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Methodological Challenges in Physical Activity Research with Older Adults

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Abstract

The aging adult population is growing, as well as the incidence of chronic illness among older adults. Physical activity has been demonstrated in the literature to be a beneficial component of self-management for chronic illnesses commonly found in the older adult population. Health sciences research seeks to develop new knowledge, practices, and policies that may benefit older adults' management of chronic illness and quality of life. However, research with the older adult population, though beneficial, includes potential methodological challenges specific to this age group. This article discusses common methodological issues in research among older adults, with a focus on physical activity intervention studies. Awareness and understanding of these issues may facilitate future development of research studies devoted to the aging adult population, through appropriate modification and tailoring of sampling techniques, intervention development, and data measures and collection.

Keywords

older adult; elderly; physical activity; methods

Introduction

The baby boomers, those individuals born between 1946 to 1964, are a rapidly growing population (American Hospital Association, 2007). In 2009, approximately 12.8% or 1 in 8 Americans, were age 65 and over (Administration on Aging, 2009). A 36% increase in this population is expected from the year 2010 to 2020 (Administration on Aging, 2009). Furthermore, it is estimated that by 2030, more than 70 million Americans will be over the age of 65 (American Hospital Association, 2007). Within this population, gender proportions are changing and racial and ethnic diversity are growing. Older adult women currently outnumber their male counterparts (Administration on Aging, 2009; He, Sengupta, Velkoff, & DeBarros, 2005). In 2003, 83% of the older population were non-Hispanic whites; however, this number is expected to drop to about 72% by 2030, with Black, Asian, and Hispanic populations steadily growing in numbers (He, et al., 2005). In terms of residency demographics, for those not living in the community setting, nursing homes provide 90% of most institutional living situations (He, et al., 2005). Of those living within

the community, approximately 31% live independently, with women outnumbering men in this category (Administration on Aging, 2009).

Older Adults and Chronic Illness

Along with increased life expectancy comes increase prevalence of chronic diseases. Approximately 80% of Americans age 65 and older report at least one chronic health condition, and 50% report at least two (American Hospital Association, 2007; He, et al., 2005). The most common chronic illnesses include hypertension, arthritis, cardiovascular disease, cancer, and diabetes (Administration on Aging, 2009; American Hospital Association, 2007). As a result, aging adults will require increased health care services, which will subsequently increase health care costs (American Hospital Association, 2007). However, the dilemma arises of how to best provide adequate, ethical, and accessible health care to the nation's growing geriatric population. Health sciences research with older adults can address this dilemma with the goal of improving health related quality of life and adaption to chronic illness.

Conducting Research with Older Adults

Research with older adults carries its own methodological challenges tied to distinct aspects of the older adult population, such as age-related changes, generational and social influences, and the potential for multiple, interacting co-morbidities (La Rue & Markee, 1995; Laird & Conn, 1996). These methodological issues can pervade several aspects of a research study, from study design to sampling criteria and data collection (Hall, Longhurst, & Higginson, 2009; Hancock, Chenoweth, & Chang, 2003; Jackson, et al., 2009; La Rue & Markee, 1995; Levy, Holmes, & Smith, 2003). Along with these considerations, research with older adults should strive to be diverse, culturally sensitive, and ethical. Furthermore, researchers must maintain the safety and integrity of its subjects, who are also the intended beneficiaries of new research knowledge (Jackson, et al., 2009). Thus, in order to conduct age-appropriate research, it is important for researchers to understand some common methodological issues in studying the older adult population.

Physical Activity Intervention Research among Older Adults

Physical activity (PA) research is especially important for older adults given the prevalence of inactivity related chronic conditions in this population, such as hypertension, cardiovascular disease, and diabetes mellitus. Physical activity intervention studies may seek to evaluate PA behavior changes after implementation of a controlled intervention, such as self-monitoring, or attending exercise counseling sessions. Other PA studies may evaluate health and well-being changes following PA interventions. Methodological issues related to the older adult population pose several challenges in creating and conducting safe, valid, and generalizable PA behavior research. The purpose of this article is to review the relevant literature regarding common methodological issues in PA intervention research with older adults and to propose suggestions for managing these challenges in future studies.

Methodological Issues

Sampling

Obtaining a representative sample is essential to the generalization and application of study findings. Researchers must determine where they will find an adequate sample meeting the predetermined inclusion and exclusion criteria for their studies. However, given the unique aspects of demographics, generational and social influences, and health characteristics of the older adult population, this can be a difficult task. Table 1 summarizes common factors contributing to sampling challenges with older adult subjects.

Inclusion and Exclusion Criteria—Inclusion and exclusion criteria are important to determining appropriate subjects and minimizing confounding factors, bias, and systematic errors. Researchers often prefer highly homogenous samples. However, strict inclusion and exclusion criteria may whittle down a potential sample and contribute to extended subject recruitment periods. Researchers will need to consider the higher incidence of co-morbidities, ethnic diversity, and possible gender biases in developing their specific criteria (Herrmann, 2004). Co-morbidities may contribute to health status and potential treatment interactions, and may need to be limited in order to reduce systematic error or potential dropout within a study. Cognitive and functional status should be considered, as these characteristics will affect older subjects' abilities to consent to and complete study protocols. Inclusion of commonly underrepresented populations, such as minorities and those in a lower socio-economic status, increases the generalizability of study findings to a diverse population.

Locating Sample Populations—Samples may be obtained from institutions such as nursing homes and hospitals, or from within the community; however, each specific environment has its advantages and disadvantages (Chouliara, Kearney, Worth, & Stott, 2004; Hall et al., 2009; Hancock et al., 2003; La Rue & Markee, 1995). For example, researchers may be able to conveniently recruit subjects from a nursing home population. Less attrition, controlling for environmental variability, and ease of monitoring are favorable attributes of these samples; however, nursing home residents are generally not representative of a community population of older adults (La Rue & Markee, 1995). Involvement of staff at hospitals and nursing home institutions may be necessary to facilitate detection of potential older adult subjects and to maintain study protocols (Berkman, Leipzig, Greenberg, & Inouye, 2001; Hancock et al., 2003; Tsai et al., 2009). Staff will need to be trained to study protocols and must be willing to participate in order for the study to proceed. This presents a challenge to researchers who must also consider the comprehension and motivation of staff, as well as the potential for error introduction as a result of staff involvement.

Community dwelling older adults provide a good sample of the general older adult population. Researchers can seek out potential subjects from naturally occurring community groups such as church organizations or volunteer groups. Older adult subjects may also be recruited from other commonly attended community sites, such as ambulatory clinic settings and senior centers. Recruitment via flyers, brochures, open forums, and presentations within familiar locations such as a community center, gym, or a communal lobby in a senior living

environment, may boost potential community-dwelling subjects' interest in a study (Jackson, et al., 2009).

Community dwelling, but homebound older adult subjects are an especially important population due to their functional limitations, yet they present some unique sampling challenges. Research bias from exposure to the subjects' environment threaten objectivity within a quantitative study design (Locher, Bronstein, Robinson, Williams, & Ritchie, 2006). Being embedded within a subject's natural environment introduces personal aspects of the individual's living situation, which may evoke subjective responses from the research team. For example, witnessing evidence of possible elder abuse conditions raises ethical concerns regarding reporting for researchers. Thus, the complexities of recruiting or conducting studies in these naturally occurring settings may cause research teams to become susceptible to therapeutic misconception and research role conflict, confusing their roles as researchers versus health care providers to the detriment of project goals (Locher, et al., 2006).

Given the diverse demography within the current older adult population, researchers have the opportunity to explore a variety of older adult subpopulations through diverse sampling strategies. However, recruiting subjects from various locations will result in more heterogeneous samples. Therefore, during data analysis, researchers will need to evaluate samples for the presence of systematic error resulting from this heterogeneity.

Obtaining Informed Consent—Once an adequate potential sample is found, the issue of informed consent in the older adult population may present complications. The Belmont Report (1979) identifies three components to adequate informed consent: information, comprehension, and voluntariness. Researchers will need to ensure that their subjects are presented information regarding risks, benefits, protocols, and alternative procedures. Furthermore, subjects will have to confirm their understanding of the information presented and agree to willingly participate in a research study.

As a result of age-related changes or co-morbidities, older adults may have some cognitive and/or functional deficits impairing competency and the decision making process (Chouliara, et al., 2004; Hall, et al., 2009; Laird & Conn, 1996). Thus an assessment of subjects' decisional capacity may be required prior to completing the informed consent process. A review of the literature surrounding consent of older adults with cognitive limitations suggests using instruments such as, the Mini-Mental Status Exam (MMSE) or the MacArthur Competence Assessment tool for Clinical Research to determine the decisional capacity of an older adult with mild to moderate cognitive impairment (Black et al., 2008; Jefferson et al., 2008; Kahn, Bourgeois, Klein, & Iosif, 2009; Rubright et al., 2010). Furthermore, adding a clinical assessment component can improve prediction of decisional capacity among adults with cognitive disorders (Kahn et al., 2009). Consent forms with clear, concise information presented in large text may facilitate subject comprehension. Extensive and repetitive communication with the potential subject regarding study purpose and protocols may be necessary to ensure promote understanding of risks, benefits, and study procedures. Power of attorney laws and proxies or surrogates may entail researchers to review research protocols not only with the subject, but also with family members.

Hospitalized and institutionalized older adult subjects are exposed to potential iatrogenic processes and may experience psychosocial complications, such as confusion and delirium, affecting the patient's ability to appropriately consent to a study (Hancock, et al., 2003). In a study involving hospitalized, older adult, cancer patients, Chouliara and colleagues (2004) described high levels of fatigue, susceptibility to clinical depression and psychological distress, and high levels of co-morbidity and polypharmacy as contributors to ethical challenges regarding the patient's ability to consent to a study. Therefore, along with the prior mentioned, age-appropriate consent forms and communication styles, researchers may need repetitive visits and involvement of family and social support systems in order to ensure informed consent from this population (Berkman et al., 2001; Chouliara et al., 2004).

Researchers must also follow legal protocols for obtaining consent if the subject is unable to do so on her own, as in the case of an older individual with severe cognitive impairment. Surrogate consent may assist researchers in obtaining access to a population with high incidences and varying degrees of cognitive impairment (Flaherty et al., 2008; Kim et al., 2009). A national survey of older Americans demonstrated support for family surrogate-consent research on dementia (Kim et al., 2009). Moreover, Flaherty et al. (2008) discussed the importance of surrogate consent in promoting timely, ground-breaking research findings, as in the current use of thrombolytics in acute ischemic stroke care. Thus, given the impact of surrogate consent on research among older adults, researchers should remain open to the opportunity and complexity of obtaining consent from those individuals consenting for a cognitively impaired older subject. Researchers should, nevertheless, maintain high ethical standards when obtaining consent through a surrogate by thoroughly discussing the risks and benefits of research, and instructing the surrogate or proxy to act upon a subject's previous wishes and to make decisions on the basis of the subject's best interests (Karlawish, 2003).

Interpersonal and intrapersonal factors may contribute to issues with informed consent in the older adult population. Family concerns regarding the welfare of a subject may affect the participant's interest or ability to be part of a study (Tai, Gould, & Iliffe, 1997). Perceptions and trust of research benefits and utilization may further affect older adults' willingness to consent to a study (Jackson, et al., 2009; Ross, et al., 2005). The current older adult population has seen many ethical violations in science. The Tuskegee syphilis trials and Nazi medical experiments are significant examples of inappropriate experimentation on vulnerable populations witnessed during their generation. Moreover, many older adults are aware of modern day ploys preying on older adults' finances and personal information. Clear, concise descriptions and presentations, focusing on the purpose of a research study as it relates to benefiting the older adult population can promote interest, participation, and retention of older adult subjects (Jackson, et al., 2009; Ross, et al., 2005; Tai, et al., 1997). In addition, involvement of older adult community leaders and a visible, positive interaction between the research team and important social support contributors, such as family members or senior community centers' staff, can enhance participants' trust of the research (Jackson, et al., 2009).

Attrition—Loss of participants can decrease the statistical power of a study and reduce generalizability when attrition is non-random. The older adult population may be prone to higher rates of attrition for unique reasons. Subject motivation may be affected by fatigue,

co-morbidities, and medical therapy. Older adults may have higher hospitalization and mortality rates, and frequent changes to medical therapy that may conflict with study protocols. For example, persistent pain from chronic arthritis, heart failure exacerbation resulting in hospitalization, or complications from worsening anxiety and depression may cause a subject to drop out of or be excluded from a study. Older adults may also rely on family or other social support services for transportation, which may compromise their ability to follow study procedures. Especially in the frail older adult population, inability to maintain these protocols contributes to missing data and selective attrition from loss to follow up or respondent burden (Chouliara, et al., 2004).

One strategy for counteracting subject dropout would be to consider the length of a study design. The selection of a cross-sectional versus a longitudinal design may decrease attrition and maintain statistical power, but inhibits a researcher's ability to determine long-term causal relationships (La Rue & Markee, 1995; Laird & Conn, 1996). Another possibility to reduce attrition would be to obtain subjects from a cohesive community setting, such as a church group, in which members participate together, motivating each other to complete the study. Additionally, oversampling can ensure adequate statistical power at study completion in spite of attrition.

Sampling Issues in Physical Activity Research—Table 2 summarizes methodological issues related to sampling in PA intervention research with older adults. Specific to PA research, sampling can present some further obstacles that may be difficult to manage, but that are not completely prohibitive. For example, fear of risk of injury or exacerbation of other medical conditions accompanying PA or a study intervention may be issues for potential subjects (Tai, et al., 1997). Therefore, many potential older adult subjects will need clearance and reassurance from a medical provider to participate in PA intervention research. This process could result in possible delayed recruitment or elimination of potential subjects. Older adults may not perceive the benefits of PA behavior or attribute low levels of PA to aging (Sarkisian, Prohaska, Wong, Hirsch, and Mangione, 2005); thus, participating and remaining in a PA intervention study may not be a priority for them. Special attention to participants' concerns and detailed explanations of study protocols during the informed consent process could help to alleviate apprehension, distrust, and could reduce attrition.

Chronic illness and co-morbidities complicate sampling for PA studies due to the potential risks of PA behavior. For example, individuals with severe heart disease, such as New York Heart Association Class IV heart failure, uncontrolled hypertension, and brittle diabetes mellitus would likely be excluded from PA intervention studies. Higher rates of hospitalization and disability among older adults with chronic illnesses and multiple co-morbidities may lead to increased subject attrition from inability to complete PA behaviors (Administration on Aging, 2009; American Hospital Association, 2007; Anderson, 2007).

The presence of co-morbidities may also deter older adults from participating in PA intervention studies. For example, arthritis is a common chronic illness among older adults (Administration on Aging, 2009; American Hospital Association, 2007). Despite the known benefits of PA among older adults with arthritis, this population is more likely to be

physically inactive (Shih, Hootman, Kruger, & Helmick, 2006). Furthermore, common reasons for physical inactivity in this population are related to social support, physical limitation, and pain (Rosemann, Keuhlein, Laux, & Szescenyi, 2007; Rosemann, Keuhlein, Laux, & Szescenyi, 2008). To approach this subpopulation of older adults, researchers may consider tailoring PA interventions to include an educational component describing the benefits of PA in relieving arthritis-related pain. Furthermore, a gradual progression of PA intensity or involvement of social support mechanisms may make the study more appealing and feasible for this subpopulation.

Inclusion and exclusion criteria common among PA intervention studies involve controlling for the presence of multiple co-morbidities, level of mobility, demographic location, cognition, or language barriers. However, these criteria may result in samples lacking in participants from commonly underrepresented groups among the older adult population, such as minorities, frail older adults, and those of a lower socioeconomic status. Researchers conducting PA intervention studies will need to carefully select eligibility criteria to obtain a controlled, but representative sample of older adults.

Potential subjects deemed admissible to a PA intervention study will need further evaluation regarding their ability to engage in PA behavior. Most current, PA clearance questionnaires, such as the PAR-Q, are not appropriate for the chronically ill and old older adult population. However, Warburton, Jamnik, Bredin, and Gledhill (2010) have announced the impending release of updated PAR-Q and PARmed-X screening tools, which would have greater applicability to older, chronically ill populations. In addition, medical clearance should be obtained for most chronically ill older adult subjects prior to their engagement in PA.

Attrition rates among older adult subjects will challenge researchers' abilities to manage data and report valid findings in PA intervention studies. For example, Brawley et al. (2009) noted that attrition rates increased as data collection points progressed from three to nine months, resulting in difficulty analyzing long-term effects of PA interventions. To address this issue, researchers could include partial data from a subject, clearly reporting the subject's exclusion from more distal data points. Those subjects unable to complete the intervention, or who have several missing data, may have to be completely excluded from analysis. Using intention-to-treat analysis is a potential strategy to preserve randomization of study groups and to reduce attrition-related bias in a PA intervention study (Sainani, 2010). However, intention-to-treat requires that outcome data is available for all subjects included in the study, which may not be possible in those subjects loss to follow up. Researchers may also consider using a combination of both intention-to-treat analysis and an analysis of those subjects who have successfully completed the study. This combination could strengthen potential positive findings of a study or help determine the presence of bias based on attrition. To further assess bias related to high attrition rates, researchers should perform statistical analyses to determine homogeneity of variance among remaining subjects and those subjects lost to attrition (Allison & Keller, 2004). Researchers should also employ oversampling strategies to ensure more than enough subjects are included in a study to maintain statistical power.

Researchers may improve attrition rates among older adults participating in PA intervention studies by considering the intensity and duration of interventions and follow up. Several recent PA intervention studies employed a gradual increase in the PA behavior of subjects as part of an intervention, which may improve subject compliance, safety, and comfort (Baker et al., 2007; Opdenacker, Boen, Coorevits, & Delecluse, 2008; Rejeski et al., 2009). Recent longitudinal studies have also demonstrated that follow ups ranging from nine to 24 months may result in attrition rates of 10 to 25 percent (Brawley, Rejeski, & Lutes, 2009; Greaney et al., 2008; Morey et al., 2009; Rejeski et al., 2009). However, studies involving shorter follow up times, such as three to six months, had attrition rates of one to 17 percent (Baker et al., 2007; Conn, Burks, Minor, & Mehr; Kelley & Abraham, 2004). Thus researchers must balance the ability to retain subjects with the need for data addressing long-term effectiveness of PA interventions among older adults.

Development of Physical Activity Interventions

Development of interventions in a PA study among older adults should account for age-related issues, co-morbidities, and potential subject compliance to study protocols. Table 3 summarizes the challenges of and recommendations for developing PA interventions for this population. Older adults may have functional deficits, such as vision and auditory impairments, which would entail modifying intervention instructions. Altered mobility or co-morbidities, such as heart disease or chronic arthritis, may limit the intensity and frequency of PA that a subject could achieve. Complex intervention components or frequency of intervention delivery requiring multiple visits can deter an older adult subject from remaining compliant to study protocols.

Researchers may consider delivery of their intervention using a face-to-face technique, allowing for participant questions to clarify understanding of the intervention study protocols. These interactions need to occur in settings without distractions or background noise for subjects with hearing deficits. Written materials must be developed at an appropriate reading level using large font printed on surfaces without glare. Frequent intervention delivery methods could incorporate distance-oriented options, such as telephone calls, mailings, or even email or text messaging to reduce travel burden for older adults subjects. Furthermore, discussion of activity levels appropriate for older adults and demonstrations of PA examples could be incorporated into an intervention, so that subjects may understand what constitutes as valid forms of PA for the study. Given evidence that some older adults have scant experience with and poor understanding of deliberate PA for health benefits, (Conn, Minor, Burks, Rantz, & Pomeroy, 2003; Sarkisian et al., 2005) researchers may need to provide more information about PA definitions than might be necessary for younger subjects.

Special regards to subject safety are imperative in PA intervention research. Gradual increases in PA intensity, duration, and frequency may be necessary for sedentary older adults with significant health problems. Very specific information about PA strategies to avoid falls or prevent cardiac symptoms may be required for subjects at high risk for these potential complications based on their existing functional status and health conditions. Adapted PA programs for elderly subjects who use assistive devices may also be necessary.

Furthermore, information about co-morbidities, such as strategies to manage arthritis discomfort while increasing PA, may be needed. Researchers should establish clear protocols regarding the management of adverse events in PA studies with older adults. These protocols may include maintaining contact with subjects' providers, documenting and reporting adverse events, and devising a plan for providing acute medical attention to subjects. Safety protocols should be disseminated among project staff, as well as presented as safety precautions to potential subjects.

Data Measures and Collection

Data collection in a sample of older adults presents an interesting set of methodological challenges based on normal developmental characteristics, influences of chronic illness or co-morbidities, and each subject's personal experiences. These factors may affect attrition and compliance. Moreover, accuracy and completeness of obtained data may be compromised due to these issues. Table 1 summarizes common factors contributing to data measures and collection with older adult subjects.

General data measures and collection issues—Older adults may experience some cognitive or functional deficits as a part of normal developmental changes, such as memory deficits, diminished vision and hearing acuity, increased reaction time, and fatigue (Charness, 2008). Age related memory deficits may decrease the accuracy of recall (Levy, et al., 2003). Corser et al. (2008) found that increased age was associated with poorer levels of concordance between patient-reported co-morbidity data and medical record documentation. Thus, frequent verbal or written follow up and prompting may be necessary during the extent of a study. Any written materials provided for subjects should be presented concisely and in large print in order to increase participant understanding of instructions, study aims, and protocols (Laird & Conn, 1996; Nahm, et al., 2009). Furthermore, options for alternative forms of communication and information delivery, such as oral and visual demonstrations, should be considered if literacy levels of older adult subjects preclude written materials.

Advancement of technology has allowed researchers to utilize novel methods of data collection and instrumentation. For example, websites providing PA self-monitoring programs, email prompting alerts, and internet-based social networking sites are available for researchers to incorporate in studies. However, using computer-based technology should be approached with caution in older adult research subjects due to decreased familiarity and comfort with newer technology. For example, Nahm et al. (2009) suggest a combination of communication techniques when utilizing an internet-based research design. Telephone contact, technical support, and developing web-based resources that are easy to navigate and in large fonts may facilitate subject compliance with study protocols and decrease attrition in these types of studies (Nahm, et al., 2009).

Data measurement and collection issues in Physical Activity Research—Table 2 summarizes methodological issues related to data measurement and collection in PA intervention research with older adults. Selecting the best data collection methods and instruments is essential to the validity of a PA intervention study design. Objective measures provide strong empirical data of PA behavior among older adult subjects. For example, the

construct validity and reliability of pedometers in measuring PA behavior has been well documented (Colbert, Matthews, Havighurts, Kim, & Schoeller, 2011; Ewald, McAvoy, & Attia, 2010; Harris et al., 2009; Kim & Lee, 2010). Given the low cost, availability, and facility of pedometers, researchers working with older adults may opt to use this objective measurement. In a comparison study of accuracy among three pedometers, Le Masurier, Lee, and Tudor-Locke (2004) found the Yamax SW-200 (Yamax Corporation, Tokyo, Japan) to be the more consistently accurate device. However, the accuracy of any pedometer data may be compromised in cases of obesity, slower walking speeds, and gait disturbances, all of which may be present among older adults (Grant, Dall, Mitchell, & Granat, 2008; Le Masurier et al., 2004; Tudor-Locke & Myers, 2001).

Piezoelectric pedometers, or accelerometers, more accurately capture slower walking tempos, PA intensity, and time spent in various levels of PA (Grant et al., 2008; Le Masurier, 2004). Tri-axial models, such as the RT3-Triaxial Research Tracker (Stayhealthy Inc., Monrovia, California) and the GT3X Actigraph (Actigraph LLC, Pensacola, Florida), are better able to reflect lighter intensity PA compared to uni-axial devices (Westerterp, 1999). Furthermore, newer accelerometers have more durable designs and increased accuracy for measuring sedentary activities common among older adults (Murphy, 2009).

Familiarity, comfort, and comprehension of the use of this technology in research instrumentation may affect the voluntary or involuntary compliance and motivation of an older research subject. Subjects may be required to independently record data using tools such as a pedometer or accelerometer. However, chronic arthritis affecting the upper extremities and hands can affect an older subject's ability to manipulate small instruments; and poor vision could lead to incorrect self-reporting of instrument data. Accuracy of data collected from these instruments depends on calibration and consistent placement of the device on the body (Garatachea, Torres Luque, & Gonzalez Gallego, 2010; Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002). Gait disturbances, such as those accompanying chronic pain, arthritic complications, or residual stroke effects may compromise data precision (Rikli, 2000).

Instruments to record PA behavior are constantly being updated and improved for increased accuracy and ease of use. Thus researchers should carefully examine several possible models prior to selecting the device. For example, in terms of durability, accelerometers with newer integrated circuit chip technology are more durable than those with a cantilever mechanism (Garatachea et al, 2010; Murphy, 2009). To further improve accuracy of these instruments' recording, researchers could provide detailed education and instructions, prompting, an activity log, and demonstrations of instrument use (Garatachea et al., 2010).

Objective measures may also include physical or clinical data. These data, such as blood sampling, radiological or physical exams, and stress testing, are useful to assess physiologic and health related outcomes from a study intervention. Researchers utilizing these instruments should consider the subject's availability, travel needs, and comfort. Moreover, ensuring participant safety related to functional testing, such as aerobic capacity testing, exercise stress testing, and the six-minute walk test, should be a high priority for researchers, as these measures carry risk of physical injury to the subject. Furthermore, values obtained

from these tests may be influenced by co-morbidities or prescribed medications. Interpretation of these clinical data is thus more complicated among older subjects than among younger subjects without significant health problems.

Subjective data related to PA behavior can be collected from different sources, each with their own pitfalls. For example, activity logs are commonly used in PA intervention research as a means of documenting activity and responses to activity. However, lack of motivation for logging activity and poor recall may affect consistency of data (Rikli, 2000).

Physical activity questionnaires (PAQ) are useful means of obtaining frequency, intensity, and duration of physical activity; however, Washburn (2000) suggests that few are age appropriate for older adults. The questionnaires may lack incorporation of measures for daily activity levels, light to moderate physical activity, or even activities such as volunteering. Many existing PAQs contain age-inappropriate items such as those addressing PA during paid employment or childcare PA. Therefore, researchers should choose PAQs developed specifically for older adults, such as the Physical Activity Scale for the Elderly (PASE), Yale Physical Activity Survey (YPAS), and the Community Health Activities Model Program for Seniors (CHAMPS). Harada, Chiu, King, and Stewart (2001) found good correlation of all three PAQs with performance-based data from the Short Form-36 Health Survey and Mini-Logger activity data among adults age 65 and older ($r = 0.44-0.68$) (Harada et al., 2001). The researchers noted higher correlation scores among men, subjects living in retirement homes, and young-older adult subjects, indicating better instrument performance for different subpopulations of older adults (Harada, et al., 2001). The PASE, CHAMPS, and YPAS questionnaires have also demonstrated adequate construct validity among culturally diverse older adults (Moore et al., 2008). In terms of types of PA measured, Resnick, King, Riebe, and Ory (2008) reported that CHAMPS may better reflect moderate-intensity PA, whereas YPAS may better capture overall PA. Thus, in selecting a PAQ, researchers should consider potential subpopulations of older adults, intensity of target PA behavior, and demonstrated validity and reliability of instruments.

Administering PAQs pose an additional issue for researchers. Definitions or clarifications of PA and PA intensity may be necessary since some older adults may interpret some social activities with limited body movement as PA. In studies requiring questionnaires as instruments, Washburn (2000), Rikli (2000) and Herrmann (2004) suggest that telephone or in-person interview, though time consuming, can improve participant comprehension and compliance.

In addition to measuring PA behavior and health outcomes in PA studies, researchers will need to measure potential confounding variables. For example, baseline functional status may strongly influence PA behavior following interventions. Accurate functional status measurement and adequate sample size to include functional status in statistical analyses may be essential to fully assess the impact of interventions. Other attributes of subjects, such as co-morbidities, may need similar management to provide valid interpretation of findings.

Data collection and measurement in PA intervention studies with older adults is a complex methodological issue. Single instruments may fail to fully capture critical and accurate data

due to participants' age-related functional changes, co-morbidities, or comfort. Therefore, a combination of instruments may best capture the most data from an objective and subjective standpoint.

Conclusion

The growth and diversity of the older adult population within the U.S. presents a unique opportunity for researchers to further knowledge across the lifespan. Research in the older adult population is necessary to improve efficiency and quality of care for older adults with chronic diseases. However, studying this population may be difficult secondary to methodological issues as described in this paper. Similar to conducting studies with a younger population, researchers may find challenges at any point in a study, from obtaining and retaining a sample representative of the population of interest, to data collection. However, the older adult population may also present distinct challenges that are generation-specific, such as comfort with technology, or age-specific, such as functional hearing or visual deficits. Furthermore, the high rates of chronic illness and co-morbidities in this population may pose problems in the areas of recruitment and retention of subjects, informed consent, and compliance with study protocols. Nevertheless, the need for informative and ethical research for this population remains.

Some specific methodological challenges pertain to PA intervention research in the older adult. The researcher should select an age-appropriate intervention, with consideration for subject safety through careful screening. Issues involving sampling may include sample inclusion and exclusion criteria, obtaining medical clearance prior to engagement in physical activity, and low PA participation interest due to other factors such as co-morbidities, poor perceived benefits from PA, and psychological distress. Issues concerning data collection and instrumentation may include subject familiarity with technology, age or disease related cognitive deficits that affect recall, and motivation to maintain study protocols. An understanding and anticipation of these potential methodological challenges, and adaption of research methods to include generation-specific, culturally sensitive, and age-adapted protocols are essential to future research in the older adult population. The enormous potential health and well-being benefits gained from adequate PA justify extensive future research with this population.

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Table 1**Factors Contributing to Methodological Challenges in Research with Older Adult Subjects**

Sampling Challenges	Restrictive inclusion criteria (e.g., functional status, co-morbidities) may hinder recruitment Difficulty locating homogenous sample populations Involvement of members outside of research team for potential subjects in nursing home or hospital settings Difficulty finding subjects from community settings Challenges obtaining informed consent due to legal, ethical, or health-related issues Potential mistrust of research activities among some potential subjects Potential difficulty securing family support for participation Increased attrition due to frailty, co-morbidities, poor understanding and compliance to study protocols
Data Measures or Collection Challenges	Decreased functional status affecting hearing, vision, memory recall, and increased response time Decreased familiarity with technology used for data collection Increased attrition due to frailty, co-morbidities, poor understanding and compliance to study protocols

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Table 2

Specific Methodological Challenges to Physical Activity Intervention Research with Older Adult Subjects

Sampling Issues	Fear of risk of injury from physical activity
	Fear of exacerbation of prior medical conditions
	Attribution of low levels of physical activity to aging
	Poor perceived benefits versus risks of physical activity
	Need for prior medical clearance to participate in physical activity
Data Measures and Collection	Unfamiliarity with technology such as pedometers or accelerometers
	Functional status or co-morbidities affecting ability to calibrate or work with measurement instruments
	Lack of motivation for maintaining activity logs
	Availability of age-appropriate physical activity questionnaire (e.g., PASE, YPAS, CHAMPS)
	Inability to maintain study protocols due to lack of transportation, hospitalization, fatigue, compliance

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Table 3**Challenges and Recommendations in Developing Interventions in Physical Activity Research with Older Adults**

Challenge	Recommendation
Risk of injury or pain from physical activity (e.g., falls)	Gradual progression of physical activity; verbal and written explanation of activities, age-specific modifications to activities, and ways to avoid falls and injuries; develop and disseminate study protocol on addressing adverse events due to PA behavior
Exacerbation of prior medical condition or co-morbidities	Assessment of readiness to participate in PA behavior (e.g., updated PAR-Q and PARmed-X, when available); medical clearance prior to participation in study; adapt physical activity programs for those with assistive devices; discuss strategies to manage co-morbid conditions while participating in physical activity
Potential for poor understanding of definition of physical activity and levels of physical activity intensity	Face-to-face verbal and large-print, written presentation of definitions of physical activity
Potential for poor compliance to study protocols requiring multiple visits for intervention delivery	Provide home-based intervention components; involvement of social support mechanisms (e.g., family members, local community centers); consider alternative, distance-oriented delivery methods, such as telephone or mail delivery, or text messaging or emailing
Potential for incomplete or inaccurate data collection via subjective and objective instrumentation	Use of age-specific physical activity questionnaires; detailed instruction and modeling of technology such as pedometers or accelerometers; use of combinations of data collecting techniques (e.g., use of questionnaire, activity log, and pedometer data)