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A brief measure of Smokers' knowledge of lung cancer screening with low-dose computed tomography

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ABSTRACT

We describe the development and psychometric properties of a new, brief measure of smokers' knowledge of lung cancer screening with low-dose computed tomography (LDCT). Content experts identified key facts smokers should know in making an informed decision about lung cancer screening. Sample questions were drafted and iteratively refined based on feedback from content experts and cognitive testing with ten smokers. The resulting 16-item knowledge measure was completed by 108 heavy smokers in Houston, Texas, recruited from 12/2014 to 09/2015. Item difficulty, item discrimination, internal consistency and test-retest reliability were assessed. Group differences based upon education levels and smoking history were explored. Several items were dropped due to ceiling effects or overlapping constructs, resulting in a 12-item knowledge measure. Additional items with high item uncertainty were retained because of their importance in informed decision making about lung cancer screening. Internal consistency reliability of the final scale was acceptable (KR-20 = 0.66) and test-retest reliability of the overall scale was 0.84 (intraclass correlation). Knowledge scores differed across education levels ($F = 3.36$, $p = 0.04$), while no differences were observed between current and former smokers ($F = 1.43$, $p = 0.24$) or among participants who met or did not meet the 30-pack-year screening eligibility criterion ($F = 0.57$, $p = 0.45$). The new measure provides a brief, valid and reliable indicator of smokers' knowledge of key concepts central to making an informed decision about lung cancer screening with LDCT, and can be part of a broader assessment of the quality of smokers' decision making about lung cancer screening.

1. Introduction

Lung cancer is the leading cause of cancer deaths among men and women in the United States (American Cancer Society, 2012). In 2011, the findings from the National Lung Screening Trial showed a 20% reduction in lung cancer deaths among high-risk smokers randomized to the low-dose computed tomography (LDCT) arm compared to those in the chest X-ray arm (Aberle et al., 2011). Shortly thereafter, the United States Preventive Services Task Force (USPSTF) released an updated statement endorsing lung cancer screening with LDCT, and the Centers for Medicare & Medicaid Services (CMS) released the national coverage determination for Medicare coverage of lung cancer screening with LDCT (Moyer, 2014; Centers for Medicare & Medicaid Services, 2015). Thus, there is growing interest in implementing lung cancer screening.

In its landmark beneficiary eligibility determination, CMS requires that a patient counseling and shared decision-making visit with a patient decision aid precedes a preventive service (Moyer, 2014; Centers for Medicare & Medicaid Services, 2015). The requirement for a shared decision-making and patient counseling visit is due in part to recognition of the potential harms associated with lung cancer screening with LDCT, including a high false positive rate, overdiagnosis, complications

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as the result of invasive diagnostic procedures, and increased risk for new cancers due to increased radiation exposure (Moyer, 2014; Bach et al., 2012; Humphrey et al., 2013). Shared decision making is recommended when the efficacy of an available option, in this case lung cancer screening with LDCT, is not always certain and when there are tradeoffs between benefits and harms associated with the options. CMS further calls for the use of patient decision aids as part of the shared decision-making visit. Patient decision aids can support shared decision making by presenting facts in a balanced manner and encouraging deliberation between patients and health care providers about the tradeoffs (O'Connor et al., 1999). In light of the requirements by CMS for lung cancer screening with LDCT, there is a clear need to have a reliable measure to assess the effectiveness of decision aids on patients' knowledge.

This paper reports the development and psychometric properties of a brief knowledge measure about lung cancer screening with LDCT for use with smokers. This measure development study (ClinicalTrials.gov ID: NCT02282969) was conducted as a precursor to a larger randomized trial evaluating the effectiveness of a video-based patient decision aid (Clinicaltrials.gov ID: NCT02286713).

2. Materials and methods

2.1. Knowledge item generation

In order to generate a pool of knowledge items, we asked tobacco control experts, cancer prevention experts, and a diagnostic radiologist to generate a list of key facts a patient should know in making an informed decision about lung cancer screening with LDCT. We supplemented the expert-generated lists with information about lung cancer screening presented in professional guidelines (Moyer, 2014; Wender et al., 2013; National Comprehensive Cancer Network, 2011), patient and physician fact sheets from professional organizations (American Lung Association, 2012; American Society of Clinical Oncology, 2012; American Cancer Society, 2013; U.S. Preventive Services Task Force, 2013; U.S. Preventive Services Task Force, 2014a; U.S. Preventive Services Task Force, 2014b), the latest evidence synthesis from the USPSTF (Humphrey et al., 2013), and knowledge items from a prior study by the research team (Volk et al., 2014).

The resulting candidate set of 107 fact-based knowledge items (key facts) was broadly grouped into 35 domains (e.g., mortality, incidence, diagnosis, risk factors). The list was reviewed and sorted by the research team, and redundant domains and key facts were collapsed or removed. The resulting 16 domains with 29 key facts were edited for literacy level in advance of cognitive testing and entered into an online survey. Medical content experts (N = 3), from cancer prevention, community oncology practice, and radiology, and research team members rated each item as “essential,” “optional,” or “not necessary” for patients to make an informed decision. From these ratings, 13 domains represented in 16 key facts about lung cancer screening were included in the knowledge measure and evaluated for face validity.

For cognitive testing, participants were recruited from the Tobacco Treatment Program (TTP) at The University of Texas MD Anderson Cancer Center. Eligible participants were current or former smokers 55 to 80 years old with no prior history of lung cancer. After obtaining written consent, research assistants conducted cognitive testing with 10 participants using a “thinking-out-loud” technique, where the participant is asked a series of questions to understand his or her interpretation of what each item is asking and what the response choices mean (Dillman, 1978). We iteratively refined the measure (items and responses) based upon cognitive testing results.

2.2. Data collection procedures

Data were collected between December 2014, and September 2015. A multipronged strategy was used to recruit participants, including contacting patients from the TTP at MD Anderson, placing advertisements in local newspapers, and relying on referrals from existing participants in the study. Eligible participants included English-speaking men and women ages 55 to 80 years who were either current smokers or had quit within the past 15 years. Individuals who had been diagnosed with lung cancer were ineligible. These criteria mirrored USPSTF criteria for lung cancer screening eligibility, except pack-year smoking history. Although pack-year smoking history was not an eligibility criterion for our study, we did assess pack-year smoking history and compared results for participants who did or did not have a minimum of a 30 pack-year smoking history.

After consenting to the study, participants completed a baseline questionnaire, and again completed a follow-up questionnaire one month later. The one month time lag was selected, instead of the standard 10 days to 2 weeks interval, to minimize priming effects on the participants' knowledge of lung cancer screening. The order of the knowledge questions was randomized at the follow-up. Participants also completed demographic questions at baseline. This study was approved by MD Anderson's Institutional Review Board.

2.3. Analysis

We tested the psychometric properties of the knowledge measure, including item difficulty, item discrimination, reliability, and validity. Not all subjects completed the follow-up questionnaire. Sensitivity analysis of data from the participants who only completed the baseline compared to participants who had completed baseline and follow-up revealed that the item characteristics did not differ significantly. Data analysis was conducted with SPSS.

2.3.1. Item difficulty and uncertainty

Item difficulty was determined by examining the proportion of correct responses. Generally, items with 50% correct responses tend to increase the reliability of a multi-item measure (Crocker & Algina, 1986), although highly difficult items may be retained in a measure if they assess constructs potentially amenable to educational interventions. Item uncertainty was defined as the proportion of “I don't know” responses.

2.3.2. Index of discrimination

The index of discrimination was used to assess the validity of the items in discriminating among high and low performers on the scale. The index of discrimination is the difference between the proportion of correct responses of participants in the upper and lower 25th percentiles. Traditionally, items with an index of discrimination of 40% are considered acceptable, and those with an index less than 20% are considered inadequate (Ebel, 1965).

2.3.3. Reliability

We assessed the reliability of the overall knowledge measure using the Kuder-Richardson 20 (KR-20) formula, an indicator of internal consistency reliability for scales with dichotomous responses (i.e., correct or incorrect responses) (Cronbach, 1951; Kuder & Richardson, 1937). Characteristics of the individual items were examined using item-total correlations, and internal consistency of the overall scale if the item was deleted (alpha if item deleted). Test-retest reliability of the individual items was calculated with kappa coefficients, and test-retest reliability of the overall knowledge measure was estimated by the intraclass correlation.

2.3.4. Differences between groups

One-way analysis of variance was used to explore group differences. It was expected that knowledge would differ between education levels, which would reflect concurrent validity, a type of criterion validity. It is expected that those with higher education (graduated high school/GED or less, some college/trade school, graduated college or more) would