ARIC Manuscript Proposal # 830

1.a. Full Title: Association between body composition and functional and self-rated health in a bi-ethnic cohort: the Atherosclerosis Risk in Communities Study

b. Abbreviated Title (Length 26 characters): Obesity and functional health

2. Writing Group (list individual with lead responsibility first):

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   Writing group members: Denise Houston, June Stevens, Jainwen Cai, Pam Haines, Sheryl Zimmerman (contacted but not confirmed)

3. Timeline: Dataset preparation and analysis will start immediately upon approval. We plan to complete the analysis and manuscript in one year.

4. Rationale:

   Body composition and functional health

   With the aging of the American population, there is increased emphasis on maintaining functional health and independence of the elderly. Among persons aged 60 years and older in NHANES III, between 14.5 and 39.3% reported having difficulty doing lower extremity functions, between 4.3 and 13.4% reported having difficulty doing Activities of Daily Living (ADLs), and between 5.4 and 15.8% reported having difficulty doing Instrumental Activities of Daily Living (IADLs). Functional dependence has been shown to predict death (OR: 4.4, 95% CI: 3.2-6.1), nursing home admission (OR: 6.7, 95% CI: 3.8-12.8), hospitalizations (OR: 3.3, 95% CI: 1.9-5.5), and physician visits (OR: 2.3, 95% CI: 1.6-3.4) in persons aged 80 years and older. Increased functional dependence was also shown to predict mortality in younger elderly aged 65 years and older. Many studies have investigated the association between obesity and weight change and decreasing functional health. The mechanisms of the association between obesity and decreasing functional health include increased risk of cardiovascular disease and osteoarthritis and decreased levels of physical activity.

   Prospective\textsuperscript{2,5-13} (see Table 1) and cross-sectional\textsuperscript{14-25} studies (see Table 2) have shown that increased BMI is associated with decreased functional health. Negative associations between increased waist and hip circumferences and waist-to-hip ratios with functional health have also
been shown in cross-sectional studies. Additionally, two prospective studies have shown that weight change is associated with decreased functional health. However, these studies have several weaknesses. First, only six of the ten prospective studies had follow-up durations > 5 years. Second, only one of the prospective studies examined these associations in African-Americans. Third, only two of the prospective studies examined the associations of weight change and functional health and only one examined the associations of waist to hip ratio and functional health.

All six of the prospective studies with 5 years of follow-up or greater observed decreased functional health with obesity. In the Framingham Disability Study, both current BMI and average BMI over 25 years of follow-up were strongly associated with physical disability among women but not among men. Men and women of moderate weight (<10% underweight and <30% overweight according to Metropolitan Life Insurance 1959 standards) were more than twice as likely to have high functioning at 19 years follow-up in the Alameda County Study. Young-old women (65.1 ± 4.2 years) with high past BMI and high current BMI had greater than a two-fold increase in the onset of mobility disability in the NHANES I Epidemiologic Follow-up Study with 12 years of follow-up (NHEFS). However, neither weight gain nor weight loss was associated with incident mobility disability among young-old women. Among old-old women (76.0 ± 3.9 years), weight loss, but not weight gain, was associated with incident mobility disability. Self-reported weight at age 40 was also associated with greater disability in the NHEFS. In the Charleston Heart Study with 25 years of follow-up, only African American females with a high Quetelet Index at baseline were at increased risk for physical disability; White males and females and African American males with a high Quetelet Index were not at increased risk of physical disability.11 Having a BMI ≥ 28 kg/m² was also predictive of mobility disability at 12-14 years follow-up among men in the British Regional Heart Study.

Body composition and self-rated health

Many studies have found associations between self-rated health and mortality. In a review of 27 community-based studies, 23 of the 27 studies found that self-rated health reliably predicted survival in populations even when known health risk factors were accounted for, with mortality risks generally between 1.5 and 3.0 for poor vs. excellent self-rated health. In the NHEFS, men with excellent self-rated health had a mortality hazard ratio of about half that of those in poor health over approximately 20 years of follow-up. However, self-rated health was not significantly associated with mortality among women. Self-rated health also predicted functional limitations at 10, 15, and 20 year follow-up in men and at 10 and 15 year follow-up in women. In an ethnic stratified sample of the NHEFS, Whites, but not African Americans, who rated their health as poor at baseline were at greater risk of mortality. However, when self-rated health was incorporated into the model as a time-dependent covariate, poor self-rated health predicted mortality in both Whites and African Americans.

Several studies have investigated the association between obesity and self-rated health (see Table 3). Of these studies, only two were prospective studies and only one had a follow-up greater than 5 years. Obesity was a strong predictor of poor self-rated health among Swedish women, but not men, aged 25-74 years at baseline and followed for approximately 8 years. Additionally, going from overweight to obese resulted in an odds ratio for poor health of 1.61 (95% CI: 1.09-2.43) while remaining obese resulted in an odds ratio of 1.48 (95% CI: 1.04-2.17) compared to those who remained normal weight. However, no association was
found between BMI or WHR and self-rated health in men or women in the Hong Kong Chinese cohort with 3 years follow-up. Several cross-sectional studies found associations with obesity and decreased self-rated health. In NHANES III, excellent self-rated health decreased with increasing obesity among Whites and African Americans. Additionally, African American men and women had a 23 and 45% increase odds of reduced self-rated health, respectively, than Whites. Both being underweight and overweight or obese increased the odds of having poor or fair self-rated health in the 1996 Behavioral Risk Factor Surveillance System. However, obesity, but not underweight, was associated with lower self-rated health among adults in the Americans’ Changing Lives Study; this association was not different among Whites and African Americans. High BMI and waist circumference were associated with poor health in general among women aged 29-59 years, but not among men, in the MORGEN cohort. Both a high BMI (≥30 kg/m²) and a low BMI (<20 kg/m²) increased the odds of poor self-rated health among adults in the 1991 Swedish Level of Living Survey. However, adjusting for functional limitations weakened this association.

The Atherosclerosis Risk in Communities Study offers a unique opportunity to examine the associations between obesity and weight change and functional and self-rated health in a biethnic cohort of men and women as they progress from middle-aged to elderly. A recent literature review of 78 longitudinal studies of risk factors for functional status decline suggested that nutritional status, along with physical environment and social support, is one of several key risk factors that deserves further research. Only two previous studies have examined the associations between body composition and self-rated health prospectively, and both of these were conducted outside of the United States. We will investigate the association of obesity independent of chronic disease (CHD, cancer, stroke, diabetes) on functional and self-rated health as well as the association of chronic disease status as a mediator of obesity’s association with functional and self-rated health.

5. **Main Hypothesis/Study Questions:**

1. Increased BMI, waist circumference and WHR will be associated with decreased functional and self-rated health in cross-sectional analyses
2. Increased BMI, waist circumference and WHR at baseline will predict decreased functional and self-rated health at follow-up
3. Weight change (from age 25 to visit 4 and from visit 1 to visit 4) will be associated with decreased functional and self-rated health
4. Increased weight at age 25 will be associated with decreased functional and self-rated health

6. **Data (variables, time window, source, inclusions/exclusions):**

BMI, waist circumference, and waist to hip ratio at visit 1 will be used for longitudinal analyses, and BMI, waist circumference, and waist to hip ratio at visit 4 will be used for cross-sectional analyses. Weight change will be calculated as the difference in weight from age 25 to visit 4 and from visit 1 to visit 4.

Responses to the Physical Ability Questionnaire administered at visit 4 will be used to determine functional health. The questions will be divided into two scales as well as overall functional health. The mobility scale will include the following questions: walking for ¼ of a mile, walking up 10 steps without resting, stooping/crouching/kneeling, lifting or carrying
something as heavy as 10 pounds. The functional ability scale will include the following questions: doing chores around the house, preparing your own meals, walking from one room to another, standing up from an armless straight chair, getting in or out of bed, eating or drinking from a glass, dressing yourself. Responses to these questions by level of difficulty were obtained: no difficulty, some difficulty, much difficulty, or unable to do. Each question will be analyzed individually on both a categorical and ordinal scale as well as a component of the mobility or functional health scales.

We will use the following data from ARIC:

Identification information:
  Participant identification number
  Visit date (visit 1 & 4)
  ARIC field center (visit 1)

Demographics:
  Age (visit 1 & 4)
  Date of birth (visit 1)
  Ethnicity (visit 1)
  Gender (visit 1)
  Education (visit 1)
  Marital status (visit 4)
  Number of household members (visit 4)

Anthropometrics (visit 1 - 4):
  Weight
  Height
  BMI
  Waist circumference
  Hip circumference
  Weight at age 25 (visit 1)

Functional health (visit 4):
  Physical Ability Questionnaire

Annual Follow-up Questionnaire:
  Functional Status
  Self-rated health

Others:
  Smoking (visit 1 & 4): smoking status and # of cigarettes
  Physical activity (visit 1 & 3)
  Prevalent and incident CHD
  Prevalent and incident cancer
  Prevalent and incident stroke
  Hypertension
  Diabetes
Exclusions:
   Minorities other than African American
   African Americans residing in Minnesota and Maryland

7.a. Will the data be used for non-CVD analysis in this manuscript?  ____ Yes  _X__ No

   b. If Yes, is the author aware that the file ICTDER02 must be used to exclude persons
      with a value RES_OTH = “CVD Research” for non-DNA analysis, and for DNA
      analysis RES_DNA = “CVD Research” would be used?  ____ Yes  ____ No
      (This file ICTDER02 has been distributed to ARIC PIs, and contains
       the responses to consent updates related to stored sample use for research.)

8.a. Will the DNA data be used in this manuscript?  ____ Yes  _X__ No

8.b. If yes, is the author aware that either DNA data distributed by the Coordinating
      Center must be used, or the file ICTDER02 must be used to exclude those with value
      RES_DNA = “No use/storage DNA”?  ____ Yes  ____ No

9. The lead author of this manuscript proposal has reviewed the list of existing ARIC
    Study manuscript proposals and has found no overlap between this proposal and
    previously approved manuscript proposals either published or still in active status.
    ARIC Investigators have access to the publications lists under the Study Members Area of
    the web site at:  http://bios.unc.edu/units/cscs/ARIC/stdy/studymem.html

   _X___ Yes  _______ No
References:


<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Description</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launer et al., 1994</td>
<td>NHEFS (n=1124): 1971-5; FU 1986-87. White women aged 45+ yrs at baseline (young-old: 45-59 yrs, old-old: 60-74 yrs).</td>
<td>High baseline BMI associated with increased mobility disability among young-old and old-old women after ~12 yrs follow-up. High current BMI associated with increased mobility disability among young-old women. Weight loss was associated with increased mobility disability among old-old women only.</td>
</tr>
<tr>
<td>Hubert et al., 1993</td>
<td>NHEFS (n=4428): 1971-5; FU 1982-4. Men and women aged 50+ yrs at baseline.</td>
<td>Greater BMI at age 40 contributed to greater disability</td>
</tr>
<tr>
<td>LaCroix et al., 1993</td>
<td>Established Populations for Epidemiologic Studies of the Elderly (n=6,981): 1981-3; 4-yr FU. Men &amp; women aged 65+ yrs.</td>
<td>BMI ≥ 80th percentile at baseline associated with loss of mobility at 4-yr follow-up in men and women.</td>
</tr>
<tr>
<td>Fine et al., 1999</td>
<td>Nurses Health Study (n=40,098): 1992; FU 1996. Women aged 46-71 yrs at baseline.</td>
<td>Weight gain was associated with decreased physical function regardless of baseline weight</td>
</tr>
<tr>
<td>Pinsky et al., 1985</td>
<td>Framingham Disability Study (1251 women, 770 men): 1948-51; FU 1976-1978. Men and women aged 56-88 yrs at follow-up.</td>
<td>Disability associated with both current BMI and baseline BMI in women only.</td>
</tr>
<tr>
<td>Guralnik et al., 1989</td>
<td>Alameda County Study (n=496): 1965; FU 1984. Men and women aged 65-89 yrs at follow-up.</td>
<td>High functioning associated with moderate weight compared to either &gt;10% underweight or &gt;30% overweight at baseline.</td>
</tr>
<tr>
<td>Keil et al., 1989</td>
<td>Charleston Heart Study (n=1022): 1960; FU 1985. African American and White men and women aged 35+ yrs at follow-up.</td>
<td>A high baseline Quetelet Index (≥3.5) associated with physical disability in African American females only.</td>
</tr>
<tr>
<td>Harris et al., 1989</td>
<td>Supplement on Aging to the 1984 National Health Interview Survey (Longitudinal Study on Aging; n=1791): 1984; FU 1986. White men and women aged 80+ yrs at follow-up.</td>
<td>BMI &lt;75th percentile at baseline associated with continued physical ability at follow-up.</td>
</tr>
<tr>
<td>Ebrahim et al., 2000</td>
<td>British Regional Heart Study (n=5717): 1978-80; FU 1992. Men aged 40-59 yrs at baseline.</td>
<td>Compared to being in the lowest BMI quintile, being in the highest BMI quintile was associated with locomotor disability at follow-up.</td>
</tr>
<tr>
<td>Woo et al., 2001</td>
<td>Hong Kong Chinese cohort (n=1171): 1991-92; 3-yr FU. Men and women aged 70+ yrs.</td>
<td>In women, BMI was inversely associated with dependency. There was no association between WHR and dependency in men or women.</td>
</tr>
<tr>
<td>Reference</td>
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<tr>
<td>Ensrud et al., 1994&lt;sup&gt;14&lt;/sup&gt;</td>
<td>Study of Osteoporotic Fractures (n=9,704): 1986. Non-African American women aged 65+ yrs.</td>
<td>Both increased BMI and WHR associated with impaired function</td>
</tr>
<tr>
<td>Galanos et al., 1994&lt;sup&gt;15&lt;/sup&gt;</td>
<td>NHEFS (n=3,053): 1982-4. Men &amp; women aged 65+ yrs.</td>
<td>BMI ≤ 15&lt;sup&gt;th&lt;/sup&gt; percentile and ≥ 85&lt;sup&gt;th&lt;/sup&gt; percentile associated with decreased functional status.</td>
</tr>
<tr>
<td>Coakley et al., 1998&lt;sup&gt;16&lt;/sup&gt;</td>
<td>Nurses’ Health Study (n=56,510): 1992. Women aged 45-71 yrs.</td>
<td>Strong inverse relationship between BMI (beginning at BMI of 25 kg/m&lt;sup&gt;2&lt;/sup&gt;) and physical functioning.</td>
</tr>
<tr>
<td>Han et al., 1998&lt;sup&gt;17&lt;/sup&gt;</td>
<td>Randomized from civil registries as part of the Monitoring Risk Factors and Health in the Netherlands (n=4041): 1995. Men &amp; women aged 20-59 yrs.</td>
<td>Increased waist circumference and BMI associated with decreased physical functioning in men and women.</td>
</tr>
<tr>
<td>Lean et al., 1998&lt;sup&gt;18&lt;/sup&gt;</td>
<td>Randomized from civil registries as part of the Monitoring Risk Factors and Health in the Netherlands (n=4041): 1993-5. Men &amp; women aged 20-59 yrs.</td>
<td>Waist action level &gt;2 associated with poor physical functioning in men and women.</td>
</tr>
<tr>
<td>Clark et al., 1997&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Health and Retirement Survey (n=8727) and Assets and Health Dynamics Study (n=4510): 1992-93. Mexican Americans, African Americans, &amp; Whites aged 51-61 yrs and 71-81 yrs.</td>
<td>Significant differences in lower body difficulty between African Americans and Whites with an ideal body mass ≥ 140% in both age cohorts.</td>
</tr>
<tr>
<td>Wray &amp; Blaum, 2001&lt;sup&gt;21&lt;/sup&gt;</td>
<td>Health and Retirement Study (n=9824 aged 51-61 yrs): 1992 Study of Asset and Health Dynamics Among the Oldest Old (n=6660 aged 70+ yrs); 1993 Men and women aged 51-61 and 70+ yrs</td>
<td>Positive association of BMI with mobility difficulty in women</td>
</tr>
<tr>
<td>Davis et al., 1998&lt;sup&gt;22&lt;/sup&gt;</td>
<td>Hawaii Osteoporosis Study (n=705): 1992-4. Women of Japanese-ancestry aged 55-93 yrs.</td>
<td>Difficulty with 3 or more ADLs associated with increased BMI.</td>
</tr>
<tr>
<td>Katz et al., 2000&lt;sup&gt;23&lt;/sup&gt;</td>
<td>Medical Outcomes Study (n=2931): 1986. Men and women aged 40+ yrs.</td>
<td>Overweight, class I obese, and class II &amp; III obese had significantly lower physical function scores.</td>
</tr>
<tr>
<td>Tucker et al., 2000&lt;sup&gt;24&lt;/sup&gt;</td>
<td>Representative sample of Hispanic elders in Massachusetts (n=471 Puerto Ricans, n=143 Dominicans, n=251 non-Hispanic Whites): 1992-97. Men and women aged 55+ yrs</td>
<td>Obesity was significantly associated with higher ADL and mobility difficulty among Puerto Ricans and non-Hispanic Whites.</td>
</tr>
<tr>
<td>Friedmann et al., 2001&lt;sup&gt;25&lt;/sup&gt;</td>
<td>Rural Pennsylvania community-dwelling older adults (n=7120): 1994-97. Men and women aged 65+ yrs.</td>
<td>Men and women with BMI ≥ 40 kg/m&lt;sup&gt;2&lt;/sup&gt; had significantly increased risk of functional limitation.</td>
</tr>
</tbody>
</table>
### Table 3. Obesity and self-rated health

<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Description</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johansson &amp; Sundquist, 199929</td>
<td>Swedish Annual Level-of-Living Survey (n=3843): 1980-81, FU 1988-89. Men and women aged 25-74 yrs</td>
<td>In cross-sectional analyses, obesity was strongly associated with an increased risk of poor health at baseline. Going from overweight to obese and remaining obese at follow-up increased the odds of poor self-rated health.</td>
</tr>
<tr>
<td>Woo et al., 200113</td>
<td>Hong Kong Chinese cohort (n=1171): 1991-92; 3-yr FU. Men and women aged 70+ yrs.</td>
<td>There was no association between BMI or WHR and self-rated health in men or women.</td>
</tr>
<tr>
<td>Okosum et al, 200130</td>
<td>NHANES III (n=10,298): 1988-94. White, African American and Hispanic men and women aged 17-90 yrs</td>
<td>Excellent self-rated health decreased with increasing obesity among Whites, African Americans, and Hispanic men and women. African American men and women were associated with a 23 and 45% increased odds of reduced self-rated health compared to Whites.</td>
</tr>
<tr>
<td>Ford et al., 200131</td>
<td>BRFSS (n=109,076): 1996. Men and women aged 18+ yrs</td>
<td>Having a BMI &lt; 18.5 kg/m² and BMI ≥ 25 kg/m² increased the odds of poor or fair self-rated health.</td>
</tr>
<tr>
<td>Ferraro &amp; Yu, 199552</td>
<td>Americans’ Changing Lives (n=3497): 1986. Men and women aged 25+ yrs</td>
<td>Increased BMI was significantly associated with poor self-rated health. The effect of obesity on self-rated health did not differ by ethnic group (Whites vs. African Americans)</td>
</tr>
<tr>
<td>Han et al., 199817</td>
<td>MORGEN cohort (n=4041): 1995. Men and women aged 20-59 yrs</td>
<td>Those in the highest tertile of BMI had increased odds of not having excellent self-rated health. Waist circumference not associated with increased odds reduced health.</td>
</tr>
<tr>
<td>Manderbacka et al., 199933</td>
<td>Swedish Level-of-Living Survey (n=5306): 1991. Men and women aged 18-75 yrs</td>
<td>Having a BMI &lt; 20 kg/m² and BMI ≥ 25 kg/m² increased the odds of poor self-rated health.</td>
</tr>
</tbody>
</table>