fully charged at the outset of your participation. We are asking that you charge the armband for 1 hour after four days of usage. This is a precautionary method to ensure the battery does not die and your data is not lost. If you provided an email address at the beginning of the study, a friendly reminder will be sent to you after four days encouraging you to recharge the device. If you do not have access to a computer you are welcome to come in to the lab at Brock University to recharge the device. The lab is located in Welch Hall Room 141. Please contact the Principle Student Investigator, Kimberly Brooks at kb12pt@brocku.ca to set up a time that is convenient for you to charge your device.

Is the Armband waterproof?

No, the Armband is not waterproof, but it is water resistant (rated IP64.) You should not submerge or perform water-based activities, such as swimming or bathing, while wearing the
Armband.

Can I wear my Armband in a Sauna?

No. Because of the extreme conditions found in a sauna we cannot confirm that the SenseWear will work properly. As such, we ask that you take off the SenseWear for the time that you are in the sauna.

Can I wear the Armband when flying?

The device and wireless accessories should not be used in airplanes, hospitals, or locations where cellular telephones or electronic devices are prohibited.

Do I have to wear the Armband all the time? What happens if I take it off?

The Armband will fill in calories for any time you were not wearing it. (That data will be an estimate based on your body parameters and your previous activity.) But the more you wear the Armband, the more accurate your values will be. Consequently, we ask that you wear the armband continuously for the seven day period (even sleeping)

unless you are in the water or extreme conditions (e.g. sauna) or charging the device.

Is it possible to mute the sounds on the Armband?

You are not able to mute the audio on the Armband. The Armband will make sounds when the battery or memory are running low, when a reminder goes off, or when you press the status button.

I have sensitive skin, should I wear the Armband?

Analysis and post market surveillance indicates that the risks of using the product are extremely low. No significant health risks have been identified. The most frequently reported health risk, occurring in less than 1% of users, is a mild to severe skin irritation resulting from wearing the Armband. Following proper wear and cleaning instructions often resolves this issue. If irritation continues, discontinue use and consult a physician. Follow all instructions regarding how to properly wear and clean the Armband to minimize the chance of irritation. If you have a known metal allergy, consult your physician prior to using the product. To reduce the risk of skin irritation, be sure to dry the Armband and your arm thoroughly before wearing the Armband.

I have a known metal allergy, should I wear the Armband?

A list of Armband and strap materials is provided below.

What materials are used in the Armband?

- Armband: ABS, polycarbonate, thermoplastic polyurethane, 304 grade stainless steel Stainless Steel #304 content includes: Chromium 18%, Nickel 8%, Manganese 2%, Silicon 1%, Carbon .08%, Phosphorous .045%, Sulfur .03%
- Armband Strap: Nylon, polyester, Lycra (no latex content) or polyisoprene, polycarbonate (frame on the 'mini' model only), thermoplastic polyurethane, silicone
-

How do I help ensure a comfortable wearing experience?

1. Clean and dry the back of Armband and the upper arm daily prior to wearing especially after sweating or when it becomes noticeably moist or dirty. This will help prevent dirt and moisture from getting trapped between the sensors and skin. Instructions for proper cleaning of the Armband can be found below.
2. Avoid wearing the Armband excessively. To reduce potential for skin irritation, wear the Armband for a maximum of 23 hours per day. The Armband can also be worn a little higher or lower on the arm to minimize reactions rather than repeatedly wearing the Armband in the exact same location.
3. Do not use moisturizers or lotions in the areas where the Armband makes contact with the skin. This may increase the chance of irritation over prolonged use and affect the performance of the sensors. Chemicals found in sunscreen and insect repellent can be particularly irritating to the skin under the Armband and may even degrade the Armband and Armband Accessories.

Care and Maintenance

Handling:

Though the Armband has been designed for wearability and long-term use, it is a sensitive monitoring device. Rough handling can break internal components. Never drop or shock the Armband, and always store it in a safe place when not in use.

Cleaning:

You should always clean and dry the Armband and Display if they become noticeably moist or dirty.

- To clean the Armband and Display: Gently wipe skin touching surfaces of the Armband and Display with a soft cloth or towel moistened with mild soap and water. Wipe with a clean damp cloth to remove any remaining soap. Use a dry, soft cloth or towel to completely dry before wearing. **Never use solvents to clean the Armband or Display!**
- To clean the strap and wing: Hand wash with mild soap and warm water, rinse, and then air dry. Machine drying may affect the performance and lifespan of the strap. The Armband and Display may need to be disinfected occasionally. Wipe the entire Armband and Display with a soft cloth dampened with 70% isopropyl alcohol. Allow to dry for 5-10 minutes before wearing. Do not sterilize the Armband, Display or strap.

Troubleshooting:

My Armband will not automatically turn on.

- Make sure the metal sensors in the Armband are in contact with your arm.
- If the Armband has not turned on within 10 minutes, lightly moisten the back of your arm.
- Press the status button.
    - If the Armband beeps, it is working correctly.
    - If the battery light is flashing red, recharge the battery using the usb cable given to you by attaching the device and plugging it into a computer.
    - If the memory light is flashing red then the memory is full. Please contact us.

My Armband is beeping while it is on my arm.

- Make sure the metal sensors in the Armband are in contact with your arm. (Tightening the strap to a comfortable fit will typically fix this.)
- Press the status button.
    - If the battery light is flashing red, recharge the battery. If flashing amber, recharge your battery within the next 24 hours.
    - If the memory light is flashing red, the memory is full. If flashing amber, the Armband has less than 24 hours of memory remaining. If this is the case, please contact us at your earliest convenience.

Preserving your devices:

- For the safety of children and animals, keep the devices out of their sight and reach
- When not using the devices, place in a safe area where they are unlikely to be bumped in order to avoid unexpected damage

Getting the most out of your devices:

- Do not allow others to wear the armband. Please remember the device measures motion/movement and it is *your* activity we are most interested in with this study.
- Over the course of the day, please do not remove the SenseWear armband unless you engage in water based activities or are playing contact sports where it is possible the armband could be damaged. Water based activities include showering, bathing, swimming, etc. Also, please remove the armband when in a sauna or on an airplane. If you have any questions regarding the use of your armband, please feel free to contact us.

Participant SenseWear Armband Checklist

- ☐ Any known metal allergies
- ☐ Wearing the Armband
- ☐ “on sound” – there is no power button
    - ☐ Status button
- ☐ Indication of Armband features
    - ☐ Check it is the right way up – logo faces up
    - ☐ Battery and memory lights
- ☐ Armband must be in contact with skin when on the arm – must not be worn over top of clothing
- ☐ Usage of armband:
    - ☐ No water
    - ☐ Wear while sleeping
    - ☐ No saunas
    - ☐ No planes
- ☐ Wearing the armband:
    - ☐ The more you wear the Armband, the more accurate your values will be.
- ☐ You are not being asked to alter your activities of daily living or engage in any behaviours beyond your ‘habitual’ routines.
- ☐ In Canada this product is not considered a medical device, nor are we medical doctors and as such are not permitted to administer medical advice.
    - ☐ For medical concerns, please consult a physician.
- ☐ Please do not forget to charge the armband after four days.
- ☐ Remember, do not hesitate to contact us if you have any questions!

Contact Information

Please do not hesitate to contact members of the research team.

Behavioural Health Sciences Research Lab Office Hours: Monday to Friday from 9am to 4pm.

After Hours: Call and leave a message or e-mail us and we will respond as soon as possible.

For analytical or methodological inquiries please contact the Principal Student Investigator or Faculty Supervisor:

Ms. Kimberly Brooks, Principal Student Investigator, MA Candidate; kb12pt@brocku.ca

Dr. Diane Mack, Faculty Supervisor, Brock University; (905) 688-5550 ext.4360; dmack@brocku.ca

You can also contact us for any concerns or questions regarding the Sensewear Armband device or information on the study. The research assistant will also be knowledgeable in this area, which you are free to contact as well.

Ms. Meghan Crouch, Research Assistant, Bachelor of Kinesiology; mc11de@brocku.ca

Thank you for your interest in our research project!

Appendix G

Email Consent

All participants are required to a valid email account prior to participating. For the purposes of this study, we will be sending a two reminder emails; 1) A reminder to charge the device on day four of the study, and 2) A reminder about your meeting 24 hours prior to the last day of the study. Your email will abide by the confidentiality and privacy actions as described in your letter of invitation and informed consent. Only the investigator(s) who will be sending the emails will have access to your email account. After the two email reminders have been sent, these forms will be properly destroyed (i.e., shredded).

If you consent to these terms, please provide a valid email address below.

Email address:

_____

_____

We appreciate your participation in our study.

Appendix H

Email Reminder Scripts

Email #1:

Dear <study participant's first name will be inserted here>

Thank you for participating in our research study entitled "Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk through Lifestyle Behaviours & Well-Being".

Your information is important to us and we appreciate your involvement in our research.

This email is simply to remind you to charge the SenseWear Armband given that it is now mid-week of the study. Take an hour out of your day today, wherever you see fit, and simply plug the device into a computer. At this time, the device will automatically charge itself and can be seen as the light on the device will remain on. This instruction is just a precaution to make sure no data is lost at the end of the seven days for study purposes. After the hour is complete, you can place the device back on your left arm for the remainder of the study.

There are only a few more days until you are at the finish line!

If you have any questions, please do not hesitate to contact a member of the research team using the information outlined below.

Kindest regards,

Kimberly Brooks, RN BScN (kb12pt@brocku.ca)

Diane E. Mack, PhD (dmack@brocku.ca)

Megan Crouch, BKin (mc11de@brocku.ca)

This project has been reviewed and cleared by the Office of Research Services Ethics Board at Brock University (File #13-096). Any questions pertaining to your rights as a participant in research at Brock University can be directed to the Research Ethics Officer (reb@brocku.ca or 905 688 5550 Ext. 3035).

Email #2:

Dear <study participant's first name will be inserted here>

Thank you for participating in our research study entitled "Unpacking Pieces of a Puzzle: Understanding Obesity-Related Health Risk through Lifestyle Behaviours & Well-Being".

Your information is important to us and we appreciate your involvement in our research. As the end of the study approaches, this email is to simply remind you about attending the final meeting at White Oaks to wrap up the last ends to our research. Your appointment will be at <insert date/time>. We will ask for your participation to complete a total of two questionnaires, return your SenseWear Armband, as well as have the opportunity the view your results if you choose to do so.

Now the only thing that remains between you and the finish line is one more day!

If you have any questions, please do not hesitate to contact a member of the research team using the information outlined below.

Kindest regards,

Kimberly Brooks, RN BScN (kb12pt@brocku.ca)

Diane E. Mack, PhD (dmack@brocku.ca)

Megan Crouch, BKin (mc11de@brocku.ca)

This project has been reviewed and cleared by the Office of Research Services Ethics Board at Brock University (File #13-096). Any questions pertaining to your rights as a participant in research at Brock University can be directed to the Research Ethics Officer (reb@brocku.ca or 905 688 5550 Ext. 3035).

Appendix I

Questionnaire Package

Section 1: This first part of the questionnaire is designed to describe the people participating in this study. All information received is held in confidence. Please provide your …

1. Age _____ *(in years)*

2. What is your sex? _____ Male _____ Female

3. What is your current marital status?

   a) Single/Never married
   b) Married/Common Law
   c) Widowed
   d) Divorced/Separated

4. How would you describe your ethnic origin?

   a) Caucasian
   b) Aboriginal
   c) Asian
   d) African American
   e) Other

5. What is your highest level of education?

   a) High school diploma
   b) College Diploma or Certificate or Trade
   c) University Degree
   d) Masters
   e) Doctorate

6. What is your employment status?

   a) Employed
   b) Unemployed
   c) Volunteer
   d) Student

*Section 2: During a typical **7-Day period** (a week), how many times on average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write in each space the appropriate number)*

Intensity of Activity	Times Per Week
Strenuous Activity *(Heart beats rapidly)* Examples of strenuous exercise include: heavy lifting, aerobics, fast bicycling, carrying heavy objects or groceries (25+ lbs) upstairs, shovelling snow, etc.	
Moderate Activity *(Not exhausting)* Examples of moderate exercise include: carrying light loads, bicycling at a regular pace, easy swimming, dancing, heavier house cleaning (i.e., washing windows, scrubbing floors), heavier outdoor work(digging, mowing, snowblowing), etc.	
Mild Activity *(Minimal effort)* Examples of mild exercise include: yoga, easy walking, slow dancing, fishing, bowling, golf, light housekeeping, light home repairs, light gardening, shopping, etc.	

During a typical **7-day period** (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

Often	Sometimes	Never/Rarely

*Section 3: These items measure how often **YOU** engaged in sedentary behaviour. Please read each question carefully and circle the appropriate response.*

Over the **past seven days**, how often did YOU participate in sitting activities such as reading, watching TV, computer activities or doing handicrafts?

1	2	3	4
Never	**Seldom**	**Sometimes**	**Often**
No days	*1-2 days*	*3-4 days*	*5-7 days*

On average, how many hours **per day** did YOU engage in these sitting activities?

1	2	3	4	5
Less than 30 minutes	*30 minutes but less than 1 hour*	*1 hour but less than 2 hours*	*2 hours but less than 4 hours*	*4 hours or more*

Section 4: The scale contains adjectives that describe different feelings and emotions. Please read each of the adjectives and indicate how YOU are feeling when you engage in physical activity by circling the appropriate response. There are no right or wrong answers.

	Definitely do not feel	**Somewhat feel**	**Feel quite a bit**	**Definitely feel**
1. Active	1	2	3	4
2. Energetic	1	2	3	4
3. Vigorous	1	2	3	4
4. Full of pep	1	2	3	4
5. Lively	1	2	3	4
6. Still	1	2	3	4
7. Quiet	1	2	3	4
8. Placid	1	2	3	4
9. Calm	1	2	3	4
10. At rest	1	2	3	4
11. Tense	1	2	3	4
12. Intense	1	2	3	4
13. Clutched up	1	2	3	4
14. Fearful	1	2	3	4
15. Jittery	1	2	3	4
16. Wide-awake	1	2	3	4
17. Wakeful	1	2	3	4
18. Sleepy	1	2	3	4

19. Drowsy	1	2	3	4
20. Tired	1	2	3	4

*Section 5: This scale contains a number of words describing different feelings and emotions. Thinking only about the last **7 days**, please indicate to what extent YOU generally feel this way when YOU engage in physical activity. That is, how you felt on average when you were physically active over the last 7 days.*

	1 *Very slightly or not at all*	**2** *A little*	**3** *Moderately*	**4** *Quite a bit*	**5** *Extremely*
1. Excited					
2. Enthusiastic					
3. Alert					
4. Inspired					
5. Determined					
6. Distressed					
7. Upset					
8. Scared					
9. Nervous					
10. Afraid					

Thank you for completing this questionnaire.

Your time is much appreciated & your information is important to us!

- *Sincerely, the Research Team*

Appendix J

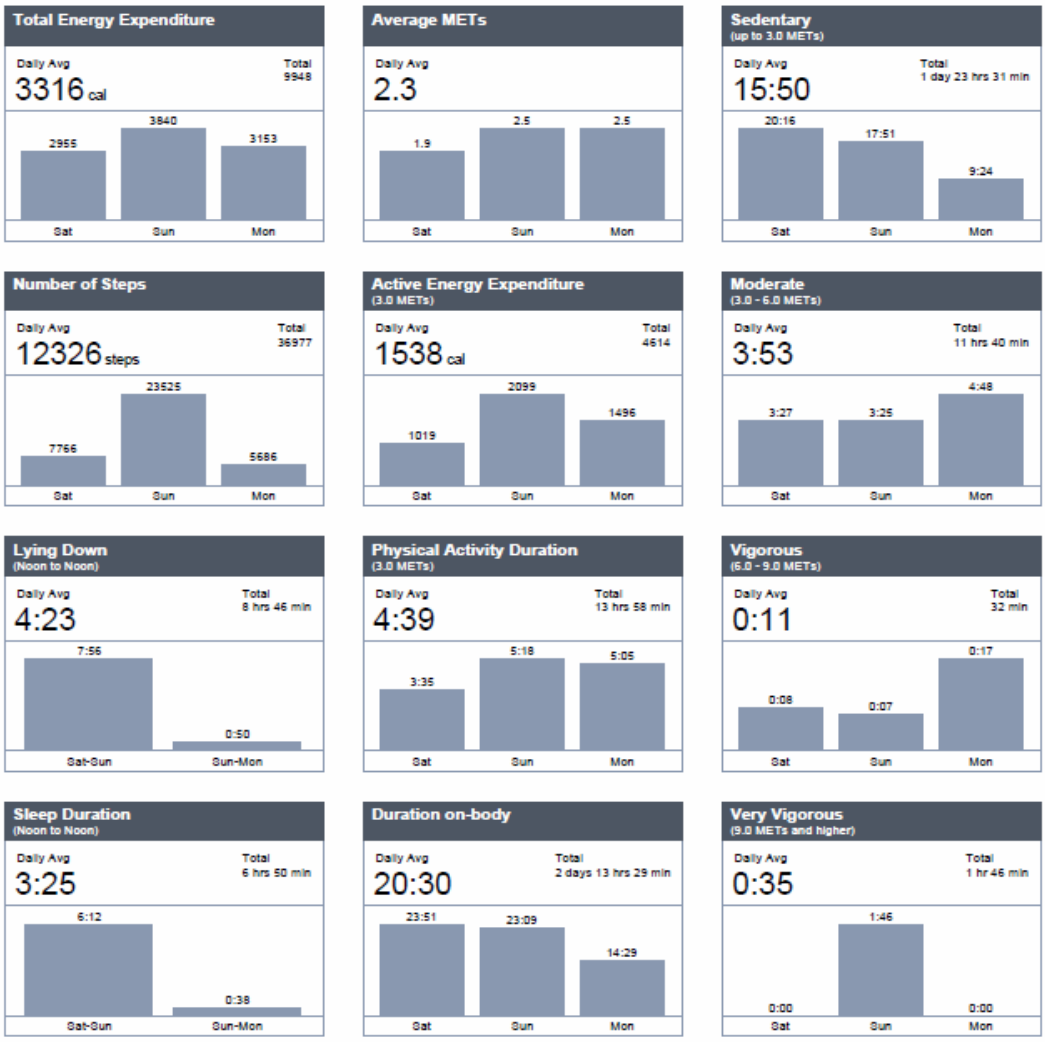
Sample Feedback

SenseWear Report Created Tue Sep 14, 2010 Page 1 of 2 enabled by BODYMEDIA

Clinician / Physician	Hospital / Organization	Practice / Department

Subject	Age	Gender	Weight	Height	Handed	Smoker	BMI
123456	40	Male	145.0 lbs (65.8 kg)	5' 10" (178 cm)	Right	No	20.77

Start Time	End Time	Duration of View	Duration on-body
Sat Jul 3, 2010 12:00 AM	Tue Jul 6, 2010 12:00 AM	3 days	2 days 13 hrs 29 min (85.4%)



The information contained within this report is not to be used for diagnostic purposes.

Appendix K

Perceptions of SenseWear Armband Questionnaire

Section 1: The following questions pertain to how YOU view the instrument as a whole as well as how YOU felt when wearing the SenseWear armband over the past seven days.

Based on your opinion, please rate the following items (from 1 to 5) in regards to using the SenseWear armband device…

Worthless	1	2	3	4	5	Worthwhile
Bad	1	2	3	4	5	Good
Foolish	1	2	3	4	5	Wise
Useless	1	2	3	4	5	Useful
Harmful	1	2	3	4	5	Beneficial
Dull	1	2	3	4	5	Interesting
Aggravating	1	2	3	4	5	Calming
Unpleasant	1	2	3	4	5	Pleasant
Exhausting	1	2	3	4	5	Invigorating
Boring	1	2	3	4	5	Fun
Discouraging	1	2	3	4	5	Motivating

To what extent did wearing the SenseWear armband change your daily physical activities across the last seven days?

1	**2**	**3**	**4**	**5**
Not at all		*Somewhat*		*Extremely*

How practical do you think it is to wear the device all day?

1	**2**	**3**	**4**	**5**
Not at all		*Somewhat*		*Extremely*

Did you know that this device is commercially available? _____ YES _____ NO

How interested would you be in purchasing this device in the future?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

Have you ever used another physical activity monitoring device (i.e., pedometer, accelerometer, fitness apps)?

_____YES _____ NO

If yes, how would you rate this device compared to other physical activity monitoring devices that you have used?

1	2	3	4	5
Very Low		*Moderate*		*Very High*

How embarrassed did you feel with wearing the device?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

How would you rate your confidence level with wearing the device in public?

1	2	3	4	5
Very Low		*Moderate*		*Very High*

Did people notice the device? _____YES _____ NO

Is yes, did they ask you about the device? _____YES _____ NO

Was it well-received by others?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

Did they assume the device measured something other than your physical activity behaviour?

_____ YES _____ NO

Section 2: These next few questions will be based on the SenseWear report you were shown based on your SenseWear data. If you chose not to view your results, you can skip this section.

How worthwhile did you feel it was to find out about your physical activity levels?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

Do you think you will use the feedback to guide future physical activities?

_____ YES _____ NO

More specifically in regards to your SenseWear report…

Did you find the feedback for energy expenditure useful?

_____ YES _____ NO

Were the graphs helpful to aid your understanding of how activity you were?

_____ YES _____ NO

How aware were you regarding your physical activity behaviours prior to your feedback?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

Are you more aware now? _____YES _____ NO

How much did you like having your health monitoring at home rather than in a clinical setting?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

How willing would you be to wear the device long-term?

1	2	3	4	5
Not at all		*Somewhat*		*Extremely*

Section 3: These questions will assess any potential barriers that existed during your experience of using the SenseWear armbands.

Please rate how the following items posed as a barrier to you for future use of the device…

	Not at all	A little	Somewhat	Quite a bit	Extremely
Wearing the device on your arm	1	2	3	4	5
Comfort of the device	1	2	3	4	5
Visibility to others	1	2	3	4	5
The clothing you wore each day	1	2	3	4	5
Charging of the device	1	2	3	4	5
Weight of the device	1	2	3	4	5
Your occupation	1	2	3	4	5

Name activities that you found difficult while wearing the device? (i.e., sleeping, shopping, going on a date, etc.)

_____

_____

_____

_____

Thank you for completing this questionnaire.

Your time is much appreciated and your information is important to us!

- *Sincerely, the Research Team*

Appendix L

Debriefing Form

If you would like to receive a summary of the results of the study please complete the following information.

Please check which results you would like to receive:

_____ I would like to receive a brief summary of my individual results

(including the SenseWear Armband report and results from my questionnaires)

_____ I would like to receive a brief summary of the final results from this study

If you would like to receive the information **by e-mail**:

Name:
_____

E-Mail Address:
_____

If you would like to receive the information **by mail** please provide your name and address:

Name:
_____
(First Name) (Last Name)

Address:
_____
(Street Number) (Street)

_____
(City) (Province) (Postal Code)