***Annual Physical Therapy Examination for Community-Dwelling Older Adults***

The older adult population in the United States is growing at an exponential rate, with projections estimating that by 2050 more than 80 million adults over the age of 65 will be living in the United States1. Data also suggests that these older adults are living longer, with life expectancies having risen in adults aged 65 and 85 over the last 40 years1. However, although Americans are living longer, they are not necessarily living healthier into their old age. Evidence shows that about two-thirds of Medicare beneficiaries over the age of 65 suffer from multiple chronic diseases, with that percentage increasing with age2. Furthermore, older adults are less likely to engage in regular physical activity, practice sound nutritional habits, and are more likely to suffer from depression compared with younger populations3-5.

Annual physical therapy (PT) visits have been proposed as a proactive healthcare solution with the hopes of decreasing the impact of chronic diseases, increasing functional capabilities, and improving quality of life in Americans6. As Dean et al. explain, physical therapists are uniquely equipped to assess, educate about, and treat many of the primary and secondary factors that contribute towards the development of chronic diseases, compound the negative effects of chronic diseases, and contribute towards decreased quality of life7. The following proposed annual PT examination highlights many of the primary areas of concern in the community-dwelling older adult population, identifies specific subjective and objective tests to screen these areas, and recommends several resources or referral sources appropriate for follow-up. A suggested order for the recommended components of the exam can be found in Table 1 Appendix A. Examples of proposed questionnaires can be found in Appendix B.

*Subjective Exam*

Because nutrition can play a large role in the aggregation or lack thereof of body fat in an individual, it is an important area for the therapist to address. *The Mini-Nutritional Assessment-Short Form (MNA-SF)* has been shown to be a “valid and sensitive rapid nutrition screen instrument” in older adults8. This short six-item questionnaire can be used during the annual PT exam to support the need for follow-up and in-depth nutritional assessment in community-dwelling older adults who may be malnourished 4,9. A score of ≤ 11 indicates the need for follow-up 4,9.

 Depression in older adults has been associated with fatigue, irritability, eating disorders, suicide, decreased activity and “is the most prevalent mental health problem among older adults” 5,10. The Patient Health Questionaire-2 (PHQ-2) is a two-item screening tool that can be used to evaluate for evidence of major depression11. Kroenke et al. found that this screen had a very high sensitivity and specificity for major depression, and established a cut-off score of ≥ 311. Using this tool, the therapist can quickly assess for presence of depressive symptoms, and determine if follow-up is needed.

 Smoking has been shown to increase the risk for a variety of disease conditions including cardiovascular disease (CVD), all-cause cancer, obstructive lung disease, and osteoporosis7. And although smoking rates for older adults are the lowest amongst all age groups, smoking into old age is related to increased incidence of disease and mortality 12,13. Further, Burns found that older adults who attempt to quit are more likely to be successful than their younger counterparts13. A series of short screening questions can be located in Table 2 Appendix A, that can be used by physical therapists to assess for tobacco use. Smoking or tobacco use of any kind is reason for follow-up.

*Objective Exam*

Body Mass Index (BMI) can be used by the therapist as a screen to estimate body fatness, and results from the BMI calculation can be used to project potential risk for development of chronic diseases and conditions 14. For example, Obesity has been linked to increased risk for CVD, certain cancers, stroke, diabetes, and decreased quality of life 7,14. Being underweight has been associated with osteoporosis and malnutrition in older adults15. Although not diagnostic, determination of a patient’s BMI outside the normal category would signal a clinician to follow-up in this area. These categories include Underweight (<18.5), Normal weight (18.5-24.9), Overweight (25-29.9), and Obese (>30) 14.

 Functional pain-free range of motion (ROM) is an essential component involved with the healthy participation of community-dwelling older adults in activities of daily living, exercise, and other lifestyle functions. And while decrements in this ROM can be expected with advancing age, these changes should not significantly impact daily function or contribute significantly to disability 16,17. However, both poor body mechanics and injuries can contribute to the typical intra-articular degeneration associated with development of osteoarthritis (OA) 18. OA is “the most common cause of chronic disability in older adults” and can lead to significant morbidity and premature death 7,18. Assessment of older adult ROM and body mechanics with functional tasks can thus be used to screen for these contributors, the presence of OA, or another musculoskeletal disorder. A list of the specific functional task assessments recommended, as described and displayed in *Chapter 4: Body Mechanics* of *Principles and Techniques of Patient Care*, can be found in Table 3 Appendix A19. While minor variations in movement mechanics and ROM can be expected from the illustrated examples, major variations would warrant attention and follow-up.

 Balance assessment in the community-dwelling older adult population is critical, as falls have been shown to be “the leading cause of injury and death by injury in adults over the age of 65 years” 20. The Timed Up & Go Test (TUG) is an efficient, reliable and valid functional outcome measure that can be used during the annual PT exam to screen for balance impairment, as well as functional mobility21. Shumway-Cook et al. determined that community dwelling older adults who took >13.5 seconds to complete this test could be predicted to incur a future fall with 90% accuracy21. This time should be used as the cut-off for follow-up balance assessment.

 Age related changes to the musculoskeletal system in older adults, including the loss of lean body mass and decreased strength have been associated with impaired function, disability, chronic diseases, and increased mortality 18,22,23. Therefore the assessment and monitoring of strength in community-dwelling older adults is critical to successful long-term health outcomes. The measurement of grip strength using a hand-held dynamometer can be used to predict adverse health outcomes in older adults 24-26. Grip strength of <26-7 kg in older adult men and <16 kg in older adult women have been associated with globally decreased strength, and poor health outcomes 25,26. The 30-second Chair-Stand test has been shown to be a reliable and valid assessment of lower body strength in older adults27. Cutoff scores of <14 for men and <13 for women indicate need for follow-up strength assessment28.

Maintenance of cardiorespiratory endurance or fitness in older adults has been shown to reduce incidence of frailty, prolong independence, reduce risk for all-cause mortality, reduce risk of obesity, and has an inverse relationship with development of CVD 29,30-2. A measure of cardiorespiratory fitness can be used to evaluate exercise endurance and screen for potential risks. The 6-minute walk test has been shown to be a valid and reliable measure of cardiorespiratory fitness across multiple different populations including community dwelling older adults 29,33,34. Fitness reference standards for community-dwelling older adults of varying ages have been listed in Table 4 Appendix A 35. Distances of less than these warrant the need for follow-up in this area.

*Resources/Referrals*

 For those older adults who are categorized outside the normal weight category on the BMI, or are indicated as potentially malnourished on the MNA-SF, further follow-up and nutritional counseling by the physical therapist is recommended. According to the American Physical Therapy Association, diet and nutrition are major areas appropriate for physical therapists to screen, educate on, and provide appropriate referral for within the scope of PT practice36. Further, on top of the aforementioned risks for chronic diseases and poor health outcomes associated with these findings, it has also been argued that improvements in nutritional status for patients undergoing physical therapy may contribute towards improved attainment of goals and therapy outcomes7. The *SuperTracker* online diet tracker is recommended as a free resource for patients classified as above37. This resource, presented by the United States Department of Agriculture, provides personalized nutrition plans based upon patient specific information including age, weight, and activity level 37. The *SuperTracker* also allows for patient specific weight gain or loss goals, or other nutritional goals to be set and modulates diet recommendations based on these goals, which goes well beyond the dietary advice and capability of the supervising physical therapist 37.

 For those older adults who score ≥ 3 on the PHQ-2, it is recommended the therapist refer the patient to their primary care physician for further psychological follow-up. This recommendation is supported by a 2014 Journal of Geriatric Physical Therapy article that advocates for patient referral to a primary care physician or another mental health specialist in lieu of a positive depression screen finding38. Not only is depression in older adults linked with decreased function and increased morbidity and mortality, but it is also associated with disability, decreased rehabilitation participation and compliance, and inferior patient outcomes 5,10,38. Therefore it is critical to ensure these patients are appropriately diagnosed and managed if we hope to have successful therapeutic patient outcomes.

 For those community-dwelling older adults who require >13.5 seconds to perform the TUG, the *Evidence-Based Falls Prevention Programs: Saving Lives, Saving Money* info-graphic, created by the National Council on Aging, is recommended as a resource39. Not only are falls the leading cause of injury and death by injury in older adults, but impaired balance and subsequent decreased fall-related efficacy have been associated with decreased activity, physical function, and quality of life 20,40. Therefore the patients who most require the rehabilitative interventions shown to improve balance and decrease falls risk may be least likely to seek out them out. This info-graphic provides a concise and evidence-based summary of the impact of falls, and highlights several evidence-based falls prevention programs 39,41-4. The breadth of information presented on this info-graphic, combined with the therapist’s patient specific recommendations could open up a dialogue between the therapist and the community-dwelling older adult about which program best suits that individual. Participation in any of the aforementioned programs, with or without concurrent PT, has shown to be effective in reducing the incidence of falls in this population 41-44.

References:

1. Ortman J, Velkoff V, Hogan H. An Aging Nation: The Older Population in the United States. In: *Current Population Reports*. ; 2014:1-28. https://www.census.gov/prod/2014pubs/p25-1140.pdf. Accessed September 10, 2017.
2. Healthy Aging. Centers for Disease Control and Prevention. https://www.cdc.gov/chronicdisease/resources/publications/aag/healthy-aging.htm. Published January 15, 2016. Accessed September 11, 2017.
3. McPhee JS, French DP, Jackson D, Nazroo J, Pendleton N, Degens H. Physical activity in older age: perspectives for healthy ageing and frailty. *Biogerontology*. 2016;17:567-580. doi:10.1007/s10522-016-9641-0.
4. Morris M., Kitchin E., Clar D. Strategies for optimizing nutrition and weight reduction in physical therapy practice: The evidence. *Physiother Therory Pract.* 2009;25:408–423. doi: 10.1080/09593980902835369.
5. Depression is Not a Normal Part of Growing Older. Centers for Disease Control and Prevention. https://www.cdc.gov/aging/mentalhealth/depression.htm. Published January 31, 2017. Accessed September 11, 2017.
6. Sullivan K, Wallace J, O'Neil M, Musolina G, Mandich M. A Vision for Society: Physical Therapy as Partners in the National Health Agenda. *Physical therapy*. 2011;91(11):1664-1672. doi: 10.2522/ptj.20100347.
7. Dean E. Physical therapy in the 21st century (Part I): toward practice informed by epidemiology and the crisis of lifestyle conditions. *Physiother Theory Pract*. 2009;25(5-6):330–353.
8. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, Thomas DR, Anthony P, Charlton KE, Maggio M, et al. Validation of the mini nutritional assessment short-form (MNA-SF): a practical tool for identification of nutritional status. *J Nutr Health Aging*. 2009;13(9):782–788. doi: 10.1007/s12603-009-0214-7.
9. Rubenstein LZ, Harker JO, Salvà A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice developing the short-form mini-nutritional assessment (MNA-SF). *J Gerontol Ser A Biol Med Sci*. 2001;56(6):M366–M372. doi: 10.1093/gerona/56.6.M366.
10. The State of Mental Health and Aging in America. Centers for Disease Control and Prevention. https://www.cdc.gov/aging/pdf/mental\_health.pdf. Published 2008. Accessed September 11, 2017.
11. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: Validity of a Two-Item Depression Screener. *Medical Care.* 2003; 41(11): 1284-1294.
12. Jamal A, King BA, Neff LJ, Whitmill J, Babb SD, Graffunder CM. Current cigarette smoking among adults: United States, 2005-2015. *Morbidity and Mortality Weekly Report*. 2016; 65(44): 1205-1211. doi:10.15585/mmwr.mm6544a2
13. Burns DM. Cigarette smoking among the elderly: disease consequences and the benefits of cessation. *Am J Health Promot*. 2000;14(6):357–61. doi: 10.4278/0890-1171-14.6.357.
14. About Adult BMI. Centers for Disease Control and Prevention. https://www.cdc.gov/healthyweight/assessing/bmi/adult\_bmi/index.html. Published August 29, 2017. Accessed September 11, 2017.
15. Coin A, Sergi G, Benincà P, et al. Bone mineral density and body composition in underweight and normal elderly subjects. *Osteoporos Int*. 2000;11:1043–1050.
16. Stathokostas L, McDonald MW, Little RMD, Paterson DH. Flexibility of Older Adults Aged 55–86 Years and the Influence of Physical Activity. *Journal of Aging Research*. 2013;2013:743843. doi:10.1155/2013/743843.
17. Anderson DE, Madigan ML. Healthy Older Adults Have Insufficient Hip Range of Motion and Plantar Flexor Strength to Walk Like Healthy Young Adults. *Journal of biomechanics*. 2014;47(5):1104-1109. doi:10.1016/j.jbiomech.2013.12.024.
18. Loeser RF. Age-Related Changes in the Musculoskeletal System and the Development of Osteoarthritis. *Clinics in geriatric medicine*. 2010;26(3):371-386. doi:10.1016/j.cger.2010.03.002.
19. Pierson F, Fairchild S. Chapter 4: Body Mechanics. In: *Principles & Techniques of Patient Care*. 4th ed. St. Louis, Missouri: SAUNDERS ELSEVIER; 2008:73-87.
20. Lee A, Lee K-W, Khang P. Preventing Falls in the Geriatric Population. *The Permanente Journal*. 2013;17(4):37-39. doi:10.7812/TPP/12-119.
21. Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Physical Therapy*. 2000;80(9):896-903.
22. Walston JD. Sarcopenia in older adults. *Current opinion in rheumatology*. 2012;24(6):623-627. doi:10.1097/BOR.0b013e328358d59b.
23. Keller K, Engelhardt M. Strength and muscle mass loss with aging process. Age and strength loss. *Muscles, Ligaments and Tendons Journal*. 2013;3(4):346-350.
24. Turusheva A, Frolova E, Degryse J-M. Age-related normative values for handgrip strength and grip strength’s usefulness as a predictor of mortality and both cognitive and physical decline in older adults in northwest Russia. *Journal of Musculoskeletal & Neuronal Interactions*. 2017;17(1):417-432.
25. Alley DE, Shardell MD, Peters KW, et al. Grip Strength Cutpoints for the Identification of Clinically Relevant Weakness. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*. 2014;69(5):559-566. doi:10.1093/gerona/glu011.
26. Dodds RM, Syddall HE, Cooper R, Kuh D, Cooper C, Sayer AA. Global variation in grip strength: a systematic review and meta-analysis of normative data. *Age and Ageing*. 2016;45(2):209-216. doi:10.1093/ageing/afv192.
27. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exerc Sport*. 1999;70(2):113–119. doi: 10.1080/02701367.1999.10608028.
28. Rikli RE, Jones CJ. Functional fitness normative scores for community-residing adults, ages 60-94. *Journal of Aging and Physical Activity*. 1999;6:160-179.
29. Rikli RE, Jones CJ. The reliability and validity of a 6-minute walk test as a measure of physical endurance in older adults. *Journal of Aging and Physical Activity*. 1998;6:363-375.
30. Batty GD. Physical activity and coronary heart disease in older adults. A systematic review of epidemiological studies. *European Journal of Public Health.* 2002;12:171-176.
31. Lee D, Artero EG, Sui X, Blair SN. Mortality trends in the general population: the importance of cardiorespiratory fitness. *Journal of Psychopharmacology (Oxford, England)*. 2010;24(4\_supplement):27-35. doi:10.1177/1359786810382057.
32. Sui X, LaMonte MJ, Laditka JN, et al. Cardiorespiratory Fitness and Adiposity as Mortality Predictors in Older Adults. *JAMA : the journal of the American Medical Association*. 2007;298(21):2507-2516. doi:10.1001/jama.298.21.2507.
33. Bohannon RW, Bubela DJ, Wang Y-C, Magasi SS, Gershon RC. Six-minute Walk Test versus Three-minute Step Test for Measuring Functional Endurance (Alternative Measures of Functional Endurance). *Journal of strength and conditioning research / National Strength & Conditioning Association*. 2015;29(11):3240-3244. doi:10.1519/JSC.0000000000000253.
34. Bautmans I, Lambert M, Mets T. The six-minute walk test in community dwelling elderly: influence of health status. *BMC Geriatrics*. 2004;4:6. doi:10.1186/1471-2318-4-6.
35. Rikli RE, Jones CJ. Development and validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years. *Gerontologist.* 2013;53:255–67.
36. THE ROLE OF THE PHYSICAL THERAPIST IN DIET AND NUTRITION HOD P06-15-22-17 [Position]. American Physical Therapy Association. http://www.apta.org/uploadedFiles/APTAorg/About\_Us/Policies/Practice/RolePTDietNutrition.pdf. Published June 3, 2015. Accessed September 12, 2017.
37. SuperTracker: My Foods. My Fitness. My Health. SuperTracker Home. https://www.supertracker.usda.gov/. Accessed September 12, 2017.
38. Vieira ER, Brown E, Raue P. Depression in Older Adults: Screening and Referral. *Journal of Geriatric Physical Therapy*. 2014;37(1):24-30. doi: 10.1519/JPT.0b013e31828df26f.
39. Evidence-Based Falls Prevention Programs: Saving Lives, Saving Money. *Evidence-Based Falls Prevention Programs: Saving Lives, Saving Money*. 2017. https://www.ncoa.org/resources/falls-prevention-programs-saving-lives-saving-money-infographic-3/. Accessed September 14, 2017.
40. Schepens S, Sen A, Painter JA, Murphy SL. Relationship Between Fall-Related Efficacy and Activity Engagement in Community-Dwelling Older Adults: A Meta-Analytic Review. *The American Journal of Occupational Therapy*. 2012;66(2):137-148. doi:10.5014/ajot.2012.001156.
41. Zijlstra GA, van Haastregt JC, Ambergen T, van Rossum E, van Eijk JTM, Tennstedt SL, et al. Effects of a multicomponent cognitive behavioral group intervention on fear of falling and activity avoidance in community-dwelling older adults: results of a randomized controlled trial. *J Am Geriatr Soc*. 2009;57(11):2020–8. doi: 10.1111/j.1532-5415.2009.02489.x.
42. Robertson MC, Campbell AJ, Gardner MM, Devlin N. Preventing injuries in older people by preventing falls: a meta-analysis of individual-level data. *J Am Geriatr Soc*. 2002;50(5):905–911. doi: 10.1046/j.1532-5415.2002.50218.x.
43. Clemson L, Cumming RG, Kendig H, Swann M, Heard R, Taylor K. The effectiveness of a community-based program for reducing the incidence of falls in the elderly: a randomized trial. *J Am Geriatr Soc*. 2004; 52(9):1487–94. doi: 10.1111/j.1532-5415.2004.52411.x
44. Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E, Wilson NL. Tai Chi and Fall Reductions in Older Adults: A Randomized Controlled Trial. *J Gerontol A Biol Sci Med Sci*. 2005;60(2):187–94. https://doi.org/10.1093/gerona/60.2.187

**Appendix A**

Table 1:

|  |  |  |
| --- | --- | --- |
| **Assessment**  | **Purpose**  | **Estimated Time Required** |
| 1. Body Mass Index
 | Screening for estimate of Body Fatness | 3-4 minutes |
| 1. Mini-Nutritional Assessment-SF
 | Screening for Malnutrition  | 2 minutes |
| 1. Patient Health Questionaire-2
 | Screening for Depression | 1 minute |
| 1. Tobacco Use Screening Questions
 | Screening for Tobacco Use | 2-3 minutes |
| 1. Timed Up & GO Test
 | Screening for balance impairment and falls risk | 3-4 minutes |
| 1. Functional ROM Assessments
 | Screening for functional ROM, body mechanics, and postural deficits | 12-20 minutes |
| 1. 30-second Chair Stand Test
 | Screening Lower body strength | 2 minutes |
| 1. Grip Strength Assessment
 | Estimating total-body strength; Screening for adverse health outcomes | 2-4 minutes |
| 1. 6-minute Walk Test
 | Screening cardio-respiratory fitness | 8-10 minutes |

*(Note: Estimated times do not include rest breaks or time required to summarize results)*

Table 2:

|  |  |
| --- | --- |
| **Screening Questions**  | **Answer** |
| 1. Have you ever smoked or used a tobacco product?
 | Yes / No |
| 1. Do you currently smoke or use a tobacco product?
 | Yes / No  |
| 1. How often do you smoke or use tobacco?
 | Insert: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Have you ever tried to quit, or thought about quitting?
 | Yes / No Insert: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Table 3:

|  |  |  |
| --- | --- | --- |
| **Assessment**  | **Purpose**  | **Estimated Time Required** |
| 1. Traditional Lift
 | Assess Hip/Knee/Ankle ROM; Assess spinal mechanics | 2-3 minutes  |
| 1. One-Leg Stance Lift
 | Assess Hip ROM; Assess spinal mechanics; Balance | 2-3 minutes |
| 1. Pushing/Pulling an Object
 | Assess body mechanics when exerting force | 2-4 minutes |
| 1. Reaching for/Placing an Object above Shoulder Height
 | Assess spinal mechanics; Assess shoulder ROM | 2-4 minutes |
| 1. Standing Posture
 | Assess spinal mechanics; Assess postural position | 2-3 minutes |
| 1. Sitting Posture
 | Assess spinal mechanics; Assess postural position; Assess Hip/Knee/Ankle ROM | 2-3 minutes  |

(Note: The “One-leg” Stance lift can be performed with both legs on the ground, with the older adult preferentially leaning over their stance leg, as depicted in the textbook)

Table 4:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Ages:** | **65-69** | **70-74** | **75-79** | **80-84** | **85-89** | **90-94** |
| **Women** | 605  | 580  | 550  | 510  | 460  | 400  |
| **Men**  | 650  | 620  | 580  | 530  | 470  | 400  |

(Note: All fitness reference standards were recorded in yards)

**Appendix B**

|  |
| --- |
| **Mini Nutrition Assessment – Short Form (MNA-SF)** |
| **A.** Has food intake declined over the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties?  |

|  |
| --- |
| 0 = severe loss of appetite  |
| 1 = moderate loss of appetite  |
| 2 = no loss of appetite  |

 |
| **B.** Weight loss during last three months |

|  |
| --- |
| 0 = weight loss greater than 3 kg (6.6 lbs)  |
| 1 = does not know  |
| 2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)  |
| 3 = no weight loss  |

 |
| **C.** Mobility |

|  |
| --- |
| 0 = bed or chair bound  |
| 1 = able to get out of bed/chair but does not go out  |
| 2 = goes out  |

 |
| **D.** Has suffered psychological stress or acute disease in the past three months  |

|  |
| --- |
| 0 = yes  |
| 2 = no  |

 |
| **E.** Neuropsychological problems  |

|  |
| --- |
| 0 = severe dementia or depression  |
| 1 = mild dementia  |
| 2 = no psychological problems |

 |
| **F.** Body Mass Index (BMI) (weight in kg)/(height in m)2  |

|  |
| --- |
| 0 = BMI less than 19  |
| 1 = BMI 19 to less than 21  |
| 2 = BMI 21 to less than 23  |
| 3 = BMI 23 or greater  |

 |
| **Screening score** (subtotal max. 14 points)  |

|  |
| --- |
| 12 points or greater: Normal – no need for further assessment  |
| 11 points or below: Possible malnutrition – continue assessment  |
|  |

 |

Adapted from Rubenstein et al. 20019

|  |
| --- |
| **Patient Health Questionaire-2 (PHQ-2)** |
| **Over the last 2 weeks, how often have you been bothered by any of the following problems?** | Not at all | Several days | More than half the days | Nearly everyday |
| 1. Little interest or pleasure in doing things
 | 0 | 1 | 2 | 3 |
| 1. Feeling down, depressed, or hopeless.
 | 0 | 1 | 2 | 3 |

Adapted from Kroenke et al. 200311