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SHORT COMMUNICATION

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Predictive validity of a fitness-fatness index in predicting cancer-specific mortality

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ABSTRACT

A fitness-fatness index (FFI) was recently (2016) developed, with FFI calculated as cardiorespiratory fitness divided by waist-to-height ratio (HR). No study has evaluated the effects of FFI on cancer-specific mortality risk, which was this study's purpose. Data from the 1999–2006 National Health and Nutrition Examination Survey were employed, with follow-up through 2011. Among the 9,974 participants, 138 died of cancer over the follow-up period; median follow-up period was 105 months (IQR: 81–129). In a Cox proportional hazard model, for every 1 FFI unit increase, participants had an 8% reduced hazard of cancer-specific death [HR = 0.92; 95% confidence interval (CI): 0.88–0.96; $P < 0.001$]. Results were unchanged when stratifying by men (HR = 0.90; 95% CI: 0.85–0.94; $P < 0.001$) or women (HR = 0.86; 95% CI: 0.79–0.93; $P = 0.001$). Results were also similar for cancer survivors (HR = 0.89; 95% CI: 0.83–0.95; $P = 0.001$). This novel study presents evidence of an inverse association between FFI on cancer-specific mortality, among those with and without cancer. Thus, the FFI may be a useful tool in the clinical setting to help identify those at high risk of early cancer-specific mortality.

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Introduction

Nutrition and physical activity cancer prevention guidelines are structured to complement those suggested to reduce the risk and prevalence of chronic disease [1]. Associations between colon, rectal, pancreas, lung, breast, and ovarian cancers are linked to a high body mass index (BMI) [1–3]. Further, research suggests a small, albeit significant, proportion of cancer-specific mortality may be attributable to elevated BMI, at, or exceeding 25 kg/m^2 [2]. However, recent work indicates BMI may not supply a gold standard measure of physical health [4]. A fitness-fatness index (FFI) is a robust alternative to the traditional BMI measurement. Unlike BMI, FFI is a concomitant index of both fitness and fatness, but also contributes a uniquely singular indication of the rationale for cardiovascular fitness and weight status to yield differential effects on health outcomes [5]. Although BMI measurements are used in research and clinical practice as a normative marker of obesity, the addition of a fitness component in a quantitative appraisal of physical health status is appropriate irrespective of age, gender, individual genetic factors, and changes in muscle mass [4]. Thus, FFI is a compendious representation of the critical interplay between inversely related fitness and fatness characteristics, and may be used to guide health promotion and chronic disease prevention initiatives.

A FFI was recently (2016) developed by Sloan et al. [4] with FFI calculated as cardiorespiratory fitness (CRF) divided by waist-to-height ratio (WHR). Notably, FFI was shown to be a better predictor of incident diabetes when compared to fitness or fatness (WHR) alone. Cancer is linked to elevated BMI; however, physical fitness is shown to be protective

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against the deleterious effects of excess central adiposity on disease risk. Further, cancer patients who engage in adequate physical activity are suggested to experience less severe treatment side effects compared to their inactive counterparts [6,7]. The present study evaluated if FFI is predictive of cancer-specific mortality, which has yet to be investigated. This is a noteworthy investigation as, for example, diabetes is linked with increased cancer and cancer-specific mortality [8,9], and the assessment of FFI within the clinical setting may be feasible. With regard to the latter, and as an example, CRF can be estimated by clinicians via prediction equations [10,11]; and WHR can easily be obtained with minimal training and resources. To our knowledge, no study to date has evaluated the potential for a relationship to exist between FFI and cancer-specific mortality among a representative sample of the broader U.S. population, which was the purpose of this study.

Methods

Study design and participants

Data from the 1999–2006 National Health and Nutrition Examination Survey (NHANES) were employed, with follow-up through 2011. After excluding those with missing data for any of the algorithm variables (described below), and those with a physician diagnosis of coronary artery disease, congestive heart failure, heart attack, angina, stroke, cancer, hypertension, diabetes, liver disease, or emphysema, 9,974 participants (20–85 years) remained and constituted the analytic sample. Among the 9,974 participants, 138 died of cancer over the follow-up period; median follow-up period was 105 months (IQR: 81–129).

FFI

FFI is calculated as CRF divided by WHR. Fitness was determined via prediction algorithms [12] that employ non-exercise testing methods to estimate one's CRF level. Parameters employed in the CRF algorithm include sex, age, BMI, waist circumference, resting heart rate, self-reported physical activity level, and smoking status [10]. This algorithm has demonstrated evidence of predictive validity by associating with all-cause and CVD-specific mortality [10,11]. Fatness was determined by WHR, as measured directly (via measurement tape) at the NHANES mobile examination center.

Results

The mean age of the sample was 39.6 years, with a mean FFI of 19.4 [95% confidence interval (CI): 19.2–19.7]. In a Cox proportional hazard model, for every 1 FFI unit increase, participants had an 8% reduced hazard of cancer-specific death (HR = 0.92; 95% CI: 0.88–0.96; $P < 0.001$). Results were unchanged when stratifying by men (HR = 0.90; 95% CI: 0.85–0.94; $P < 0.001$) or women (HR = 0.86; 95% CI: 0.79–0.93; $P = 0.001$).

Additional analyzes evaluated the association between FFI and cancer-specific mortality among those with a cancer diagnosis at baseline. This sample constituted 530 cancer survivors. For every 1 FFI unit increase, cancer survivors had an 11% reduced hazard of cancer-specific death (HR = 0.89; 95% CI: 0.83–0.95; $P = 0.001$).

Discussion

As of 2016, cancer is the second leading cause of death; thus, identification of clinically modifiable factors to mitigate cancer mortality is of major public health and clinical importance. The present brief report highlights the utility of a clinically feasible parameter, the FFI, in predicting cancer-specific mortality. Specifically, the FFI may serve as a useful indicator for metabolic health, which may influence cancer-specific mortality risk. As such, and if confirmed by future work, then clinicians and oncologists should be encouraged to assess their patients FFI to provide diagnostic information regarding their current and future health status.

Physical activity should be promoted across all domains, as research indicates various modalities and levels of physical activity are advantageous in risk-reduction, relative to an array of negative health outcomes including diabetes, heart disease, stroke, breast cancer, and colon cancer [1–3,7,13]. Time spent engaging in physical activities may be accumulated via activities of daily living such as occupational, leisure time, and transportation-related physical activity. In fact, time spent participating in activities not within a structured exercise program may be sufficient to satisfy the current national recommendations for physical activity [1,14,15].

Regardless of the exercise selection, the role of health promoters is to encourage long-term participation, behavioral compliance, safe practice, and enjoyable physical activities for individuals susceptible to, or diagnosed with cancer. Health professionals may also be capable of initiating lasting

behavior change among patients who recently was diagnosed with cancer. The gravity of the situation may prompt individuals to conduct an appraisal of suboptimal health behaviors, and enact meaningful changes in their dietary, physical activity, and overall lifestyle choices. The emotional magnitude of cancer diagnoses can intercalate every aspect of basic and personal wellbeing. Clinicians should aim to explain treatment and quality of life benefits associated with physical activity and weight management that will underscore the protective effects of a healthy lifestyle; effects that may sustain life.

In conclusion, our findings demonstrated that a higher FFI (favorable fitness-to-fatness ratio) was associated with reduced risk of cancer specific-mortality among a large sample of adult individuals within the broader United States population. Strengths of our study include the novel evaluation of FFI on cancer-specific mortality as well as our utilization of an objective measurement of waist circumference to assess WHR for all participants. Waist circumference is easily calculable with a tape measure; and thus, introduces no additional costs or equipment when compared to measuring BMI. Despite these strengths, future longitudinal work should examine fitness and fatness in isolation and when applied concurrently to facilitate understanding of the development and attenuation of cancer-specific mortality and other chronic lifestyle diseases.

Conflict of Interest

No conflicts of interest are disclosed.

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