MEASURING KNOWLEDGE AND HEALTH LITERACY AMONG MEDICARE BENEFICIARIES

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Executive Summary

The Centers for Medicare and Medicaid Services (CMS) conducts various educational activities designed to inform Medicare beneficiaries about available health plan choices and to increase awareness of resources for obtaining additional information and assistance. To evaluate the effectiveness of these efforts, measures are needed to assess Medicare beneficiaries' knowledge. With its large, longitudinal sample of Medicare beneficiaries, the Medicare Current Beneficiary Survey (MCBS) provides a potential source of data for evaluating the impact of educational programs on beneficiary knowledge. However, traditionally, knowledge questions on the MCBS have changed from year to year to adapt to changes in the Medicare program. The changing content makes it difficult to measure improvement or decline in beneficiary knowledge over time and therefore to evaluate the effectiveness of educational interventions.

Item Response Theory (IRT) may be used to remedy this problem by assigning a comparable metric to knowledge measures that differ from year to year in future rounds of the MCBS. The goal of RTI's project, *Questionnaire Development and Cognitive Testing Using Item Response Theory (IRT)*, was to develop a pool of knowledge items with known IRT item parameters. Developing this item pool will allow the knowledge items in the MCBS to be rotated from year to year while still providing comparable scores across years. Further, it allows for the addition of new items once the IRT parameters of the current items have been established.

In the first phase of this project, a large pool of knowledge items were developed and cognitively tested. To pilot test the knowledge items, they were then administered to a group of Medicare beneficiaries as a part of Round 36 of the MCBS. During the second phase of the project described in this report, we used the MCBS data to evaluate the psychometric properties of the knowledge items and to calibrate them using IRT.

Factor analysis results suggested that the knowledge items split into two factors representing the two primary components of the Medicare program, Original Medicare and Medicare+Choice. The items on each factor were calibrated using IRT and the resulting item parameters were used to develop and score three possible alternate forms of the knowledge quizzes for each topic (Original Medicare and Medicare+Choice). Each quiz form was short in length with four items for the Original Medicare quizzes and seven items for the Medicare+Choice quizzes, resulting in low respondent burden and allowing the quizzes to easily be incorporated into the MCBS. The three forms of each quiz had similar Cronbach's alphas, mean scores, and test information curves, and detected similar group differences, supporting their equivalence.

As a part of this project, we also developed new measures for assessing health literacy among Medicare beneficiaries. These measures focus on insurance-related terminology and scenarios which beneficiaries are likely to encounter when obtaining and paying for their health care and choosing a health plan. The health literacy items divided into two factors, representing understanding of terminology and reading comprehension. As with the knowledge items, we calibrated the items using IRT and developed three alternate forms for each type of quiz (terminology and reading comprehension). Group comparisons suggested that higher scores on the health literacy quizzes were associated with greater educational achievement, higher self-

reported knowledge of Medicare, less difficulty understanding Medicare, and reading more of the *Medicare & You* handbook.

The development of an item pool and calibration of the items as a part of this project allows for more dynamic measures of knowledge than previously available in the MCBS. The quizzes described in this report are just a few possible forms that can be developed. Additional alternate forms can be created when needed by selecting items from the item pool and using the established item IRT parameters to compute scores for the new forms. Furthermore, in the future as changes occur in the Medicare program, new items can easily be developed and added to the item pool. The transition between old and new items can be made by administering the new items for the four quizzes (Original Medicare, Medicare+Choice, Terminology, Reading Comprehension) along with some of the existing items on the corresponding quiz in order to calibrate the new items. Then a new set of IRT scores can be developed which are comparable to the scores computed using the old items.

Several possible future studies could be conducted using these knowledge and/or health literacy quizzes. For example, as discussed in the recent CMS symposium on "Normative Standards and Limits on Beneficiary Knowledge of the Medicare Program," a common question among researchers and policy makers is whether or not beneficiaries have the level of knowledge they need to effectively navigate the Medicare program and make informed decisions about health plans. While research has uncovered several areas in which beneficiaries' lack knowledge, there are currently no clear guidelines or methods for classifying beneficiaries according to whether they have the minimum level of knowledge they need. Future research could be conducted to establish a cutoff score for each of the knowledge quizzes in this study that would indicate whether a beneficiary has met this minimum level of knowledge. Some possible uses for such a cutoff score is to determine whether a particular education program is effective in increasing the number of beneficiaries who meet this minimum level of knowledge. Another potential use is to identify particular subgroups that are lacking in knowledge and may need tailored materials or messages targeted specifically to them.

1. Background

1.1 Beneficiary Knowledge

The Medicare program insures more than 40 million people (CMS, 2003) and pays over $236 billion in beneficiary health care expenditures each year (CMS, 2001). However, Medicare without supplemental insurance covers only about half of beneficiaries' health care costs (Caplan, 2002). To make an informed decision about supplemental coverage to help pay these remaining costs, beneficiaries need to consider the costs, benefits, and restrictions of a variety of plan choices, including managed care, Medigap, and employer-sponsored plans.

Medicare beneficiaries may face many obstacles to making informed health insurance decisions. Research suggests that particular population subgroups may be especially limited in their knowledge of the Medicare program and health plans. The literature suggests that the level of understanding regarding the Medicare program varies based on education, income, age, gender, and type of insurance (Hibbard, Jewitt, Englemann, & Tusler, 1998; McCormack, Anderson, Kuo, Daugherty, Bann, & Hibbard, 2001; McCormack, Garfinkel, Hibbard, Keller, Kilpatrick, & Kosick, 2002; McCormack & Uhrig, 2003). Beyond these factors, an individual's level of interest in health insurance issues – sometimes described as "readiness" – is also related to understanding of the Medicare program (Levesque, Prochaska, Cummings, Terrell, & Miranda, 2001). Other factors influencing beneficiary knowledge include low rates of literacy and lack of access to important sources of information such as the Internet.

As a further challenge, the Medicare program is continually evolving, making it even more imperative that beneficiaries stay informed and have knowledge of resources and benefits that could help them obtain and pay for the health care they need. For example, one important recent change is the passing of the Medicare Modernization Act (MMA). However, despite the media coverage of the MMA, a recent study found that nearly 70 percent of Medicare beneficiaries are unaware of the new Medicare prescription drug benefit (Kaiser Family Foundation, 2004).

1.2 Health Literacy

One possible factor contributing to low levels of Medicare-related knowledge may be inadequate health literacy. Several definitions of health literacy have been put forth. *Healthy People 2010* and the National Library of Medicine define health literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services necessary to make appropriate health decisions" (Ratzan and Parker, 2000). Others have defined it as "a constellation of skills, including the ability to perform basic reading and numerical tasks required to function in the health care environment" (American Medical Association, 1999). Based on these definitions, health literacy requires a variety of skills, including reading, writing, arithmetic, speaking, listening, using technology, networking, and rhetorical discourse (Institute of Medicine, 2004). Although the definitions of health literacy vary somewhat, they reflect common elements, particularly the focus on an individual's *capacity* to undertake certain activities.

Much of the concern for the nation's health literacy rests on data showing that many adults lack the basic reading skills they need to function effectively in several important arenas. An important source for reaching this conclusion is the 1992 National Adult Literacy Survey (NALS), which evaluated the literacy skills of American adults between the ages of 16 and 65 years old. Approximately 90 million adults (47 percent of the population) scored in the lowest two levels on the NALS composite scale, a figure that has been widely cited as evidence that nearly half of the nation's adults lack adequate literacy skills. Respondents were more likely to score in Levels 1 and 2 if they had lower levels of education.

Few studies have been conducted to assess the health literacy among older adults. One study using the short-form of the Test of Functional Health Literacy in Adults (S-TOFHLA) found that the prevalence of inadequate to marginal health literacy ranged from 27 to 44 percent for English-speaking and 40 to 76 percent of Spanish-speaking Medicare beneficiaries over age 65 who were enrolled in four managed care plans (Gazmararian, Baker, Williams, Parker, Scott, Green, Fehrenback, Ren, & Kaplan, 1999). While measures such as the S-TOFHLA are useful for assessing general health literacy, to our knowledge, no measures have been developed to assess health literacy specifically related to navigating the Medicare program and health plans.

1.3 Medicare Current Beneficiary Survey (MCBS)

The Centers for Medicare and Medicaid Services (CMS) conducts various educational activities designed to inform Medicare beneficiaries about available health plan choices and to increase awareness of resources for obtaining additional information and assistance, such as the 1-800-Medicare information line and the Medicare website. To evaluate the effectiveness of these efforts, measures are needed to assess Medicare beneficiaries' knowledge. With its large, longitudinal sample of Medicare beneficiaries, the Medicare Current Beneficiary Survey (MCBS) provides a source of data for evaluating the impact of educational programs on beneficiary knowledge. However, traditionally, knowledge questions on the MCBS have changed from year to year to address the newest features of Medicare health plans and changes in Medicare benefits, and to adapt to the changing priorities and goals of CMS. The changing content makes it difficult to measure improvement or decline in beneficiary knowledge from year to year and therefore to evaluate the effectiveness of educational interventions.

Item Response Theory (IRT) may be used to remedy this problem by assigning a comparable metric to knowledge measures that differ from year to year in future rounds of the MCBS. One goal of RTI's project, *Questionnaire Development and Cognitive Testing Using Item Response Theory (IRT)*, was to develop a pool of knowledge items with known IRT item parameters. Developing this item pool will allow the knowledge items in the MCBS to be rotated from year to year while still providing comparable scores across years. Further, it allows for the addition of new items once the IRT parameters of the current items have been established. This approach enables the MCBS knowledge index to remain adaptable to changes in the Medicare program while also allowing for the analysis of change in knowledge over time.

In the first phase of this project, RTI staff developed and cognitively tested a large pool of knowledge items. (Details about the item development activities are described by Uhrig and colleagues (2002).) To test the knowledge items, they were then administered to a group of

Medicare beneficiaries as a part of Round 36 of the MCBS. The goal of the second phase of the project described in this report was to use the data that was collected to evaluate the psychometric properties of the knowledge items and to calibrate them using IRT (i.e., establish their IRT parameters). In addition, to illustrate how the IRT parameters for the items may be used, we developed three alternative knowledge forms and scored them using IRT. The functional equivalence, psychometric properties, and possible uses of these new knowledge forms are described.

In addition to developing knowledge measures, this project also developed new measures of health literacy, specifically designed for Medicare beneficiaries. Existing health literacy measures do not focus on health literacy in the context of health insurance. This project addressed this gap by developing health literacy measures which contain insurance-related terms and scenarios, such as choosing an insurance plan and understanding a claims notice. Similar to the knowledge items, the health literacy items were calibrated using IRT and three alternate forms of the health literacy quizzes were developed.

2. Methods

2.1 Respondents

The Medicare Current Beneficiary Survey (MCBS) utilizes a rotating panel design in which a national probability sample of approximately 16,000 Medicare beneficiaries is interviewed every four months for up to four years. Participants in the MCBS are administered questions on topics, such as health insurance, service utilization, expenditures, and information needs. For this study, 2,634 respondents who were in their final round of participation in the MCBS responded to the Medicare Knowledge (MK) supplement which included the newly developed knowledge questions. The MK supplement was administered during MCBS Round 36 from May to August 2003. To minimize respondent burden, participants were divided into two cohorts. Cohort 1 received questions on knowledge and health literacy (items MK1-MK76) while Cohort 2 received questions on knowledge and cognition, as well as the remaining items in the supplement (items MK1-43 and MK77-96). Table 2.1 presents the demographic characteristics of the respondents in both cohorts.

Table 2.1. Demographic Profiles of Respondents

Variable	N	%
Gender		
Male	1105	42.0
Female	1529	58.1
Race		
White	2222	84.4
Non-white	407	15.5
Education		
8th grade or less	358	13.6
More than 8th grade, but no college	1407	53.4
College	863	32.8
Age		
Under 65	376	14.3
65-75	1065	40.4
Over 75	1193	45.3
Income		
Under $25,000	1612	61.2
$25,000 or more	1022	38.8
Managed care		
Some enrollment	431	16.4
No enrollment	2203	83.6
Private Supplemental Insurance		
Supplemental insurance	1581	60.0
No supplemental insurance	1041	39.5

2.2 Item Development

Uhrig and colleagues (2002) describe the development of the knowledge items in detail in an earlier report for this project. Briefly, several key principles guided the development of the health literacy and knowledge items for this study. Specifically, each item must have only one correct answer and the information needed to answer the question should be widely available to beneficiaries. In addition, because the MCBS includes a diverse group of beneficiaries, the scales should contain items with a wide range of difficulty levels to obtain the most precise measurements for this population. Finally, to ensure content validity, the items should measure those concepts which CMS and policy experts indicate beneficiaries need to effectively navigate the Medicare program. To meet these criteria, we developed the items using a comprehensive multi-step process that included (a) background research; (b) review of existing Medicare informational materials and surveys, including the MCBS; and (c) multiple meetings and discussions with CMS and the project's seven-member Technical Advisory Panel (TAP) which included members with expertise in areas such as health policy, health education, consumer information and rights, decision-making research, law, and cognitive psychology.

Once the items were developed, we conducted two rounds of cognitive interviews with a total of 21 Medicare beneficiaries. Cognitive testing is routinely used for survey questionnaire development (Forsyth and Lessler, 1991; DeMaio and Rothgeb, 1996). Cognitive interviews provide information about item comprehension, information retrieval, and decision processes. The items were revised based on the results of the cognitive interviews. After the final items were developed, CMS and Westat made further revisions of the items, such as changing some response options to true/false, before adding them to the MCBS. It is important to note that these changes may have altered beneficiaries' use and interpretation of the items from that found during the cognitive testing.

Table 2.2 presents 41 of the knowledge items that were pilot tested during Round 36 of the MCBS. In addition, we analyzed 14 knowledge items that had been included in Round 35 of the MCBS. Although these items were not developed as a part of the pool of new knowledge items, they were completed by the same set of respondents. All of the knowledge items are grouped according to the original content areas used while developing the Round 36 items.

Table 2.3 presents the pool of health literacy items administered during Round 36. Two types of questions were included. The first set of questions measures beneficiaries' knowledge of terms associated with Medicare and health insurance, referred to as the health literacy terminology questions. The second set of questions contains five different scenarios designed to evaluate the ability of beneficiaries to use information presented in the *Medicare & You* handbook to answer related questions which are referred to as the health literacy reading comprehension questions. The *Medicare & You* handbook was selected for the reading excerpts because it is provided by CMS to all Medicare beneficiaries and is a primary source of information about the Medicare program.

2.3 Psychometric Analyses

To evaluate the psychometric properties of the items, we began by computing descriptive statistics for each item, including the percentage of correct and don't know responses. Next, we conducted exploratory factor analyses to determine whether the items met the IRT assumption of unidimensionality. Because the items were coded dichotomously (i.e., correct vs. incorrect), tetrachoric correlations were computed and an unweighted least squares factor analyses with promax rotation was conducted. Based on the factor analysis results, we divided the items into unidimensional groupings and ran 1-, 2-, and 3-parameter logistic IRT models. All of the IRT models were computed using the Multilog for Windows software program (Scientific Software International, 2003). We compared the log-likelihood values of these models to determine the best-fitting IRT model which was then used to calibrate the items.

Based on the IRT parameters as well as content considerations, we selected the best performing items and developed three equivalent knowledge and health literacy quizzes. Scoring algorithms were created for each form and the internal consistency of the forms was assessed using Cronbach's alphas (Cronbach, 1951). To evaluate the construct validity of the quizzes, we conducted analyses of variance (ANOVAs) and t-tests to compare the quiz scores by groups that should vary with respect to knowledge and/or health literacy. Based on prior studies, we expected higher knowledge and/or health literacy quiz scores for respondents who: (1) have more education, (2) have greater self-reported knowledge of Medicare, (3) reported less difficulty understanding Medicare and insurance options, (4) read more of the *Medicare & You* handbook, and (5) participated in their health insurance decisions (Bann & Berkman, 2002; Bann, Berkman, & Kuo, 2004). Due to the study design, respondents who completed the health literacy questions did not complete all of the items used for the group comparisons of the knowledge questions. Therefore, we were only able to compare health literacy quiz scores according to education, self-reported knowledge and understanding of Medicare, and amount of handbook read.

Table 2.2. MCBS Medicare Knowledge Questions by Original Content Areas

Item #	Question
Eligibility for and Structure of Original Medicare	
KN35	Medicare covers an annual flu shot. (*True*/False)
KN39	Medicare without a supplemental insurance policy pays for all of your health care expenses. (True/*False*)
KN40	Some people with lower incomes can get help paying for Medicare's premiums. (*True*/False)
MK4	People are eligible for Medicare because they have low or moderate incomes. (True/*False*)
MK5	Part A of the Medicare program covers hospital stays. (*True*/False)
MK6	Part B of the Medicare program covers medical services like doctors' visits. (*True*/False)
MK7	The premium, or monthly payment, that Medicare beneficiaries have to pay for doctors' visits and other medical services, can change at any time during the year. (True/*False*)
MK8	Some people with lower incomes can get help paying for Medicare's premiums. (*True*/False)
MK9	Medicare without a Medigap or supplemental insurance policy pays for all of your health care expenses. (True/*False*)
MK10	Medicare covers some preventive and screening services such as colorectal cancer screening. (*True*/False)
MK11a	Covered by Original Medicare? – Routine eye exams (Covered/*Not covered*)
MK11b	Covered by Original Medicare? – Annual dental exams (Covered/*Not covered*)
MK11c	Covered by Original Medicare? – Home health care services (*Covered*/Not covered)
MK11d	Covered by Original Medicare? – Prescription drugs outside the hospital (Covered/*Not covered*)
MK11e	Covered by Original Medicare? – Six-month stay in a nursing home (Covered/*Not covered*)
MK11f	Covered by Original Medicare? – Hospital emergency room visit for a life-threatening situation (*Covered*/Not covered)
MK23	Would the Original Medicare plan usually cover routine health care received while a Medicare beneficiary is traveling outside the United States? (Yes/*No)*

Table 2.2 (Continued)

Item #	Question
Medicare + Choice	
KN42	Medicare managed care plans (HMOs) often cover more health services, like prescribed medicines, than Medicare without a supplemental insurance policy. (*True*/False)
KN43	With a Medicare HMO, people can go to any doctor or hospital in the United States for routine care and the visit will be covered. (True/*False*)
KN44	If your Medicare HMO stops serving people with Medicare in your area, you can join another HMO if one is available. (*True*/False)
KN45	If your Medicare HMO leaves the Medicare program and you do not choose another one, you will be covered by the Original Medicare plan. (*True*/False)
KN46	A Medicare HMO can raises its fees or changes its benefits each year. (*True*/False)
MK12	Medicare beneficiaries can sign up to get their health care through a Medicare+Choice plan instead of the Original Medicare plan. (*True*/False)
MK13	When someone who is enrolled in a Medicare HMO goes to the hospital emergency room visit for a life-threatening situation, the visit will be covered. (*True*/False)
MK14	A beneficiary who is enrolled in a Medicare HMO can go to any doctor or hospital in the United States for routine care and the visit will be covered. (True/*False*)
MK15	In most cases, a beneficiary who is enrolled in a Medicare HMO can see a specialist without a referral and the visit will be covered. (True/*False*)
MK16	A Medicare HMO plan can change its monthly premium at any time during the year. (True/*False*)
MK17	If a Medicare HMO leaves the Medicare program, a beneficiary who was enrolled in it can join another HMO if one is available in their area. (*True*/False)
MK18	If a Medicare HMO leaves the Medicare program and the enrolled beneficiary does not choose another HMO, the beneficiary will automatically be returned to the Original Medicare plan. (*True*/False)
MK19	If a Medicare HMO leaves the Medicare program and the enrolled beneficiary does not choose another one, the beneficiary will be assigned to another HMO. (True/*False*)
MK20	Medicare Private Fee-for-Service plans are only available to people who have health insurance through their employer. (True/*False*)
MK21	Medicare beneficiaries can join a Medicare Private Fee-for-Service plan if one is available in their area. (*True*/False)
MK22	A Medicare Private Fee-for-Service plan provides benefits not usually covered by Medicare, but the cost for covered services may be more. (*True*/False)
MK24	Would a Medicare HMO plan usually cover routine health care received while a Medicare beneficiary is traveling outside the United States? (Yes/*No*)

Table 2.2 (Continued)

Item #	Question
Plan Choices and Health Plan Decision-Making	
KN37	Most people covered by Medicare can select among different kinds of health plan options within Medicare. (*True*/False)
KN38	Your out-of-pocket costs will vary depending on which health plan options you choose. (*True*/False)
MK25	No matter which health insurance option you choose, your out-of-pocket costs will be the same. (True/*False*)
MK26	Which type of health insurance option gives people more freedom to choose the doctors and hospitals they want to go to? (*Original Medicare*/Medicare HMO/Both)
MK27	Which type of health insurance option is more likely to cover prescription drugs outside of a hospital? (Original Medicare/*Medicare HMO*/Both)
MK28	Which type of health insurance option covers preventive care services? (Original Medicare/Medicare HMO/*Both*)
Information and Assistance	
KN47	Medicare offers a free information and counseling service in your state that beneficiaries can use to help them understand and compare health insurance options. (*True*/False)
KN48	In order to answer your Medicare questions, the Medicare program offers various ways for you to receive information and help. (*True*/False)
MK37	Information is available about the quality of care people get with different Medicare health insurance options. (*True*/False)
MK38	The Medicare program does not have its own Internet website. (True/*False*)
MK39	When can you call 1-800-MEDICARE to speak to someone at Medicare about your questions? (Only during business hours/Only on the weekends/*24 hours a day, 7 days a week)*
MK40	Is there a service or a place in your area where people with Medicare can get help understanding and comparing health insurance options? (*Yes*/No)

Table 2.2 (Continued)

Item #	Question
Beneficiary Rights	
KN49	People can report complaints to Medicare about their Medicare managed care plans (HMOs) or supplemental insurance policies if they are not satisfied with them. (*True*/False)
MK34	As a part of the Original Medicare plan, you have the right to appeal any decision made about which health care services Medicare will pay for. (*True*/False)
MK35	You have the right to appeal a Medicare HMO plan's decision about which health care services it will pay for. (*True*/False)
MK36	If you have Medicare, your health insurance plan or your doctor must keep your information private, unless you give your permission for them to share it. (*True*/False)
Medigap/Employer-Sponsored Supplemental Insurance	
KN41	If you had a Medigap or supplemental insurance policy and dropped it, you could get it back at any time
MK29	If you have a Medicare HMO, you need to also buy a Medigap or supplemental insurance policy. (True/*False*)
MK30	Medicare beneficiaries can buy a Medigap or supplemental health insurance policy at any time, regardless of their health. (True/*False*)
MK31	If you had a Medigap or supplemental insurance policy and canceled it, when could you get it back? (At any time/*Only under certain circumstance*s/Never)
MK32	During the six months after a person is enrolled in Medicare Part B, can an insurance company refuse to sell the person a Medigap supplemental policy? (Yes/*No*)

Note: Correct answers are shown in italics.

Table 2.3. MCBS Health Literacy Questions

Item #	Question
Terminology	
MK44	Which of the following two statements defines the term appeal? • *A special kind of complaint you make if you disagree with a treatment or payment decision* • A request for more time to pay your medical bills
MK45	Which of the following two statements defines the term assignment? • When doctors bill you for the difference between what they charged and what Medicare paid • *When doctors accept the amount Medicare pays as payment in full*
MK46	A formulary is: • *A list of approved drugs* • Another word for a pharmacy
MK47	Preventive care is: • *Care you get to keep you healthy* • Care you get to treat an illness or disease that you have
MK48	Generic drugs: • Contain different active ingredients than brand name drugs • *Contain the same active ingredients as brand name drugs*
MK49	Outpatient care refers to: • *Care you get at a hospital without being admitted* • Care you get at a hospital when you are admitted
MK50	A provider network is a group of doctors, hospitals, and other health care professionals who: • Specialize in treating people with certain diseases • *Work with an HMO to take care of its members*
MK51	A primary care doctor is: • *A doctor trained to take care of your routine health care needs* • A doctor trained to treat special diseases or illnesses
MK52	The Medicare deductible is: • The amount that Medicare pays for your health care • *The amount you must pay for your health care before Medicare begins to pay*
MK53	Medigap refers to private supplemental health insurance policies that: • Require you to go to doctors or hospitals that are on an approved list • *Cover most costs that the Original Medicare plan does not cover*

Table 2.3 (Continued)

Item #	Question
Reading Comprehension	
MK59	Is information available in Spanish if you call 1-800-MEDICARE? (*Yes*, No)
MK60	Imagine that you call 1-800-MEDICARE because you lost your card and need to get a new one. Which number would you press? (*1*, 2, 3)
MK61	Imagine that you call 1-800-MEDICARE and want to speak with a customer service representative. Which number would you press? (*0*, 1, 2, 3)
MK62	How much did the doctor charge Medicare for this person's office visit on March 7, 2003? ($0, $44.35, *$55*, Any other amount)
MK63	How much did Medicare pay the doctor for the office visit on March 7, 2003? (*$0*, $44.35, $55, Any other amount)
MK64	According to this notice, how much of this person's 2003 deductible has been met? ($0, *$44.35*, $55, Any other amount)
MK65	The purpose of the Medicare Personal Plan Finder is to help you choose a primary care doctor. (True, *False*)
MK67	The Medicare Personal Plan Finder is available on the Medicare website, www.medicare.gov. (*True*, False)
MK69	People with Medicaid sometimes have their prescription drug costs covered. (*True*, False)
MK70	People with Medicaid sometimes have their nursing home care costs covered. (*True*, False)
MK71	The Medicaid program is run only by the Federal government. (True, *False*)
MK72	Are Medicaid programs different from one state to another? (*Yes*, No)
MK73	Which of the plans cover vision services? • *Silver Life – Silver Option 1 Plan* • Health Plan Plus – Senior Secure Plan • *Elder Health – Blue Choice Plan* • None of the Plans
MK74	Which of the plans cover routine physical exams? • Silver Life – Silver Option 1 Plan • Health Plan Plus – Senior Secure Plan • *Elder Health – Blue Choice Plan* • None of the Plans
MK75	Which of the plans has the lowest monthly premium? • Silver Life – Silver Option 1 Plan • *Health Plan Plus – Senior Secure Plan* • Elder Health – Blue Choice Plan
MK76	Which of the plans cover prescription drugs? • Silver Life – Silver Option 1 Plan • *Health Plan Plus – Senior Secure Plan* • Elder Health – Blue Choice Plan • None of the Plans

Note: Correct answers are shown in italics.

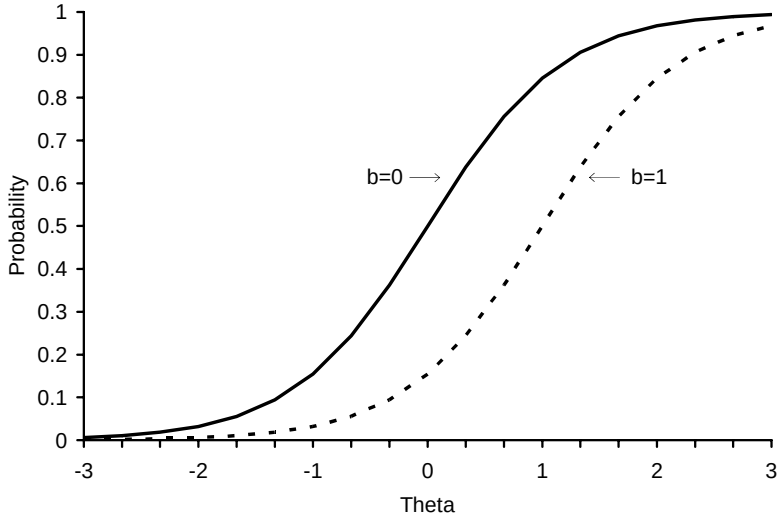
3. Item Response Theory

This section provides a brief introduction to Item Response Theory (IRT; Embretson & Reise, 2000; Hambleton, Swaminathan, & Rogers, 1991) to serve as a basis for understanding the analyses described in this report. IRT uses responses to questionnaire items to estimate an individual's level on an underlying construct (denoted as θ). For example, in the present study, responses to the MCBS knowledge items may be used to estimate a beneficiary's knowledge of the Medicare program.

IRT computes statistical models to describe the relationship between an individual's response to an item and the underlying construct. Because the MCBS knowledge and health literacy items were coded into two categories (correct vs. incorrect), there are three possible IRT models that may be used. For each model, a set of parameters is estimated to describe the characteristics of each item. The first model is the **1-parameter logistic (1PL) model**. As the name implies, the 1PL model estimates one parameter for each item; this parameter is called the **threshold** or *b* parameter. The threshold is the level of the underlying construct for which there is a 50 percent probability of answering the item correctly. An item with a threshold of 0 (i.e., at theta of 0 there is a 50 percent probability of a correct response) may be thought of as having an average level of difficulty. In this case, items with positive threshold parameters would have greater than average difficulty because they require a higher level of knowledge to reach the same probability of correctly answering the item (50 percent) while items with negative threshold parameters have lower than average difficulty.

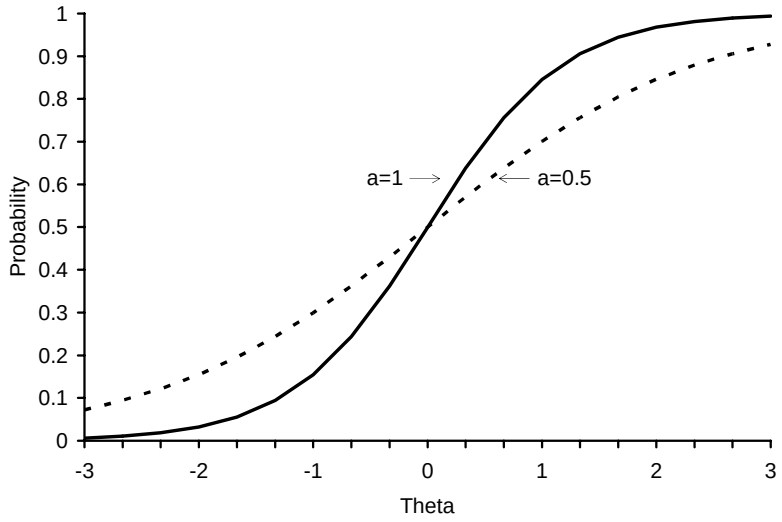
For illustration purposes, Figure 3.1 presents the **item characteristic curves (ICC)** for two items with different threshold parameters. The X-axis of an ICC represents the different levels of the construct and is denoted as theta (θ). The Y-axis of the ICC represents the probability of answering the item correctly. The ICC shows that as theta (i.e., knowledge) level increases, the probability of answering the item correctly increases. As shown in the figure, the item represented by the solid line has a threshold of 0 meaning that at theta equal to 0 there is a 50 percent probability of answering the item correctly. The second item represented by the dashed line is more difficult. It has a threshold of 1, indicating that a much higher theta (θ=1) is required to reach a 50 percent probability of a correct response.

Figure 3.1. Item Characteristic Curves of Items with Differing Threshold Parameters



The second type of IRT model is the **2-parameter logistic (2PL) model**. In addition to the threshold, the 2PL model estimates a **slope** or *a* parameter for each item. The slope is a measure of the ability of the item to discriminate between respondents above and below the threshold. Figure 3.2 presents the ICCs for an item with a slope of 1 (represented by the solid line) and an item with a slope of 0.5 (represented by the dashed line). The item with the higher slope is steeper and therefore has a better ability to discriminate between respondents.

Figure 3.2. Item Characteristic Curves of Items with Differing Slope Parameters

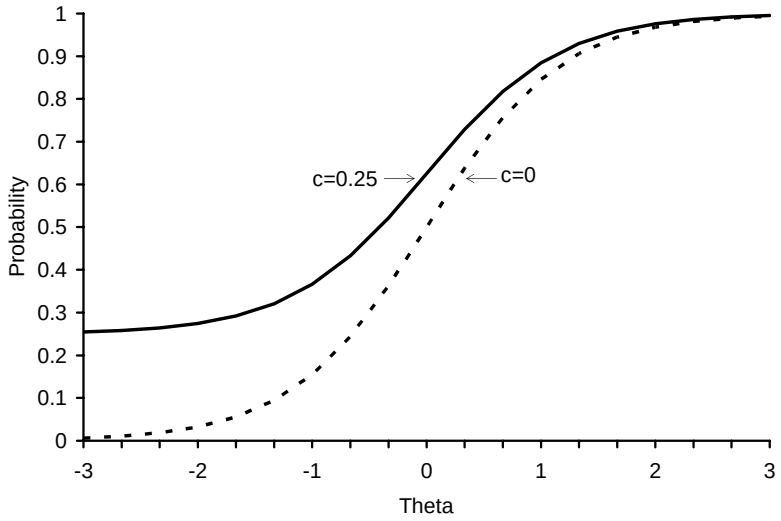


Finally, the third type of IRT model for dichotomous items is the **3-parameter logistic (3PL) model**. In addition to the slope and threshold parameters, the 3PL model includes a **guessing** or *c* parameter to help explain why some respondents with low knowledge levels answer an item correctly. As shown in Figure 3.3, when an item has a guessing parameter equal to 0, individuals with very low levels on theta are expected to have near 0 probabilities of answering the item correctly. However, for an item with a guessing parameter of 0.25, the probability of a correct response does not drop lower than 0.25.

Item Response Theory has several useful features. First, the person and item parameters are placed on the same scale, allowing an item to be selected to match an individual's ability level. Next, the information about both the individual's responses and the item parameters are used to compute scores. For example, rather than simply computing the number of knowledge questions a respondent answered correctly, IRT also uses information about the characteristics of the items (e.g., item difficulty) to compute a more precise knowledge score. Another useful feature is that IRT computes standard error estimates for each level of the construct rather than assuming average standard errors across all levels. This feature allows us to develop a test that has the greatest precision for the ability level of our target population.

Along with these useful features, most IRT models require that the items meet two primary assumptions. First, the items must form a single, unidimensional construct.[1] Second, the items must be locally independent. Local independence requires that the only dependencies between items be due to the construct of interest. Before conducting an IRT analysis, it is necessary to verify that the items meet these assumptions. For example, a factor analysis may be used to determine if the items form a single underlying factor.

Figure 3.3. Item Characteristic Curves of Items with Differing Guessing Parameters



[1] Some multidimensional IRT models are currently under development, but are not widely available.

4. Medicare Knowledge Quizzes

This chapter describes the development and psychometric evaluation of the Medicare knowledge quizzes. We began by exploring the properties of the knowledge items, using descriptive statistics, factor analyses, and IRT analyses. Based on this information, we selected items for the three alternate forms of each quiz and then evaluated the reliability and validity of the quiz forms.

4.1 Descriptive Statistics

Tables 4.1 and 4.2 display the percentage of correct and don't know responses for the knowledge items included in Rounds 35 and 36, respectively. Overall, more difficult items (i.e., those with lower percentages correct) tended to have higher don't know percentages while less difficult items had fewer don't know responses. These results suggest that beneficiaries seem to use the don't know response when they do not know the answer to the question rather than guessing the answer. Of the knowledge items, items KN35 (Medicare covers an annual flu shot) and MK36 (Insurance plan and doctor must keep information private) had the highest percentages correct (89% and 86%, respectively). In contrast, questions MK16 (Medicare HMO can change monthly premium at any time) and MK19 (If HMO leaves Medicare and do not choose one, will be assigned to another HMO) had the lowest percentages correct (25% and 26%, respectively), suggesting that beneficiaries generally had less knowledge of HMOs.

4.2 Dimensionality

To evaluate the dimensionality of the items, we computed tetrachoric correlations and conducted both principal components analyses and exploratory factor analyses. Based on the scree plots, eigenvalues, and interpretability of the factors, it appears that the items form two factors; the corresponding eigenvalues were 15.5 and 3.7[2]. The factor loadings from the exploratory factor analysis with promax rotation are presented in Table 4.3. The first factor (Factor 1) represents knowledge of Medicare+Choice options. Items loading highly on this factor include MK12 (Can get health care through a Medicare+Choice plan), MK 17 (If HMO leaves Medicare, can join another HMO), and MK 35 (Medicare HMO-Right to appeal decision about coverage). This factor also includes the items related to Private Fee-for-Service plans, such as MK21 (Can join a Private Fee-for-Service plan if one is available) and MK22 (Private Fee-for-Service plan provides benefits not usually covered by Medicare). Some of the items related to information and assistance also load on this factor, possibly because beneficiaries tend to use these services to make choices among Medicare+Choice plans. Factor 2 contains the items related to Original Medicare. Items loading highly on this factor include MK6 (Part B covers medical services), MK9 (Medicare without a supplemental policy pays all health care expenses), and MK11d (Original Medicare-Coverage of prescription drugs outside of hospital).

[2] The eigenvalues are based on a principal components analysis.

Table 4.1. Percentage of Correct and Don't Know Responses by Item – Round 35

Item #	Description	% Correct	% Don't Know
KN35	Medicare covers an annual flu shot	89	10
KN37	Most people covered by Medicare can select among different kinds of health plan options within Medicare	56	39
KN38	Your out-of-pocket costs will vary depending on which health plan options you choose	70	27
KN39	Medicare without a supplemental insurance policy pays for all of your health care expenses	83	13
KN40	Some people with lower incomes can get help paying for Medicare's premiums	55	40
KN41	If you had a Medigap or supplemental insurance policy and dropped it, you could get it back at any time	35	53
KN42	Medicare managed care plans (HMOs) often cover more health services, like prescribed medicines, than Medicare without a supplemental insurance policy	35	51
KN43	With a Medicare HMO, people can go to any doctor or hospital in the United States for routine care and the visit will be covered	49	42
KN44	If your Medicare HMO stops serving people with Medicare in your area, you can join another HMO if one is available	41	53
KN45	If your Medicare HMO leaves the Medicare program and you do not choose another one, you will be covered by the Original Medicare plan	40	51
KN46	A Medicare HMO can raises its fees or changes its benefits each year	55	42
KN47	Medicare offers a free information and counseling service in your state that beneficiaries can use to help them understand and compare health insurance options	42	40
KN48	In order to answer your Medicare questions, the Medicare program offers various ways for you to receive information and help.	74	24
KN49	People can report complaints to Medicare about their Medicare managed care plans (HMOs) or supplemental insurance policies if they are not satisfied with them	70	26

Table 4.2. Percentage of Correct and Don't Know Responses by Item – Round 36

Item #	Description	% Correct	% Don't Know
MK4	Eligible for Medicare because of low incomes	71	15
MK5	Part A covers hospital stays	68	24
MK6	Part B covers medical services	75	19
MK7	Premium for doctors' visits and other medical services can change at any time	40	31
MK8	Some people with lower incomes can get help paying for Medicare's premiums	52	38
MK9	Medicare without a supplemental policy pays for all health care expenses	83	13
MK10	Medicare covers some preventive services	70	26
MK11a	Original Medicare - Coverage of routine eye exams	49	10
MK11b	Original Medicare - Coverage of annual dental exams	81	10
MK11c	Original Medicare - Coverage of home health care services	55	22
MK11d	Original Medicare - Coverage of prescription drugs outside the hospital	82	7
MK11e	Original Medicare - Coverage of six-month stay in a nursing home	46	32
MK11f	Original Medicare - Coverage of hospital emergency room visit	82	11
MK12	Can get health care through a Medicare+Choice plan	43	50
MK13	Medicare HMO – Coverage of hospital emergency room visit	52	41
MK14	Beneficiary in Medicare HMO can go to any doctor and visit will be covered	50	36
MK15	Beneficiary in Medicare HMO can see a specialist without a referral and visit will be covered	58	35
MK16	Medicare HMO plan can change monthly premium at any time	25	51
MK17	If HMO leaves Medicare, can join another HMO	46	50
MK18	If HMO leaves Medicare and do not choose another HMO, will automatically be returned to Original Medicare plan	39	54
MK19	If HMO leaves Medicare and do not choose one, will be assigned to another HMO	26	62
MK20	Private Fee-for-Service plans only available to those with employer insurance	29	63
MK21	Can join a Private Fee-for-Service plan if one is available	38	58
MK22	Private Fee-for-Service plan provides benefits not usually covered by Medicare	31	64

Table 4.2. (Continued)

Item #	Description	% Correct	% Don't Know
MK23	Original Medicare – Coverage of health care outside United States	40	36
MK24	Medicare HMO – Coverage of health care outside United States	44	43
MK25	Out-of-pocket costs same for each health insurance option	50	37
MK26	Which health insurance option gives more freedom to choose doctors	63	16
MK27	Which health insurance option is more likely to cover prescription drugs	40	27
MK28	Which health insurance option covers preventive care services	42	24
MK29	If have a Medicare HMO, also need to buy a Medigap policy	38	43
MK30	Beneficiaries can buy a Medigap policy at any time, regardless of their health	27	41
MK31	If cancel Medigap policy, when can you get it back?	41	35
MK32	During six months after enrolling in Part B, can insurance company refuse to sell a Medigap policy?	30	51
MK34	Original Medicare – Right to appeal decision about coverage	78	17
MK35	Medicare HMO – Right to appeal decision about coverage	52	41
MK36	Insurance plan and doctor must keep information private	86	11
MK37	Information on quality of care is available	48	42
MK38	Medicare program does not have its own Internet website	49	43
MK39	When can call 1-800-MEDICARE to speak to someone at Medicare	53	18
MK40	Place where can get help understanding health insurance options	48	37

Table 4.3. Results of Two-Factor Exploratory Factor Analysis

Item #	Description	Factor 1: Medicare + Choice	Factor 2: Original Medicare
Round 35			
KN35	Medicare covers an annual flu shot	0.12	**0.37**
KN37	Most people covered by Medicare can select among different kinds of health plan options within Medicare	**0.46**	0.15
KN38	Your out-of-pocket costs will vary depending on which health plan options you choose	**0.50**	0.21
KN39	Medicare without a supplemental insurance policy pays for all of your health care expenses	0.20	**0.50**
KN40	Some people with lower incomes can get help paying for Medicare's premiums	**0.36**	0.13
KN41	If you had a Medigap or supplemental insurance policy and dropped it, you could get it back at any time	0.10	**0.34**
KN42	Medicare managed care plans (HMOs) often cover more health services, like prescribed medicines, than Medicare without a supplemental insurance policy	**0.70**	-0.13
KN43	With a Medicare HMO, people can go to any doctor or hospital in the United States for routine care and the visit will be covered	**0.58**	0.08
KN44	If your Medicare HMO stops serving people with Medicare in your area, you can join another HMO if one is available	**0.86**	-0.18
KN45	If your Medicare HMO leaves the Medicare program and you do not choose another one, you will be covered by the Original Medicare plan	**0.76**	-0.10
KN46	A Medicare HMO can raises its fees or change its benefits each year	**0.76**	-0.14
KN47	Medicare offers a free information and counseling service in your state that beneficiaries can use to help them understand and compare health insurance options	**0.46**	0.11
KN48	In order to answer your Medicare questions, the Medicare program offers various ways for you to receive information and help.	**0.41**	0.24
KN49	People can report complaints to Medicare about their Medicare managed care plans (HMOs) or supplemental insurance policies if they are not satisfied with them	**0.53**	0.07

Table 4.3 (Continued)

Item #	Description	Factor 1: Medicare + Choice	Factor 2: Original Medicare
Round 36			
MK4	Eligible for Medicare because of low incomes	0.08	**0.65**
MK5	Part A covers hospital stays	0.01	**0.41**
MK6	Part B covers medical services	0.03	**0.50**
MK7	Premium for doctors' visits and other medical services can change at any time	0.13	**0.45**
MK8	Some people with lower incomes can get help paying for Medicare's premiums	0.16	0.17
MK9	Medicare without a supplemental policy pays for all health care expenses	0.11	**0.71**
MK10	Medicare covers some preventive services	0.21	**0.50**
MK11a	Original Medicare - Coverage of routine eye exams	-0.08	**0.43**
MK11b	Original Medicare - Coverage of annual dental exams	-0.11	**0.72**
MK11c	Original Medicare - Coverage of home health care services	0.03	0.26
MK11d	Original Medicare - Coverage of prescription drugs outside the hospital	-0.24	**0.76**
MK11e	Original Medicare - Coverage of six-month stay in a nursing home	-0.06	**0.35**
MK11f	Original Medicare - Coverage of hospital emergency room visit	0.11	**0.46**
MK12	Can get health care through a Medicare+Choice plan	**0.67**	0.09
MK13	Medicare HMO – Coverage of hospital emergency room visit	**0.71**	-0.06
MK14	Beneficiary in Medicare HMO can go to any doctor and visit will be covered	**0.51**	0.28
MK15	Beneficiary in Medicare HMO can see a specialist without a referral and visit will be covered	**0.59**	0.24
MK16	Medicare HMO plan can change monthly premium at any time	**0.54**	0.05
MK17	If HMO leaves Medicare, can join another HMO	**0.83**	-0.06
MK18	If HMO leaves Medicare and do not choose another HMO, will automatically be returned to Original Medicare plan	**0.75**	-0.03
MK19	If HMO leaves Medicare and do not choose one, will be assigned to another HMO	**0.66**	0.05
MK20	Private Fee-for-Service plans only available to those with employer insurance	**0.34**	0.16
MK21	Can join a Private Fee-for-Service plan if one is available	**0.60**	0.01

Table 4.3 (Continued)

Item #	Description	Factor 1: Medicare + Choice	Factor 2: Original Medicare
MK22	Private Fee-for-Service plan provides benefits not usually covered by Medicare	**0.60**	0.03
MK23	Original Medicare – Coverage of health care outside United States	0.23	0.14
MK24	Medicare HMO – Coverage of health care outside United States	**0.33**	0.17
MK25	Out-of-pocket costs same for each health insurance option	**0.40**	0.29
MK26	Which health insurance option gives more freedom to choose doctors	-0.04	**0.63**
MK27	Which health insurance option is more likely to cover prescription drugs	**0.42**	0.20
MK28	Which health insurance option covers preventive care services	**0.35**	0.00
MK29	If have a Medicare HMO, also need to buy a Medigap policy	**0.70**	-0.02
MK30	Beneficiaries can buy a Medigap policy at any time, regardless of their health	0.10	0.29
MK31	If cancel Medigap policy, when can you get it back?	0.28	**0.30**
MK32	During six months after enrolling in Part B, can insurance company refuse to sell a Medigap policy?	0.16	0.19
MK34	Original Medicare – Right to appeal decision about coverage	0.26	**0.46**
MK35	Medicare HMO – Right to appeal decision about coverage	**0.59**	-0.01
MK36	Insurance plan and doctor must keep information private	0.28	**0.46**
MK37	Information on quality of care is available	**0.35**	0.19
MK38	Medicare program does not have its own Internet website	0.29	**0.31**
MK39	When can call 1-800-MEDICARE to speak to someone at Medicare	0.16	0.17
MK40	Place where can get help understanding health insurance options	**0.36**	0.19

Note: Factor loadings greater than or equal to .30 are shown in bold.

Ideally, all of the knowledge items would have formed one factor, representing overall knowledge of Medicare. If this were the case, we could compute IRT parameters for all of the items together and then use those parameters to create several different knowledge forms containing any combination of the items. However, the factor analysis results clearly suggest that the items form more than one factor. In addition, the division of items into Original Medicare and Medicare+Choice items reflects the structure of the Medicare program in which beneficiaries have these two possible avenues for receiving their Medicare benefits. Although IRT can be fairly robust to violations of unidimensionality, valuable information could be lost by failing to take this distinction into account when developing the knowledge forms. Therefore, we developed separate Original Medicare and Medicare+Choice knowledge quizzes.

4.3 IRT Analyses

Based on the factor analysis results, we divided the items into two groups, representing knowledge of Original Medicare and Medicare+Choice[3]. We then computed 1-, 2-, and 3-parameter logistic models separately for the two groups of items. To determine the most appropriate IRT model for each set of items, the statistical fit of competing models was compared. Specifically, the difference between the negative twice the log-likelihood values for two alternative models was interpreted as a chi-square with degrees of freedom equal to the number of additional parameters estimated by the less-constrained model. In other words, the test for the comparison between a 1PL model and a 2PL model may be expressed as:

$$\chi^2 = (\text{-2*log-likelihood}_{1PL}) - (\text{-2*log-likelihood}_{2PL})$$

The test for the Original Medicare items indicates that the 2PL model provides a significantly better fit than the 1PL model ($\chi^2(13) = 261.5$, $p < .001$). Next, the 2PL model was compared to the 3PL model; the results indicate that the 3PL model does not provide a significant improvement in fit over the 2PL model ($\chi^2(14) = 0.0$, $p > .05$). In fact, the values for negative twice the log-likelihood were nearly identical in the two models. When the *c* parameters were freely estimated in the 3PL model, they generally remained equal to 0 as in the 2PL model, confirming that most respondents utilized the don't know option rather than guessing when they did not know the answer to the question. Overall, the model comparisons indicated that the 2PL model provided the best fit and therefore this model was used to evaluate the Original Medicare knowledge items.

Similar results were found for the Medicare+Choice items. The 2PL model significantly improved the fit over the 1PL model ($\chi^2(28) = 1084.1$, $p < .001$). However, no further improvement in fit was gained with the 3PL model ($\chi^2(29) = 4.5$, $p > .05$). Therefore, the 2PL model was also used to calibrate the Medicare+Choice items.

[3] When analyzing only the Round 36 knowledge items, Items 31, 36, and 38 loaded on the Medicare+Choice factor rather than the Original Medicare factor. Because these items do not appear to be consistent, they were excluded from the subsequent IRT analyses.

The final 2PL IRT parameters for the Original Medicare items are presented in Table 4.4. In general, most of the items had high slope parameters, indicating good discrimination ability; two exceptions are items MK11a and 11e which related to coverage of eye exams and nursing home stays. The majority of items tended to be on the mid- to lower end of difficulty with thresholds ranging from -2.55 to 0.46. Table 4.4 lists the final IRT parameters for the Medicare+Choice items. Almost all of the items had high slope parameters. Consistent with the percentages of correct responses reported earlier, these items appear to be slightly more difficult for respondents than the Original Medicare items with thresholds ranging from -1.21 to 1.18.

Table 4.4. Two-Parameter Logistic IRT Parameters for Original Medicare Items

Item #	Description	a	b
KN35	Medicare covers an annual flu shot	0.93	-2.55
MK4	Eligible for Medicare because of low incomes	1.73	-0.76
MK5	Part A covers hospital stays	0.83	-1.03
MK6	Part B covers medical services	1.05	-1.30
MK7	Premium for doctors' visits and other medical services can change at any time	1.17	0.46
MK9	Medicare without a supplemental policy pays for all health care expenses	1.15	-1.68
MK10	Medicare covers some preventive services	1.25	-0.90
MK11a	Original Medicare - Coverage of routine eye exams	0.66	0.03
MK11b	Original Medicare - Coverage of annual dental exams	1.54	-1.36
MK11d	Original Medicare - Coverage of prescription drugs outside the hospital	1.55	-1.37
MK11e	Original Medicare – Coverage of six month stay in nursing home	0.57	0.33
MK11f	Original Medicare – Coverage of emergency room visit	1.09	-1.71
MK26	Which health insurance option gives more freedom to choose doctors	1.26	-0.56
MK34	Original Medicare – Right to appeal decision about coverage	1.25	-1.29

Note: KN39 is excluded because it is identical to MK9

Table 4.5. Two-Parameter Logistic IRT Parameters for Medicare + Choice Items

Item #	Description	a	b
KN37	Most people covered by Medicare can select among different kinds of health plan options within Medicare	1.05	-0.27
KN38	Your out-of-pocket costs will vary depending on which health plan options you choose	1.25	-0.87
KN42	Medicare managed care plans (HMOs) often cover more health services, like prescribed medicines, than Medicare without a supplemental insurance policy	1.44	0.60
KN43	With a Medicare HMO, people can go to any doctor or hospital in the United States for routine care and the visit will be covered	1.35	0.05
KN44	If your Medicare HMO stops serving people with Medicare in your area, you can join another HMO if one is available	2.09	0.30
KN45	If your Medicare HMO leaves the Medicare program and you do not choose another one, you will be covered by the Original Medicare plan	1.79	0.35
KN46	A Medicare HMO can raises its fees or change its benefits each year	1.59	-0.16
KN47	Medicare offers a free information and counseling service in your state that beneficiaries can use to help them understand and compare health insurance options	0.97	-0.40
KN48	In order to answer your Medicare questions, the Medicare program offers various ways for you to receive information and help.	1.05	-1.21
KN49	People can report complaints to Medicare about their Medicare managed care plans (HMOs) or supplemental insurance policies if they are not satisfied with them	1.11	-0.95
MK12	Can get health care through a Medicare+Choice plan	1.85	0.23
MK13	Medicare HMO – Coverage of hospital emergency room visit	1.54	-0.09
MK14	Beneficiary in Medicare HMO can go to any doctor and visit will be covered	1.61	-0.01
MK15	Beneficiary in Medicare HMO can see a specialist without a referral and visit will be covered	1.86	-0.27
MK16	Medicare HMO plan can change monthly premium at any time	1.31	1.09
MK17	If HMO leaves Medicare, can join another HMO	2.45	0.13
MK18	If HMO leaves Medicare and do not choose another HMO, will automatically be returned to Original Medicare plan	2.03	0.37
MK19	If HMO leaves Medicare and do not choose one, will be assigned to another HMO	1.94	0.85
MK20	Private Fee-for-Service plans only available to those with employer insurance	0.87	1.18

Table 4.5 (Continued)

Item #	Description	a	b
MK21	Can join a Private Fee-for-Service plan if one is available	1.35	0.47
MK22	Private Fee-for-Service plan provides benefits not usually covered by Medicare	1.42	0.77
MK24	Medicare HMO – Coverage of health care outside United States	0.76	0.35
MK25	Out-of-pocket costs same for each health insurance option	1.15	0.00
MK27	Which health insurance option is more likely to cover prescription drugs	1.11	0.46
MK28	Which health insurance option covers preventive care services	0.61	0.54
MK29	If have a Medicare HMO, also need to buy a Medigap policy	1.74	0.45
MK35	Medicare HMO – Right to appeal decision about coverage	1.14	-0.12
MK37	Information on quality of care is available	0.80	0.09
MK40	Place where can get help understanding health insurance options	0.83	0.12

4.4 Development of Knowledge Quizzes

Now that the items have been calibrated, the IRT parameters may be used to develop alternate short forms of the knowledge quiz. Although each form of the knowledge quiz can contain a different set of items, the IRT parameters may be used to compute knowledge scores that are comparable. To illustrate the usefulness of the IRT parameters, we developed three possible alternate forms of each of the knowledge quizzes.

As noted by Smith, McCarthy, and Anderson (2000), short form developers often fail to consider content when constructing new forms. Ideally, a short form should cover the same content areas as the long form. Therefore, to develop the new knowledge quizzes, we began by classifying the items into content areas. As shown in Table 4.6, the Original Medicare items were grouped into two content areas: (1) coverage/benefits, and (2) program features/enrollment. The Medicare+Choice items were classified into five content areas: (1) coverage/benefits, (2) private fee-for-service plans, (3) plan rules, (4) enrollment/disenrollment, and (5) choosing a plan (see Table 4.7).

Table 4.6. Original Medicare Items by Content Area

Item #	Description
Coverage/Benefits	
KN35	Medicare covers an annual flu shot
MK5	Part A covers hospital stays
MK6	Part B covers medical services
MK10	Medicare covers some preventive services
MK11a	Original Medicare - Coverage of routine eye exams
MK11b	Original Medicare - Coverage of annual dental exams
MK11d	Original Medicare - Coverage of prescription drugs outside the hospital
MK11e	Original Medicare - Coverage of six-month stay in a nursing home
MK11f	Original Medicare - Coverage of hospital emergency room visit
Program Features/Enrollment	
MK4	Eligible for Medicare because of low incomes
MK7	Premium for doctors' visits and other medical services can change at any time
MK9	Medicare without a supplemental policy pays for all health care expenses
MK26	Which health insurance option gives more freedom to choose doctors
MK34	Original Medicare – Right to appeal decision about coverage

Table 4.7. Medicare + Choice Items by Content Area

Item #	Description
Coverage/Benefits	
KN42	Medicare managed care plans (HMOs) often cover more health services, like prescribed medicines, than Medicare without a supplemental insurance policy
MK13	Medicare HMO – Coverage of hospital emergency room visit
MK24	Medicare HMO – Coverage of health care outside United States
MK27	Which health insurance option is more likely to cover prescription drugs
MK28	Which health insurance option covers preventive care services
MK35	Medicare HMO – Right to appeal decision about coverage
Private Fee-for-Service Plans	
MK20	Private Fee-for-Service plans only available to those with employer insurance
MK21	Can join a Private Fee-for-Service plan if one is available
MK22	Private Fee-for-Service plan provides benefits not usually covered by Medicare
Plan Rules	
KN43	With a Medicare HMO, people can go to any doctor or hospital in the United States for routine care and the visit will be covered
MK14	Beneficiary in Medicare HMO can go to any doctor and visit will be covered
MK15	Beneficiary in Medicare HMO can see a specialist without a referral and visit will be covered
Enrollment/Disenrollment	
KN45	If HMO leaves Medicare and you do not choose another one, you will be covered by Original Medicare plan
KN46	A Medicare HMO can raises its fees or change its benefits each year
MK12	Can get health care through a Medicare+Choice plan
MK16	Medicare HMO plan can change monthly premium at any time
MK17	If HMO leaves Medicare, can join another HMO
MK18	If HMO leaves Medicare and do not choose another HMO, will automatically be returned to Original Medicare plan
MK19	If HMO leaves Medicare and do not choose one, will be assigned to another HMO
Choosing a Plan	
KN37	Most people covered by Medicare can select among different kinds of health plan options within Medicare
MK25	Out-of-pocket costs same for each health insurance option
MK29	If have a Medicare HMO, also need to buy a Medigap policy
MK37	Information on quality of care is available
MK40	Place where can get help understanding health insurance options

Items were selected so that each form would: (1) contain at least one item from each content area[4], (2) have similar total percentages correct, (3) include items with high slopes and a variety of difficulty levels, and (4) include items that seem most relevant from a policy standpoint. Balancing these criteria, we developed three knowledge forms (Forms A to C) each containing one Original Medicare quiz and one Medicare+Choice quiz. Each Original Medicare quiz contains four items and each Medicare+Choice quiz contains seven items for a total of 11 items on each form. The items comprising the Original Medicare and Medicare+Choice forms are presented in Tables 4.8 and 4.9, respectively.

Table 4.8. Items on Original Medicare Quizzes

Item #	Description	% Correct	a	b
Form A				
KN35	Medicare covers an annual flu shot	89%	0.93	-2.55
MK4	Eligible for Medicare because of low incomes	71%	1.73	-0.76
MK9	Medicare without a supplemental insurance policy pays for all of your health care expenses	83%	1.15	-1.68
MK34	Original Medicare – Right to appeal decision about coverage	78%	1.25	-1.29
Form B				
MK10	Medicare covers some preventive services	70%	1.25	-0.90
MK11b	Original Medicare - Coverage of annual dental exams	81%	1.54	-1.36
MK11f	Original Medicare – Coverage of emergency room visit	82%	1.09	-1.71
MK26	Which health insurance option gives more freedom to choose doctors	63%	1.26	-0.56
Form C				
MK5	Part A covers hospital stays	68%	0.83	-1.03
MK6	Part B covers medical services	75%	1.05	-1.30
MK11d	Original Medicare - Coverage of prescription drugs outside the hospital	82%	1.55	-1.37
MK26	Which health insurance option gives more freedom to choose doctors	63%	1.26	-0.56

[4] The Medicare+Choice items that refer to private fee-for-service plans were excluded due to the current low levels of enrollment in these plans.

Table 4.9. Items on Medicare+Choice Quizzes

Item #	Description	% Correct	a	b
Form A				
KN37	Most people covered by Medicare can select among different kinds of health plan options within Medicare	56%	1.05	-0.27
KN42	Medicare managed care plans (HMOs) often cover more health services, like prescribed medicines, than Medicare without a supplemental insurance policy	35%	1.44	0.60
KN43	With a Medicare HMO, people can go to any doctor or hospital in the United States for routine care and the visit will be covered	49%	1.35	0.05
KN45	If your Medicare HMO leaves the Medicare program and you do not choose another one, you will be covered by the Original Medicare plan	40%	1.79	0.35
KN46	A Medicare HMO can raises its fees or change its benefits each year	55%	1.59	-0.16
KN49	People can report complaints to Medicare about their Medicare managed care plans (HMOs) or supplemental insurance policies if they are not satisfied with them	70%	1.11	-0.95
MK25	Out-of-pocket costs same for each health insurance option	50%	1.15	0.00
Form B				
KN38	Your out-of-pocket costs will vary depending on which health plan options you choose	70%	1.25	-0.87
KN44	If your Medicare HMO stops serving people with Medicare in your area, you can join another HMO if one is available	41%	2.09	0.30
MK14	Beneficiary in Medicare HMO can go to any doctor and visit will be covered	50%	1.61	-0.01
MK15	Beneficiary in Medicare HMO can see a specialist without a referral and visit will be covered	58%	1.86	-0.27
MK28	Which health insurance option covers preventive care services	42%	0.61	0.54
MK35	Medicare HMO – Right to appeal decision about coverage	52%	1.14	-0.12
MK37	Information on quality of care is available	48%	0.80	0.09

Table 4.9 (Continued)

Item #	Description	% Correct	a	b
Form C				
KN47	Medicare offers a free information and counseling service in your state that beneficiaries can use to help them understand and compare health insurance options	42%	0.97	-0.40
KN49	People can report complaints to Medicare about their Medicare managed care plans (HMOs) or supplemental insurance policies if they are not satisfied with them	70%	1.11	-0.95
MK13	Medicare HMO – Coverage of hospital emergency room visit	52%	1.54	-0.09
MK17	If HMO leaves Medicare, can join another HMO	46%	2.45	0.13
MK18	If HMO leaves Medicare and do not choose another HMO, will automatically be returned to Original Medicare plan	39%	2.03	0.37
MK29	If have a Medicare HMO, also need to buy a Medigap policy	38%	1.74	0.45
MK35	Medicare HMO – Right to appeal decision about coverage	52%	1.14	-0.12

A useful feature of IRT is the ability to easily present the characteristics of the items graphically. Figures 4.1 to 4.6 display the item characteristic curves for the items on each quiz. The forms contain items with a range of threshold parameters and the curves for almost all of the items are steep, indicating good discrimination ability. As might be expected, items on the Original Medicare forms tend to have slightly lower than average difficulty while those on the Medicare+Choice forms have slightly higher than average difficulty.

Figure 4.1. Item Characteristic Curves for Original Medicare (Form A)

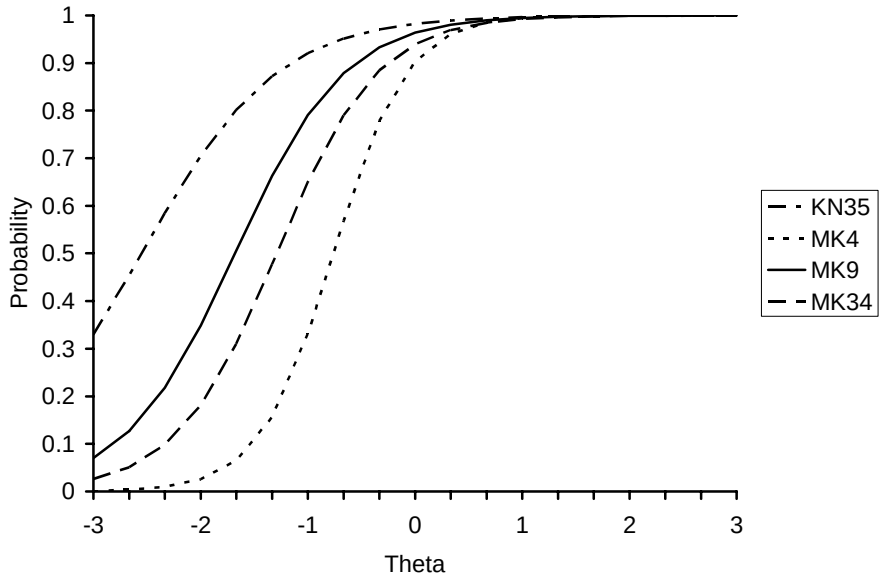


Figure 4.2. Item Characteristic Curves for Original Medicare (Form B)

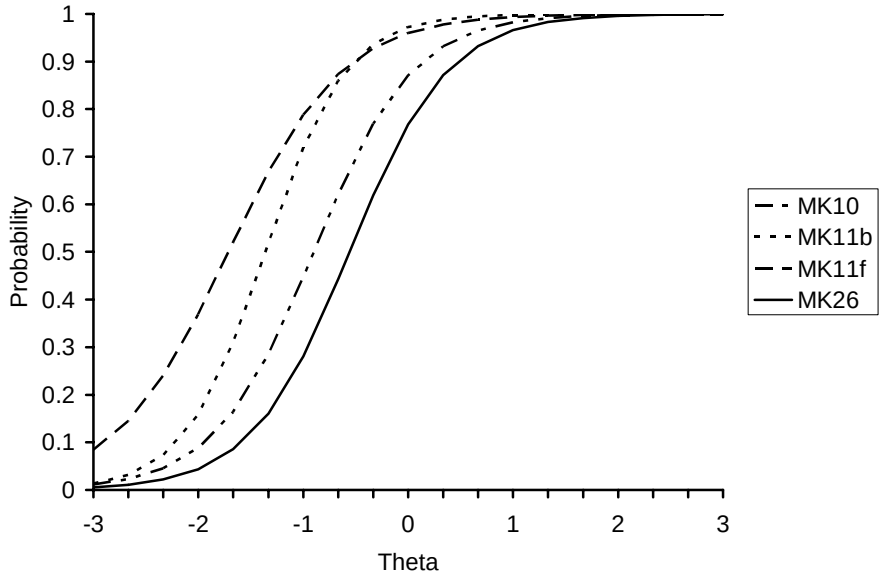


Figure 4.3. Item Characteristic Curves for Original Medicare (Form C)

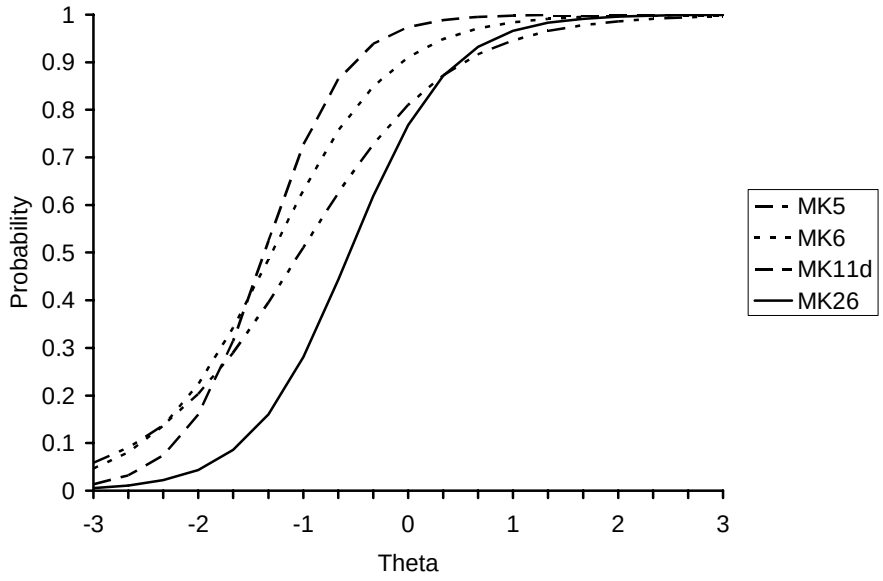


Figure 4.4. Item Characteristic Curves for Medicare+Choice (Form A)

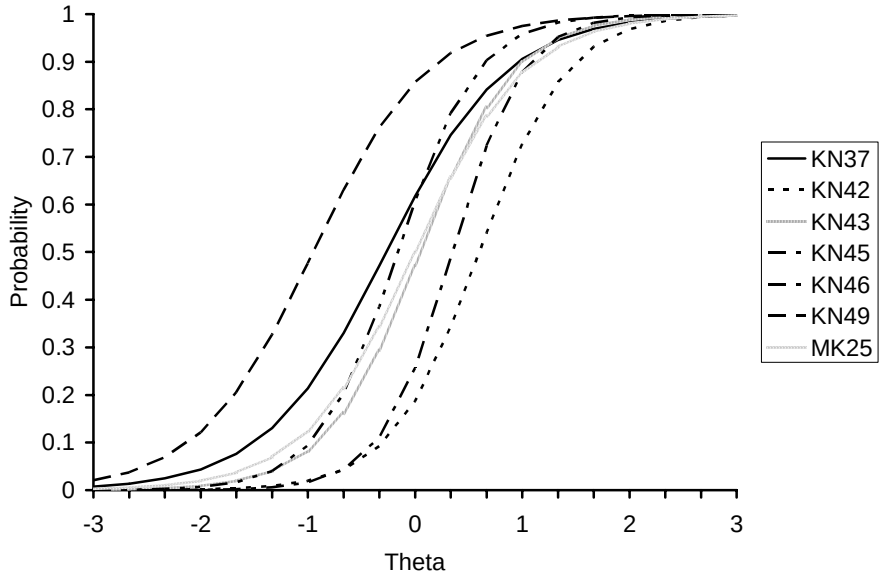


Figure 4.5. Item Characteristic Curves for Medicare+Choice (Form B)

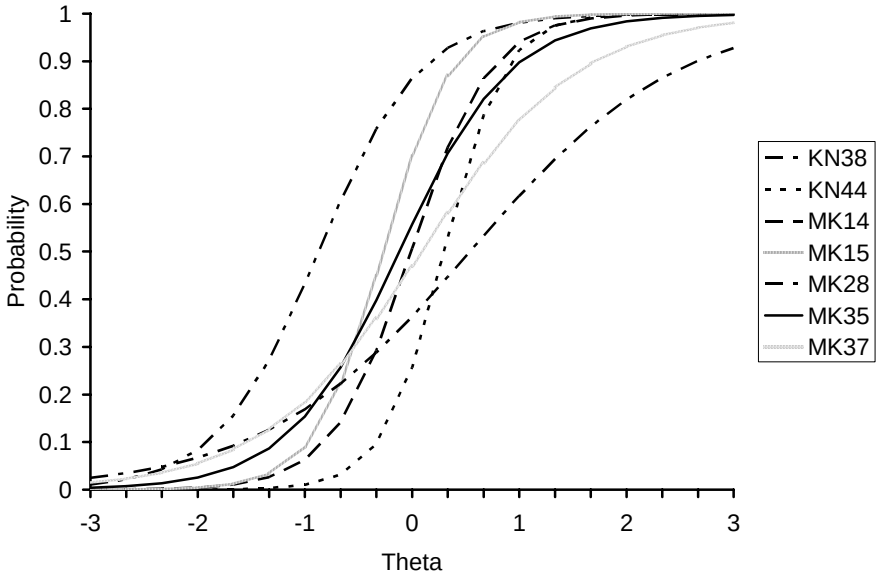
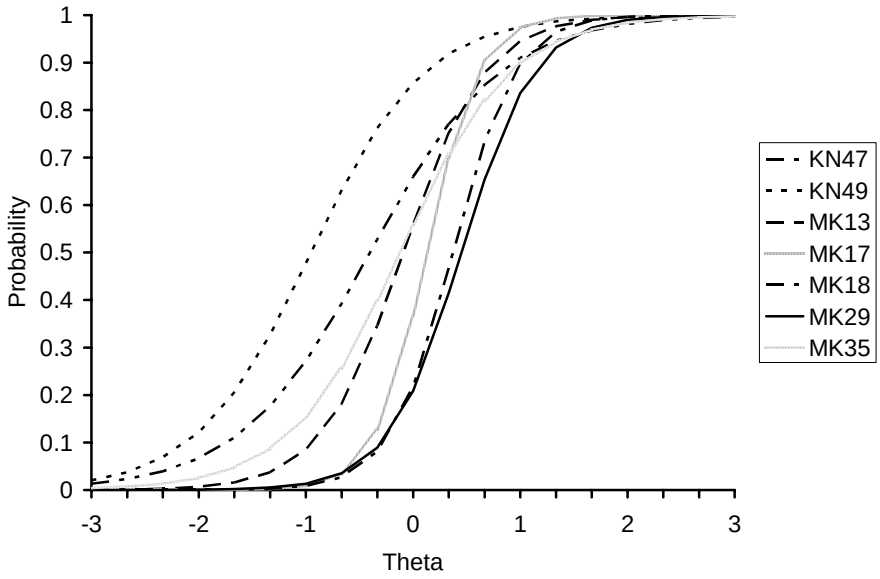
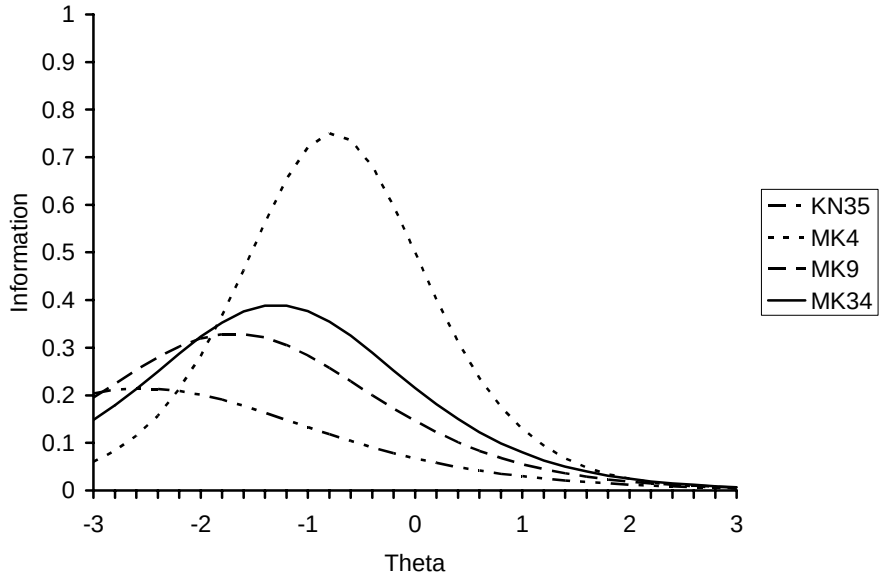


Figure 4.6. Item Characteristic Curves for Medicare+Choice (Form C)



Figures 4.7 to 4.12 present the item information curves for each form.[5] Information is the inverse of the standard error and indicates the precision of an item and/or test at a particular level of theta. As shown in Figures 4.7 to 4.9, items on the Original Medicare quizzes have the highest levels of information at theta levels below 0 which is consistent with the lower difficulty levels of the items. Among these items, MK4 (Eligible for Medicare because of low incomes) clearly is the most informative, reflecting its high slope (slope = 1.73). Figures 4.10 to 4.12 show that the information curves for the Medicare+Choice items generally peak at higher values for theta, indicating their greater difficulty. With respect to the Medicare+Choice items, KN45 (If HMO leaves Medicare, will be covered by the Original Medicare plan) was the most informative item.

Figure 4.7. Item Information Curves for Original Medicare (Form A)



[5] Scales of the Y-axes of the information curves vary across the quizzes to allow readers to distinguish between the curves for different items.

Figure 4.8. Item Information Curves for Original Medicare (Form B)

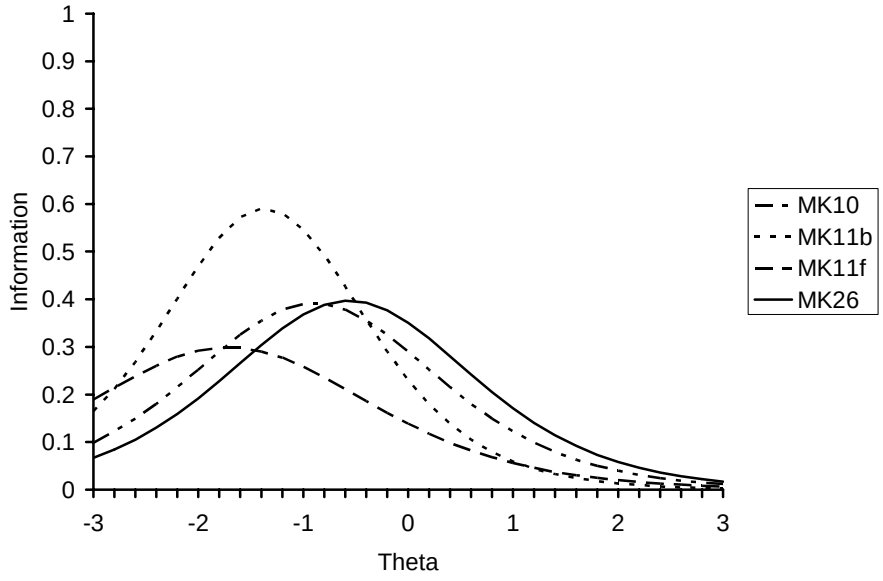


Figure 4.9. Item Information Curves for Original Medicare (Form C)

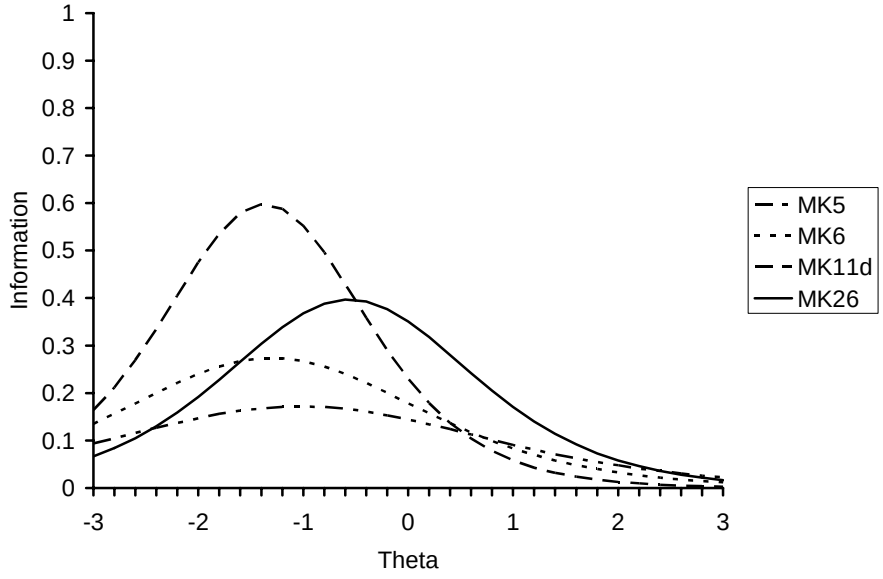


Figure 4.10. Item Information Curves for Medicare+Choice (Form A)

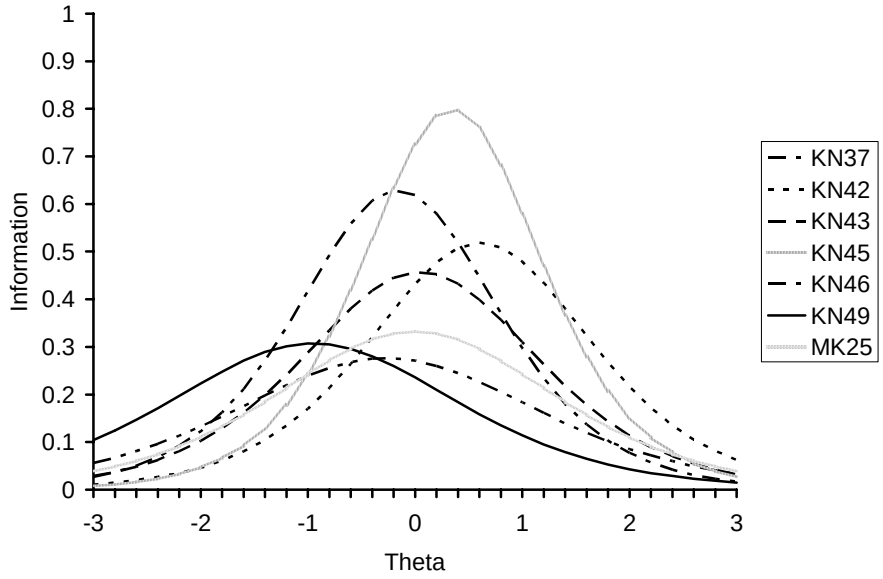


Figure 4.11. Item Information Curves for Medicare+Choice (Form B)

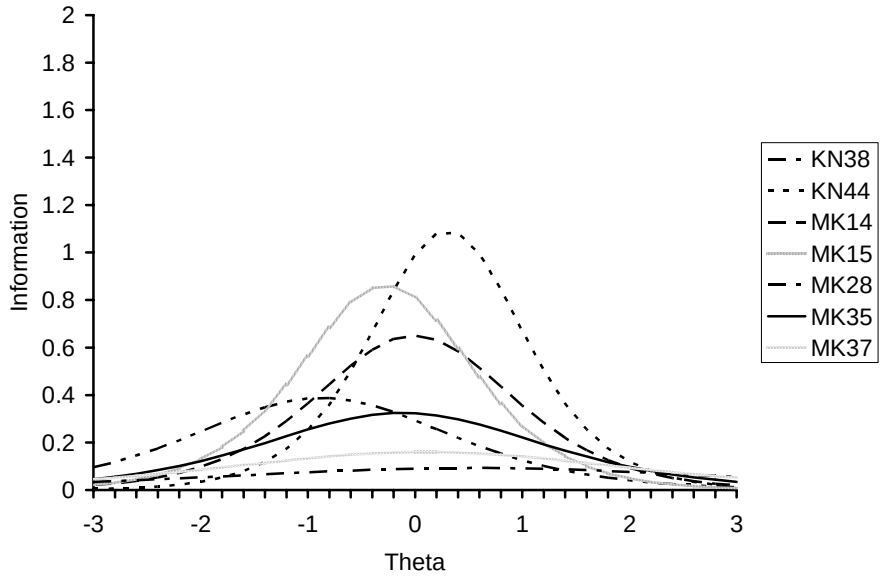
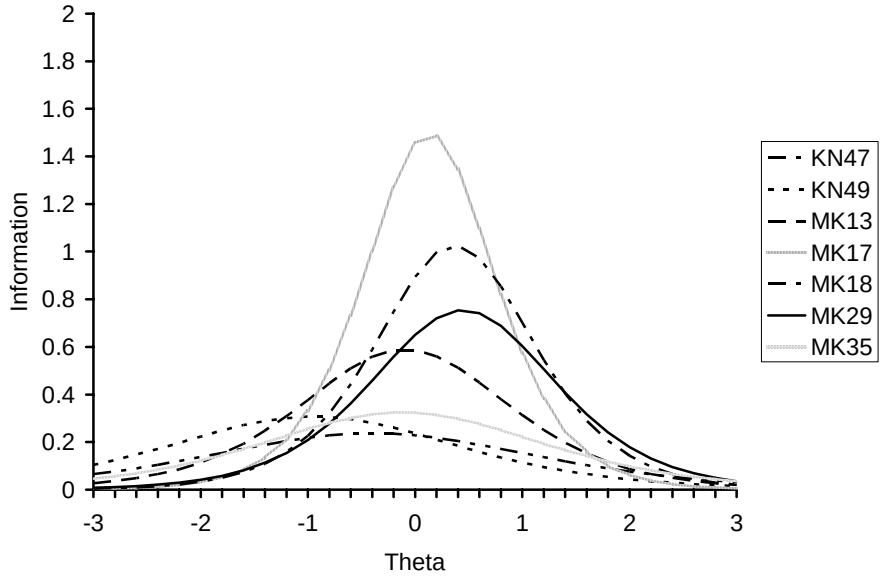


Figure 4.12. Item Information Curves for Medicare+Choice (Form C)



Using a procedure described by Rosa and colleagues (2001), we computed IRT scores which correspond to the number of items on the quiz form answered correctly. The IRT scores (referred to as the expected *a posteriori* or EAP*)* are expressed in terms of theta. In other words, an EAP of 0 represents a mid-level of knowledge while negative values are below average and positive values are above average. To make the scores more user-friendly and easy to interpret, we converted the EAPs into a 0 to 100 scale for the final knowledge scores.

The scoring tables are shown in Tables 4.10 to 4.12. The first column in each table shows the number of items the respondent answered correctly, the second column is the raw IRT score (EAP), and the third column is the score for the knowledge quiz. To use the scoring tables, simply compute the number of items a respondent answered correctly and then select the appropriate score from the table. For example, a respondent who answered two of the Original Medicare items correctly on Form A would receive a knowledge quiz score of 39.

Table 4.10. Scoring Algorithm for Knowledge Quiz - Form A

# of Correct Items	Raw IRT Score	Knowledge Quiz Score
Original Medicare Items		
0	-2.20	0
1	-1.60	21
2	-1.10	39
3	-0.55	58
4	0.48	95
Medicare + Choice Items		
0	-1.40	0
1	-0.89	21
2	-0.50	34
3	-0.17	46
4	0.13	56
5	0.44	67
6	0.81	80
7	1.40	100

Table 4.11. Scoring Algorithm for Knowledge Quiz - Form B

# of Correct Items	Raw IRT Score	Knowledge Quiz Score
Original Medicare Items		
0	-1.90	11
1	-1.40	28
2	-0.86	47
3	-0.29	67
4	0.60	99
Medicare + Choice Items		
0	-1.50	0
1	-0.94	19
2	-0.55	33
3	-0.22	44
4	0.09	55
5	0.44	67
6	0.87	82
7	1.30	97

Table 4.12. Scoring Algorithm for Knowledge Quiz - Form C

# of Correct Items	Raw IRT Score	Knowledge Quiz Score
Original Medicare Items		
0	-1.90	11
1	-1.30	32
2	-0.78	50
3	-0.20	71
4	0.63	100
Medicare + Choice Items		
0	-1.40	0
1	-0.89	21
2	-0.50	34
3	-0.18	46
4	0.11	56
5	0.40	66
6	0.75	78
7	1.30	97

4.5 Psychometric Properties of Knowledge Quizzes

Once the quiz forms were developed, we evaluated their psychometric properties. To assess the total level of information for a quiz, we can sum the individual item information curves to create a test information curve. If different forms of a quiz are equivalent, they should have IRT test information curves that overlap and generally peak in the same range of theta, indicating that they are most precise for the same knowledge levels. Figure 4.13 presents the test information curves for Forms A, B, and C of the Original Medicare quiz. All three forms have very similar information curves, supporting their equivalence. As shown in Figure 4.14, the test information curves for the three forms of the Medicare+Choice quiz peak at similar values of theta, however, it appears that Form C is more informative than the other two forms.

Figure 4.13. Test Information Curves for Original Medicare Quizzes

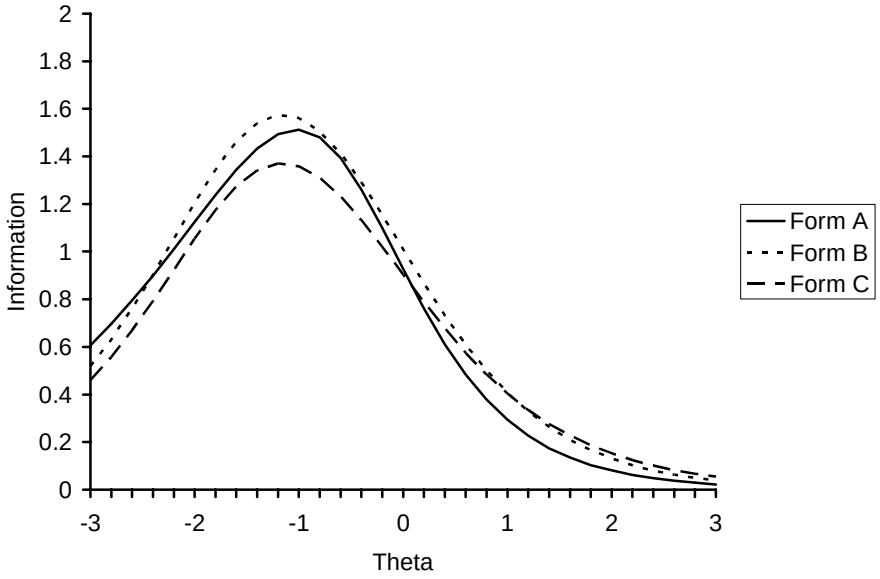


Figure 4.14. Test Information Curves for Medicare+Choice Quizzes

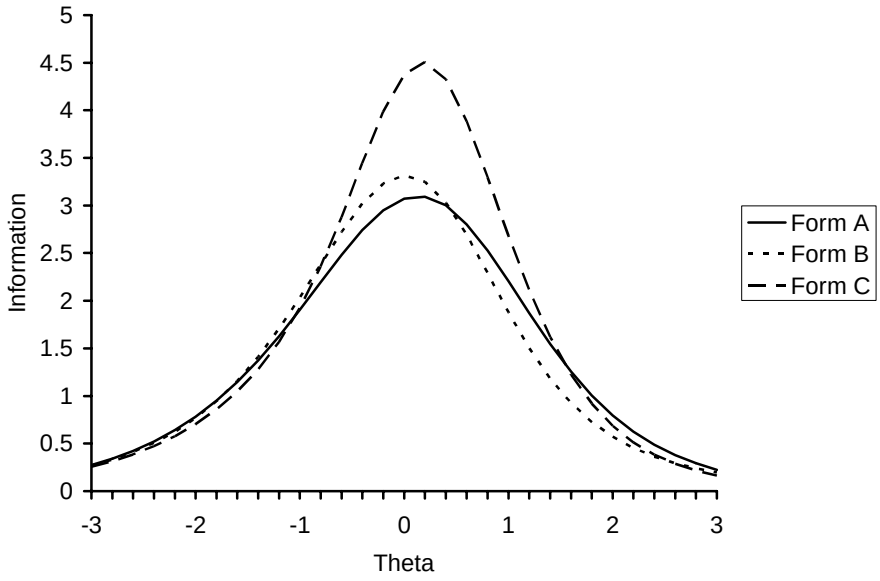


Table 4.13 contains the Cronbach's alphas for the three forms of each knowledge quiz. The forms of each quiz have similar reliability coefficients. The alphas for the Medicare+Choice quizzes are slightly higher, possibly due to the larger number of items. The overall means and standard deviations of the scores for each quiz are presented in Table 4.14. Once again, the values are similar across forms, further supporting their equivalence.

Table 4.13. Coefficient Alphas of the Knowledge Quizzes

Knowledge Quiz	Form A	Form B	Form C
Original Medicare	.52	.50	.54
Medicare+Choice	.73	.66	.74

Table 4.14. Means (and Standard Deviations) for Each Knowledge Quiz

Knowledge Quiz	Form A	Form B	Form C
Original Medicare	71.4 (26.9)	71.8 (26.1)	72.3 (26.6)
Medicare + Choice	51.2 (26.8)	51.4 (25.6)	51.0 (26.3)

4.6 Group Comparisons

To explore the construct validity of the Original Medicare and Medicare+Choice quizzes, we compared the quiz scores for groups of beneficiaries who are expected to have differing knowledge levels. Figures 4.15 to 4.23 present the group comparisons for the Original Medicare quizzes and Figures 4.24 to 4.33 present the comparisons for the Medicare+Choice quizzes.

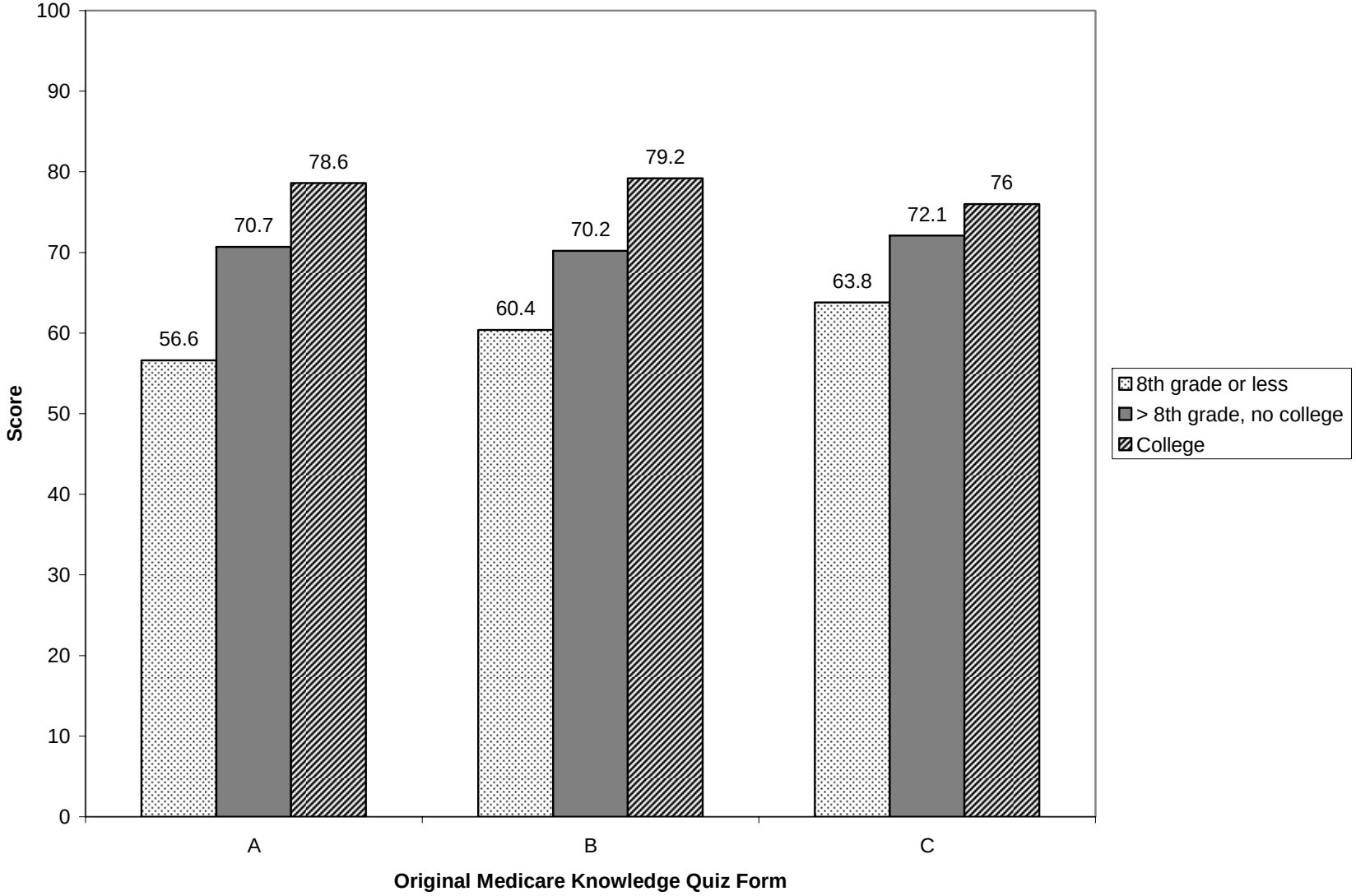
The graphs show a strong relationship between educational achievement and quiz scores. For both quizzes, those with greater educational achievement received higher scores (see Figures 4.15 and 4.24). As shown in Figures 4.16, 4.17, 4.25, and 4.26, beneficiaries who felt they had greater understanding of Medicare received higher scores on both the Original Medicare and Medicare+Choice knowledge quizzes, suggesting that most beneficiaries can generally provide an accurate assessment of their knowledge. Similarly, beneficiaries who felt it is difficult to understand Medicare and the various insurance options or who felt they would have difficulty choosing which insurance option is best for them received lower knowledge scores (see Figures 4.18-4.20 and 4-27-4.29).

Among beneficiaries who received the handbook, those who read at least some of the *Medicare & You* handbook demonstrated greater knowledge of both Original Medicare and Medicare+Choice than those who had read none of it (Figures 4.22 and 4.30). Knowledge also varied according to who makes the beneficiary's health insurance decisions. Those who participated in their insurance decisions (i.e., self or self and someone else made decisions) had significantly higher knowledge than those for whom someone else made the decisions (Figures 4.22 and 4.31).

Type of insurance was also related to level of knowledge. Beneficiaries who had been enrolled in a managed care plan at any time during the past year had significantly higher scores on the Medicare+Choice quizzes (Figure 4-32), but lower scores on the Original Medicare quizzes (Figure 4-23). In addition, beneficiaries who had been enrolled in a managed care plan before becoming Medicare-eligible had higher Medicare+Choice quiz scores than those who had not been previously enrolled in a managed care plan (Figure 4-33).

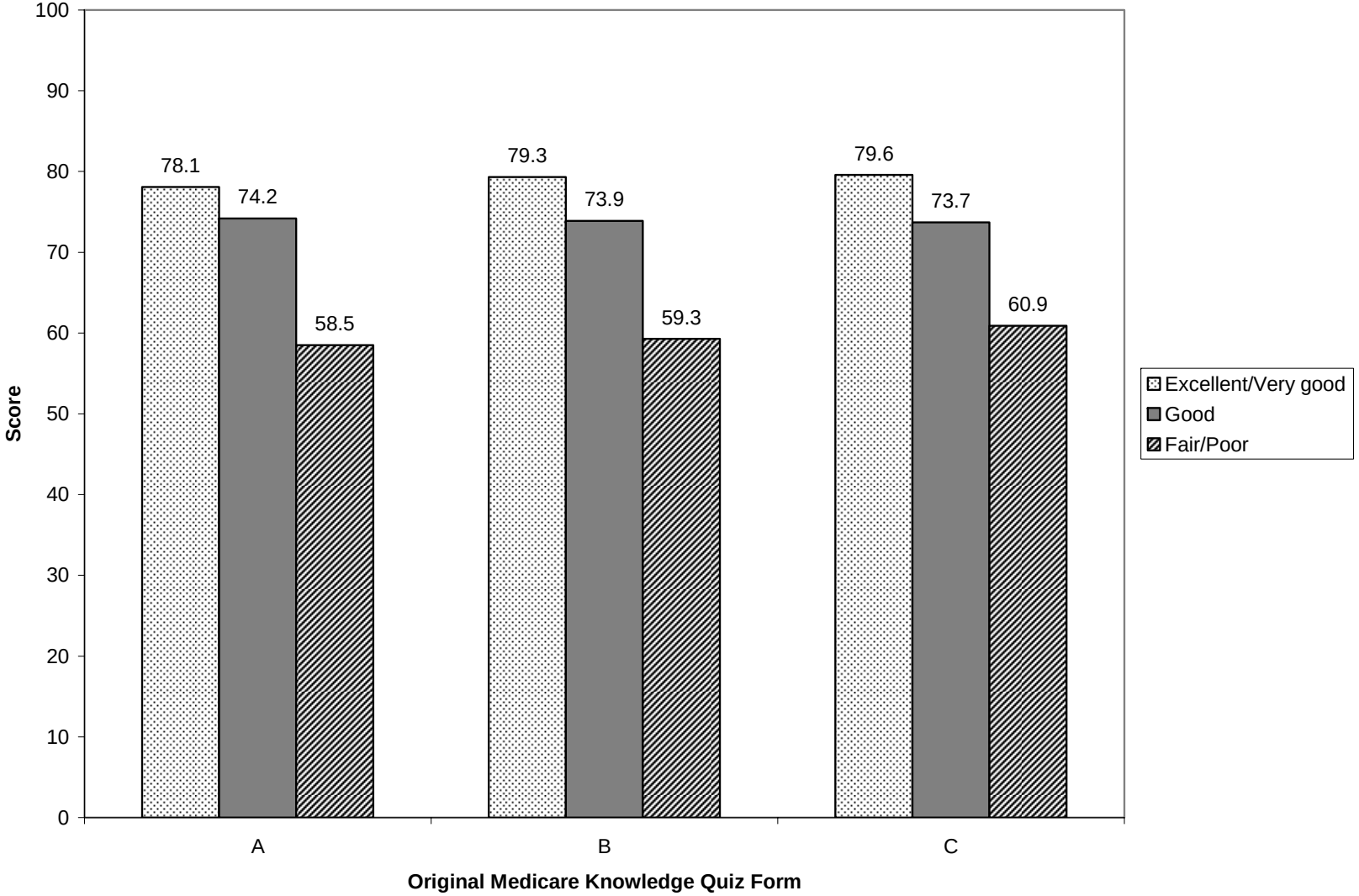
Overall, the group comparisons were consistent with our hypotheses, supporting the construct validity of both the Original Medicare and Medicare+Choice quizzes. In general, those with greater self-reported understanding of Medicare, less difficulty understanding Medicare and insurance plans, who had read the *Medicare & You* handbook, and who participated in their health insurance decision-making demonstrated more knowledge of Medicare.

Figure 4.15. Original Medicare Quiz Scores by Educational Achievement



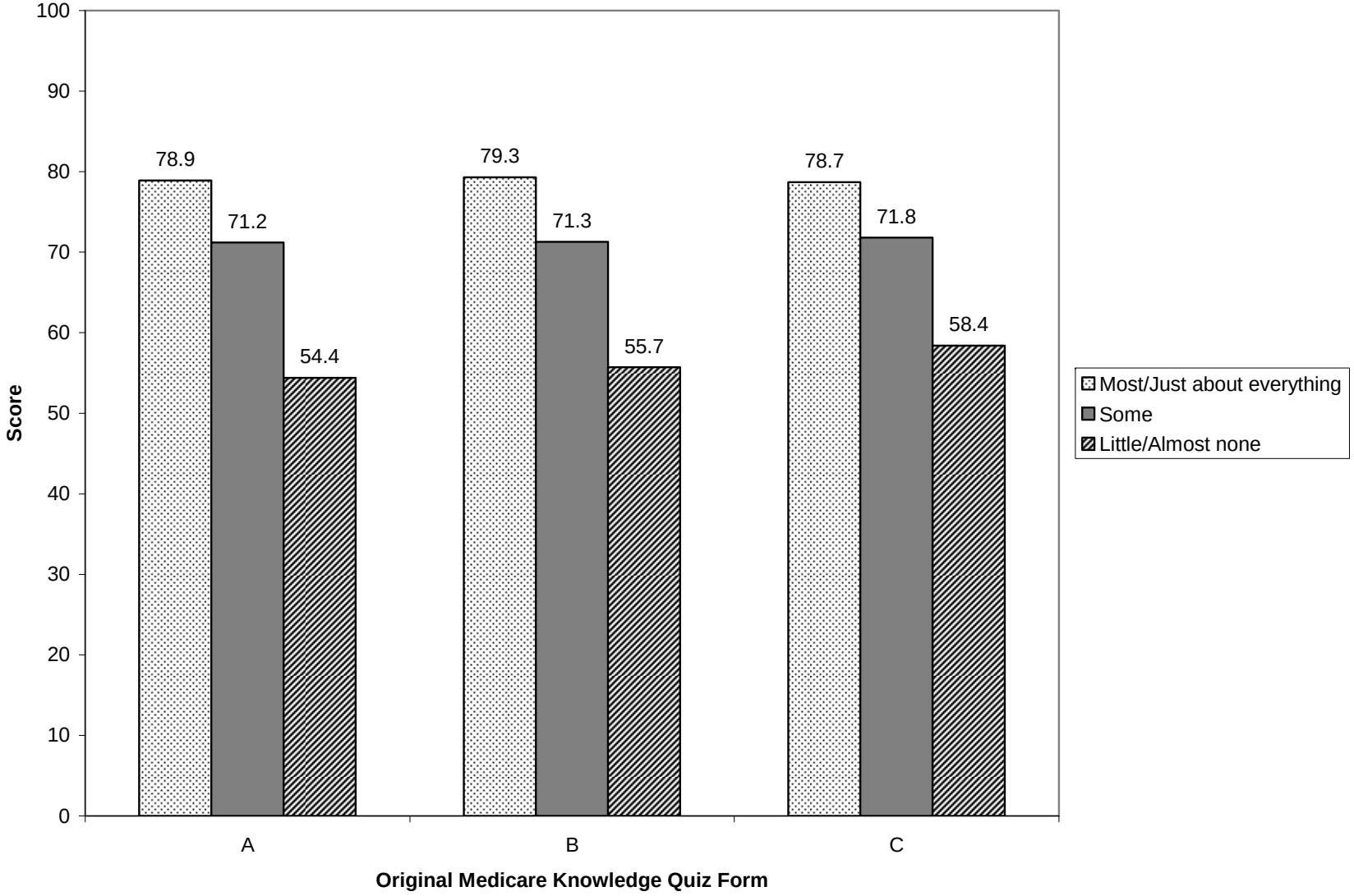
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons between education levels are significant for each form ($p < .001$).

Figure 4.16. Original Medicare Quiz Scores by MK1 (Self-Reported Understanding of Medicare)



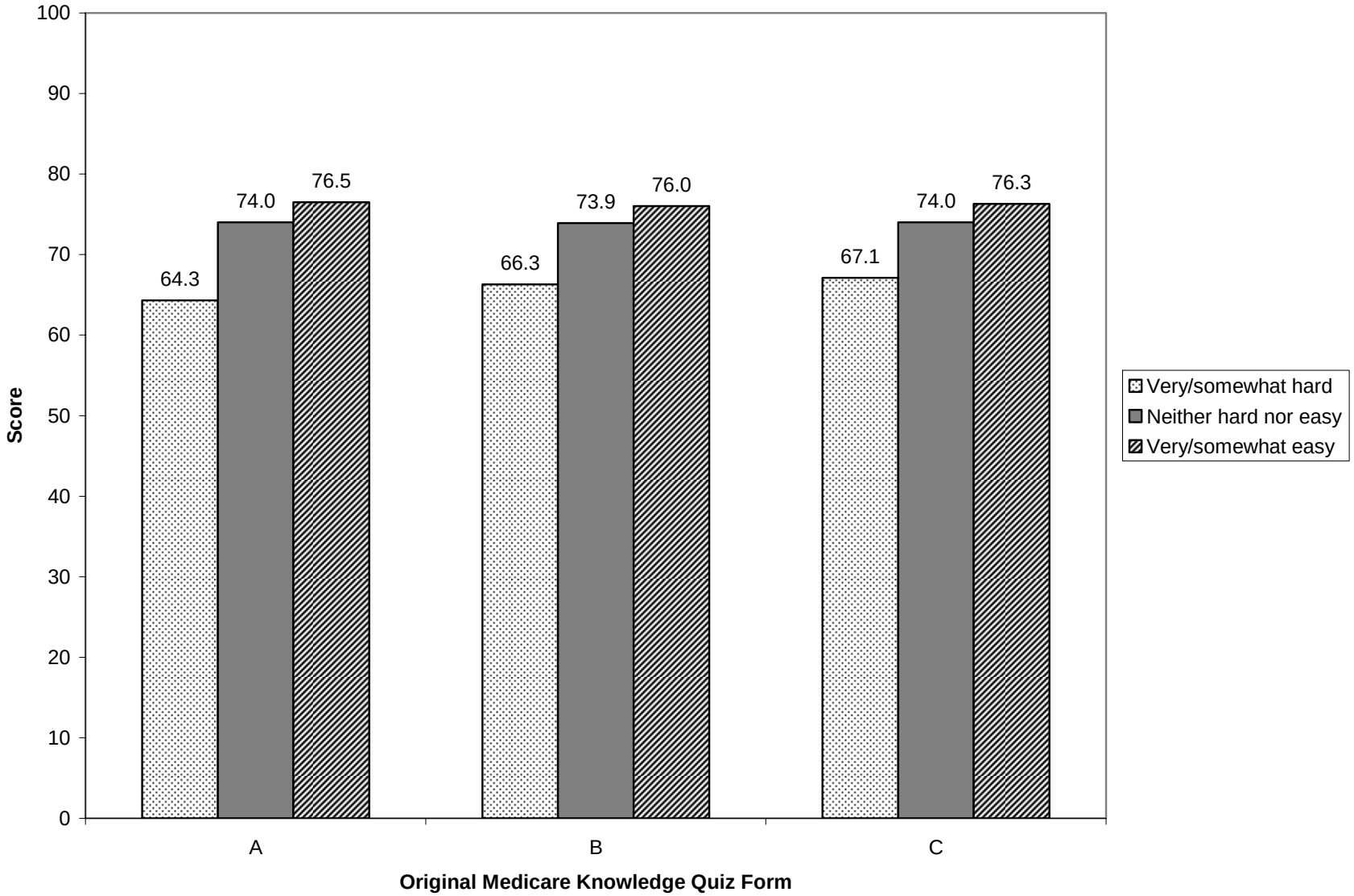
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons between response options on MK1 (e.g., good vs. fair/poor) are significant for each form ($p < .001$).

Figure 4.17. Original Medicare Quiz Scores by MK2 (How Much Know About Medicare)



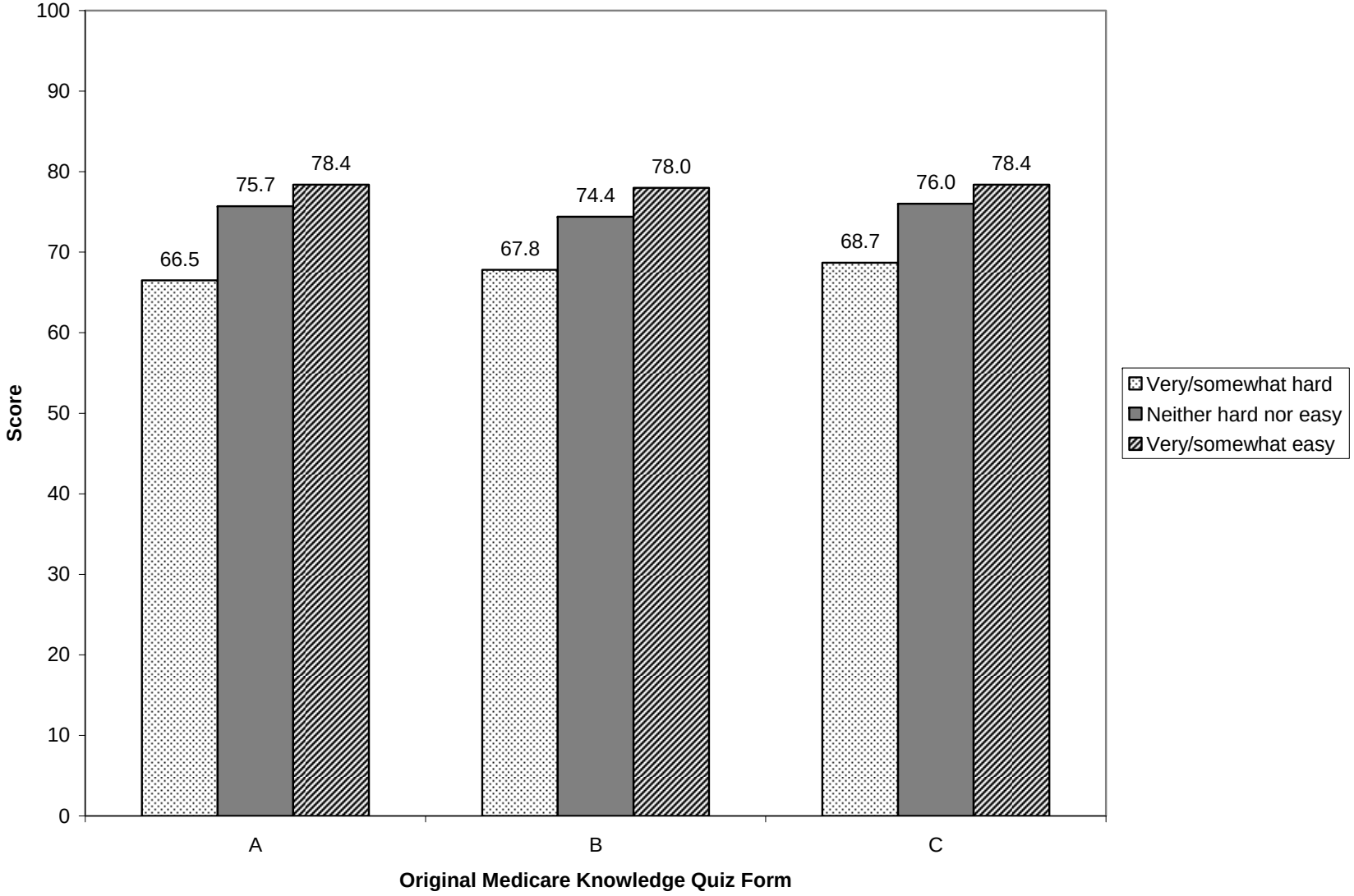
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons between response options on MK2 (e.g., some vs. most/everything) are significant for each form ($p < .001$).

Figure 4.18. Original Medicare Quiz Scores by MK3 (Difficulty Understanding Medicare)



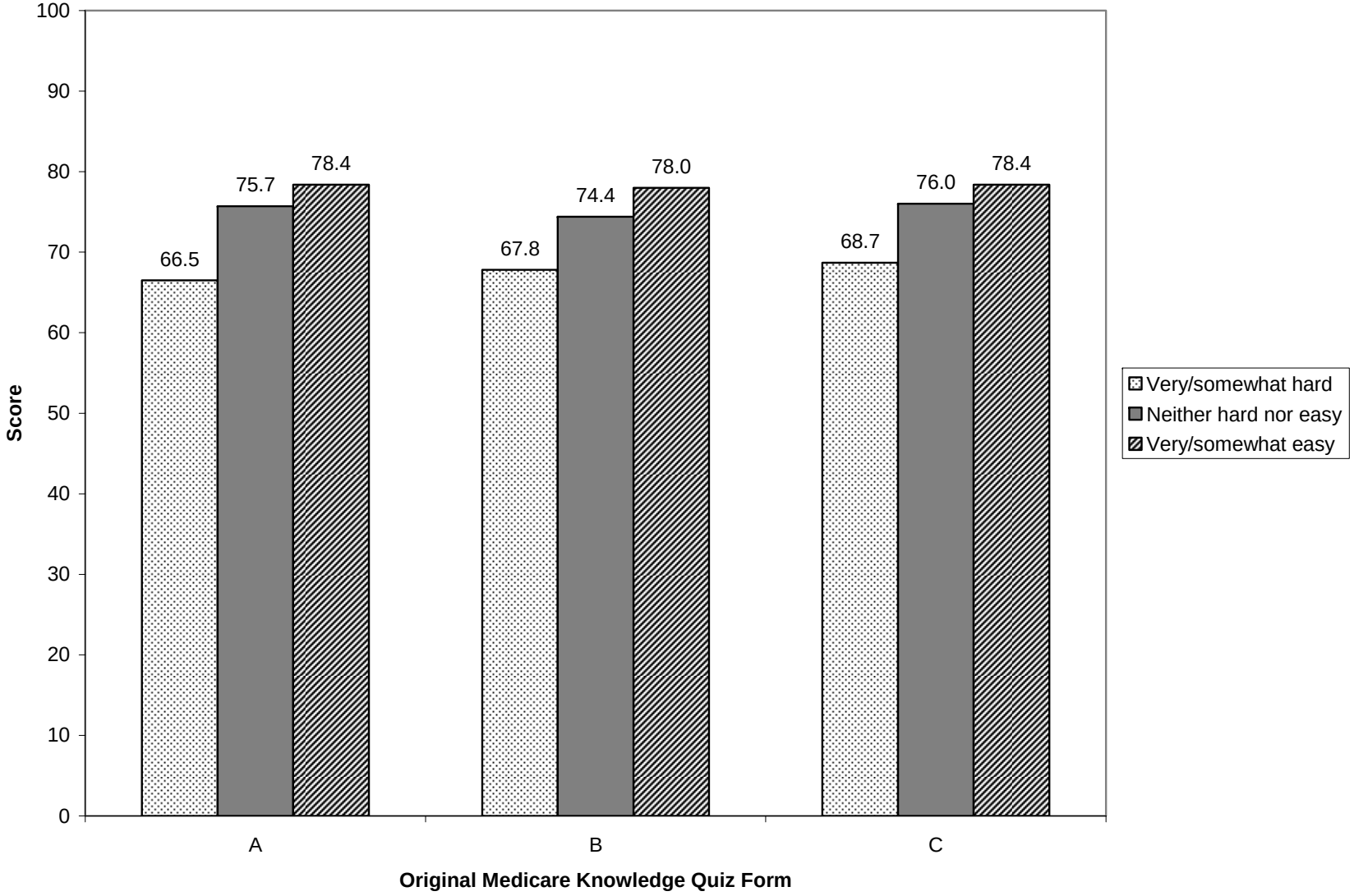
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except neither hard nor easy vs. very/somewhat easy are significant for each form ($p < .001$).

Figure 4.19. Original Medicare Quiz Scores by MK92 (Difficulty Understanding Insurance Options)



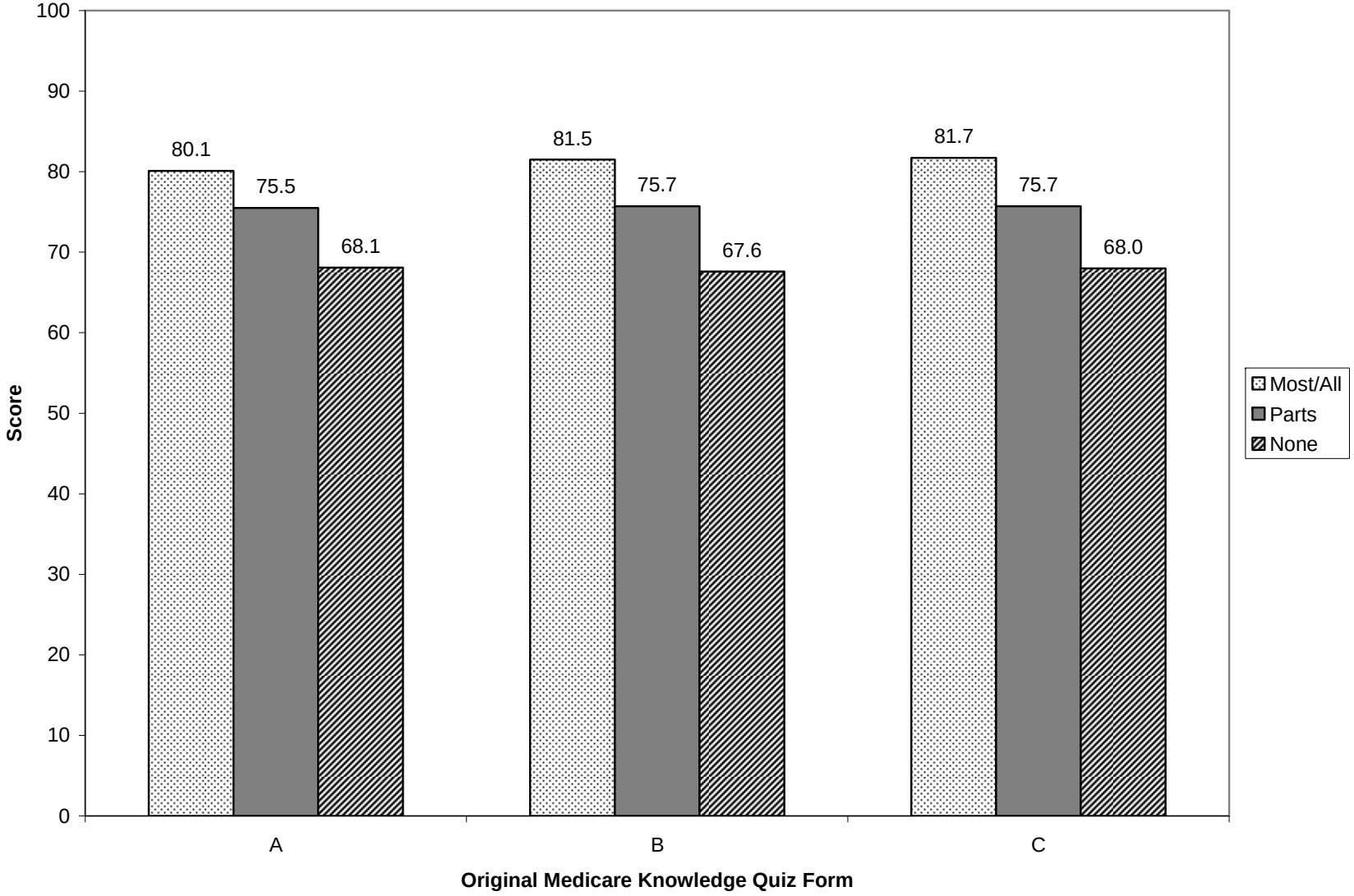
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except neither hard nor easy vs. very/somewhat easy are significant for each form ($p < .001$).

Figure 4.20. Original Medicare Quiz Scores by MK93 (Difficulty Choosing Which Insurance Option is Best)



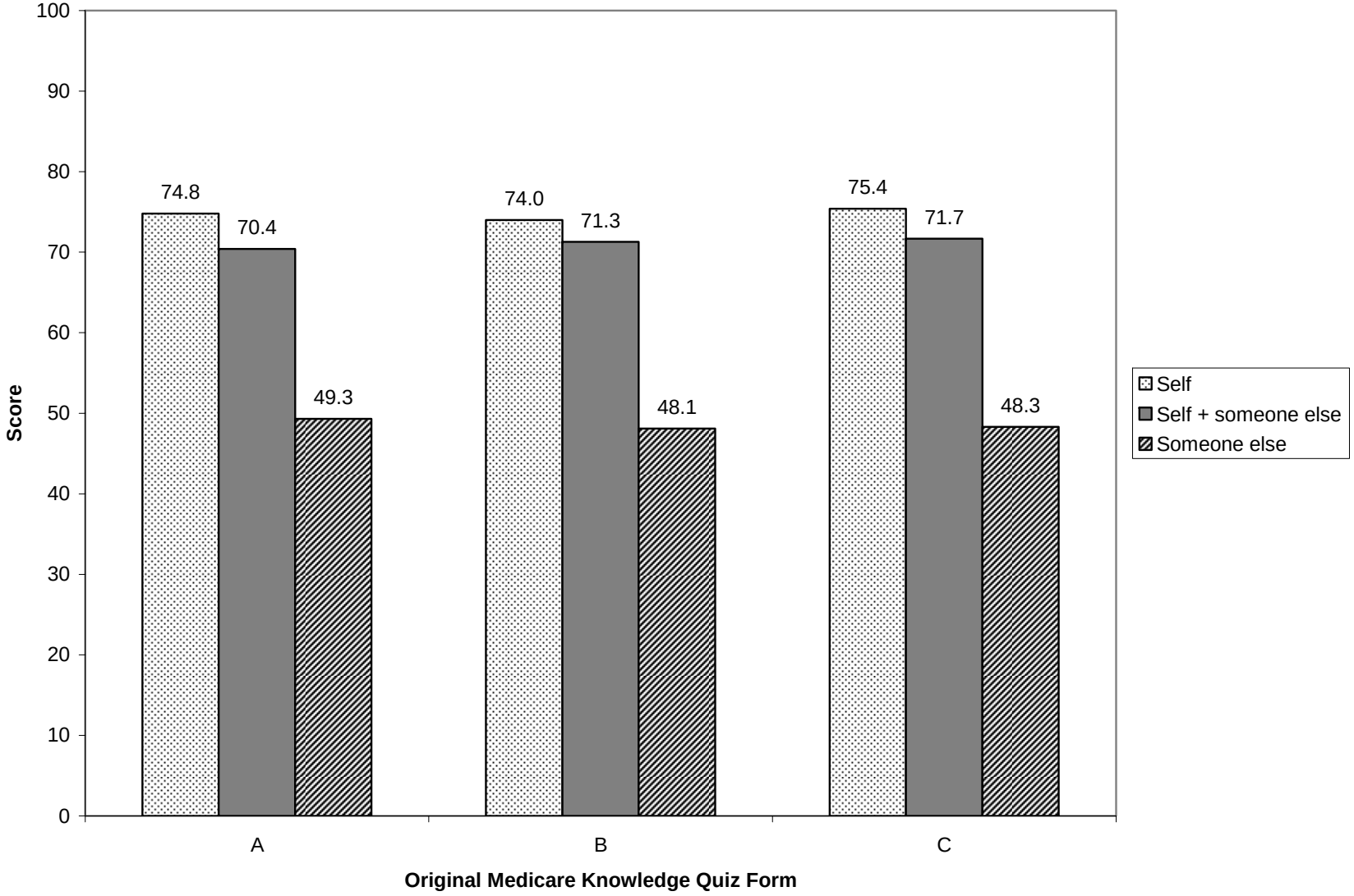
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except neither hard nor easy vs. very/somewhat easy for Forms B and C are significant ($p < .001$).

Figure 4.21. Original Medicare Quiz Scores by MK42 (Amount of Handbook Read)



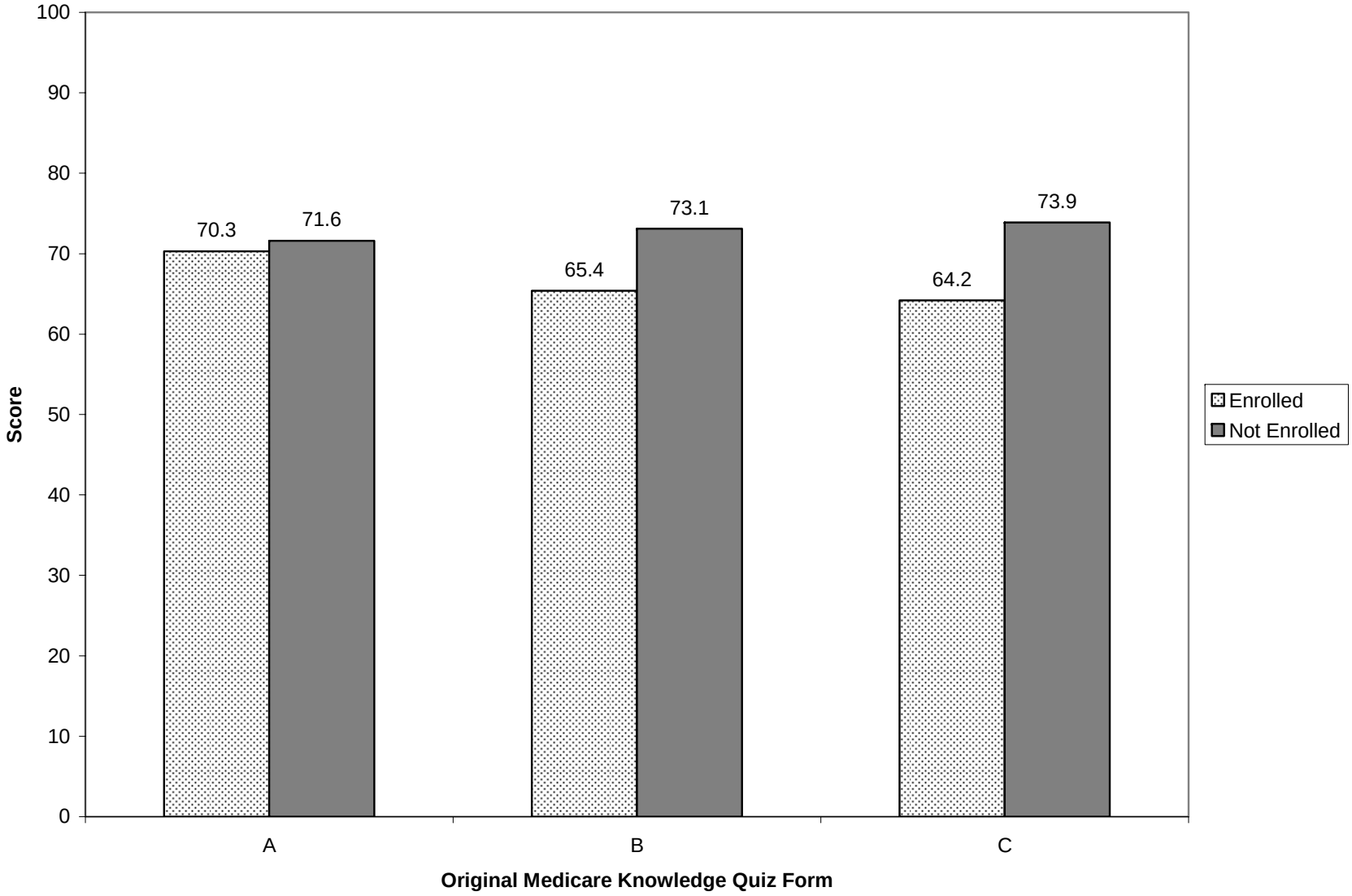
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons between response options on MK42 are significant for each form ($p < .01$).

Figure 4.22. Original Medicare Quiz Scores by MK84 (Who Makes Health Insurance Decisions)



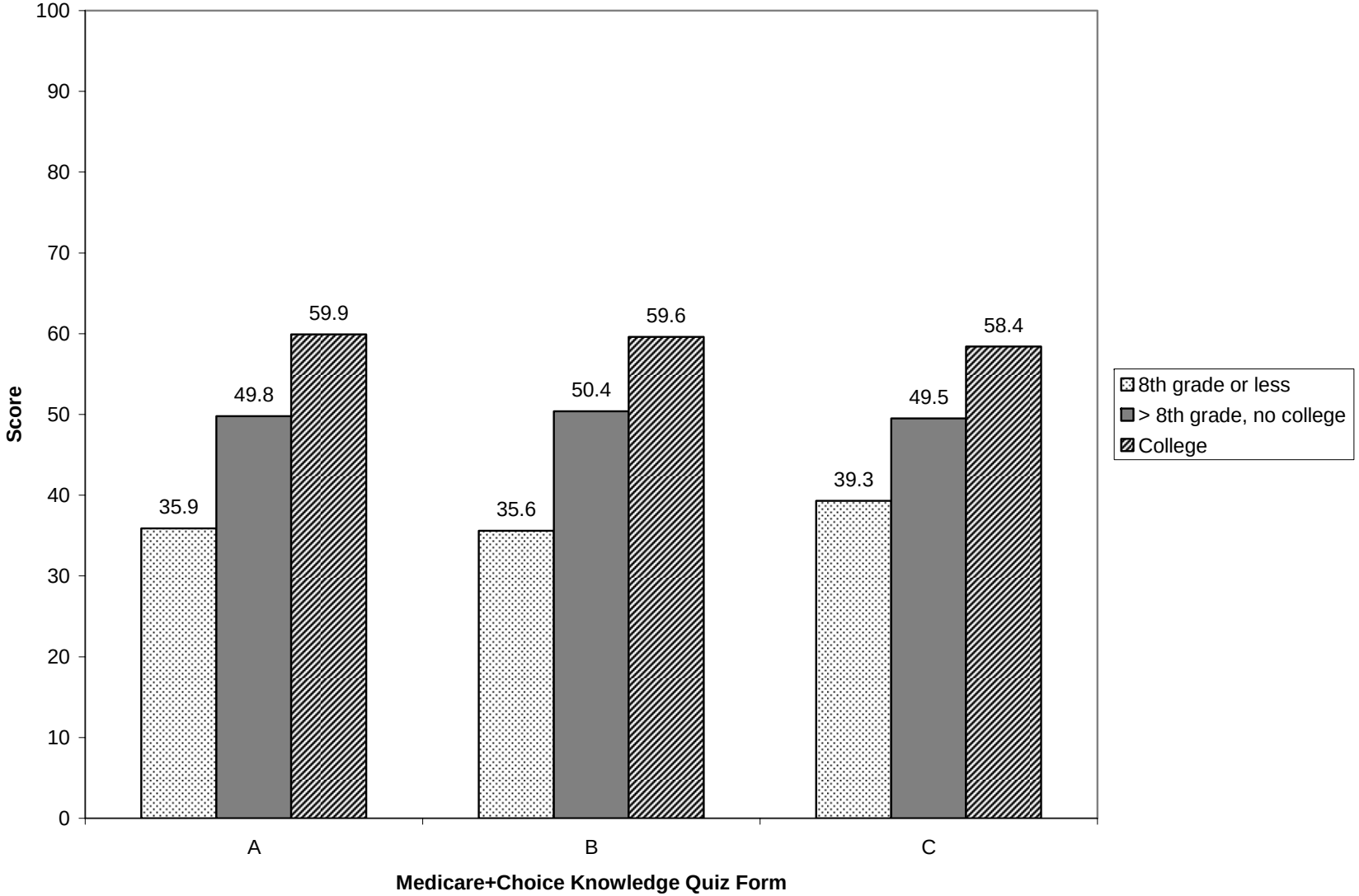
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except self vs. self+someone else for Form B are significant ($p < .05$).

Figure 4.23. Original Medicare Quiz Scores by Any Managed Care Enrollment during Past Year



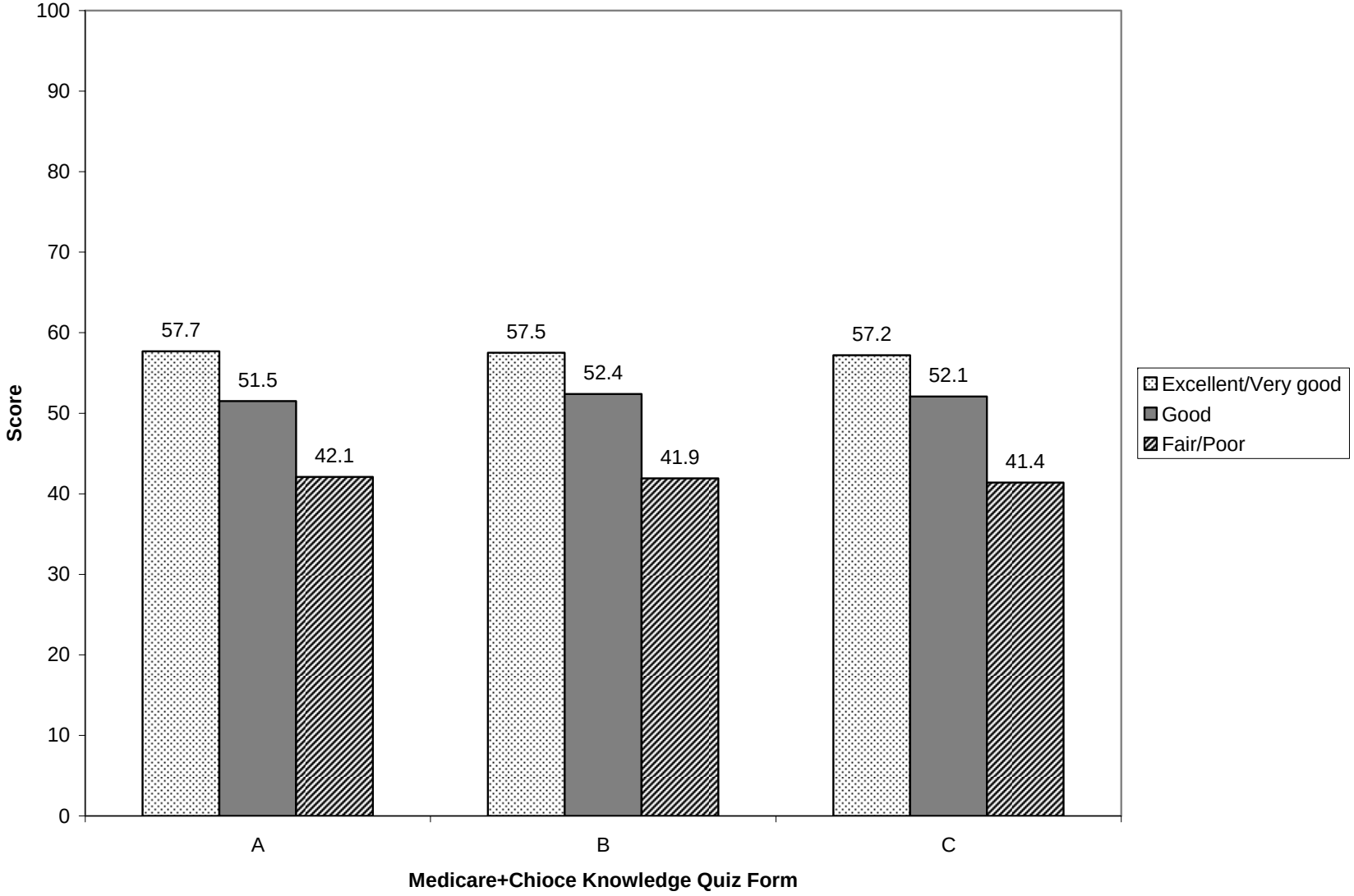
Note: T-tests indicated significant group differences for Forms B and C ($p < .001$).

Figure 4.24. Medicare+Choice Quiz Scores by Educational Achievement



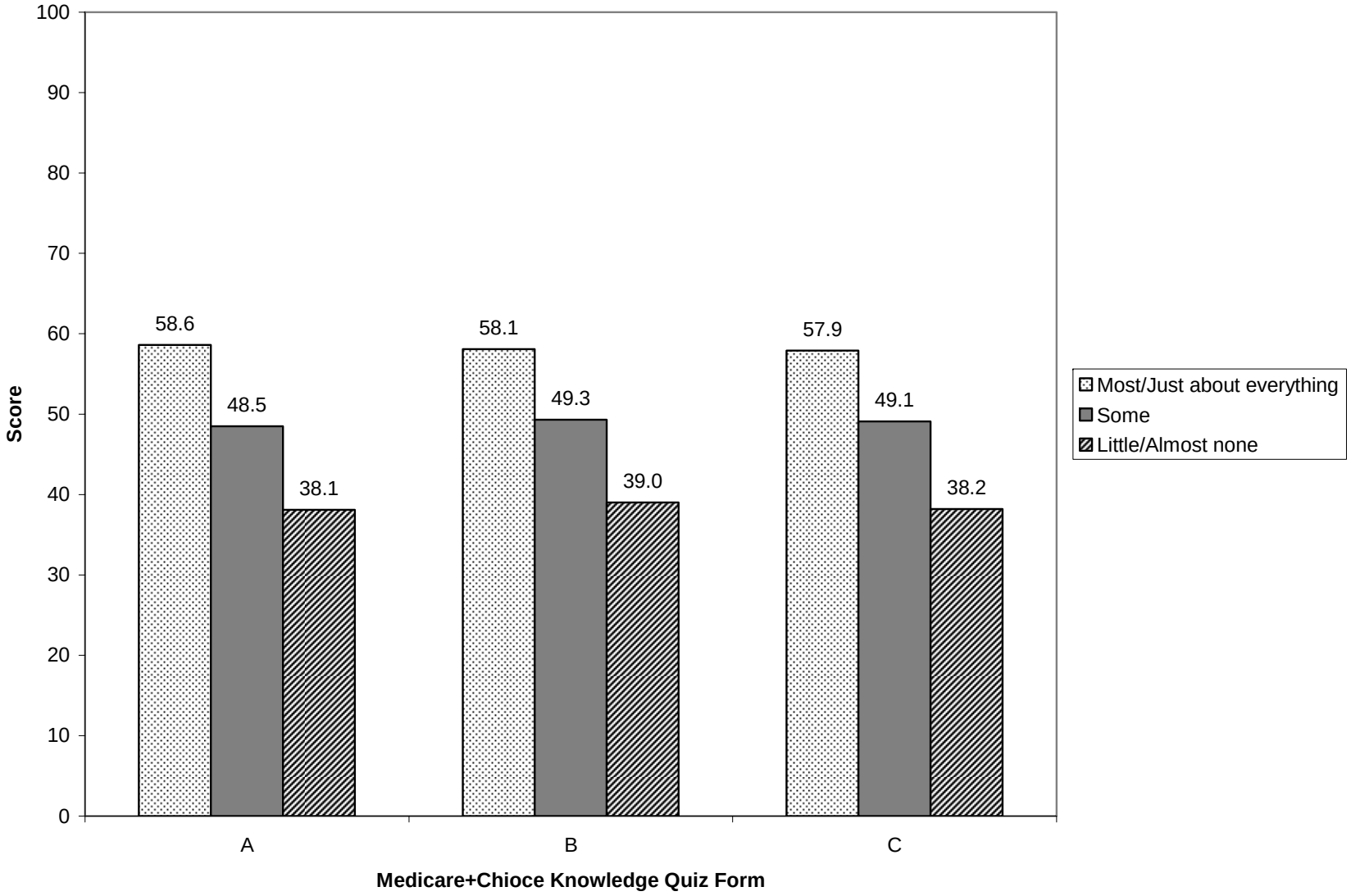
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons between education levels are significant for each form ($p < .001$).

Figure 4.25. Medicare+Choice Quiz Scores by MK1 (Self-Reported Understanding of Medicare)



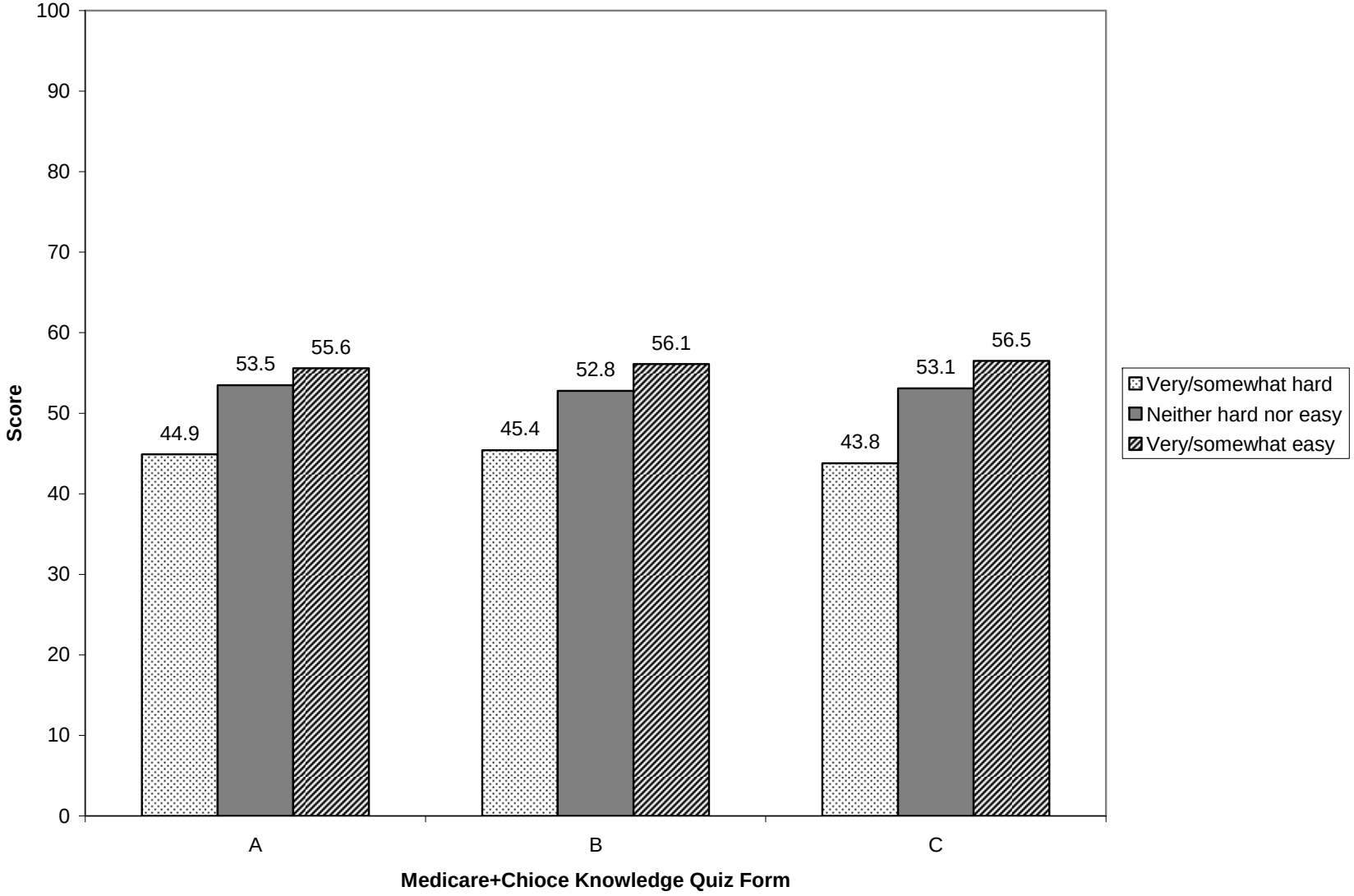
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across response options on MK1 are significant for each form ($p < .001$).

Figure 4.26. Medicare+Choice Quiz Scores by MK2 (How Much Know About Medicare)



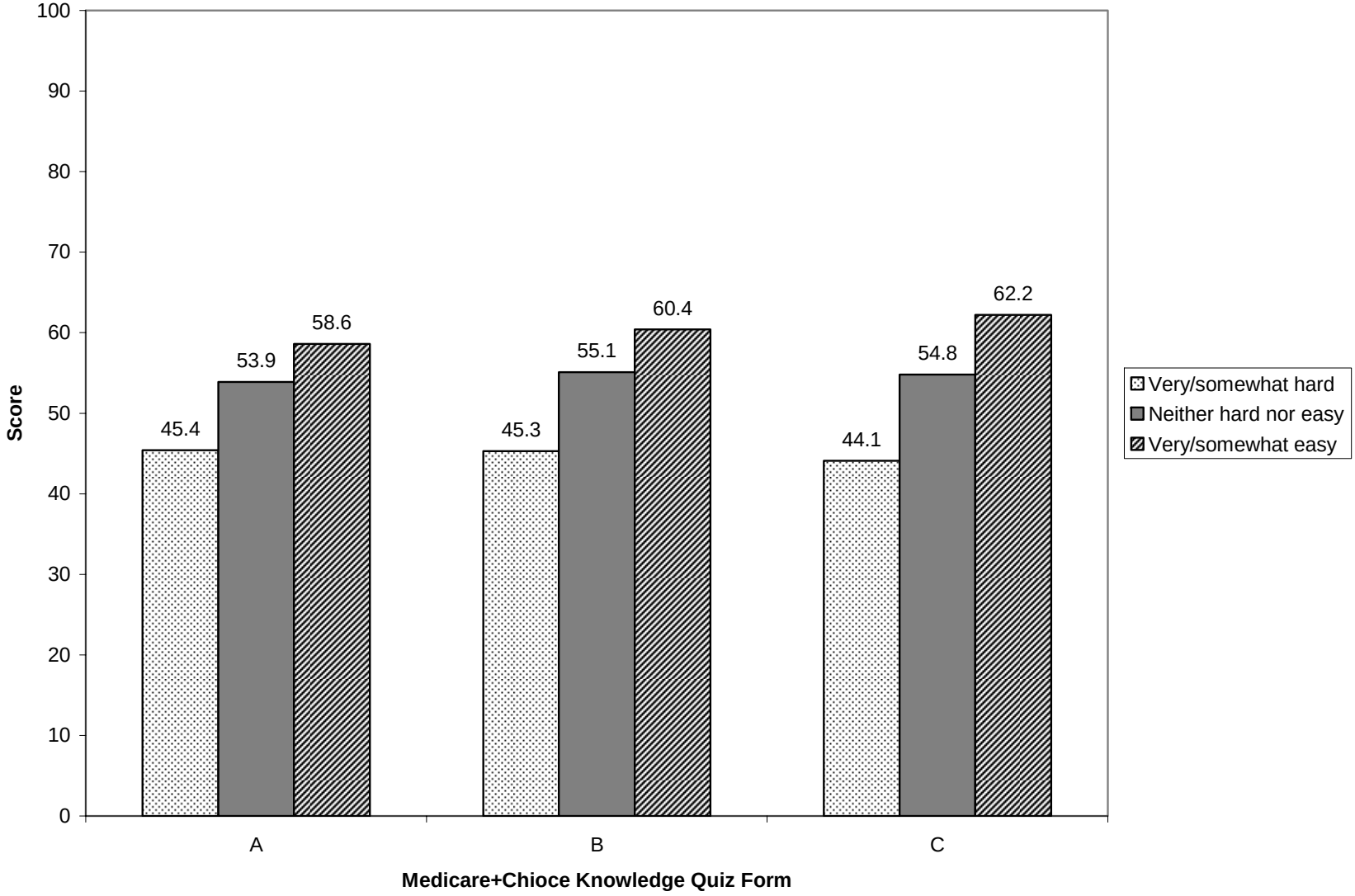
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across response options on MK2 are significant for each form ($p < .001$).

Figure 4.27. Medicare+Choice Quiz Scores by MK3 (Difficulty Understanding Medicare)



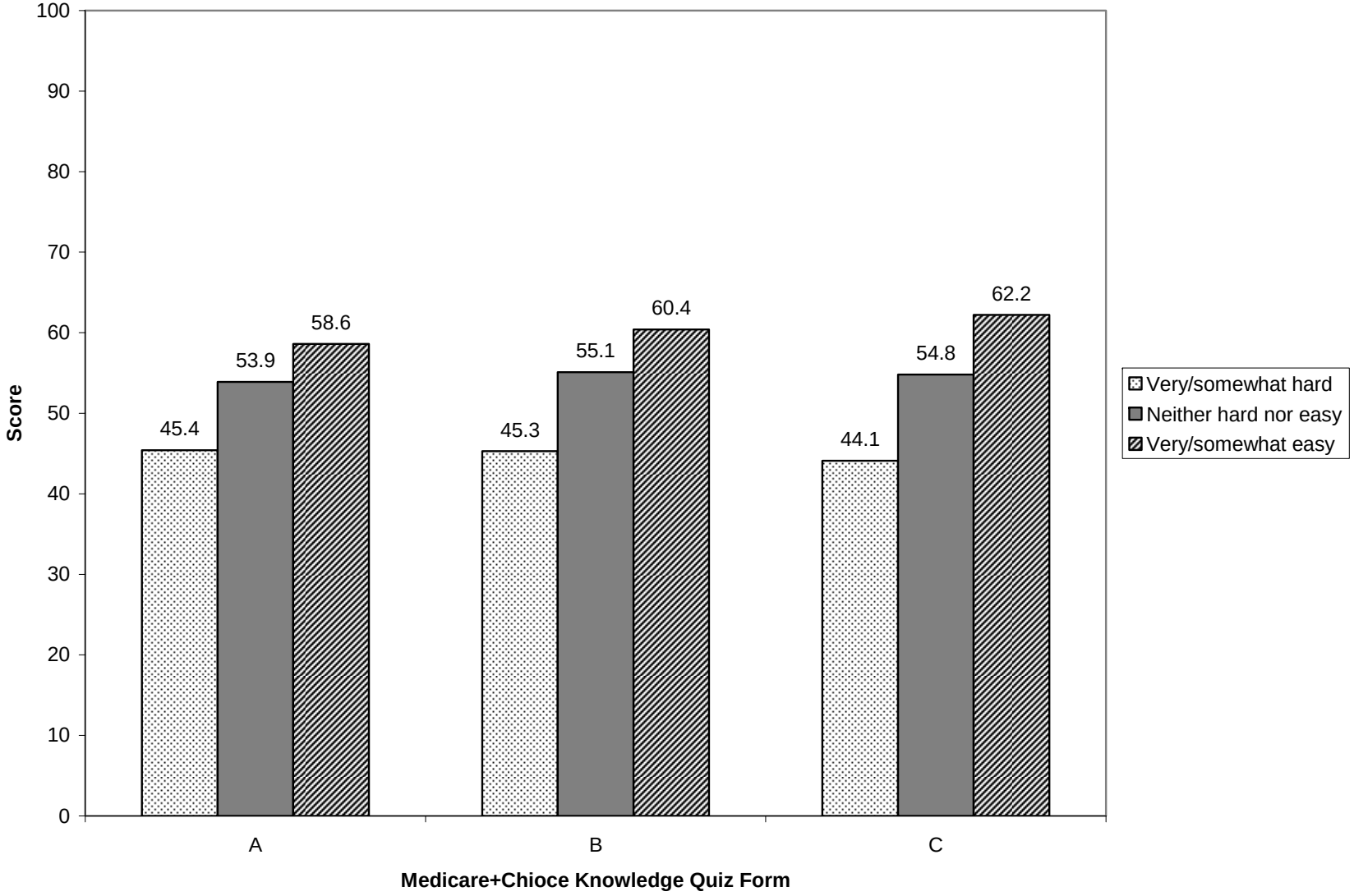
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except neither hard nor easy vs. very/somewhat easy for Form A are significant ($p < .01$).

Figure 4.28. Medicare+Choice Quiz Scores by MK92 (Difficulty Understanding Insurance Options)



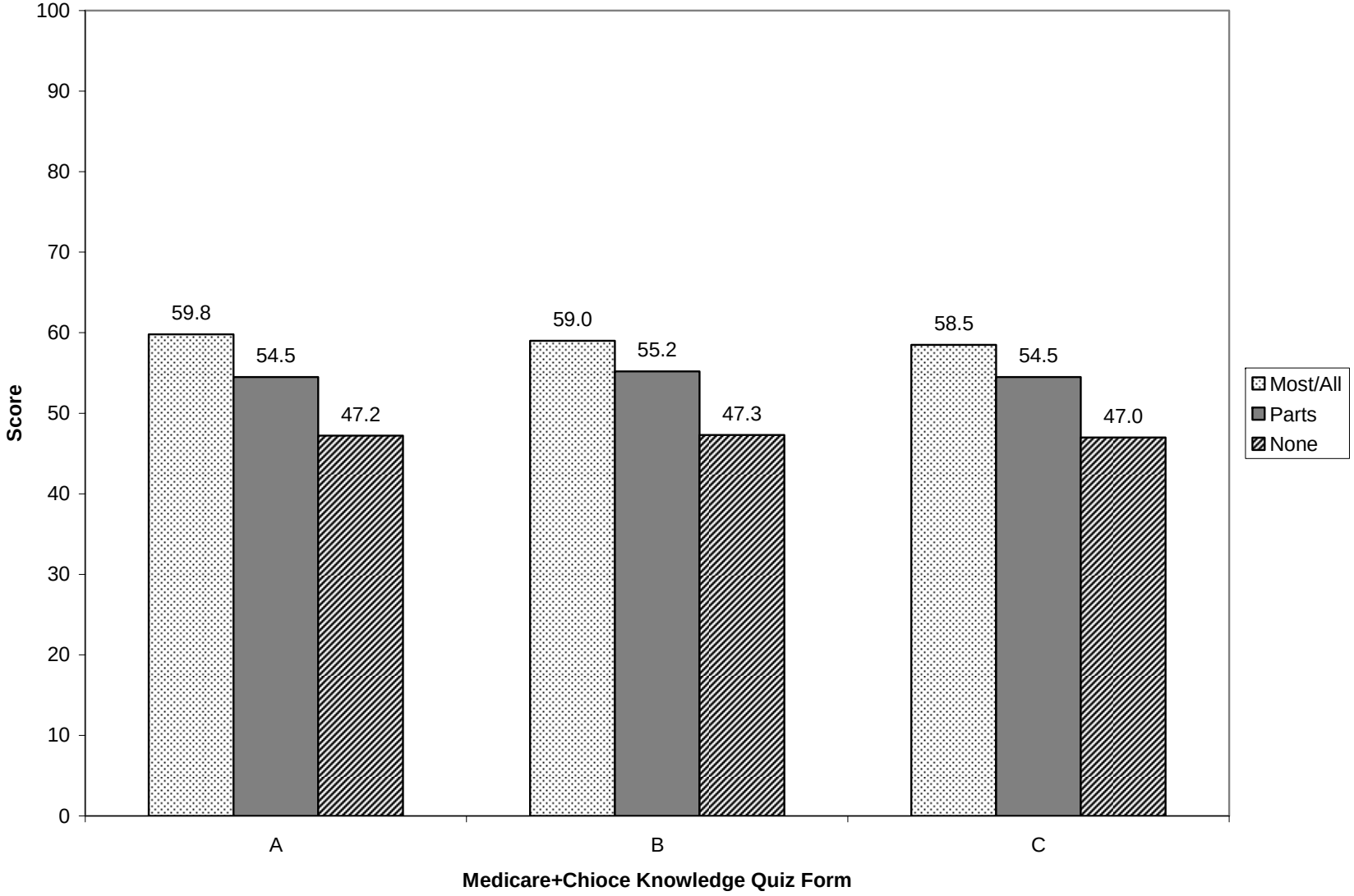
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across response options on MK92 are significant for each form ($p < .05$).

Figure 4.29. Medicare+Choice Quiz Scores by MK93 (Difficulty Choosing Which Insurance Option is Best)



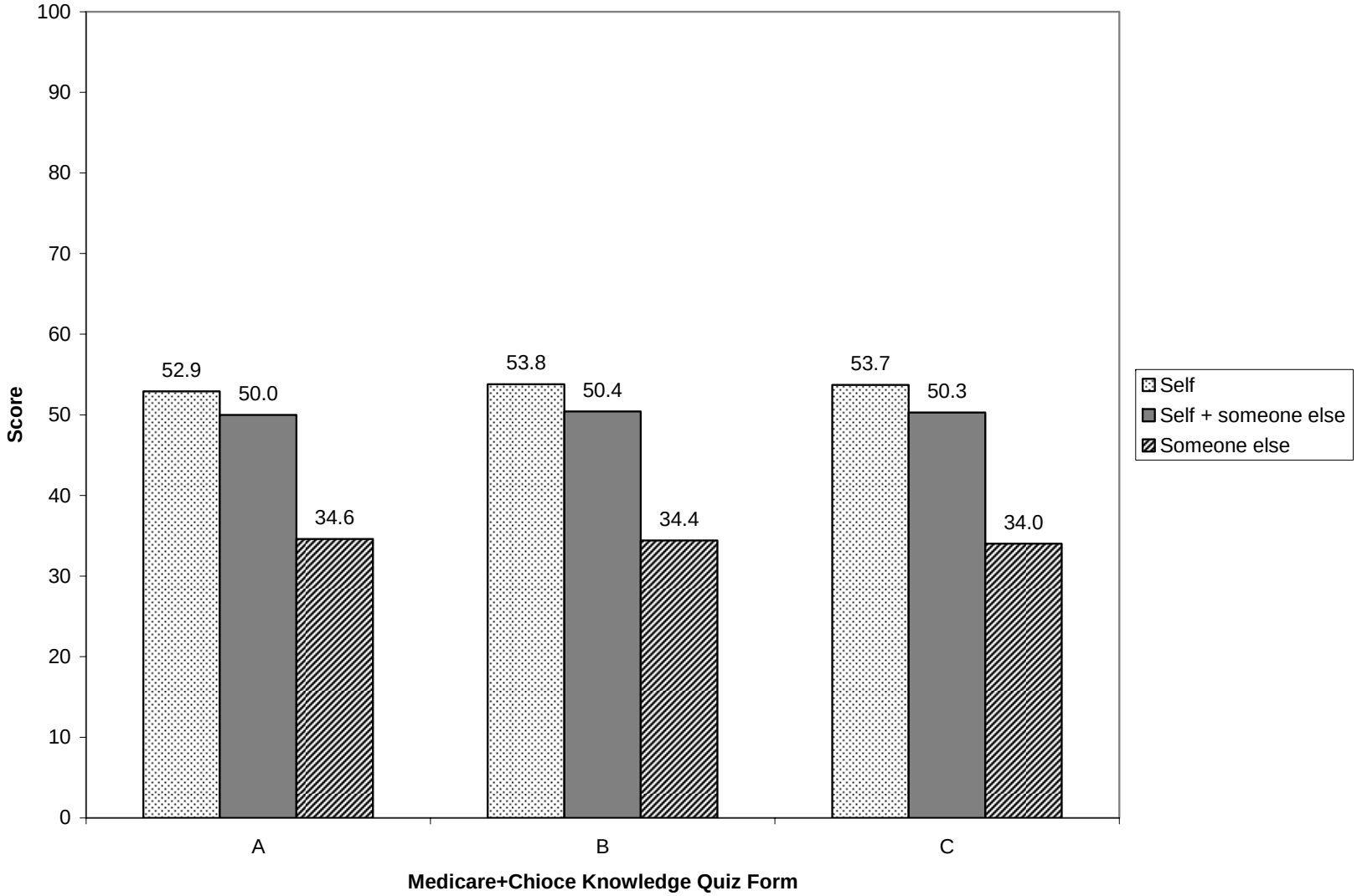
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across response options on MK93 are significant for each form ($p < .001$).

Figure 4.30. Medicare+Choice Quiz Scores by MK42 (Amount of Handbook Read)



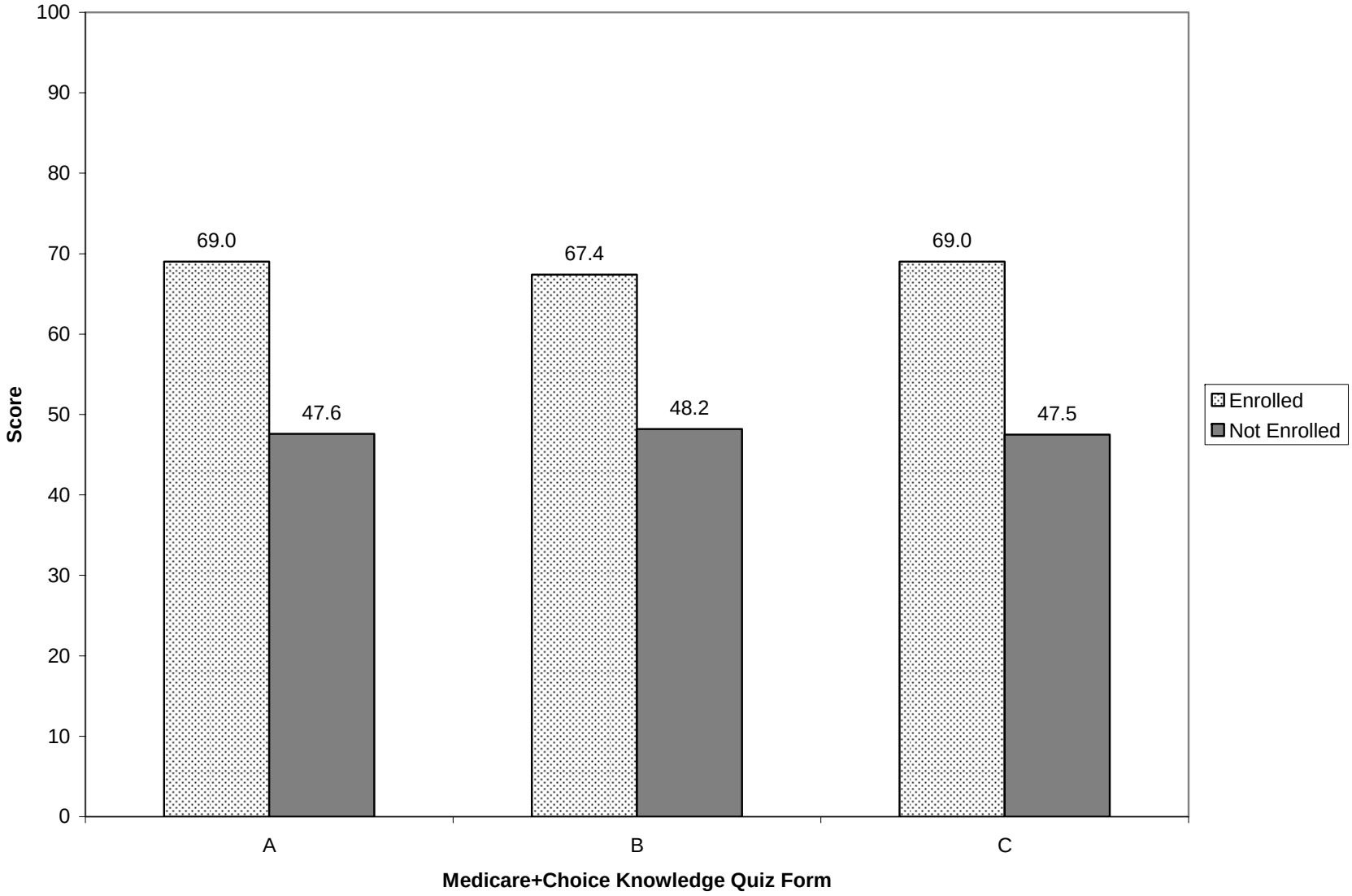
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across response options on MK42 are significant for each form ($p < .05$).

Figure 4.31. Medicare+Choice Quiz Scores by MK84 (Who Makes Health Insurance Decisions)



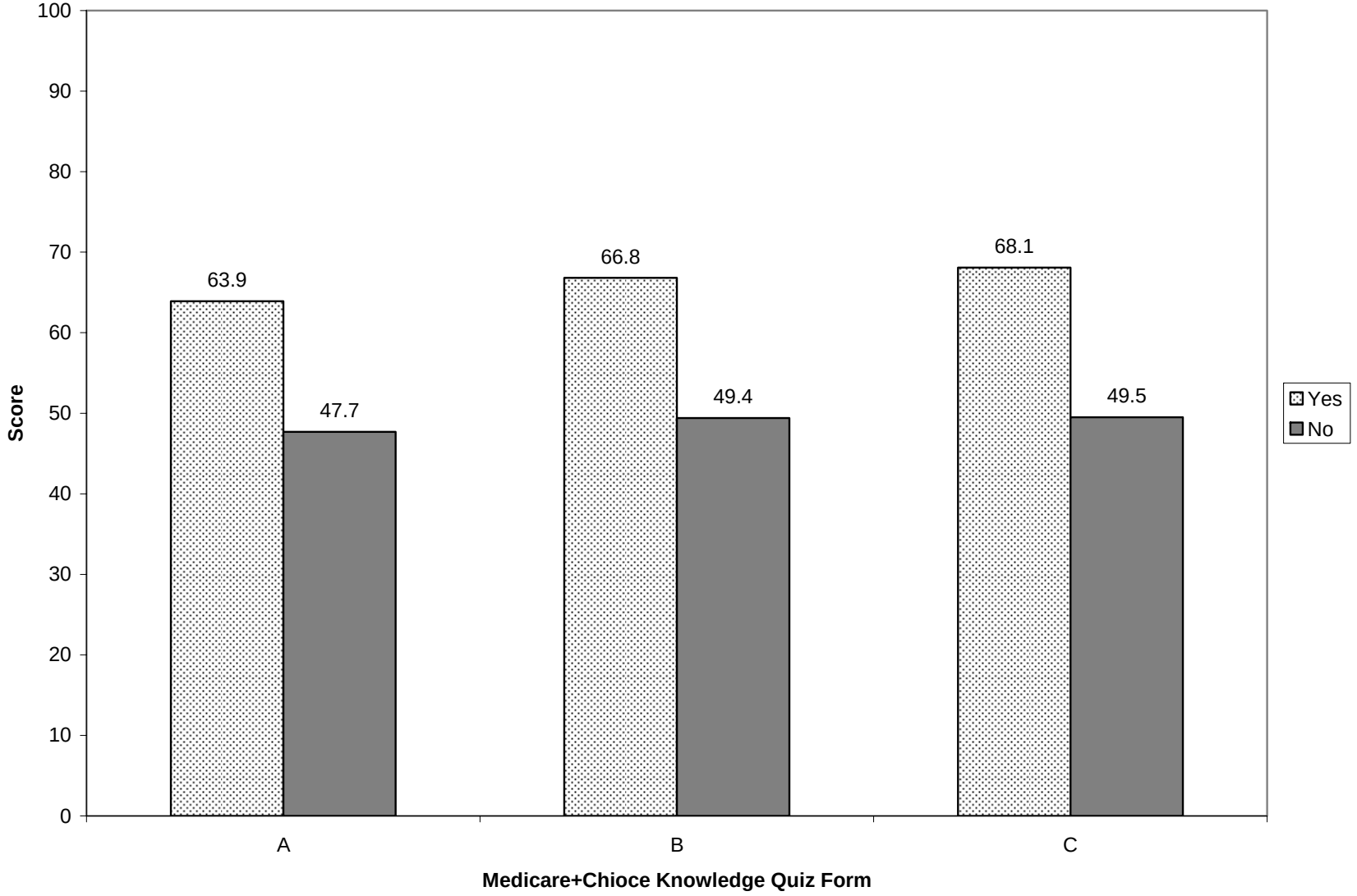
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except self vs. self+someone else on Form A are significant ($p < .05$).

Figure 4.32. Medicare+Choice Quiz Scores by Any Managed Care Enrollment during Past Year



Note: T-tests indicated significant group differences for each form ($p < .001$).

Figure 4.33. Medicare+Choice Quiz Scores by MK94 (Enrolled in Managed Care Plan Before Medicare-Eligible)



Note: t-tests indicated significant mean differences by responses to MK94 for each form ($p < .001$).

5. Health Literacy Quizzes

This chapter describes the development and psychometric evaluation of the health literacy quizzes. Similar to the knowledge quizzes described in Chapter 4, we evaluated the psychometric properties of the health literacy items and used those results to develop three equivalent forms for each quiz. Finally, we evaluated the reliability and validity of the quiz forms.

5.1 Descriptive Statistics

Tables 5.1 and 5.2 present descriptive statistics for the health literacy terminology and reading comprehension items, respectively. For the terminology items, the percentages of correct responses ranged from 39% for MK50 (provider network) to 88% for MK51 (primary care doctor). The percentages correct for the reading comprehension items range from a low of 40% for MK65 (purpose of plan finder is to help choose a doctor) to a high of 93% for MK59 (information available in Spanish). Overall, the most difficult scenario appears to the Personal Plan Finder scenario with an average difficulty of 59% and the easiest scenario was the 1-800-MEDICARE scenario with an average percentage correct of 85%.

Table 5.1. Percentage of Correct and Don't Know Responses for Terminology Items

Item #	Description	% Correct	% Don't Know
MK44	Appeal	80	6
MK45	Assignment	64	10
MK46	Formulary	42	23
MK47	Preventive care	85	4
MK48	Generic drugs	74	5
MK49	Outpatient care	87	3
MK50	Provider network	39	15
MK51	Primary care doctor	88	4
MK52	Deductible	70	6
MK53	Medigap	55	15

Table 5.2. Percentage of Correct and Don't Know Responses for Reading Comprehension Items

Item #	Description	% Correct	% Don't Know
1-800-MEDICARE		**85**	**2**
MK59	Info available in Spanish at 1-800-MEDICARE	93	1
MK60	Number to press to order a new card	87	3
MK61	Number to press to speak to customer service	75	2
Medicare claims notice		**62**	**5**
MK62	Amount doctor charged for office visit	79	4
MK63	Amount Medicare paid doctor	50	4
MK64	Amount of deductible met	58	8
Personal plan finder		**59**	**0**
MK65	Purpose of Plan Finder is to help choose a doctor	40	0
MK66	Purpose of Plan Finder is to help choose a plan	67	0
MK67	Plan Finder is available on Medicare website	70	0
Medicaid		**75**	**1**
MK69	Medicaid covers prescription drugs	84	0
MK70	Medicaid covers nursing home costs	84	0
MK71	Medicaid is run only by Federal government	59	0
MK72	Medicaid programs differ from one state to another	74	5
Plan comparisons		**73**	**4**
MK73	Which plans cover vision services	63	4
MK74	Which plans cover routine physical exams	74	4
MK75	Which plan has lowest monthly premium	81	4
MK76	Which plans cover prescription drugs	74	4

5.2 Dimensionality

The dimensionality of the health literacy items was evaluated using exploratory factor analysis. Based on several criteria, including the scree plot, eigenvalues, residuals, demonstration of simple structure, and interpretation of the factors, a two factor structure seemed most appropriate (eigenvalues = 10.6 and 3.0). The factor loadings are presented in Table 5.3. As expected, the items split into factors based on the type of item. Factor 1 included the terminology items while Factor 2 included the reading comprehension items.

Table 5.3. Results of Two-Factor Exploratory Factor Analysis

Item #	Description	Factor 1: Reading Comprehension	Factor 2: Terminology
MK44	Appeal	.15	**.69**
MK45	Assignment	-.04	**.66**
MK46	Formulary	-.05	**.63**
MK47	Preventive care	.05	**.77**
MK48	Generic drugs	-.17	**.75**
MK49	Outpatient care	.27	**.59**
MK50	Provider network	.02	**.60**
MK51	Primary care doctor	-.06	**.82**
MK52	Deductible	.00	**.68**
MK53	Medigap	.02	**.66**
MK59	Info available in Spanish at 1-800-MEDICARE	**.57**	.12
MK60	Number to press to order a new card	**.68**	-.07
MK61	Number to press to speak to customer service	**.65**	-.04
MK62	Amount doctor charged for office visit	**.75**	-.05
MK63	Amount Medicare paid doctor	**.70**	-.09
MK64	Amount of deductible met	**.67**	-.02
MK65	Purpose of Plan Finder is to help choose a doctor	**.48**	.21
MK66	Purpose of Plan Finder is to help choose a plan	**.41**	.29
MK67	Plan Finder is available on Medicare website	**.53**	.24
MK69	Medicaid covers prescription drugs	**.49**	.26
MK70	Medicaid covers nursing home costs	**.50**	**.34**
MK71	Medicaid is run only by Federal government	**.42**	**.39**
MK72	Medicaid programs differ from one state to another	**.37**	**.32**
MK73	Which plans cover vision services	**.90**	-.11
MK74	Which plans cover routine physical exams	**.92**	-.04
MK75	Which plan has lowest monthly premium	**.90**	-.02
MK76	Which plans cover prescription drugs	**.86**	-.06

Note: Loadings ≥ .30 are shown in bold.

5.3 IRT Analyses

Next, we calibrated the health literacy items using IRT. An assumption of most IRT models is that the items form a unidimensional construct. Therefore, we calibrated the terminology and reading comprehension items separately[6]. When comparing the 1-, 2-, and 3-parameter logistic IRT models, the 2-parameter logistic (2PL) model provided the best fit for the terminology items (1PL vs. 2PL: $\chi^2(9)=47.7$, $p < .0001$; 2PL vs. 3PL: $\chi^2(10) = 0$, n.s.). The 2PL item parameters are presented in Table 5.4. All of the items demonstrated good discrimination with slope parameters higher than one; the item difficulty parameters ranged from -1.57 for MK49 (outpatient care) to 0.47 for MK50 (provider network).

Table 5.4. Two-Parameter Logistic IRT Parameters for Terminology Items

Item #	Description	a	b
MK44	Appeal	1.91	-1.09
MK45	Assignment	1.29	-0.57
MK46	Formulary	1.12	0.36
MK47	Preventive care	2.02	-1.33
MK48	Generic drugs	1.26	-1.06
MK49	Outpatient care	1.75	-1.57
MK50	Provider network	1.23	0.47
MK51	Primary care doctor	2.07	-1.52
MK52	Deductible	1.42	-0.79
MK53	Medigap	1.39	-0.19

In addition to unidimensionality, another assumption of IRT is that the items demonstrate local independence. Local independence specifies that the relationship between responses to the items is due only to the construct being measured (i.e., health literacy). However, we would expect groups of items on the reading comprehension scale that correspond to the same scenario to be more related than those that correspond to different scenarios, thereby violating the assumption of local independence. To address this issue, we created testlets from items in each scenario and computed the IRT parameters using Samejima's graded response model (Sameijima, 1969) as suggested by Wainer and Thissen (1996). In contrast to the 2PL model used for the terminology items, the graded response model estimates more than one threshold parameter. In the case of the testlets, the number of thresholds is the number of items referring to the scenario minus one. In other words, the 1-800-MEDICARE scenario includes four items, so three threshold parameters are estimated. The parameters for the reading comprehension scenarios are shown in Table 5.5. All of the scenarios demonstrated good discrimination (a) parameters and a spread of threshold (b) parameters.

[6] Items MK70-72 load on factors, possibly reflecting familiarity with the term Medicaid. These items were included on the reading comprehension scale for the IRT analyses because the tasks required by these items are most similar to the other reading comprehension items and their loadings were higher for the reading comprehension factor.

Table 5.5. Graded Response Model IRT Parameters for Reading Comprehension Scenarios

Scenario	Items	a	b1	b2	b3	b4
1-800-MEDICARE	MK59-61	1.74	-3.19	-1.88	-0.55	--
Medicare claims notice	MK62-64	1.50	-1.64	-0.55	0.57	--
Personal plan finder	MK65-67	1.53	-1.61	-0.40	0.79	--
Medicaid	MK69-72	1.35	-2.55	-1.74	-0.85	0.06
Plan comparisons	MK73-76	2.18	-1.32	-1.05	-0.71	-0.09

Note: Scenarios were combined into testlets representing the number of items corresponding to the scenario that were answered correctly.

5.4 Development of Health Literacy Quizzes

After calibrating the items, we developed three alternate forms of the terminology quiz from the pool of items (see Table 5.6). The terminology items may be divided into two general content areas, general health care terms (MK47-49, 51), such as preventive care or generic drugs, and insurance-related terms (MK44-46, 50, 52, 53), such as deductible or provider network. Items were selected so that each form included at least one item related to general health care and had a similar range of item difficulty levels.

Table 5.6. Items on Terminology Forms

Item #	Description	% Correct	a	b
Form A				
MK46	Formulary	42	1.12	0.36
MK48	Generic drugs	74	1.26	-1.06
MK51	Primary care doctor	88	2.07	-1.52
MK53	Medigap	55	1.39	-0.19
Form B				
MK44	Appeal	80	1.91	-1.09
MK45	Assignment	64	1.29	-0.57
MK47	Preventive care	85	2.02	-1.33
MK50	Provider network	39	1.23	0.47
Form C				
MK45	Assignment	64	1.29	-0.57
MK46	Formulary	42	1.12	0.36
MK49	Outpatient care	87	1.75	-1.57
MK52	Deductible	70	1.42	-0.79

Table 5.7 presents the scenarios included on each of the three reading comprehension forms. Given that the pool contained only five scenarios, it was not possible to develop three quiz forms with the same difficulty levels. Based on the item parameters, it appears that Form C is easier than the other two forms. However, with the use of IRT scoring, the scores from the different forms are still comparable.

Table 5.7. Scenarios on Reading Comprehension Forms

Scenario	Items	a	b1	b2	b3	b4
Form A						
Personal plan finder	MK65-67	1.53	-1.61	-0.40	0.79	--
Medicaid	MK69-72	1.35	-2.55	-1.74	-0.85	0.06
Form B						
Medicare claims notice	MK62-64	1.50	-1.64	-0.55	0.57	--
Plan comparisons	MK73-76	2.18	-1.32	-1.05	-0.71	-0.09
Form C						
1-800-MEDICARE	MK59-61	1.74	-3.19	-1.88	-0.55	--
Medicaid	MK69-72	1.35	-2.55	-1.74	-0.85	0.06

Next, we present the ICCs and information curves for each of the terminology items (see Figures 5.1-5.6). (These curves are not presented for the reading comprehension items because these items were combined into testlets.) As shown in the figures, each form contains informative items with steep slopes and thresholds that are spread across the continuum of theta[7].

[7] The scales of the Y-axes of the information curves vary across the forms to allow readers to distinguish between the curves for different items.

Figure 5.1. Item Characteristic Curves for Terminology (Form A)

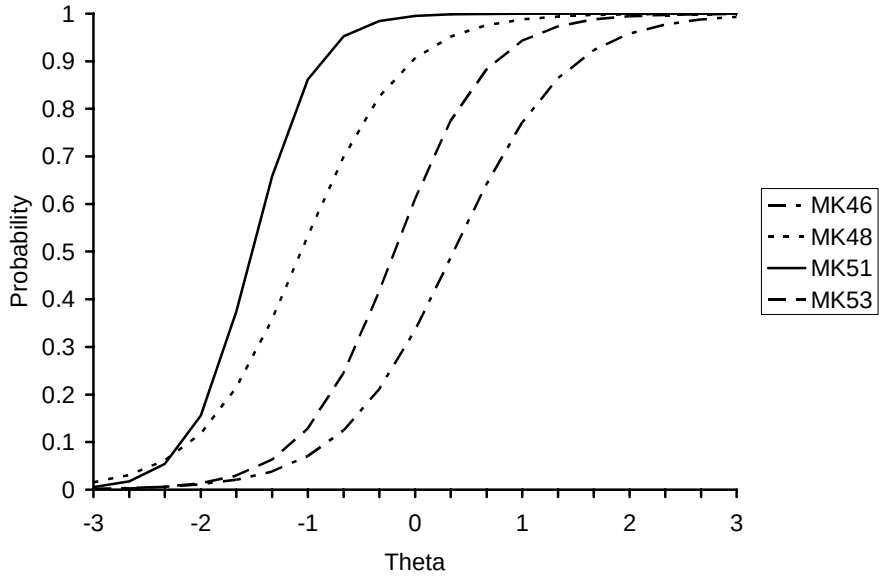


Figure 5.2. Item Characteristic Curves for Terminology (Form B)

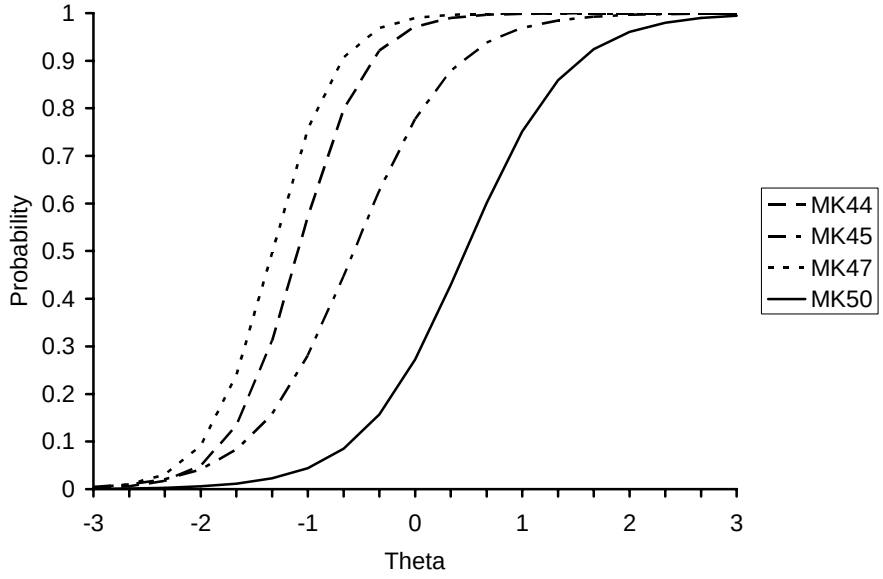


Figure 5.3. Item Characteristic Curves for Terminology (Form C)

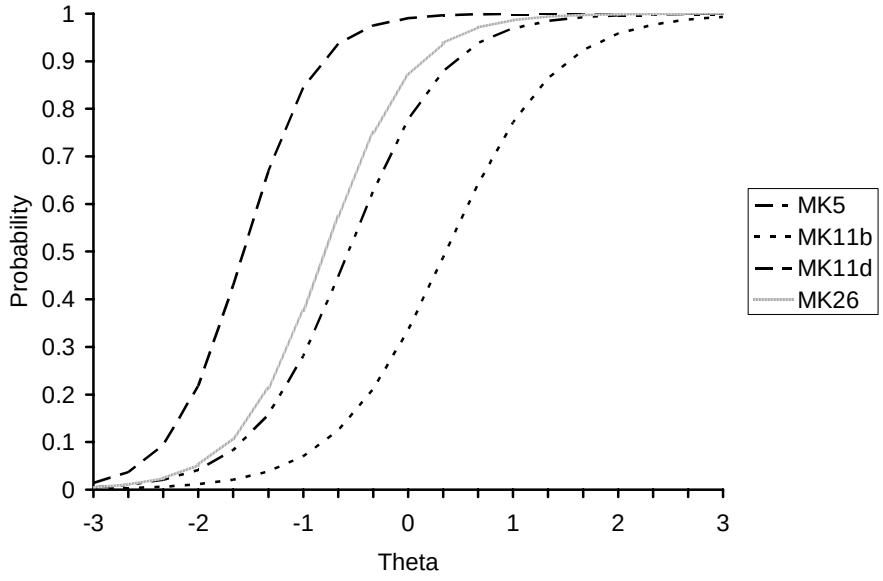


Figure 5.4. Item Information Curves for Terminology (Form A)

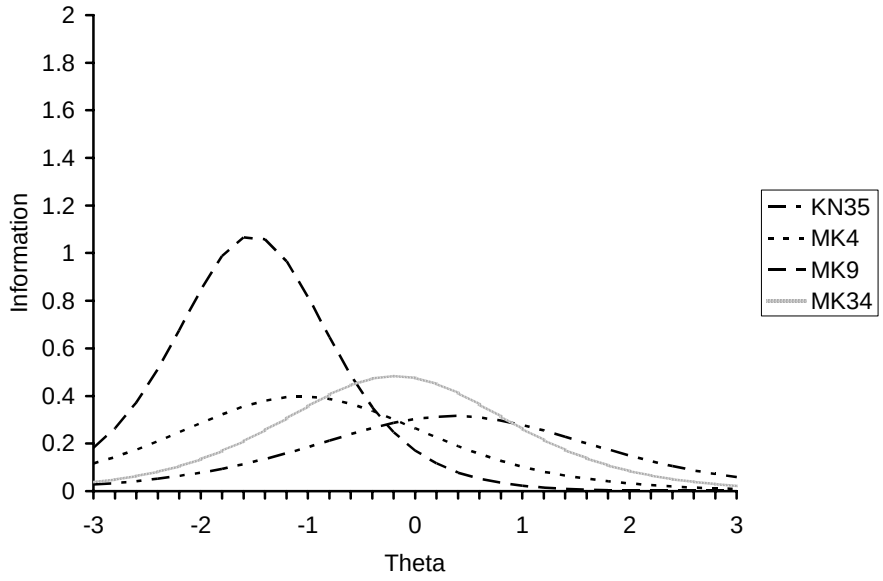


Figure 5.5. Item Information Curves for Terminology (Form B)

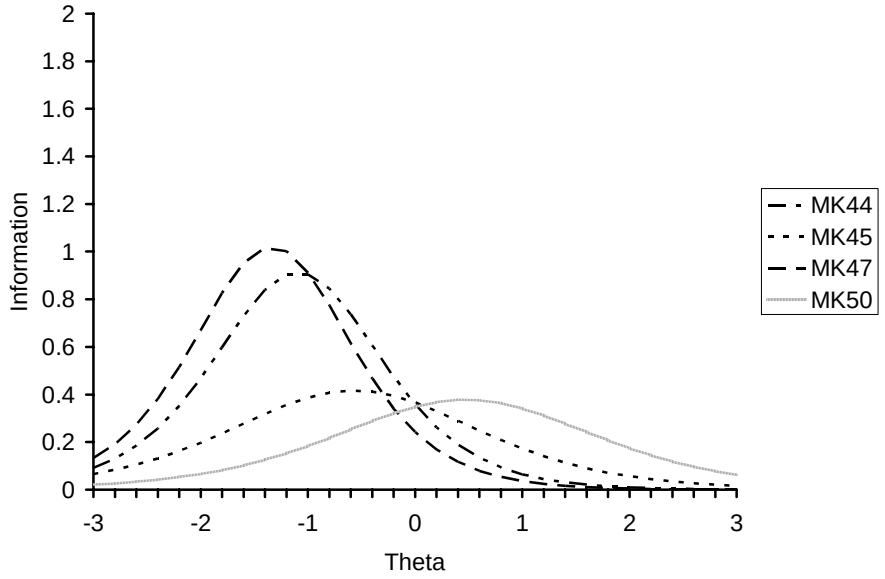
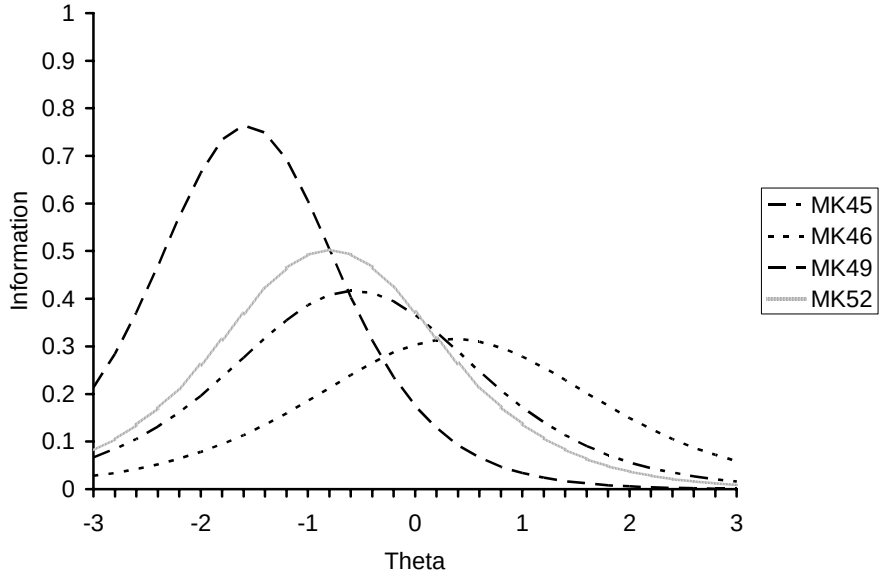


Figure 5.6. Item Information Curves for Terminology (Form C)



5.5 Psychometric Properties of Health Literacy Quizzes

The IRT parameters for each item were used to compute IRT scores for each form. The IRT scores were then converted to a 0-100 scale to produce the final quiz scores. Table 5.8 presents the scoring algorithms for the terminology forms. Similar to the knowledge quizzes, to obtain a score for a respondent, simply calculate the number of items on the form he/she answered correctly and then select the terminology score that corresponds to the number of correct responses. For example, a beneficiary who answered two of the items on Form B correctly would receive a score of 46.

Table 5.8. Scoring Algorithms for Terminology Forms

# of Correct Items	Raw IRT Score	Terminology Score
Form A		
0	-1.80	0
1	-1.00	29
2	-0.47	48
3	0.17	72
4	0.95	100
Form B		
0	-1.80	0
1	-1.10	25
2	-0.54	46
3	0.09	69
4	0.93	99
Form C		
0	-1.80	0
1	-1.10	25
2	-0.51	47
3	0.12	70
4	0.90	98

Due to the conversion of the reading comprehension items into testlets, a slightly more complicated scoring algorithm is required (see Tables 5.9-5.11). In this case, we would compute the number of items in each scenario that the beneficiary answered correctly and then use that information to select the appropriate score. For example, if a beneficiary who was given Form A answered none of the personal plan finder questions correctly, but answered two of the Medicaid questions correctly, he/she would receive a reading comprehension score of 28.

Table 5.9. Scoring Algorithm for Reading Comprehension (Form A)

# of Correct Items		IRT Score	Reading Comprehension Score (Form A)
Personal plan finder scenario	Medicaid scenario		
0	0	-1.72	9
0	1	-1.43	19
0	2	-1.15	28
0	3	-0.83	39
0	4	-0.43	53
1	0	-1.10	30
1	1	-0.94	35
1	2	-0.72	43
1	3	-0.46	52
1	4	-0.08	64
2	0	-0.57	48
2	1	-0.46	52
2	2	-0.29	57
2	3	-0.05	65
2	4	0.37	80
3	0	-0.09	64
3	1	-0.01	67
3	2	0.14	72
3	3	0.39	80
3	4	0.97	100

Table 5.10. Scoring Algorithm for Reading Comprehension (Form B)

# of Correct Items		IRT Score	Reading Comprehension Score (Form B)
Medicare claims notice scenario	Plan comparisons scenario		
0	0	-1.72	9
0	1	-1.43	19
0	2	-1.14	28
0	3	-0.82	39
0	4	-0.41	53
1	0	-1.14	28
1	1	-0.97	34
1	2	-0.76	41
1	3	-0.49	51
1	4	-0.11	63
2	0	-0.65	45
2	1	-0.54	49
2	2	-0.36	55
2	3	-0.11	63
2	4	0.30	77
3	0	-0.17	61
3	1	-0.08	64
3	2	0.08	70
3	3	0.32	78
3	4	0.90	98

Table 5.11. Scoring Algorithm for Reading Comprehension (Form C)

# of Correct Items		IRT Score	Reading Comprehension Score (Form C)
1-800-MEDICARE scenario	Personal plan finder scenario		
0	0	-1.98	0
0	1	-1.33	22
0	2	-1.13	29
0	3	-0.83	39
0	4	-0.34	56
1	0	-1.65	11
1	1	-1.21	26
1	2	-1.03	32
1	3	-0.76	41
1	4	-0.30	57
2	0	-1.22	26
2	1	-0.92	36
2	2	-0.76	41
2	3	-0.51	50
2	4	-0.07	65
3	0	-0.72	43
3	1	-0.51	50
3	2	-0.36	55
3	3	-0.09	64
3	4	0.60	87

Figures 5.7 and 5.8 display the test information curves for the terminology and reading comprehension quizzes. As shown in Figure 5.7, the three terminology forms are generally peaked in the same region of theta with Form B providing somewhat more information than the other two forms. The information curves for the reading comprehension quizzes appear to be flatter and less informative than the terminology quizzes, possibly as a result of combining the items into testlets.

Figure 5.7. Test Information Curves for Terminology Quizzes

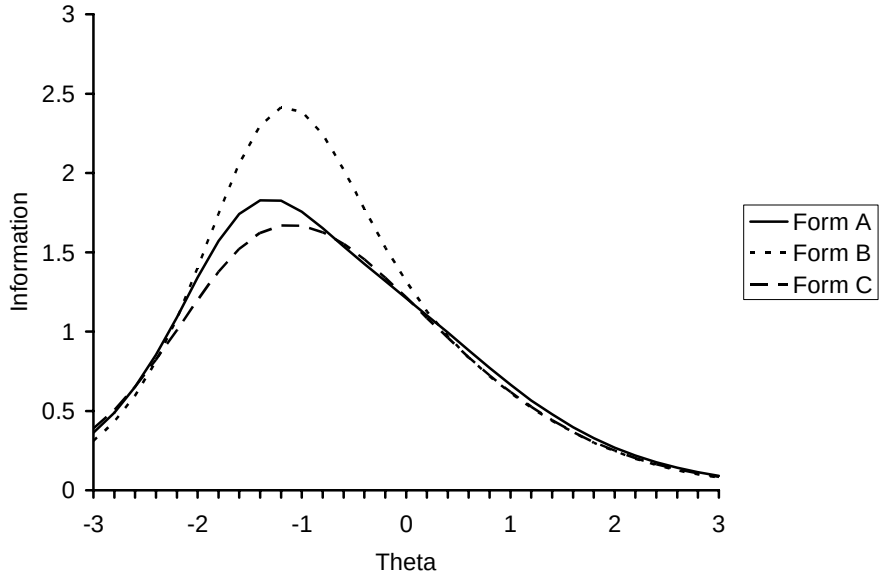
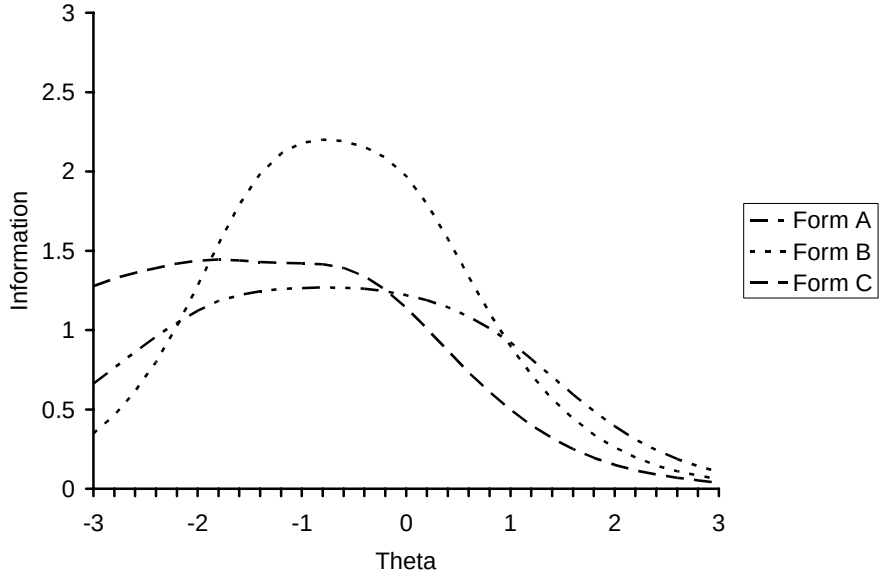


Figure 5.8. Test Information Curves for Reading Comprehension Quizzes



The internal consistency reliability of the health literacy quizzes was estimated using Cronbach's alpha (see Table 5.12). The reading comprehension forms had good internal consistency with alphas near or above 0.70. The terminology quizzes have lower alphas, however, values of 0.50 are sometimes considered acceptable levels of reliability for use in making group comparisons.

Table 5.12. Coefficient Alphas of the Health Literacy Quizzes

Health Literacy Quiz	Form A	Form B	Form C
Terminology	0.52	0.55	0.53
Reading Comprehension	0.73	0.82	0.68

Table 5.13 contains the means and standard deviations of the quiz scores by form. The values for the terminology quizzes are similar, supporting the equivalence of the three forms. However, while Form A and B of the reading comprehension quiz have similar means, the mean score for Form C is much lower. Because this form contains easier items, answering the items correctly is not indicative of as high of knowledge as answering more difficult items correctly and therefore, the IRT scores for this form would be expected to be lower.

Table 5.13. Means (and Standard Deviations) for Each Health Literacy Quiz

Health Literacy Quiz	Form A	Form B	Form C
Terminology	63.5 (27.8)	63.6 (28.2)	62.8 (28.0)
Reading Comprehension	66.7 (24.8)	66.6 (26.8)	48.6 (14.2)

In addition, we computed the correlations between the various reading comprehension scenarios. Similar to item-total correlations, we would expect the scenarios to have correlations of at least 0.30. All of the scenarios are moderately correlated with the highest correlation between the Medicare claims notice and the plan comparisons scenarios (r = .50).

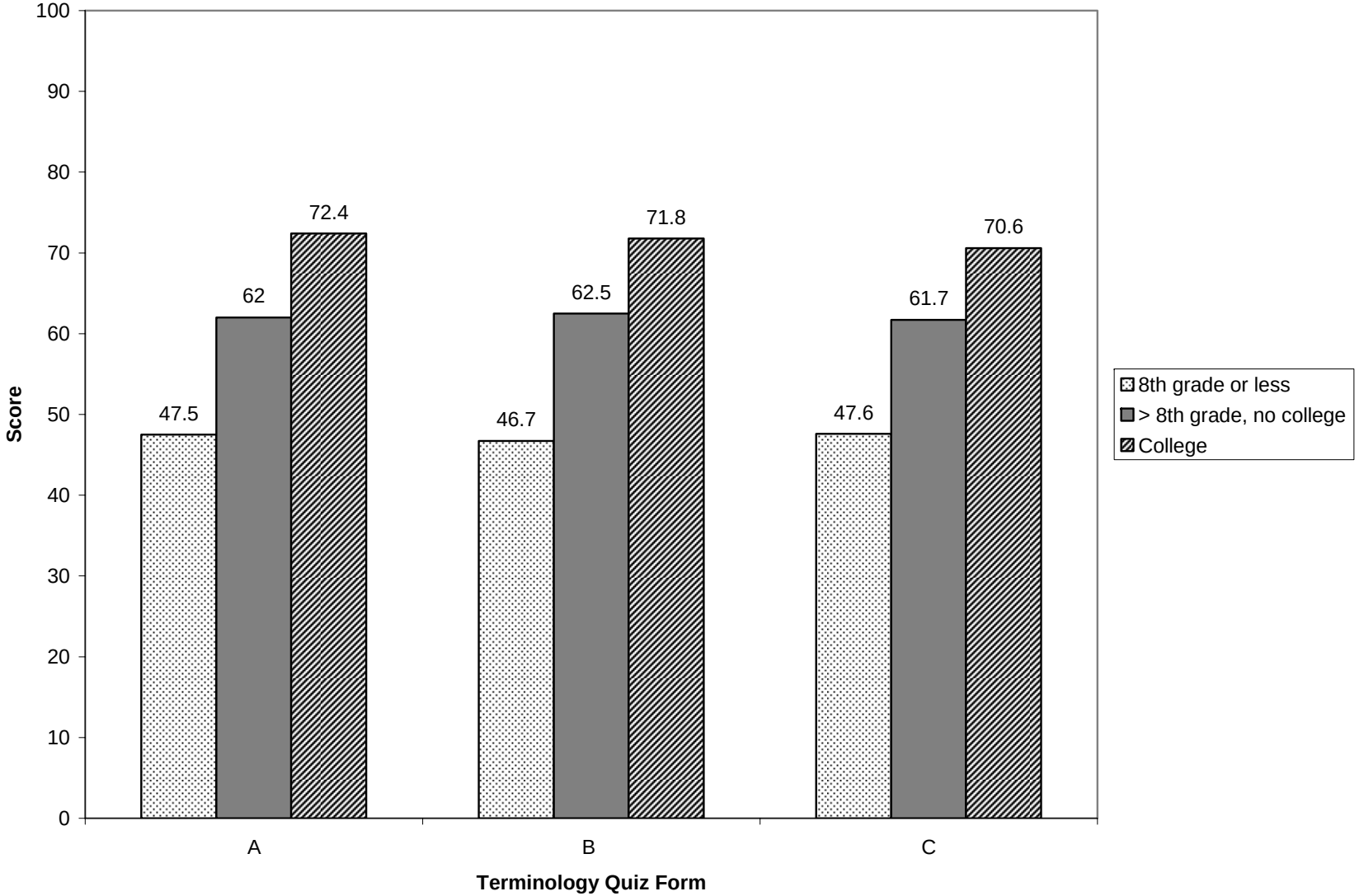
Table 5.14. Correlations between Reading Comprehension Scenarios

Scenario	Scenario				
	1-800-MEDICARE	Medicare claims notice	Personal plan finder	Medicaid	Plan comparisons
Calling 1-800-MEDICARE	1.00				
Medicare claims notice	.41	1.00			
Personal plan finder	.38	.35	1.00		
Medicaid	.34	.31	.44	1.00	
Plan comparisons	.45	.50	.43	.42	1.00

5.6 Group Comparisons

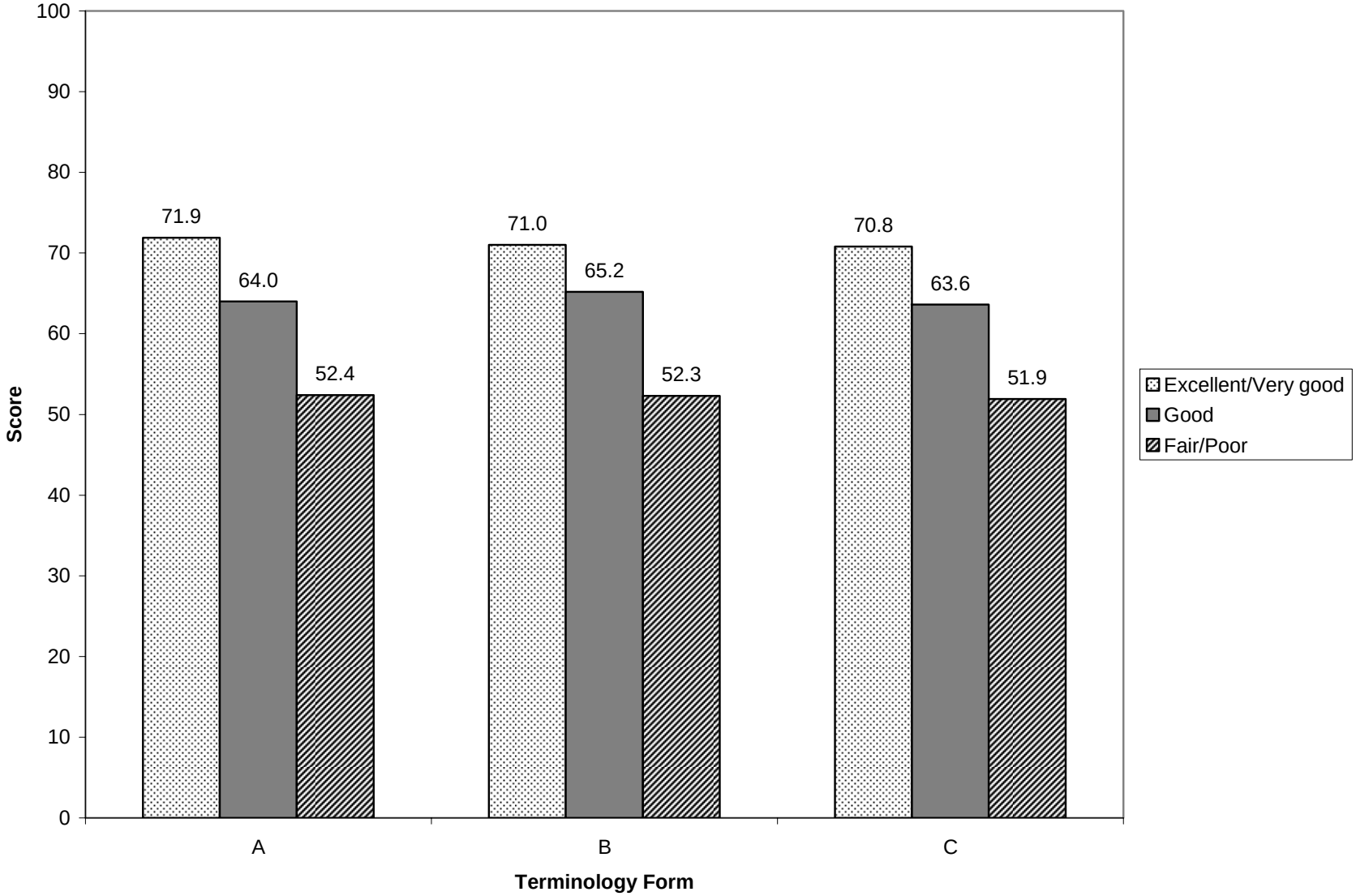
To assess the construct validity of the scales, we compared health literacy scores for groups who would be expected to receive different scores. Figures 5.9 to 5.13 present the group comparisons for the terminology quizzes and Figures 5.14 to 5.18 present the results for the reading comprehension quizzes. Consistent with our hypotheses, higher scores on the health literacy terminology scales were associated with more education, higher self-reported knowledge of Medicare, less self-reported difficulty understanding the Medicare program, and reading more of the *Medicare & You* handbook. Similar results were found for the health literacy reading comprehension scores. Beneficiaries with more education, higher self-reported knowledge, less difficulty understanding Medicare, and who read more of the handbook generally had higher reading comprehension scores.

Figure 5.9. Terminology Scores by Educational Achievement



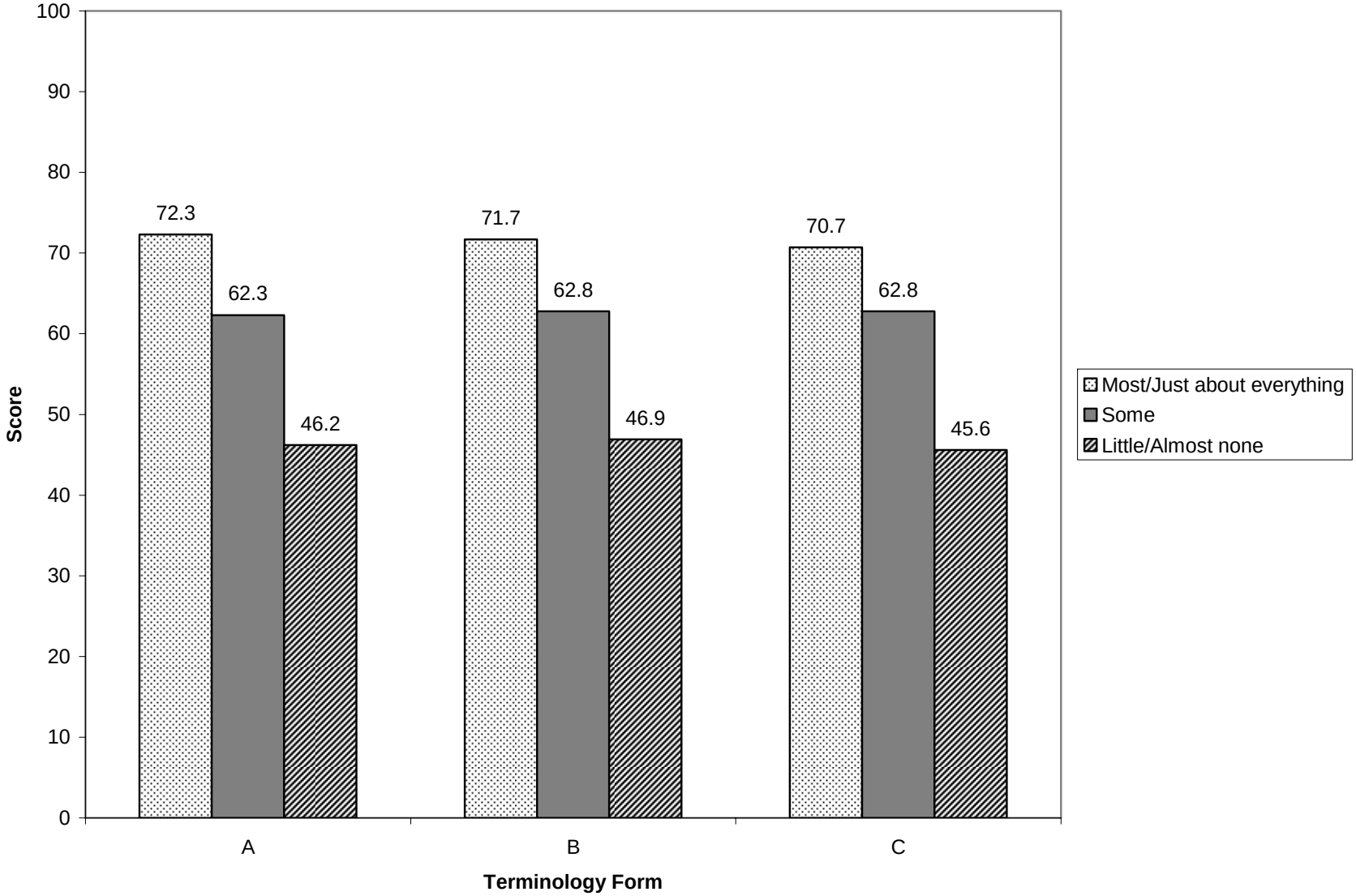
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across education levels are significant ($p < .001$).

Figure 5.10. Terminology Scores by MK1 (Self-Reported Understanding of Medicare)



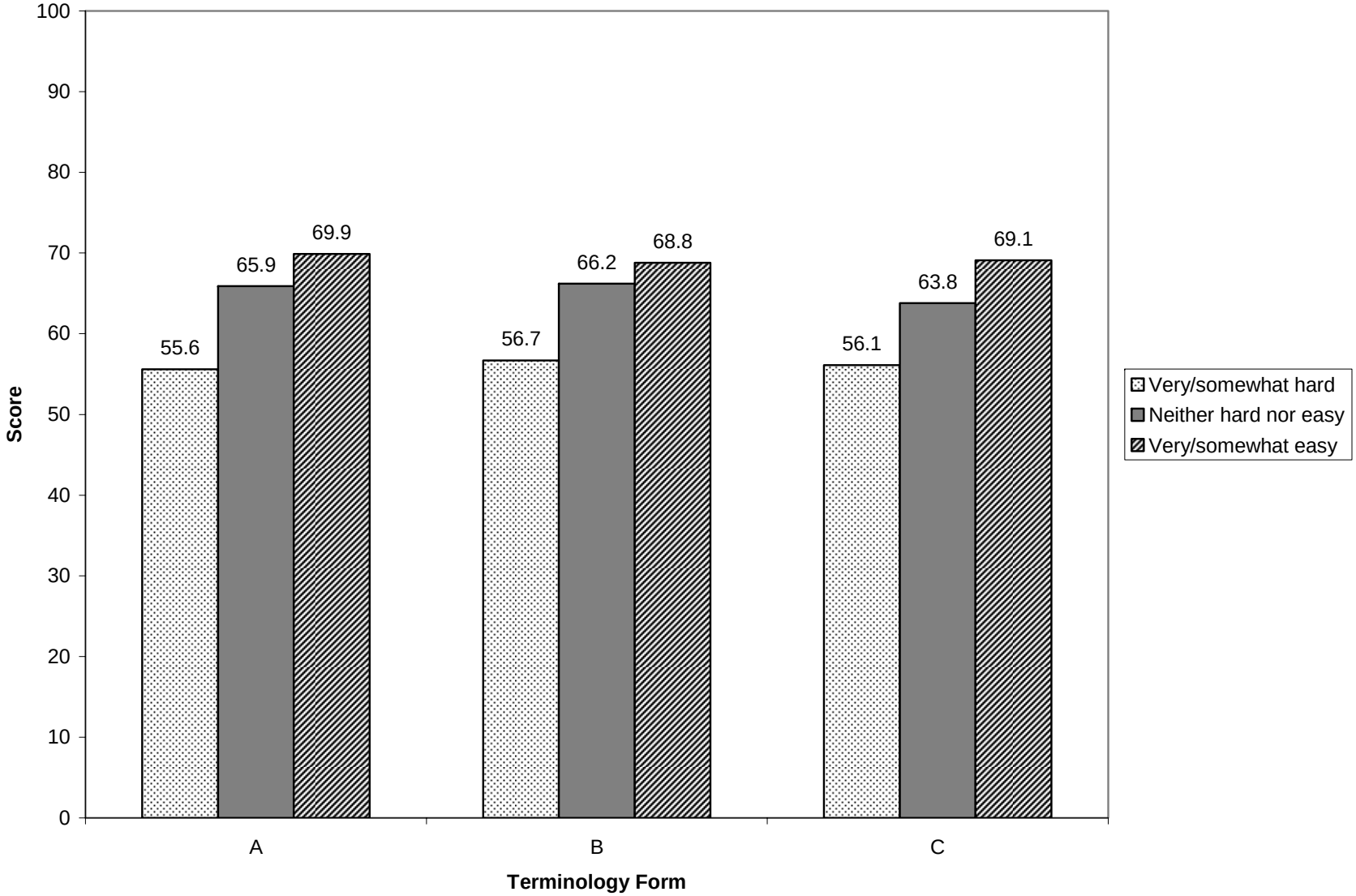
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across these response options on MK1 are significant ($p < .001$).

Figure 5.11. Terminology Scores by MK2 (How Much Know About Medicare)



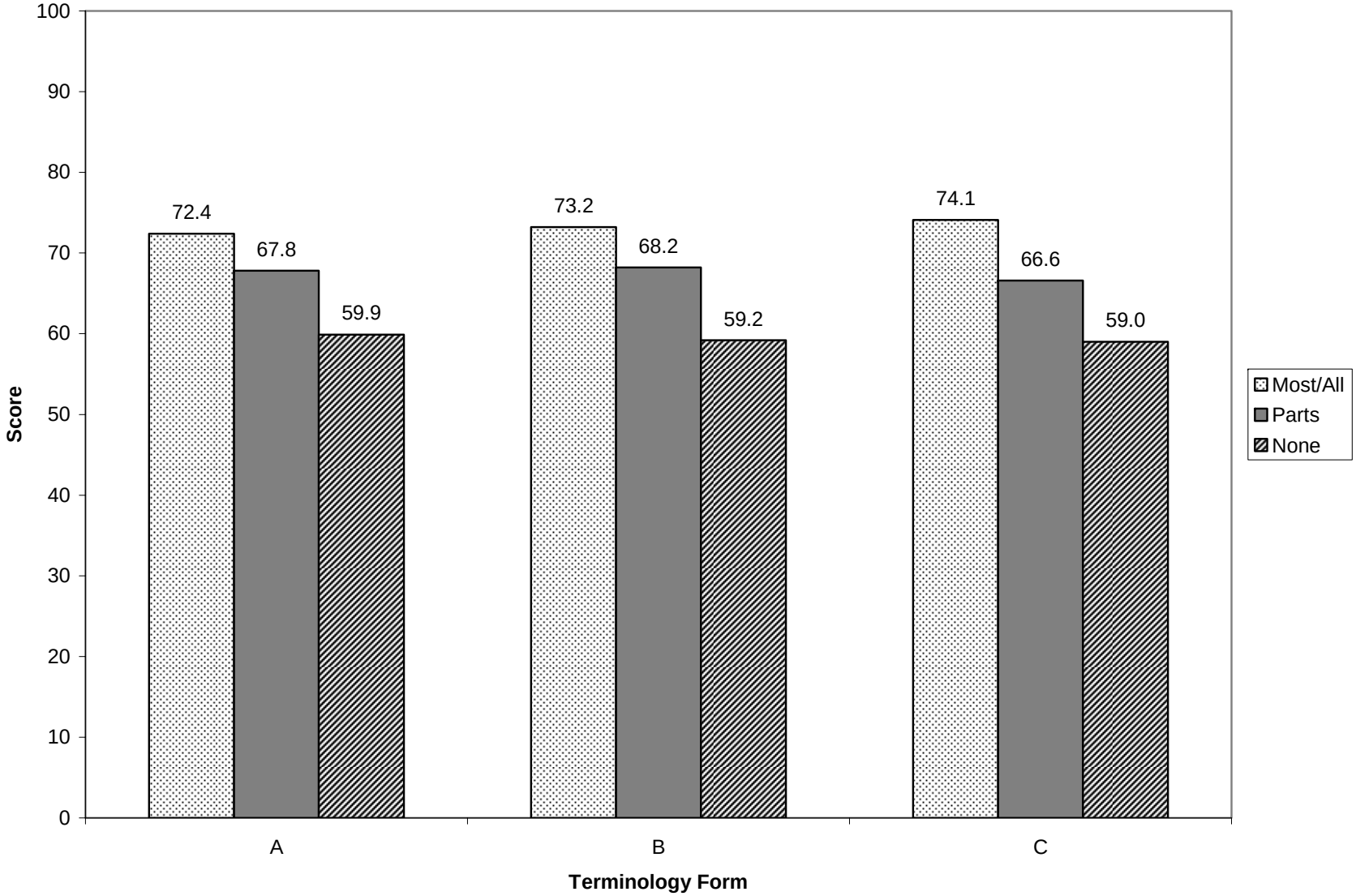
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across these response options on MK2 are significant ($p < .001$).

Figure 5.12. Terminology Scores by MK3 (Difficulty Understanding Medicare)



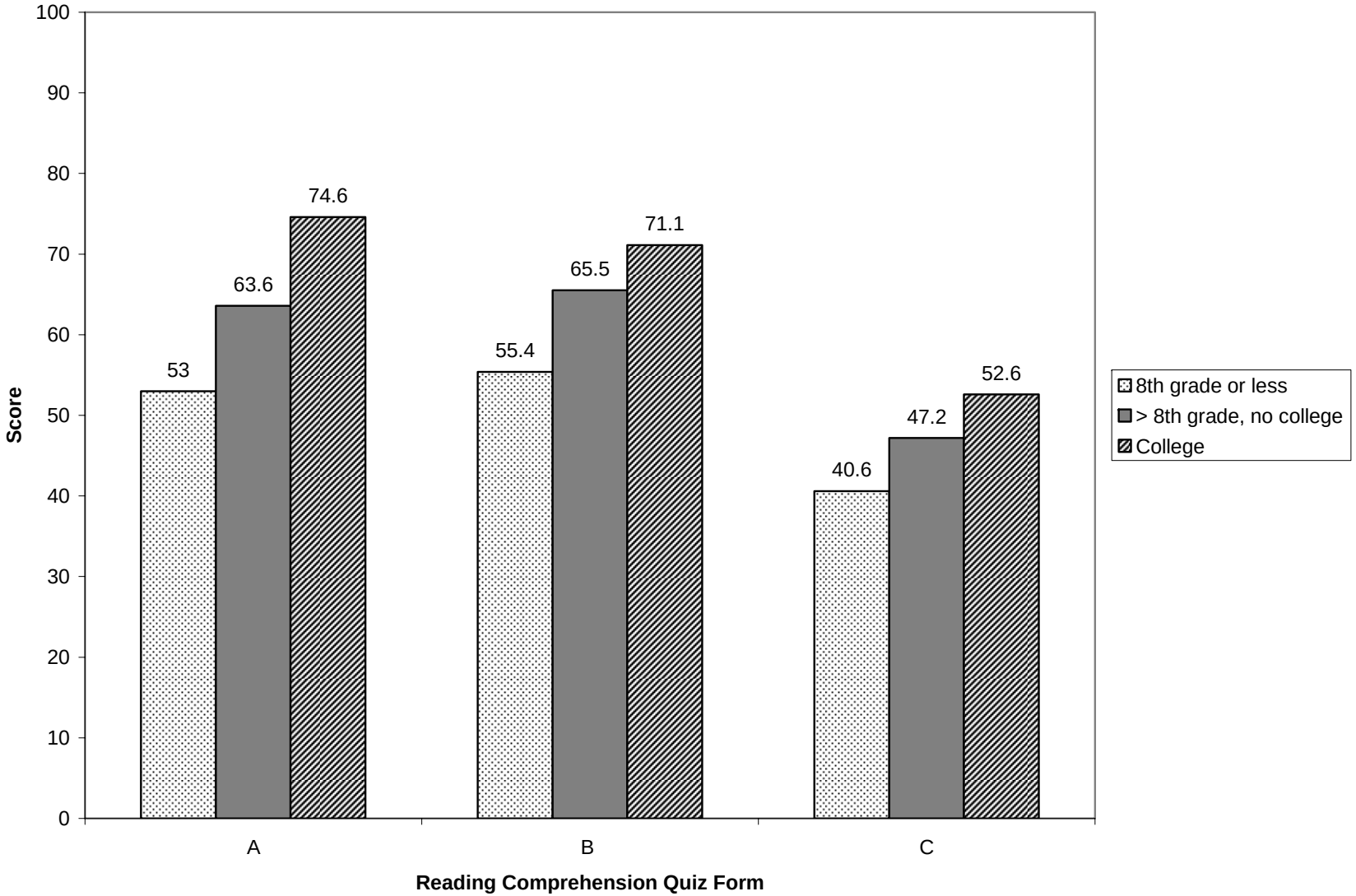
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons except neither hard nor easy vs. very/somewhat easy are significant ($p < .05$).

Figure 5.13. Terminology Scores by MK42 (Amount of Handbook Read)



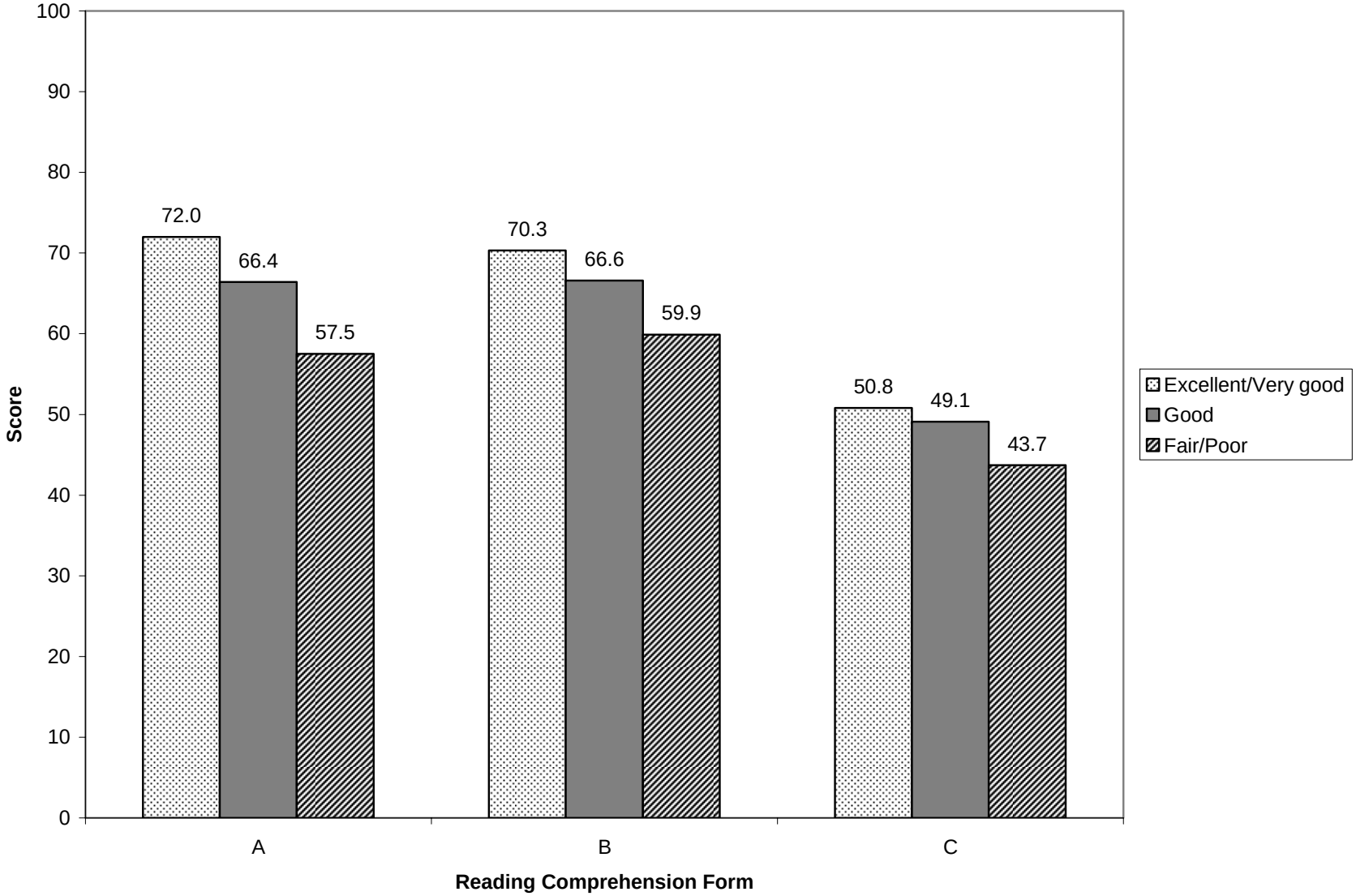
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across these response options on MK42 are significant ($p < .05$).

Figure 5.14. Reading Comprehension Scores by Educational Achievement



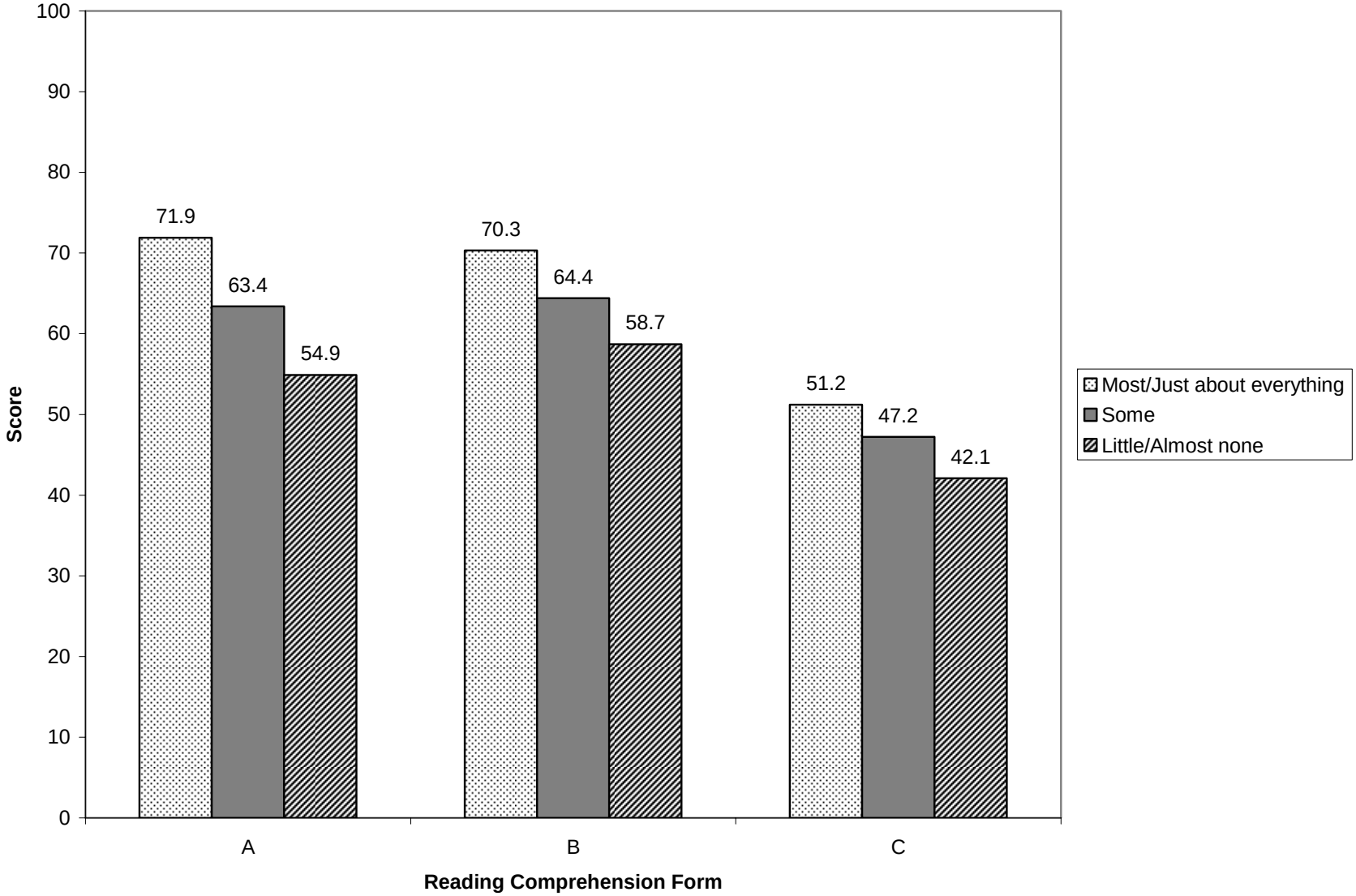
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across education levels are significant ($p < .001$).

Figure 5.15. Reading Comprehension Scores by MK1 (Self-Reported Understanding of Medicare)



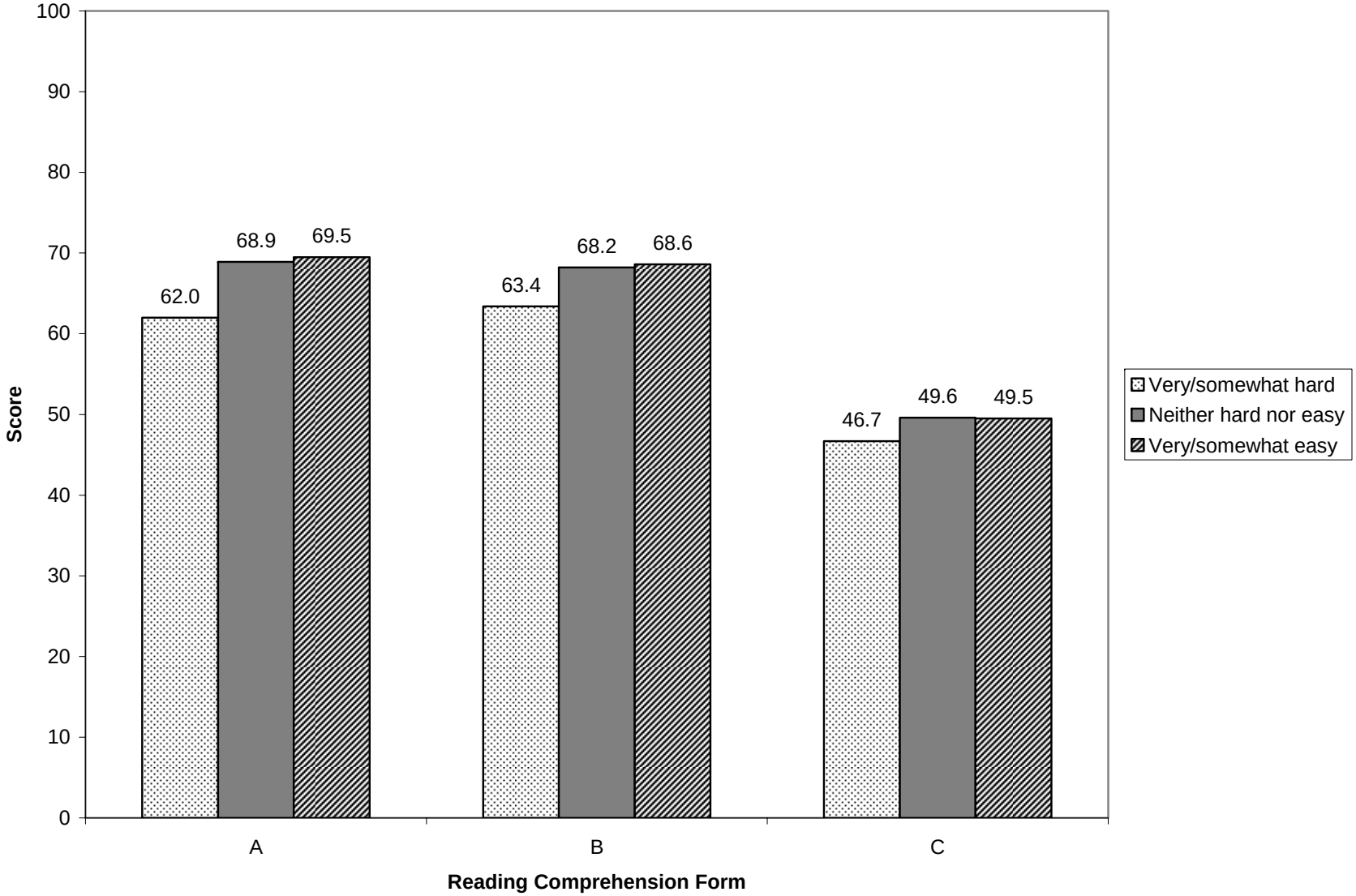
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across these response options on MK1 are significant ($p < .001$).

Figure 5.16. Reading Comprehension Scores by MK2 (How Much Know About Medicare)



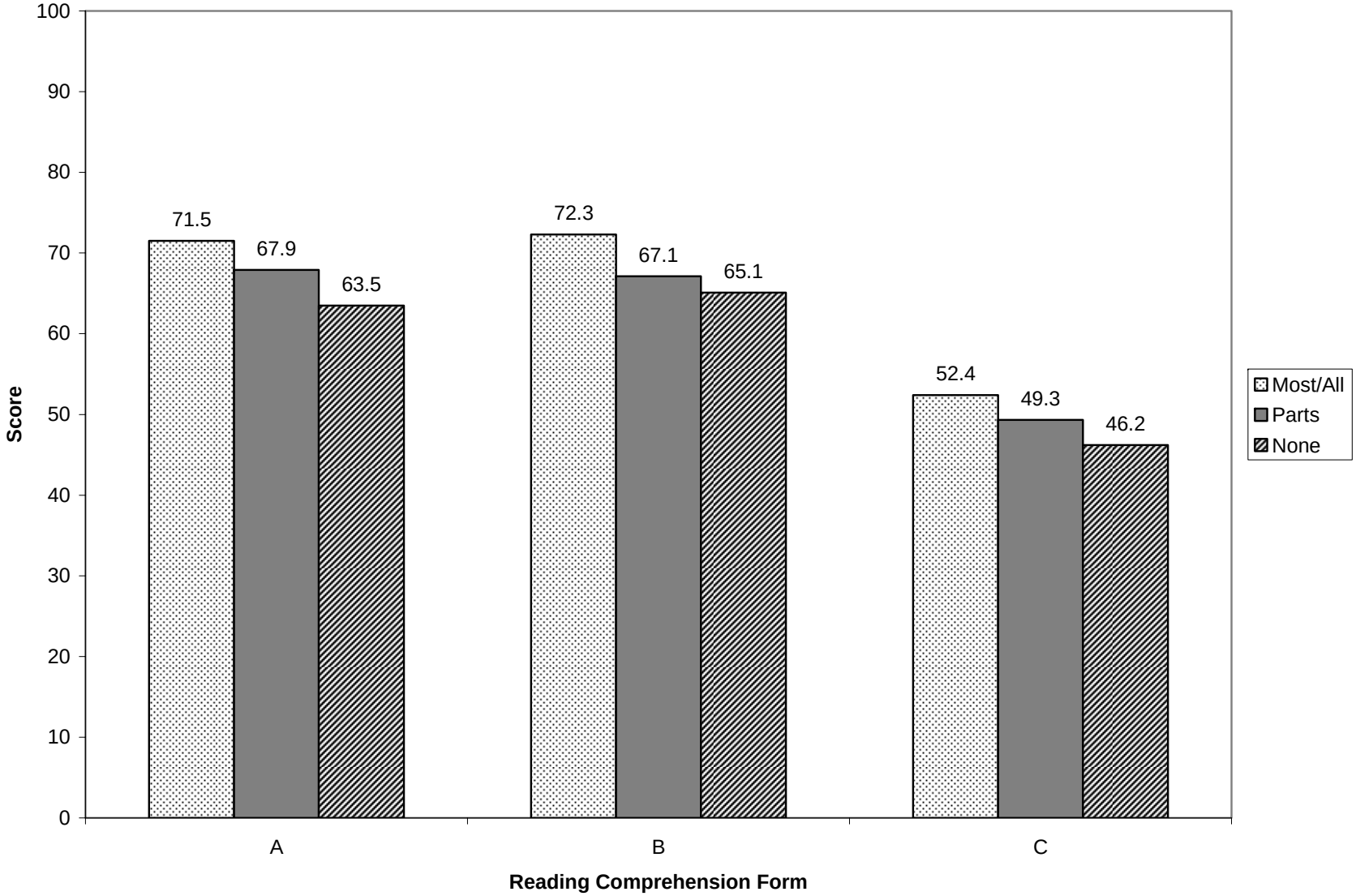
Note: ANOVAs indicated significant group differences for each form ($p < .001$).
All pairwise comparisons across these response options on MK2 are significant ($p < .05$).

Figure 5.17. Reading Comprehension Scores by MK3 (Difficulty Understanding Medicare)



Note: ANOVAs indicated significant group differences for each form ($p < .05$).
All pairwise comparisons except for neither hard nor easy vs. very/somewhat easy are significant ($p < .05$).

Figure 5.18. Reading Comprehension Scores by MK42 (Amount of Handbook Read)



Note: ANOVAs indicated significant group differences for each form ($p < .05$).
All pairwise comparisons except most/all vs. parts for Form A and parts vs. none for Form B are significant ($p < .05$).

6. Conclusion and Discussion

As described in this report, we were able to successfully develop and calibrate a pool of items measuring beneficiary knowledge of Medicare-related topics. As a part of this study, we evaluated the factor structure of the knowledge items to determine if they met the IRT assumption of unidimensionality. Although the knowledge items did not form a single underlying knowledge factor as hypothesized, they grouped into two meaningful factors representing the two primary components of the Medicare program, Original Medicare and Medicare+Choice. A two-parameter logistic IRT model was then used to calibrate the items addressing each topic. These two sets of items will allow researchers to measure knowledge of the different insurance options and perhaps target educational interventions to the areas in which beneficiaries lack knowledge.

Using the IRT parameters and the item content, we then developed three possible alternate forms of the knowledge quizzes for each topic (Original Medicare and Medicare+Choice). The parameters were used to compute comparable scores for the three forms of each knowledge quiz. Each quiz was short in length with four items for the Original Medicare quizzes and seven items for the Medicare+Choice quizzes, resulting in low respondent burden and allowing the quizzes to easily be incorporated into the MCBS. The three forms of each quiz had similar Cronbach's alphas, mean scores, and test information curves, and detected the same group differences, supporting their equivalence.

As a part of this project, we also developed new measures for assessing health literacy among Medicare beneficiaries. To our knowledge, these are the first measures designed specifically for Medicare beneficiaries that focus on insurance-related terminology and scenarios which beneficiaries are likely to encounter when obtaining and paying for their health care and choosing a health plan. The results indicated that the health literacy items divided into two factors, representing understanding of terminology and reading comprehension. As with the knowledge items, we calibrated the items using IRT and developed three alternate forms for each type of quiz (terminology and reading comprehension). Group comparisons suggested that higher scores on the health literacy quizzes were associated with greater educational achievement, higher self-reported knowledge of Medicare, less difficulty understanding Medicare, and reading more of the *Medicare & You* handbook.

It is important to note a limitation of this study. There was a time lag between development of the items and their inclusion in Round 36 of the MCBS. During this intervening period, changes in the Medicare program decreased the relevance of some of the items. For example, given the low enrollment in Private Fee-for-Service plans, knowledge of these plans is no longer considered necessary for beneficiaries to effectively navigate the Medicare program. Perhaps more importantly, the passing of the Medicare Modernization Act suggests the need to develop additional items to measure knowledge of new plan structures and benefits, including the drug benefit, which could be added to the pool of knowledge items described in this report. Updated health literacy items are also needed to reflect changes in Medicare, including the program's key messages.

The development of an item pool and calibration of the items as a part of this project allows for more dynamic measures of knowledge than previously available in the MCBS. The quizzes described in this report are just a few possible forms that can be developed. Additional alternate forms can be created when needed by selecting items from the item pool and using the established item IRT parameters to compute scores for the new forms. Furthermore, in the future as changes occur in the Medicare program, new items can easily be developed and added to the item pool. The transition between old and new items can be made by administering the new items for the four quizzes (Original Medicare, Medicare+Choice, Terminology, Reading Comprehension) along with some of the existing items on the corresponding quiz in order to calibrate the new items. Then a new set of IRT scores can be developed which are comparable to the scores computed using the old items.

Now that the knowledge and health literacy quizzes have been developed, future studies could be conducted to explore the link between these constructs and future health outcomes and service utilization. For example, perhaps those with greater health literacy and knowledge are more likely to use preventive services. Also, research is needed to further explore the link between knowledge and health literacy. One possible hypothesis is that knowledge serves as a mediator of the relationship between health literacy and outcomes.

Finally, as discussed at the November 2004 CMS symposium on "Normative Standards and Limits on Beneficiary Knowledge of the Medicare Program," a common question among researchers and policy makers is whether beneficiaries have the level of knowledge they need to effectively navigate the Medicare program and make informed decisions about health plans. While research has uncovered several areas in which beneficiaries' lack knowledge, there are currently no clear guidelines or methods for classifying beneficiaries according to whether they have the minimum level of knowledge they need. Future research could be conducted to establish a cutoff score for each of the knowledge quizzes in this study that would indicate whether a beneficiary has met this minimum level of knowledge. An important use of a cutoff score is to assess whether a particular education program is effective in increasing the number of beneficiaries who meet this minimum level of knowledge. Another potential use is to identify particular subgroups that are lacking in knowledge and may need materials or messages targeted specifically to them.

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