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Development of a foot care knowledge test for elderly people with diabetes

Martinez, Nelda Christine, Ph.D.
The Ohio State University, 1992

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DEVELOPMENT OF A FOOT CARE KNOWLEDGE TEST
FOR ELDERLY PEOPLE WITH DIABETES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Nelda C. Martinez, B.S.N., M.S.

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To my father who taught me belief in education of the mind, and, to my mother who showed me how with heart and soul.
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CHAPTER I

INTRODUCTION

Background of the Problem

Diabetes mellitus is a heterogeneous metabolic disorder characterized by abnormally elevated blood glucose levels. Approximately 5.8 million people in the United States have been diagnosed with diabetes with another 4-5 million suspected of having the disease but, as of yet, are undiagnosed (National Diabetes Data Group, 1985). Of the known cases of diabetes, 80% are classified as type II non-insulin dependent diabetes mellitus (NIDDM) of which elderly people, predominantly in the sixth and seventh decades of life, dominate the ranks. This translates into a prevalence of NIDDM of about 1 in 10 among those aged 65 and older (Huse, et al, 1989).

Diabetes is largely considered a manageable chronic disease. Its management status is primarily a function of direct patient self-care interventions related to medication therapy, diet, and exercise. Patient self-care management of diabetes is aimed at not only affecting normoglycemia, but at delaying the onset and/or minimizing the severity of long term diabetes related complications such as retinopathy, nephropathy, and peripheral and autonomic neuropathy. Since glucose control is largely a function of patient self-care ability, diabetes patient education has long been recognized as a crucial means of treatment and, hence, glucose control. Diabetes education is the primary means of providing patients and/or their families with the knowledge and information necessary for self-care management of this disease.

With the critical function of diabetes education to impart self-care knowledge, the evaluation of the resultant nature and type of knowledge acquired by the patient/family is equally
important. This is true of any discipline or specialty field which involves the teaching of a body of knowledge to any one individual or group of individuals. Yet, in the diabetes education field, few valid and reliable measures of diabetes patient knowledge exist. With the limited availability of such valid and reliable measures, it is perplexing to note the lack of patient knowledge related to any degree with patient nonadherence to prescribed diabetes regimens.

Patient nonadherence to prescribed diabetic therapeutic regimens has emerged as one of the more significant problems in diabetes care today (Becker & Janz, 1985). Diabetes research in nonadherence has involved exploration of such issues as the patient's health beliefs (Cerkoney & Hart, 1980); the nature of family/social support interactions (Glasgow & Toobert, 1988); stress (Cox, et al, 1984); and, the nature of patient-professional interactions (Lange, Heins, Fisher, & Kopp, 1988) to name just a few. Though significant correlations between these variables and nonadherence have been noted, this area of research has been marked by discrepant outcomes among related studies. This has resulted in the failure of any variable, or combination of variables, to consistently account for patient nonadherence as noted by self-care behavioral outcomes. Assuming that the patient's ability to enact self-care behaviors is predicated on knowing what one should do, it would appear that documenting patient knowledge is essential as a fundamental determinant of self-care.

Compliance issues in diabetes have generally been explored considering people with diabetes as a homogenous group. Diabetes, as previously noted, is a heterogenous disorder. So too are the people who live with diabetes. Diabetes differs by type. As such, type I-insulin dependent diabetes mellitus (IDDM) tends to afflict people less than 40 years of age--most of whom are children or adolescents when diagnosed. People with NIDDM tend to be over the age of 40 at the time of diagnosis and vary by treatment modality for glucose control. If one assumes similarity in patient attributes, then assessment of adherence, patient knowledge, or any factor related to glucose control typically disregards patient differences.
Older adults are a rather unique population however. This uniqueness can affect their responses as participants in research studies. Sensory and motor deficits may affect their ability to appropriately respond to questionnaires. McAuley (1987) notes that older adults respond better to instruments that are "easier" to complete. In particular, instruments printed in bold face and larger than normal black type print yield higher response rates that those not printed in this manner. Gueldner & Hanner (1989) report that even being asked to complete a questionnaire can be anxiety producing for older adults. Sinnott, et al (1983) suggest that time to complete questionnaires be minimized for elderly people. Fifteen to twenty-five minutes would be ideal for this age group.

Considering the heterogenous nature and treatment of diabetes as well as factors that may influence an older adults response to inquiry, it is critical that patient knowledge/adherence research be considerate of the unique attributes of this age group. This has not typically been the case, however, in diabetes related research.

Nonetheless, patients with diabetes are expected to assimilate a vast and complex amount of self-care knowledge to effect prescribed therapeutic self-care behaviors. One area of particular importance for the elderly person with NIDDM is self-care management of the feet. Diabetes complications associated with the feet account for a significant amount of treatment cost, morbidity, and mortality in people with NIDDM. Peripheral vascular disease (PVD) and peripheral neuropathy (PN) largely account for foot problems prevalent in this population. PVD, which increases dramatically with age and duration of diabetes, results in decreased arterial perfusion in the lower extremities (Carter Center, 1985). This can lead to intermittent claudication and subsequently to skin ulcerations, gangrene, and amputation (Greene, 1986). Approximately 50% of the estimated 31,000 lower extremity amputations performed yearly in the United States are performed on people with diabetes (Carter Center, 1985). This represents a sixteen fold increase in lower extremity amputations in people with diabetes compared to people without the disease.
Considering the prevalence of NIDDM in the aged population coupled with the increased life expectancy of people in the United States, it is clearly evident that PVD represents one of the leading complications associated with elderly people with NIDDM. All the leading cause of death in people with NIDDM is cardiovascular disease, hypertension, which is two times more prevalent in older adults with diabetes, is recognized as a significant risk factor associated with foot complications (Carter Center, 1985). All of this data does not include the role of PN as a contributing factor to foot complications. PN is largely associated with duration of the disease. Again, considering the prevalence of diabetes and the life expectancy of the aged person, PN represents a significant contributing risk factor associated with foot problems in this older adult population with NIDDM.

Economically, the cost associated with providing health care to people with NIDDM has been estimated at $11.56 billion/year (Huse, et al, 1989). Of this, almost 60%, or $6.83 billion/year, is attributable to treatment of care for diabetic complications for people with this type of diabetes. Treatment for circulatory disorders, neuropathic complications, and skin ulcerations account for the majority of total health care dollars spent. The single largest area responsible for expenditure of the health care dollar is hospitalization, followed by nursing home care, physician visits, drugs, and other professional services. In 1986, the average cost of caring for people with NIDDM was $3,073/year.

This figure does not include the cost associated with morbidity of the disease as noted by its causal relationship to total disability and loss of productivity. That has been estimated at $2.6 billion/year with an additional $5.6 billion/year related to foregone productivity as a result of premature mortality. In summary, NIDDM represents a total economic cost of $19.8 billion/year (Huse, et al, 1989).

To say that diabetes foot related complications can be prevented or minimized as a direct function of patient self-care, is to say that the costs associated with NIDDM can be affected as well.
The underlying premise of diabetes foot care education is that the provision of self-care knowledge can greatly influence the ability of the patient to recognize and/or prevent foot related problems. Documentation of patient foot care knowledge has been problematic however. This is the result of the fact that no valid and reliable measure of patient foot care knowledge exists.

Rather than employ reliable and valid indices of patient knowledge, a large number of diabetes education intervention studies have explored the efficacy of patient teaching using indices of metabolic control (e.g., glycosylated hemoglobin) as correlates of self-care and/or patient knowledge. The result is that abnormal levels of glycosylated hemoglobin are interpreted as either indicative of the lack of patient knowledge, the lack of patient adherence, or the ineffectiveness of diabetes education to effect self-care behavioral outcomes. At best, not only are metabolic indices indirect representations of patient knowledge/adherence, these indices are increasingly considered invalid representations of these outcomes (Kurtz, 1990).

In studies that have attempted to document patient knowledge, typically global measures of knowledge have been employed. Such measures seek to capture a broad and comprehensive array of self-care knowledge. The result is that a limited number of items represent any one of the multitude of behavior and knowledge domains related to diabetes. Furthermore, one area of weakness in studies that claim and/or disclaim the efficacy of diabetes educational is the lack of valid and reliable measures of patient knowledge. Reliable and valid measures of patient knowledge are needed to assess the efficacy of diabetes educational interventions designed to positively effect patient learning outcomes and self-care behaviors. One of the bigger challenges facing diabetes educators today is whether the nature of education can effect such learning of self-care knowledge. Hospital administrators are seeking evidence to account for the efficacy of diabetes education in light of the costs associated with maintaining personnel and programs in this field. Furthermore, it is difficult to account for the billion of dollars spent by third-party
insurance sources in treating problems associated with diabetes which, for the most part, is considered a manageable chronic disease.

**Problem Statement**

Elderly people with diabetes represent the largest group of people with diabetes. Prevalence rates are expected to increase as the number of older adults in the United States dramatically increases. Costs attributed to this age group for diabetes treatment and associated complications range in the billions of dollars. Problems associated with the feet represent one of the largest areas of treatment and costs in this age group. With diabetes recognized as a manageable chronic disease, nonadherence with prescribed therapeutic regimens remains a significant challenging problem for health care providers. Numerous factors have been explored to account for patient nonadherence. None have yielded consistent, significant explanatory power. Patient knowledge of diabetes has received limited attention in adherence-related research. Attention given to this variable has been global in concept, subsuming all aspects of diabetes self-care in assessing patient knowledge. Furthermore, these studies typically do not employ valid and reliable indices of patient knowledge. One reason is that few valid and reliable measures of patient knowledge exist. Of those available, they are global measures of knowledge. In addition, it does not appear that attention has been given to acknowledging the unique attributes of elderly people. Rather, adherence-related research tends to consider and measure all people with diabetes, particularly adults, as a homogenous group of people. The heterogenous nature of diabetes suggests that research within the domain of adherence, such as patient knowledge, be considerate of the unique attributes of various age groups. It is within this frame of reference that research may contribute to our understanding of patient adherence-related factors. As such, this study will focus on the development of a
knowledge instrument to address one of the most critical elements in the provision of diabetes education for older adults—foot care.

Appropriate measurement of such a basic and fundamental outcome sought in patient teaching would serve two purposes: 1) enable educators to better evaluate the efficacy of diabetes education programs; and, 2) assist the patient achieve the highest potential for adherence by allowing educators to use such measures for the diagnosis of knowledge deficits and the prescription of educational interventions in a timely and cost effective manner.

Purpose of the Study

The purpose of this study is to develop a reliable and valid instrument to measure the foot care knowledge in elderly people with diabetes.

Research Objectives/Hypotheses

The study is guided by the following research objectives and hypotheses:

1. to identify major content categories of diabetes foot care knowledge considered important for elderly people with diabetes to have in order to care for their feet;
2. to establish content validity of foot care knowledge categories employing card sorting methodology and the D-L Test of Agreement with a panel of diabetes experts;
3. to construct a norm-referenced, 25 item multiple choice instrument to measure foot care knowledge in elderly people with diabetes;
4. to establish face and content validity of the constructed instrument using a panel of experts;
5. to construct the instrument corresponding to a 4th to 7th grade reading level;
6. to establish psychometric indices of instrument reliability employing Kuder-Richardson 20 formula and test-retest technique to evaluate internal consistency and stability respectively;
7. to establish psychometric index of the instrument's construct validity by testing the following hypotheses:
   a) the foot care knowledge test will be comprised of items clustered into two major content areas;
   b) elderly people with diabetes will score significantly higher on the foot care knowledge test than elderly people without diabetes;
   c) elderly people with diabetes who have received diabetes and/or specific foot care education will score significantly higher on the foot care knowledge test than elderly people with diabetes who have not received such education;

8. to evaluate the difficulty level of each item on the foot care knowledge test;
9. to evaluate the discriminating power of each item on the foot care knowledge test; and,
10. to evaluate the effectiveness of distracters per item on the foot care knowledge test.

Definition of Terms

The following section defines several key terms to be used for the purposes of this study.

Elderly Person - an individual at least 60 years of age but not more than 75 years of age.

Chronological age is to be determined by age in years as noted by patient self-report.

Foot Care Knowledge - information regarding pathophysiology, treatment, and management principles necessary for care of the feet in people with diabetes. To be measured using the foot care knowledge test developed in this study.

Diabetes Mellitus - a chronic metabolic disorder characterized by elevated blood glucose levels.

Selected aspects of the study will involve known subjects with diabetes, otherwise, history of diabetes will be ascertained by patient self-report.

Foot Care Behavior - activities taught by diabetes nurse educators and undertaken by an elderly patient with diabetes to be performed on a regular basis in care for the feet. Foot care behaviors
will be measured using survey methods asking subjects to record what they perceive to be important self-care behaviors for elderly people to perform regularly, and, for diabetes educators to teach.

Limitations of the Study

Several limitations define the parameters of this study. These are described below.

1. The elderly sample group will be drawn conveniently from several diabetes agencies in the Dayton and Columbus area. These include the Dayton Area Diabetes Association, the Dayton Area Senior Citizens Center, the Central Ohio Diabetes Association (Columbus area), Life Care Alliance (Columbus area), and the Diabetes Outpatient Clinic at The Ohio State University Hospitals. Convenience sampling will limit generalizability of study findings.

2. Every effort will be made to obtain the needed sample size of elderly patient subjects. Failure to obtain an adequate sample size may threaten the ability to appropriately statistically analyze the data.

3. Completion of the questionnaires by both the sample of diabetes nurse educators and elderly patients is based on self-administration. Both sample groups are entrusted with the ability to read and follow questionnaire instructions correctly. For the elderly subject group, the appropriateness of the instructions, clarity, and general readability level of the instrument will be addressed in measures concerning the establishment of face and content validity. Furthermore, subjects are entrusted with providing data reflective of their perceptions and not that of others such as colleagues, friends, or family.

4. Elderly subjects participating in the study are self-selected. The voluntary nature of subject participation may attract a more highly motivated sample group with characteristics not reflective of the larger population.
CHAPTER II

THEORETICAL FRAMEWORK
AND
REVIEW OF LITERATURE

This section describes the theoretical framework guiding the study and the literature as it relates to the nature of this study. The review of literature includes studies related to patient compliance in disease states other than diabetes; patient compliance with prescribed diabetes therapeutic regimens; psychometric studies of diabetes patient knowledge tests; and, studies relating measurement of any dimension of patient foot care knowledge.

Theoretical Framework

Measurement theory serves as the framework guiding this study. The following sections describe the theory with particular emphasis on validity and reliability.

According to Nunnally (1978) measurement embodies "rules for assigning numbers to objects in such a way as to represent quantities of attributes" (pg. 3). He asserts that an attribute is what is measured, not an object such as a person. As such, attributes are features, or characteristics, of objects. Furthermore, attributes are abstractions. Measurement involves a process that ultimately results in an instrument or procedure that represents an attribute in quantifiable terms.

Quantification of an attribute is an important aspect of measurement. Numbers are used to represent an attribute so that the amount, or quantity, of an attribute can be determined.
Numerical values assigned to attributes are derived from the application of rules. These rules are standardized procedures that, when applied, yield consistent measures of the attribute defined across people employing the measure, and, across time. Nunnally (1978) states that rules for quantifying an attribute "are at the heart of measurement" (pg. 5).

Scaling Models

Development of an instrument to measure, or quantify, an attribute requires a plan. Nunnally (1978) defines this plan as a scaling model with a scale defined as the resultant measurement tool.

The problem inherent in scaling models is that scaling involves three dimensions—the person, the stimulus, and the response. A stimulus is something done or presented to a person. In this study, stimuli are represented by items on the foot care knowledge test. A response is something a person does when presented with a stimulus. In this study, responses are represented by the subject's answer to the test items on the foot care knowledge test. The third dimension, person, are the subjects themselves. What can be problematic in scaling an attribute is that there are many ways to scale each of these dimensions. Furthermore, measurement of an attribute usually focuses on unidimensional scaling as opposed to three-dimensional.

Measurement models usually involve the scaling of stimuli or the scaling of people. Scaling responses fall more within the realm of multidimensional scaling when more than one type of response is used to measure an attribute. This study does not propose the use of multi-type responses. Responses to the knowledge test are consistent involving dichotomous data derived from a multiple choice format. Therefore, scaling for responses is not problematic leaving scaling for stimuli and for people of concern.

In scaling for stimuli, the primary focus is to develop a scale to measure an attribute that can be applied under different conditions (Nunnally, 1978). Though people may be used in the measurement process, it is the stimuli that are important. In particular, development of a scale that
differentiates varying levels of the stimuli. Nunnally (1978) cites the example of a scale that
differentiates varying degrees of light from high to low intensity. The resultant scale can then be
applied to different test conditions with response curves obtained from each application
mathematically related for consistency.

Stimulus scales are derived from data obtained from subjects/objects responding to one
of three levels of estimation. These are ordinal, interval, and ratio. There are numerous methods
of estimation for each level. Since scaling for stimuli is not the focus of this study, these methods
will not be explicated. What is important to note is that each level of estimation yields a
Corresponding stimulus scale of measurement. For example, ordinal estimation techniques yield
ordinal scales.

This study focuses on developing a scale for people. As such, the dimension of scaling
stimuli is "collapsed" in lieu of differentiating people as opposed to levels of the stimuli.
Categorizing people is the end result of measures that scale people. In this study, the knowledge
test is designed to differentiate people into essentially two groups—those who have foot care
knowledge versus those who do not.

Items (i.e., stimuli) used in an instrument designed to scale people are very important. As
such, Nunnally (1978) advocates multi-item instruments as it is highly unlikely that any one item is
sufficient to represent an attribute. Furthermore, any one item potentially relates to other
attributes as well. Nunnally uses the term "specificity" to indicate the unique relationship of an
item with a particular attribute. An item with a high degree of specificity has a high correlation with
the attribute in question. Conversely, low specificity items may have little unique relationship with
an attribute of interest. Disregarding specificity and assuming that items have the power to
categorize people, it is still difficult for one item to accomplish this. Nunnally attributes this to
measurement error that is associated with repeated use of an item. Measurement error, or random
error, results from response inconsistency thereby making an item potentially unreliable. By using
multiple items to represent an attribute, the effect of random error can be minimized.
Nunnally (1978) describes several models for scaling people. They are defined as either deterministic or probability models. They are distinguished by their assumptions governing the nature and distribution of responses to items representing an attribute. Deterministic models assume no error in responses such that each item has the capability of discriminating people based on the nature of their responses to other items. Probability models assume response error in that the distribution of scores represents an average of all scores. As such, any point on the distribution of scores includes people who have scored above or below the mean. This study involves the use of probability model to scale people.

The type of probability model most applicable to this study is what Nunnally (1978) describes as a monotonic model. In this model, response distribution curves for each item have fairly equal ascending lines from low to high on the attribute being measured. This means that subjects scoring high on an attribute are those who tend to respond correctly to test items. A distribution of scores across all subjects represents an average of responses. This type of model is also referred to as a linear, or, summative model. The model assumes measurement error plus the notion that all measurement items represent the defined attribute. Inherent in this model is the summing of scores obtained on all test items. Summing scores gives an indication of the quantity of the attribute being measured. This type of model is the most common approach to scaling people used in psychological research such as the development of achievement measures (Nunnally, 1978).

Validity

One aspect of evaluating the utility of an instrument is to ascertain its validity. A valid instrument is one that does what it is purported to do (Nunnally, 1978). In this study, a valid knowledge test is one that measures foot care knowledge in elderly people with diabetes. Nunnally states that validity is established in varying degrees; never as an absolute property of an instrument. Three types of validity are described by Nunnally—predictive, content, and construct.
Predictive validity involves correlating performance on one attribute with behavior or performance on another attribute. This correlation actually may be between attributes in the present (concurrent) or in the future (predictive). The higher the correlation between the two attributes, the greater the amount of validity. In this study, predictive validity of the foot care knowledge test will be evaluated. Emphasis will be on evaluating the content and construct validity of the instrument.

Content validity deals with the content domain represented by items in an instrument (Nunnally, 1978). Nunnally emphasizes the importance of assuring an instrument represents the domain of interest during the test construction phase. Constructing an instrument comprised of items representative of the content may involve sampling existent items from the content domain, or, one may also formulate items to represent the content. Regardless of the approach, Nunnally stresses that instrument items must represent the construct of interest. Deciding what items to include in an instrument represents a value judgment as some method of subjectivity is involved in selecting and/or constructing content items. Nunnally regards this aspect of subjectivity as an "appeal to reason regarding the adequacy with which important content has been sampled and on the adequacy with which the content has been cast in the form of test items" (pg. 93).

In this study, items to be constructed regarding foot care knowledge will be derived from data obtained primarily from diabetes nurse educators and elderly people with diabetes. Other content sources will also be used. Educators and patients will be asked to indicate the importance of foot care content areas thereby representing the element of subjectivity in deciding content items.

Nunnally (1978) indicates that content validity is not sufficient as an index of instrument validity. Instruments represent constructs which Nunnally describes as abstract variables. These abstract variables typically are not observable as behaviors. As such, items on instruments are constructed to represent variables that otherwise cannot be readily observed in the world. These items are referred to as observables. Nunnally states that construct validity deals with three
aspects: 1) specifying the domain of observables related to the construct; 2) evaluating the
degree to which the observables measure the construct or something else; and, 3) evaluating the
degree to which the instrument measures the construct predictable from hypotheses regarding
the construct.

With regard to the first aspect, Nunnally (1978) indicates that there is no set way to specify
the domain of observables to represent the construct of interest. One reason is the difficulty in
capturing all the elements within any given domain. Another reason is that the construct itself may
be vaguely understood. As such, there may be little knowledge of what observables to specify
when constructing an instrument. Regardless, some means of specifying observables to be
included in an instrument needs to be employed. In this study, specifying the content domain
from which test items will be formulated will be achieved through content validity activities.

The second aspect of construct validity relates to determining how well the items in an
instrument measure the same thing--the construct of interest. Essentially, this involves
correlating items to determine how well items "go together." Factor analysis and cluster analysis
are two statistical techniques used to address this aspect of validity.

The last aspect of construct validity relates to how well an instrument corresponds to other
constructs in which one would expect to see a relationship. Known groups (i.e., criterion groups)
technique is an example of this form of evaluation. In this study, an expected outcome is that
elderly subjects with diabetes who received foot care education will score significantly higher on
the knowledge test than subjects without diabetes. Failure to achieve this outcome may suggest
that the items in the instrument do not measure the construct foot care knowledge.

Nunnally (1978) gives great attention to predictive, content, and construct validity within
the theory of measurement. He briefly attends to face validity but subsumes this type of validity
within the domain of content validity. He defines face validity as the extent to which an instrument
measures what it looks like it is supposed to measure. Face validity is addressed after an
instrument is constructed and is reviewed judged by both content experts and, ideally, people representing objects of measurement.

Reliability

Reliability of an instrument focuses on its ability to repeatedly measure an attribute. In doing so, people are "ordered" alike or differently based on the quantity of the attribute being measured. This holds true across different people using the same instrument, across different times, and across different test conditions. As such, the same results should be obtained each time the instrument is used. This aspect of instrumentation relates to stability.

Rarely does measurement in the behavioral and social sciences produce exactly the same results. Variations in test administration, test conditions, and in subjects themselves may contribute to different measurement outcomes. Outcome variations reflect measurement error which, related to reliability, represents random error. A high degree of random measurement error threatens the stability of an instrument such that the same results cannot be obtained each time the instrument is used.

Measurement error is derived from the difference in scores actually obtained on a measuring instrument from true score assuming no error in measurement. The standard deviation derived from the distribution of errors represents the amount of measurement error and is referred to as the standard error of measurement (Nunnally, 1978). The greater the standard deviation, the greater the standard error of measurement and, hence, the less reliable (i.e., less stable) the instrument.

Basic to psychometrically evaluating the stability of an instrument is correlational analysis (Nunnally, 1970). Correlational analysis is used to evaluate two aspects of reliability--internal consistency and stability. Nunnally notes that in measurement theory, these two aspects are differentiated but both relate to the concept of stability of an instrument to order people on the construct of interest.
Internal consistency is a special method of estimating the reliability of an instrument (Nunnally, 1970; 1978). It is based on the concept of homogeneity among test items. To determine whether the items on a test essentially measure the same construct consistently, correlational analysis is employed. Correlation is based on the assumption, however, that a hypothetical equivalent form of the actual test exists. As such, internal consistency represents an index of the relationship between test scores (actual and hypothetical) and within item correlations. This last feature assumes that the same within item correlations would exist for the hypothetical form of the test.

The reliability coefficient alpha is the most commonly used equation for estimating the degree of internal consistency (Nunnally, 1970). Kuder-Richardson 20 formula is an example and is ideal for estimating reliability of achievement tests yielding dichotomous data.

The higher the reliability coefficient, the greater the reliability of the instrument. Nunnally (1978) notes a reliability index of at least .60 as an acceptable standard of reliability. In early test development, however, coefficients in the .5-.6 range may be considered acceptable. To achieve a reliability coefficient of .80, twenty to thirty dichotomous items are required (Nunnally, 1970).

Since reliability of an instrument reflects stability of the measure over time, internal consistency methods of reliability do not actually embody the effect of time. This would not be problematic if the construct of interest is not one expected to change over time. In achievement testing however, knowledge represents a changing construct. As such, a measure of the effect of time should be evaluated to rule out its effect on measurement error.

The test-retest method is the simplest and the most common approach to test the stability of an instrument over time. This method involves administering the same test to the same people following a period of time (e.g., 2-4 weeks). Total test scores as well as item-to-item scores are correlated for consistency. High correlation coefficients indicate a high degree of reliability.
This approach can be affected by memory in that subjects may recall their initial responses. As such, test-retest correlations tend to overestimate reliability. Another disadvantage to this approach is that it cannot account for any error in sampling the domain content. Poorly sampled content is simply measured again. This reflects the fact that reliability is a necessary condition for validity but, not sufficient.

The most ideal method to test stability is to employ equivalent, or parallel, forms of the test. As such, memory is not a factor. However, it may be difficult to construct an equivalent form of the test let alone just one test that represents the construct of interest. Furthermore, budgetary and time constraints may preclude the ability to formulate an equivalent test form. To approximate parallel forms, the split halve method can be used.

In this approach, the test is split in half. For example, all even numbered items are considered one form of the test with all odd numbered items considered the parallel form. There are problems with this approach. One is that the effect of time is not really measured. Another is that, as with the test-retest method, this approach does not account for poorly sampled content. Reliability can be overestimated.

In this study, the test-retest method approach will be employed to test the stability of the foot care knowledge test. This approach assumes that a hypothetical equivalent form of the test exists but accounts for the dimension of time in assessing instrument stability.

**Item Analysis**

Related to both validity and reliability of an instrument are item analysis techniques. Item analysis evaluates the properties of items such as difficulty level, discriminating power, and the effectiveness of distracters.

Item difficulty is basically an index of the percentage of people who got an item correct (Ghiselli, Campbell, & Zedeck, 1981). The higher the percentage, the easier the item. Values range from 0%, in which no one answered the item correctly, to 100% in which everyone
answered the item correctly. Either extreme distorts the distribution of test scores and minimizes score variance. Ideally, an item should be difficult enough such that it is possible for high test scorers to correctly answer it and low test scorers to fail it. Assuming measurement error follows a normal distribution, a difficulty index of 50% would maximize variance in scores. It is not always possible to achieve a 50% level of difficulty. Ghiselli, et al (1981) consider values ranging from 40-70% to be acceptable. Values above or below this may sufficiently skew test score distribution thereby threatening the reliability of the instrument. Items outside this range can be eliminated from the instrument or possibly revised.

Constructing a sufficient number of test items can be difficult however. As such, Ghiselli, et al (1981) suggest that a test be constructed comprised of items whose difficulty level averages 50%. In this way, some items will have a high level of difficulty, some will have moderate, and some will have low levels. Normal variance in score distribution may still be achieved.

The underlying premise related to item difficulty is that items should be able to distinguish high test scorers from low test scorers. Items too easy or hard do not achieve this outcome. Distinguishing these two groups essentially demarcates those people who have knowledge of the construct versus those who do not. The ability to discriminate these two groups is the function of the discriminating power of an item. Discriminating power of an item is inversely related to difficulty level. Discriminating power is expressed in values ranging from -1.00 to +1.00 with high positive values exhibiting better discriminating power. High positive discriminating values are associated with difficulty levels approaching 50%.

Multiple choice test items are comprised of a stem followed by a list of alternatives, one of which is the correct answer. The other alternative choices are referred to as distractors. An effective distracter is one that tends to attract low test scorers rather than high scorers. To be effective, a distracter should appear to be a feasible correct choice to one who does not possess the bit of knowledge embodied in the stem of the item. As such, people without knowledge tend to select distracters more often than those who possess knowledge of the construct being.
measured. To evaluate this, the frequency of responses per alternative for each item is noted for high and low test scorers respectively. If more high test scorers select distracters as opposed to low test scorers, the distracters are not very effective. Findings such as this would indicate the need to replace the distracter with another one or modify it to increase its effectiveness.

It is evident that ineffective distracters may contribute to less than ideal values obtained on indices of item difficulty and discriminating power. All of these attributes of test items are highly related. All embody the notion of homogeneity among test items. Homogenous test items essentially measure the same thing. As such, items highly correlated with one another and with total test scores contribute to distinguishing high from low test scorers and to overall validity of the instrument.

Summary

Measurement theory, as described by Nunnally, serves as the theory guiding this study. This section described critical elements of the theory with particular focus on scaling models, validity, reliability and associated measurement error, and item analysis. As the purpose of this study is to design an achievement test to measure foot care knowledge in elderly people with diabetes, these components of the theory will be addressed in the various stages of study design and implementation.
Review of Literature

Patient Compliance in Other Disease States

Literature related to patient compliance with disease states other than diabetes will be reviewed in this section. Emphasis will be made to explicate the role of patient knowledge as it relates to compliance.

Mazzuca (1982) conducted a meta-analysis of patient education experimental literature in chronic disease to assess the efficacy of educational interventions to effect outcomes related to patient compliance, physiological process toward therapeutic goals, and long range health outcomes. His analysis was intended not only to estimate the magnitude of experimental effects on these outcomes, but also to examine the differing effects of educational and behavioral approaches to patient education.

Mazzuca (1982) employed a literature search for relevant articles from January 1970 to March 1981. He also used secondary sources derived from the reference sections in reviews conducted in patient education at that time. Mazzuca selected articles that involved investigator control of an educational intervention; utilized a control group for comparative purposes; used subjects with a chronic medical problem/disease; if the educational intervention was conducted by a health professional; and, if the dependent measure involved at least an index of compliance with a prescribed therapeutic regimen and/or therapeutic progress, or, a long-term health outcomes.

Three hundred twenty articles were identified initially with 30 subsequently judged to meet selection criteria. These studies dealt with hypertension, heart disease, asthma, obesity, diabetes, and other chronic diseases. Eighteen studies measured the effect of educational intervention to affect compliance with a medical regimen; 13 involved the effect of education on the patient's therapeutic progress; and, 5 concerned the effect of education on long-term health outcomes. Mazzuca (1982) used effect size (ES) to represent the magnitude of the experimental effect to affect compliance, therapeutic progress, and/or long-term outcomes. Effect size...
represents the difference between the post-instructional means of the experimental and control
groups divided by the standard deviation of the control group (Mazzuca, 1982).

Mazzuca (1982) found that educational interventions had the largest effect size in
affecting patient compliance with medical regimens, followed by affecting therapeutic progress,
and long-term health outcomes. With regard to the effect of education (i.e., knowledge only
based interventions) versus behavioral approaches, Mazzuca found that behavioral approaches
were more effective in all three indices of outcome. He concludes with recommending that
patient education programs involve not only the provisions of knowledge, but also incorporate
measures of helping patients learn to cope with their disease.

Whereas Mazzuca (1982) focused on the difference between educational and behavioral
approaches to effect compliance outcomes, Mullen, Green, & Persinger (1985) focused their
meta-analysis of educational programs for people with long-term health problems to determine the
relative effectiveness of specific types of interventions. In particular, they focused on patient
knowledge as a function of type of intervention in affecting adherence. The analysis involved 70
articles which employed a measure of patient knowledge of prescribed drug therapy. The larger
number of studies involved hypertension followed by diabetes, mental problems, asthma, and a
diverse range of other chronic illnesses. Eight types of educational interventions were identified
across studies ranging from one-to-one counseling to patient package inserts to behavior
modification approaches.

Using ES as representative of the magnitude of the effect of intervention on patient
knowledge, the authors found that one-to-one counseling, group education, and these
interpersonal strategies combined with audiovisual materials generated the highest ES values
(Mullen, Green, & Persinger, 1985). Patient package inserts (primarily derived from prescriptive
drugs) obtained a virtual zero ES. Subsequent analysis revealed that the higher the ES rating
obtained by an educational intervention, the greater the positive effect on patient knowledge.
With regard to the type of intervention to effect rate of patient drug errors, the authors found that ES values were fairly equal across interventions. This suggests that no one type of intervention was more effective in reducing drug errors. This is an interesting finding. Obviously type of educational intervention can affect the level of patient knowledge but cannot account for patient errors in adhering to prescribed drug therapy. This analysis does not indicate however, if studies employed valid and reliable measures of patient knowledge of drug therapy. Mullen, Green, & Persinger (1985) do note that the studies used in this analysis had several shortcomings that may influence interpretation of findings. For example, in general, the studies, contained inadequate descriptions of educational content, frequency, duration, style/nature of the educational exchange, reading level of patient content material, and the mode by which audiovisual materials were delivered. This lack of information does make it difficult to judge the overall merits of the educational intervention to affect patient knowledge level.

Hanson & Pichert (1985) note that health care providers attempt to enhance patient knowledge and skill to effect positive patient outcomes. Stating that research in assessing the efficacy of patient education programs to optimize health outcomes has yielded variable results, these authors discuss the importance of identifying and investigating the elements of an instructional program most conducive to effecting positive patient outcomes. In a clinical study using the Patient Instruction Evaluation System, Hanson & Pichert (1985) found that patients spent a disproportionate amount of time in a health care interaction setting providing what they term "assessment" information. This included information such as height, weight, time spent on physical examination, and time spent giving routine medical status information. Twenty percent of patient time was spent receiving information from health care providers with only a fraction of time spent in which the patient was actively involved in some domain of the provider-patient interaction. Hanson & Pichert (1985) assert that though principles of patient teaching support active involvement of the patient, the small amount of time actually spent by patients in the teaching session suggests violation of this premise. They maintain that active patient involvement
and sufficient time for this activity should be integral parts of educational programs. Though these authors speak to practical constraints on educator’s time and ability to increase time with, and involvement of, the patient, they nonetheless assert that these dimensions of educational interventions are important.

Though this descriptive type of research does not explicitly relate to measures of patient knowledge or compliance, it does speak to aspects of the patient teaching interaction that, if not addressed, may influence the nature and degree of knowledge acquired by the patient. This in turn has serious implications with regard to the ability of the patient to enact expected self-care behaviors.

Hanson & Pichert’s (1985) research is in agreement with Levin’s (1978) contention that effective patient education to improve self-care should not be conceptually limited simply to the provision of health care knowledge. Levin asserts that education should not only involve elements considered important by the health professional but that effective education must embody what patients perceive as their needs and goals (i.e., self-care). Levin recognizes that fiscal pressures and the nature of the institutional environment may affect the ability of the health care provider to fully operationalize the concept of patient self-care. However, she asserts that patient education and self-care education must operate in tandem of the health care status of the patient is to be maximized.

Citing that successful therapy with chronically ill ambulatory patients depends on patient compliance, Brody (1980) explored the number of patient errors in recall of medications immediately after the patient’s visit with their physician. In addition, he sought to determine if any factor(s) would discriminate patients who accurately recalled their therapeutic regimens from those who do not. Patients’ recall of their therapeutic regimen was assessed by comparing patient interview data with physician data charted in the medical record. Patients who understood their regimen were those judged to know their current prescribed medications and correct dosage frequencies. Discriminating variables consisted of patient characteristics (e.g., age, gender,
marital status), severity of disease, nature of the prescribed medical regimen, and patient satisfaction with the physician.

The sample was comprised of 116 patients followed by 48 physicians. Fifty-three percent of the subjects made some error in recalling their prescribed regimens with the greatest percent of errors in failure to recall all prescribed medications. These subjects tended to be older, live alone, and have more medications prescribed than subjects less prone to make recall errors. Discriminant function analysis revealed that 13 independent variables accounted for 74% of the cases correctly classified as to whether they would make errors or not. The number of medications prescribed and ancillary measures needed to comply with medication regimens accounted for almost 61% of correct classification. This was followed by satisfaction with the physician, and, whether or not the patient lived alone.

Though this study does not involve direct assessment of patient knowledge, it does explicate the fact that patient compliance can be greatly affected by the ability of the patient to recall information. Furthermore, characteristics of the patient may account for compliance such as age of the patient and social support.

Levy & Loftus (1984) present an overview of compliance defined as a special situation where a person is a) requested to carry out some assignment after a delay in time, and b) the assignment giver is not present at the time the required action is enacted. They define compliant behavior within the realm of "uncued remembering" which is something every person requires to function in everyday life (Levy & Loftus, 1984). Assessing one's ability to remember a prescribed therapeutic activity, such as daily diabetic self-care behavior, involves the construct of memory which is different from the type of memory researched in a laboratory setting. These authors assert that minimal research in memory and compliance exists as opposed to extensive research in factors that affect compliance per se (Levy & Loftus, 1984). Acknowledging that these factors may have their effect on compliance, they claim that their effects are mediated by memory factors. For example, Levy & Loftus proffer three necessary requirements for compliance: 1) one must
remember that something is to be done at a particular time; 2) one must remember what the thing is; and, 3) one must carry out the action. An individual who fails to meet any of these requirements fails to comply. However, failure to meet #1 and #2 constitutes forgetting which involves memory.

Levy & Loftus (1984) cite the review of studies conducted by Haynes, et al (1979) in which patients self-reported forgetting as a reason for failure to keep a medical follow-up appointment. Though these studies are indicative of the relationship between memory and compliance that Levy & Loftus speak to, they are critical of studies that rely on patient self-reports because of their potentially high degree of unreliability.

Other memory factors that may mediate compliance include the use of memory aids such as reminder cards or phone contacts with the patient. Shepard & Mosely (1976) compared compliance rates with appointment keeping by comparing subjects who received some form of reminder notice compared to those subjects who did not. Regardless of whether subjects were contacted by mail or phone, their compliance with appointment keeping was substantially higher than those who received no reminder.

These results were consistent with those obtained by Gates & Colborn (1976) in which subjects who received reminder letters exhibited the highest compliance rates with appointment keeping followed by those contacted by phone, then those who received no contact. Though other similar studies have yielded discrepant outcomes, Frank & Hovell (1978) suggest that the failure of reminder cues the effect compliance with appointment keeping may be a function of the type of patient targeted for cueing.

**Patient Compliance with Diabetes Regimen**

Compliance with prescribed diabetic therapeutic regimens focuses on behavioral outcomes enacted by the patient for the purpose of achieving and/or maintaining normoglycemia. A wide range of variables have been explored to account not so much for patient compliance as much as patient noncompliance.
Cerkoney & Hart (1980) explored the relationships between compliance and attributes of the Health Belief Model in adult patients with diabetes. Self-report was the method employed to measure patient compliance across four regimen domains—insulin administration, hypoglycemia, urine testing, and foot care. Health belief was measured by 15 items adapted from the Standardized Compliance Questionnaire developed by Sackett, et al (1974) to measure components of the Health Belief Model. These components include perceived susceptibility, perceived severity, perceptions of benefits, barriers or costs, and cues. No indices of instrument validity were reported. However, test-retest, using 22 of the 30 subjects in the study, was employed as an index of reliability (r=.886).

With 61 the maximum score possible on the compliance measure, subjects’ scores ranged from 36-55. A little over half the subjects indicated compliance with their regimen at least 70% of the time. When therapeutic behaviors were demarcated into essential versus non-essential, less than 7% of the subjects reported compliance with prescribed essential behaviors.

Correlating self-reported compliance measures with attributes of the Health Belief Model, Cerkoney & Hart (1980) found that “cues motivators” yielded the highest correlations across behavioral outcomes. However, the only significant correlation between this attribute and behavior was with insulin therapy. Perceived severity was significantly correlated with total compliance scores and foot care behavior. Perceived susceptibility was significantly correlated with hypoglycemia/insulin reactions with total compliance significantly correlated with insulin therapy. Perceived barriers and perceived benefits did not significantly correlate with any dimension of patient self-reported compliance with prescribed behaviors.

Compliance was limited to patient self-report. Investigators did not have actual prescribed regimens in which to compare self-reported data. It would appear to be difficult to judge compliance without knowledge of exactly what behaviors patients were prescribed to enact. Furthermore, compliance measures assumed patients had appropriate knowledge of diabetes in order to enact behaviors. Level of patient knowledge was not assessed in the study. In fact
Cerkoney & Hart (1980) cite anecdotal evidence of a subject unable to recognize a hypoglycemia reaction when it was occurring during time of data collection.

Speers & Turk (1985) identify knowledge as one of four diabetes patient self-care components. The other three are beliefs, motivation, and action. These components are interactive with any one component likely to affect self-care behavior and, hence, compliance at any one time. With regard to knowledge, they assert that patients need appropriate knowledge about diabetes in order to enact specified self-care behaviors. Furthermore, not only is knowledge about diabetes needed, but patients must also know how to enact prescribed behaviors. Speers & Turk (1985) assert that health care providers have given insufficient attention to the patient's ability to process information. Rather, the assumption is made that patients who report understanding diabetes regimens know what self-care behaviors to enact and how to perform them. Patients unable to enact self-care behaviors are then classified as nonadherent. Relying on patient self-report may not serve as a valid and reliable index of patient knowledge by which to judge compliance.

Cerkoney & Hart's (1980) study reflects a number of studies that have explored patient compliance based on self-report and/or undocumented evidence of valid and reliable measures of patient knowledge as a correlate of compliance. Other variables have received attention as possible factors related to patient compliance. Social support is one such variable.

Glasgow & Toobert (1988) found that global measures of social environment were generally predictive of regimen adherence after accounting for selected demographic attributes. Using the Diabetes Family Behavior Checklist, the investigators found that those subjects reporting greater levels of adherence perceived greater levels of family support. Adherence, however, was more closely associated with specific aspects of the diabetes regimen. Perceived family support to one aspect of the regimen did not necessarily predict adherence to other components of the regimen.
Whereas Glasgow & Toobert (1988) assessed family social support, Wilson & Pratt (1987) assessed peer support as a correlate of glycemic control and weight reduction in elderly people with NIDDM. Elderly subjects were divided into three groups. Group 1 (n=19) received ten one hour education sessions related to diabetes and nutrition. Group 2 (n=32) received the same educational program plus peer support interventions Group 3 (n=28) served as the control group.

Peer support interventions involved the use of a facilitator promoting self-help group dynamics and peer interactions. Hemoglobin A1C was used as the measure of glycemic control with a portable scale used to measure the subjects' weight in pounds. Perceived peer support was measured by the Arizona Social Support Schedule (no indices of validity/reliability reported).

Results indicate that peer support can affect glycemic control and weight loss as noted by reductions in both in Group 2 subjects as opposed to subjects in the other two groups.

Other psychosocial correlates have been included in compliance related studies. Including social support as a variable of inquiry, Wilson, et al (1986) explored stress, depression, anxiety, diabetes--specific health beliefs, and knowledge of diabetes as correlates of compliance and glycemic control in patients with NIDDM. In addition, selected demographic attributes (age and sex) were explored as predictors affecting glycemic control and enactment of self-care behaviors. Employing a multiple regression analysis, investigator found that psychosocial and demographic variables accounted for almost 25% of the variance in adherence with self-care behaviors. Self-care behaviors were defined as those related to diet, exercise, glucose testing, and medication taking. Compliance with prescribed behaviors was assessed by asking subjects to indicate the percent of time in the previous three months they had enacted each respective self-care behavior "as instructed." As in the study by Cerkoney & Hart (1980), specific knowledge of just what subjects had been instructed (i.e., prescribed) to do was not assessed. The use of self-reports of compliance and undocumented evidence of actual prescribed regimens were the two limitations of the study recognized by the investigators. With specific regard to glycemic control,
only age was significantly correlated with this dependent variable. The correlation was moderate and negative.

Davis, Hess, Harrison, & Hiss (1987) considered disease type and treatment modality as influential factors relating to psychological adjustment to, and control of, diabetes. Their study focused on development of the Diabetes Education Profile (DEP) closely modeled after constructs in the Health Belief Model and designed to measure psychosocial adjustment. Subjects were divided by type of diabetes (IDDM vs. NIDDM) based on age and ideal body weight. Control of diabetes was measured by values obtained on glycosylated hemoglobin tests.

Psychometric evaluation of the DEP instrument revealed six subscales—control problems, social problems, barriers to adherence, benefits to adherence, regimen complexity, and risk of complications. Cronbach's alpha for measure of internal consistency per subscale ranged from .69 to .86 with no index of stability over time determined. Content validity was addressed by qualitatively evaluating the congruency between an original scheme of content items with the resultant subscale structure of the instrument. Construct validity was addressed by factor analysis that yielded the six subscales previously noted.

Davis, et al (1987) found that diabetes control was related to disease type and treatment modality. For example, none of the six subscales significantly correlated with glycosylated hemoglobin in NIDDM patients who used insulin ($r=.26, p<.01$). For those subjects with IDDM (insulin therapy dependent), control and social problems were significant correlates of glycosylated hemoglobin levels. Other DEP subscales exhibited joint association with disease type and treatment and, as such, these attributes could not sufficiently indicate psychosocial adjustment. However, results appear to support the notion that variances in diabetes control may be associated with differences in diabetes type and elements of psychosocial adjustment. As older adults with diabetes largely have NIDDM that does not require insulin, these findings emphasize the heterogenous nature of people with diabetes. The investigators conclude from their research that clinicians and researchers need to recognize that patients, dissimilar in
diabetes by type and treatment, have different norms for adjustment and glucose control. In the diabetes education field however, a homogenous approach to teaching and learning is the typical standard of intervention. If people with diabetes differ in control and adjustment as Davis, et al, suggest, then potentially norms for expected compliance outcomes should differ across patient groups as well.

Ary, Toobert, Wilson, & Glasgow (1986) took a different approach to explore the issue of compliance with diabetes regimens. They explored the levels of regimen adherence and reasons for nonadherence from the patient's perspective. Twenty-four subjects with IDDM and 184 subjects with NIDDM were asked to indicate percent of time within the previous three months they adhered to prescribed regimens. Responses were ordered from 0% to 100% in quarterly intervals. Responses were related to six regimen areas-insulin therapy, oral medication, eating habits, blood glucose testing, urine glucose testing, and physical activity. For each respective area, subjects indicated the frequency of nonadherence from 1 (0 times) to 8 (more than 50 times). Frequencies however, corresponded to five possible reasons for nonadherence: 1) subject was upset; 2) could not afford the materials; 3) too busy, 4) did not have materials available; and 5) presence of others made subject uncomfortable. In addition, an open-ended question format was employed to delineate the two most common reasons associated with the following: 1) why they purposefully decided not to adhere; 2) things the subject did, said, or felt that made it difficult to adhere; 3) things that other people said or did that made it difficult to adhere; and, 4) places or locations in which it was difficult to adhere. Responses were coded using two raters trained in the coding system. A random sample of 20% of the subjects' responses achieved an interrater reliability index of .81 (mean Kappa coefficient).

Both groups were found to be fairly equal in reporting adherence across regimens. The only significant difference between groups was found in adherence to time schedules for insulin administration. NIDDM subjects reported taking prescribed insulin almost 91% of the time as scheduled while IDDM subjects reported adherence 78% of the time. Greater variance in
adherence across regimens were found in the NIDDM group with greater nonadherence noted among males and those greater than 57 years of age.

The reason for nonadherence noted most frequently across both groups was "too busy." Open-ended responses regarding reasons for nonadherence were widely diverse across regimen areas. For example, being at a restaurant or the unavailability of appropriate foods were common reasons cited for nonadherence to dietary prescriptions. Discomforting physical symptoms such as chest or extremity pain were cited for nonadherence to exercise regimens.

With the varied outcomes, investigators recommend tailoring diabetes treatment regimens. They assert the importance of recognizing that adherence to one aspect of the diabetes regimen does not relate to adherence to other parts of the regimen. Furthermore, this study exemplifies the difference in adherence by diabetes type thereby reinforcing the heterogeneity of patients with diabetes.

In this area of study, varied factors have been explored in attempts to account for patient noncompliance with prescribed diabetic regimens. No factor has been able to consistently account for the variance in this phenomenon. The studies cited in this review represent an awareness that compliance varies by type of diabetes and by treatment modality. Furthermore, compliance with prescribed regimens may be domain specific accounting for the fact that adherence cannot be measured as a global concept.

General Tests of Diabetes Knowledge - Psychometric Studies

This section describes research involving the psychometric evaluation of tests developed for general diabetes knowledge. Attention to tests that include some element of assessing foot care knowledge will be noted.

Miller, Goldstein, & Nicolaisen (1978) undertook a study as part of an assessment to validate the need for a structured diabetes patient education program in large VA medical center. They attempted to document the lack of diabetes knowledge in patients admitted to the center.
To measure knowledge, the investigators devised a 130 item questionnaire relating to general knowledge of self-management of diabetes. The questionnaire included items on urine testing, diet, hypoglycemia, foot care, and medication therapy (when appropriate). Each of these sections were identified as "modules." Items were selected based on literature sources related to diabetes patient education. Patient responses to these items were to be recorded as yes, for correct response, and no, for incorrect answers. Some questions yielded a definite yes or no response. Some items required a narrative response from which yes or no responses could be determined and recorded. As such, this required an interviewer to administer the questionnaire. Three medical students were used to conduct the interviews. Each received training in interviewing techniques, however, of inter-rater reliability was not noted. The students were primarily responsible for recording whether patients met knowledge criteria/item or not. Patients were judged to either pass or fail a module, however, the score required to pass or fail a module was not noted. No validity or reliability testing of the patient questionnaire was mentioned in the report either.

Results of the study revealed that a greater percent of patients claiming to have had diabetes education/self-care training passed each module. Forty-five percent claiming previous education failed in all areas of diabetes management. Roughly an equal percent of patients on insulin, oral agent therapy, or diet therapy failed in all areas of diabetes knowledge. Of the patients who reported no previous exposure to diabetes education, 67% failed the knowledge test. Knowledge of diabetes, as these investigators measured it, decreased with increasing age. Even so, 30% of "young" patients (age 31-50) failed the test. Fifteen percent passed foot care to a high of 50% passing urine testing. For the "older" groups (ages 51-64 and > 65 years), 59% of the 51-64 year olds failed, 77% of those > 65 years of age failed. Longer duration of diabetes was not significantly correlated with greater knowledge.

Based on this data, the authors recommended that the VA system develop an organized, primarily outpatient, formal diabetes education program. Authors assert that health educators
need to explore whether diabetes education program contain 1) vital information necessary for understanding self-management; 2) information effectively transmitted to the patient; 3) determine if transmitted information improves compliance; and, 4) determine whether compliance alters outcomes and process of care. They stress that the results of teaching assessment and intervention are an important part of a teaching program. Furthermore, patient assessment of knowledge needs to be conducted before and after educational intervention. This would facilitate identification of knowledge deficits thereby allowing the educator to explore aspects of the teaching program that may, or may not, be supportive of meeting the learning needs of the patient.

This last claim is in accordance with standards of diabetes education programs. However, considering their claim that identification of knowledge deficits to be a fundamental aspect of an education program, it would be important that the instrument used to assess knowledge be a valid and reliable index of patient knowledge. These authors based their findings and recommendations on an instrument with no established validity and reliability.

Marguis & Ware (1979) undertook a study on behalf of the Centers of Disease Control (CDC). The CDC sought to identify reliable and valid measures of patient behavior, knowledge, and attitude regarding diabetes for the purpose of using these measures to better evaluate the efficacy of diabetes patient education program as it related to patient compliance. Using a panel of diabetes and measurement experts, the authors developed a measure of diabetes knowledge largely because of the unavailability of such measures in the literature. The content experts identified 57 self-care items perceived to be highly important for patients to implement. These items involved five major content areas--safety, medication, nutrition, urine testing, getting medical care, and hygiene. Hygiene encompassed only one item and that was "inspects feet daily, cuts nails correctly, and wears shoes that fit well" (Marquis & Ware, 1979). This item was defined primarily for patients with neuropathy and/or vascular impairment.
A total of 14 items were constructed to cover these five content areas. No information regarding the format of the items is noted. Alone, the foot care item achieved an internal consistency of .65; internal validity could not be evaluated. The authors proceeded to further refine the knowledge instrument by specifying a four factor model using factor analysis. In doing so, the foot care item was not included. The four factor model involved items related to nutrition, general safety, oral medication, and urine testing. Reliability estimates were .65, .90, .82, and .79 respectively.

The authors summarize their efforts by proffering a major recommendation to continue research that seeks to validate knowledge scales. They assert that formal measurement of knowledge, attitude, or behavior was an "advanced art" in the diabetes field (Marquis & Ware, 1979). With regard to compliance outcomes, they found that patient compliance is selective and that compliance in one area of diabetes self-care is not related to compliance with other areas of self-care management. In other words, compliance is not uniform across all dimensions of patient self-care. They suggest that theory of patient compliance be expanded to better account for the variation of results or that extensive measurement techniques be developed to account for meaningful evaluation of patient outcomes.

Garsteff, Windsor, & Jones (1979) attempted to construct a valid and reliable measure of general diabetes knowledge. Asserting that these measures were required for effective diabetes education, they identified from the literature 108 items felt to be essential elements for diabetes education programs. With the assistance of a panel of experts, these items were classified as essential, helpful, or unnecessary. This process addressed content validity. The essential items were used to develop an assessment instrument designed to determine level of previous instruction, self-reported behaviors, observed performance of self-care tasks, and patient knowledge. The test was administered to 56 patients for pilot testing. With results indicating the test fell within acceptable ranges of standards for development of knowledge and performance
tests for diabetic patients. There is no specific information as to how many, if any, of the questionnaire items dealt with foot care.

Hess, Barr, & Gjerde (1979) report the results of a pilot test to develop a general test of diabetes knowledge for patient use. The authors justified their study based on the fact that though patient education classes are prevalent, the effectiveness of these programs had not been documented primarily due to the lack of a valid measure of patient knowledge. Using the course content presented to patients over 13 separate diabetes education classes, the authors identified 250 potential knowledge items for use. A panel of experts was employed to refine this original number down to 142 items which were then administered to 41 patients for pilot testing and item analysis. From this process the items were further reduced to 56 with a Cronbach's alpha = .93. The items covered such areas as blood sugar regulation, diet management, insulin use, and diabetes complications. As this information was published in an abstract, no specifics regarding the range of questions that dealt with the foot care, the format of the questionnaire items, the type of subject used in pilot testing, or the factor structure of the test is available. The authors summarize their findings asserting that development of a sound instrument for measuring patient knowledge is both a necessary and first step in exploring relationships among knowledge, compliance, and health outcomes.

In a more detailed description of developing a knowledge test, Windsor, et al (1981) conducted a pilot study involving an instrument comprised of three indices of educational assessment. These were cognitive (aggregate knowledge), performance (self-care skill), and behavior (current practice). The cognitive index was measured using 25 true-false-don't know questions which were derived from the literature and from convenience survey of diabetes education programs from across the country. The items generated were grouped into four categories: 1) foot/skin care; 2) urine testing; 3) insulin therapy; and, 4) safety measures. Though the instrument itself was not available for review, the authors reported four foot care content items were measured—circulation, heating pads/hot water, corns and callouses, and wound treatment.
Performance and behavior indices were measured by observation and focused only on urine testing and insulin therapy.

Windsor, et al (1981) report the use of the Kuder-Richardson 21 formula to determine internal consistency of the cognitive measure and item-to-total correlation to denote discriminant function. KR21= .89 for the cognitive measure with each of the four foot care items exceeding the minimum .20 standard of acceptability in educational measurement for item analysis.

Content validity was established using a panel of experts who reviewed the items generated prior to pilot testing. Convergent validity was established by correlating cognitive measure with corresponding performance index scores. With respect to foot care, cognition and performance correlated at $r=.44$.

Pilot testing was conducted with 56 patients, 46 of whom were insulin-dependent, 10 of whom were non-insulin dependent. No other characteristics of the sample were provided. In formal clinical testing of the instrument, 100 patients were used---73 with insulin dependent diabetes, 27 with NIDDM. Again, no other characteristics of the sample were reported. In clinical testing, study patients were found to be comparable to other patients admitted to the clinic facility for diabetes services. Both the cognitive and performance indices were expanded to include urine ketone testing and diet. In all, KR 21 = .87 for the cognitive index and .86 for the performance index. Convergent validity between cognition and performance however, was only supported for urine testing. Foot care instruction and foot care knowledge correlated at $r = .18$ with knowledge and behavior at $r = .15$, neither of which were significant at the .05 level. The authors conclude that areas such as foot care require further validity testing.

Recent studies in psychometric evaluation of patient knowledge tests continue to focus on the need for developing valid and reliable measures in order to better evaluate the efficacy of patient education programs. Asserting that patient knowledge is a recognized necessary ingredient in the patient's ability to enact self-care, Garrard, et al (1987) undertook a psychometric study of the Test of Patient Knowledge. Their motivation centered on the continued lack of
diabetes education researchers to address the psychometric properties of the instruments used to conclude the effectiveness of education on patient outcomes. The authors assert that studies should describe the results of psychometric research on tests used before reporting results of patient educational outcomes.

Using 50 multiple-choice items developed by the staff at the International Diabetes Center (Minneapolis), the investigators employed four content experts to categorize the items based on what they perceived to be items of similar content. From this, another panel of diabetes experts refined and labeled the categories. Any discrepancies in item categorization were resolved by consensus. This two-step process addressed issues related to face and content validity.

Pilot testing involved 324 subjects who were participants in a 5 day comprehensive diabetes education program over the course of two years. Subjects ranged from 14 to 77 years of age, were equally distributed by gender, had achieved a mean educational level of 13.68 years, and took insulin for treatment (87%).

Concurrent validity was established using indices of patient's self-reported level of diabetes knowledge, whether the patient used insulin for treatment, and whether diabetes was diagnosed before or after age 30. In each of these criterion indices, the hypothesized differences in test scores were realized at established levels of significance.

Construct validity was addressed by correlating the level of education with test scores. This analysis was done to eliminate higher level of education with greater ability to achieve high test scores as a function of greater general knowledge as opposed to diabetes knowledge. Correlations between education level and pretest, posttest, and differences between pretest and posttest scores ranged from -.10 to .24. The authors do not report if any of these correlations were significant only indicating that this range of correlations provide evidence of discriminant validity.
Cronbach's alpha formula was employed to assess the internal consistency of the test. An alpha level of .88 (using pretest data) was obtained. To assess the readability level of the instrument for patient use, the Dale-Chall formula was employed. Grade-levels varied from 5th - 12th grade level with the overall test at the 7th - 8th grade level.

The instrument achieved a difficulty index of 85% as a whole and ranged from 78% - 89% across the seven categories. A discrimination index of .47 for the test as a whole was obtained and ranged from .29 - .64. Instructional sensitivity of the instrument to measure gains in knowledge was 25% as a whole with a range of 15 - 36% across the content categories.

The authors conclude that the Test of Patient Knowledge does exhibit validity and reliability for general patient use. The reliability coefficient of .88 appears to be well within acceptable standards (Nunnally, 1978). Construct validity was limited to discriminant validity based on the patient's education level. It may have been helpful to consider factor analysis as a means of generating further evidence of construct validity. This type of analysis would lend support for categorizing the items as the panel of experts did as well as assessing the correlations of factors (i.e., categories) to the total test scores.

Authors achieved a difficulty index of 85% as a whole which exceeds recommended standards (Gronlund, 1982). Difficulty index is closely related to discriminating power of a test. As difficulty level increases, discriminating power decreases (Gronlund, 1982; Tuckman, 1988). In this study, a difficulty index of 85% was associated with a discrimination index of .47. This may suggest that the test items were too easy. The authors appear cognizant of this possibility and justify these results by the fact that the goal of the IDC program is to assist patients master core content over the course of 5 days. As such, achieving discriminating power of the test was not the primary objective as was measuring total knowledge gained over time. Granted that assessing knowledge gained is the primary fundamental objective of achievement testing, a test deemed "too easy" may in itself not measure knowledge as much as such phenomena as test-taking skills.
Of interest to note is that 3 of the 50 items on the test referred to elements of foot care. However, with no specific item-to-total correlations or item analysis measures reported, it is difficult to assess how valid and reliable these items were.

**Studies Measuring Patient Foot Care Knowledge**

There are no studies in the literature that involve the development of a valid and reliable measure of foot care knowledge in either elderly people with NIDDM or any other age group or population of people with diabetes. A few studies, however, have focused on the measurement of some domain of foot care knowledge.

Delbridge, Appleberg, & Reeve (1983) sought to determine factors associated with the development of foot lesions in patients with diabetes (> age 50 years). Eighty subjects were divided into four groups based on the nature and severity of foot problems (none, ischemic, ulcer, and septic). By group, subjects were fairly matched on age, duration of disease, and treatment modality for diabetes control. Subjects were measured on the variables glycosylated hemoglobin (i.e., HgA1c); frequency of hospital admissions for diabetes control; degree of vascular impairment; history of smoking; presence of neuropathy; delay in treatment for foot lesions; and, patient understanding and education of diabetes, diabetes management, foot complications, and care of the feet. Groups did not differ significantly with regard to HgA1c levels, frequency of hospital admissions, or presence of neuropathy. Subjects with foot lesions did exhibit, however, significantly higher degrees of vascular impairment, history of smoking, increased delay in referral for foot lesion treatment, and lower scores on the knowledge test. The authors conclude that education of patients related to foot care management of the feet can effect the development of foot care lesions. Without ascertaining if subjects had received any diabetes education, the authors claim that subjects with foot lesions may not have wanted to "know" about problems in their feet. As such, these subjects may engage in "willful self-neglect" as evidenced by indifference to diabetes/diabetes complications. This claim and speculation
about the lack of self-care motivation was made based on a knowledge test without indices of reliability or validity. It is possible that the instrument lacked construct validity in that it failed to address or capture critical factors of self-care foot knowledge. Furthermore, the knowledge measure may not have been internally consistent (i.e., reliable).

In a study to assess the effects of a home based diabetes education program, Rettig, Shrauger, Recker, Gallagher, and Wiltse (1986) measured patient knowledge and self-care skills in both randomly assigned treatment and control groups of subjects. A total of 373 subjects (193 control, 180 treatment) were measured on self-care knowledge using a series of seventy multiple-choice questions divided into four content areas—diet, urine testing, medication therapy (e.g., insulin, hypoglycemic agents), and foot care. Patient self-care skills were measured by one-to-one demonstrations and focused on skill in urine testing, medication use, and diet prescription skill as noted by ability to draw up a 24 hour meal plan, and, foot care. Foot care skills were noted by nurse examination of the feet and included the presence of dirty foot soles, presence and type of socks, and method of toenail clipping. In addition, a 16 item checklist for abnormal conditions of the feet was used to generate a total foot appearance score.

To analyze the effectiveness of the teaching program, mean self-care knowledge and skill scores plus foot appearance scores were used as some of the indices of program efficacy. Results indicate that knowledge and skill scores were significantly higher for the treatment group in all subject areas and in total. With regard to foot appearance scores however, no significant differences were noted between the two groups. With a possible score of 100, the treatment group obtained a mean score of 70.2 ± 0.7 and controls, 68.8 ± 0.7 (higher scores indicated better condition of the feet). The authors conclude that though home-based diabetes education interventions can effect positive patient knowledge and skill outcomes, it did not appear to significantly impact such variables as diabetes foot problems, hospitalizations, length of hospital stay, emergency room visits, sick days, and physician visits.
One methodological problem noted by the authors was the lack of validity and reliability testing of the self-care knowledge and skills instruments. Though they indicate this type of testing should be done to enhance the validity of study outcomes, they perceive their measure to have "acceptable" but not optimal, quality" (Rettig, et al, 1986). This claim is based on qualitative comparison of the characteristics of their instruments with that of already established valid measures used by a large university medical center, and, by a list of self-care concepts identified by the Rand Corporation (Marquis & Ware, 1979).

In addition, the authors note that instrument reliability may have been threatened by the fact that subject responses were, to some degree, based on rater interpretations. Though no indication of the number of nurses used to gather data is made, Rettig, et al (1986) state that the "large" number of nurses gathering data may have introduced inter-rater bias.

Considering these methodological limitations, the authors are quick to assert that study outcomes should not discount the efficacy of diabetes education programs. They note that measures of study outcomes may have been inadequate to effectively ascertain instructional outcomes.

Wood (1989) assessed outcomes of reduced fasting blood glucose levels, reduced insulin requirements, decreased hospitalizations, and fewer emergency room visits as indices of the effectiveness of a diabetes education program to improve diabetes-related behaviors/outcomes, and, the effect of time on these behaviors and outcomes. Comparing 53 subjects who had attended an inpatient diabetes education program with 40 subjects who had not, Wood notes that those subjects attending the program reported better compliance for all self-care behaviors and outcomes at 1 month and 4 month post-discharge.

One aspect of educational intervention focused on foot care management principles. Treatment subjects were provided information on this matter in addition to other aspects of general diabetes self-care in a formal diabetes inpatient education program, and, in routine care of the bedside. Control subjects were provided diabetes self-care knowledge as part of routine
bedside care. A survey instrument was developed and tested in the 5 months prior to the study. No report of validity and reliability testing is reported by the author. Though Wood (1989) reports interventions based on effecting knowledge outcomes, it is interesting to note that the survey instrument identified items only in relation to "behavioral" and "outcome" measures. It would appear that knowledge was inferred and indirectly associated with behavioral and outcome measures as a function of diabetes education.

Outcomes related to foot care compliance behaviors were not significantly different between the treatment and control groups at baseline, 1 month, and 4 months. In fact, only compliance with an exercise program was significantly higher in the treatment vs. control group at 4 months. Wood's assertion that the treatment group reported better compliance with a self-care behaviors is based on the fact that the treatment group reported a higher percentage of compliance behaviors. All self-reported indices of compliance behaviors increased over time in both groups but increases did not differ significantly.

This same position was reflected in outcome measures. The treatment groups showed better outcomes compared to control group but only decreased blood glucose levels and decreased emergency room visits were significantly noted in the treatment group at four months.

Wood (1989) undertook this study asserting that a combination of knowledge-based educational interventions and behavioral-based interventions would be the most effective in influencing daily diabetes management as opposed to just one approach or the other. Though measures of knowledge and behavior were employed, it was metabolic indices and service utilization rate that primarily served as indirect measures of the education program to effect knowledge and behaviors on the part of the patient. Along with the assertion that diabetes education programs should, and can, be an effective aspect of diabetes care, the author that study outcomes are suggestive rather than conclusive. This claim is based on recognition of the fact that the survey used to obtain subject data did not have established validity and reliability. Furthermore, data was primarily a reflection of patient self-report which may not be a reliable index
of the knowledge variable. These elements in and of themselves may have threatened the validity of study outcomes.

Asserting that assessment of the effectiveness of diabetes education has implications for health care policy, Bloomgarten, et al (1987) undertook a randomized controlled trial of diabetes education stating that education, per se, may not be a major factor related to metabolic outcomes. They hypothesized that systematic education intervention would result in improved metabolic outcomes. Glycosylated hemoglobin levels were used as the primary index of glucose control. Other outcomes measured post-education intervention were fasting glucose levels, weight, lipid levels, foot lesion development, hypertension control, and utilization of medical care services. A total of 127 subjects comprised the treatment group at completion of the study with 139 subjects in the control group. Subjects were predominately Black and Hispanic with almost 30% greater than 70 years of age.

Treatment subjects were exposed to nine education sessions, one of which focused on foot and skin care emphasizing early detection of infections. A 15-item instrument was used to measure both knowledge and self-care behavior pre-and post education program. One behavior assessment item related to the frequency of checking feet for sores. No index of the instrument's validity or reliability were reported.

At baseline, Bloomgarten, et al (1987) note that the groups were comparable in knowledge and behavior scores. Upon completion of the study however, the treatment group exhibited a significant increase in knowledge scores compared to the control group. Furthermore, behavior scores increased significantly in the treatment group over time when compared to the control group. As authors compared scores of all subjects entering the study in each group with those who completed the entire education program, they attribute significant increases in knowledge and behavior to "graduates" of the program. Since treatment group graduates largely accounted for these significant increases, Bloomgarten, et al (1987) hypothesized that these subjects would also show an improvement in metabolic control
outcomes. Analysis of HgA1c levels however, revealed no significant difference in glucose control between treatment and control groups. With regard to the development of foot care lesions, the two groups did not differ significantly over time on this variable of inquiry.

The authors assert that in light of the failure of patient education programs to effect improvement in metabolic control, patient education may be "functionally meaningless" in that improvement in knowledge does not result in long term benefit for the patient. It is difficult to concur with this claim considering the lack of instrument validity and reliability, particularly as it applies to use with Black and Hispanic populations. For example, lack of construct validity may suggest that the items used in the questionnaire to measure diabetes knowledge may not have been those that best captured critical self-care knowledge especially in these ethnic groups. The nature of the responses themselves relied essentially on self-report that involved simple yes-no answers. As such, respondents had at least a 50% chance of giving the correct answer regardless of the nature of the item. This raises the questions whether the respondents were lucky in guessing of whether their responses were actually reflective of their basic knowledge. Furthermore, considering that a large number of subjects were Hispanic and some required that diabetes education classes be conducted in Spanish, it is possible that the knowledge and behavior instrument had to be translated for the subject as well. If so, the nature of the translation may have affected the content and meaning of the items where converted to Spanish.
Chapter II described key components of measurement theory which served as the guiding framework for this study. Also included in this chapter was a review of relevant literature related to the measurement of diabetes patient foot care knowledge, psychometric evaluation of general tests of diabetes patient knowledge, patient compliance with prescribed diabetic therapeutic regimens, and factors related to patient adherence in disease states other than diabetes. This review supports several conclusions:

1. studies in other chronic disease states have limited explication of the role of patient knowledge on effecting patient compliance with prescribed therapeutic regimens;
2. research in patient noncompliance with diabetic regimens has not explored the lack of patient self-care knowledge as a significant contributing factor to this outcome;
3. patient noncompliance with prescribed diabetic therapeutic regimens involves a wide and diverse range of variables or factors, none of which significantly and consistently account for this phenomenon;
4. noncompliance with diabetes regimens is a heterogenous phenomenon and may be dictated by diabetes type and treatment modality;
5. though several tests of general diabetes knowledge have been developed and psychometrically tested for validity and/or reliability, methodological problems greatly limit their application, particularly as it relates to the measurement of foot care knowledge; and,
6. no valid and reliable measures of diabetes foot care knowledge exist for use with elderly patients and diabetes.
CHAPTER III

METHODOLOGY

This study was implemented in three phases: Phase I-Determination of Content Domain; Phase II - Development of the Foot Care Knowledge Test; and, Phase III - Psychometric Evaluation of the Instrument. In this chapter, each phase and its methodological activities will be described. All results related to statistical analysis of data will be reported in the proceeding chapter.

PHASE I - DETERMINATION OF CONTENT DOMAIN

Foot care content from which instrument items were constructed were identified from four major sources: a.) diabetes nurse educators; b.) elderly people with diabetes; c.) selected diabetes education programs; and, d.) review of literature. The following sections describe the activities related to each of these content sources of information.

A. Diabetes Nurse Educators

Sampling Procedures

A mail survey of diabetes nurse educators was conducted to identify patient foot care behaviors and knowledge perceived important for elderly people with diabetes to enact and possess, respectively, in regular care of the feet. A random stratified sample of diabetes nurse
educators was obtained from the active membership list of the American Association of Diabetes Educators (AADE) (Appendix A). Stratification was based on geographic location of the educator using the six regions of the United States demarcated by AADE for its administrative purposes (Table 1). Regions were coded 1-6 to indicate locale.

Table 1

REGIONS OF COUNTRY AS DEFINED
BY THE AMERICAN ASSOCIATION OF DIABETES EDUCATORS

<table>
<thead>
<tr>
<th>Region</th>
<th>Geographic Area</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Northeast</td>
<td>ME, VT, NH, MA, CT, NY, PA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NJ, RI, DE</td>
</tr>
<tr>
<td>2</td>
<td>Southeast</td>
<td>VA, WV, MD, NC, SC, GA, FL,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AL, MS, TN, KY</td>
</tr>
<tr>
<td>3</td>
<td>North Central</td>
<td>OH, IN, IL, MI, WI, MN, IO,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NE, ND, SD</td>
</tr>
<tr>
<td>4</td>
<td>South Central</td>
<td>KS, MO, OK, AR, LA, TX</td>
</tr>
<tr>
<td>5</td>
<td>Southwest</td>
<td>CO, NM, AZ, UT, NV, CA, HI</td>
</tr>
<tr>
<td>6</td>
<td>Northwest</td>
<td>MT, WY, ID, WA, OR, AK</td>
</tr>
</tbody>
</table>

From each region, 15 names of diabetes nurse educators were randomly selected and numerically coded for tracking purposes. A total of 90 subjects were obtained using this procedure.

Each subject was mailed a packet that included a cover letter describing the nature of the study (Appendix B), and, a questionnaire for completion (Appendix C). Subjects were advised that the questionnaire was numerically coded for follow-up purposes. As AADE was unable to provide a list of educators whose practice was limited to patients within the targeted age range
(60-75 years of age), subjects whose practice did not include patients in this age group were asked to indicate their ineligibility to participate based on this criteria and return the questionnaire. Subjects were provided a pre-addressed, stamped envelope for convenience of returning the questionnaire.

One week following initial mailing of the packet, all subjects were mailed a reminder card requesting their response (Appendix D). Three weeks following mailing of reminder cards, nonrespondents were mailed another packet containing a cover letter, (Appendix E), another copy of the questionnaire, and, a pre-addressed stamped envelope for convenience of return. All responses returned one month following this last mailing were those used for data analysis.

**Instrumentation**

The questionnaire mailed to diabetes educators was comprised of three sections. Part A instructed subjects to list eight foot care behaviors perceived important for elderly people with diabetes to enact on a regular basis in care of the feet. Subjects were to list behaviors in order of importance with 1 being the most important. Part B instructed subjects to list up to three bits of foot care knowledge taught to elderly patients to correspond with each respective foot care behavior identified in Part A. Part C inquired as to demographic attributes of the subject including age, years in nursing, years in diabetes education, education level, gender, practice setting, and certification in diabetes education. In addition, subjects were asked to indicate whether they wished to receive a summary of findings upon completion of the study. Each questionnaire was numerically coded to reflect region of the country as well as individual respondent. Names and addresses of subjects were known only to the investigator and records are being maintained by same.
Human Subjects Concerns

This study used a questionnaire format to derive the data. No psychological, social, or legal risk to the subject was involved. Completing the survey form was not considered stress inducive and subjects were not misled or deceived regarding study purposes or use of data. None of the information requested from subjects was considered to be personal or sensitive in nature, offensive, threatening, or degrading. In the cover letter, subjects were advised of the voluntary nature of their participation. No inducements were used to encourage participation. Subjects were advised that they, or their employing institution, could, in no way, be identified in study outcomes. No aspect of the data could be made part of any permanent employment record associated with the subject nor reported to a supervisor or employer. With these attributes of subjects' participation, the Human Subjects Review Committee waived the need to obtain signed consent from subjects to participate (Appendix F). As such, return of the completed questionnaire was considered consent to participate.

Compilation of the Data

Responses obtained from diabetes nurse educators completing the survey form were compiled according to each section of the questionnaire. Each foot care behavior response was assigned a numerical code plus coding to reflect respondent's region of the country ("REG" - coded 1-6); that the response reflected a foot care behavior versus a foot care knowledge item ("B" versus "K"); the rank value of the responses ("R#" - coded 1-8); and, that the response were derived from a diabetes nurse educator versus an elderly person with diabetes ("DNE" versus "EPD").

Foot care knowledge responses were compiled and coded such that they reflected correspondence with each respective foot care behavior response obtained. In addition, each foot care knowledge item was assigned the rank value of its corresponding foot care behavior.
Demographic attributes of respondents were compiled and summarized for descriptive purposes.

B. Elderly People with Diabetes

Sampling Procedures

A convenience sample of elderly people with diabetes (aged 60-75 years) was obtained from two support group meetings sponsored by the Central Ohio Diabetes Association, and the Dayton Area Diabetes Association.

At each meeting, attendees were advised of the nature of the study, voluntary nature of participation, and measures and assurances of anonymity and confidentiality. Subjects willing to participate were given the option of completing the questionnaire on site, or, returning it in a pre-addressed stamped envelope. All respondents elected to complete the questionnaire on site. Approximate time to complete the questionnaire was twenty minutes.

Instrumentation

Elderly subjects were administered a questionnaire printed in booklet form comprised of two sections (Appendix G). Part A instructed subjects to list four foot care behaviors they perceived important for an elderly person with diabetes to enact on a regular basis in care of the feet. Responses were to be listed in order of importance with 1 being the most important. As it was proposed that elderly subjects may have difficulty discerning foot care behavior from foot care knowledge, only behavior responses were requested. Part B of the questionnaire requested information regarding demographic attributes of the respondent. Questionnaires were only numerically coded to represent the site from which the data were derived.

The survey form was printed in large bold face type on white paper to facilitate ease in reading. A diabetes nurse educator, master's prepared in education and certified in diabetes education,
plus, a 68 year old male with diabetes reviewed the instrument for face validity. Their feedback, in addition to commentary from committee members, was used to modify the instrument to facilitate subjects' ease in reading and understanding of survey instructions.

**Human Subject Concerns**

Human Subjects Review Committee also waived the need to obtain signed consent from elderly subjects. The data derived from respondents was not deemed to pose any psychological, social, physical or legal risk. Completion of the questionnaire was not considered stress inducive with data requested not considered to be offensive, threatening, or degrading in any manner. In describing the nature of the study and use of the data, subjects were not misled/deceived in any way, and, no inducements to participate were used. Subjects were informed that responses were anonymous with questionnaires numerically coded only to represent site from which data were derived. Subjects were assured that participation in the study was not associated with any aspect of their current medical care.

**Compilation of Data**

Responses obtained from elderly subjects were compiled according to section of the questionnaire. Each foot care behavior response was assigned a numerical code with the corresponding rank value of the response noted. Additional coding of these responses reflected the fact that data were derived from an elderly person with diabetes ("EPD"), and, that the response was a behavior response versus a knowledge response ("B" versus "K"). Note was also made of the site from which data were derived.

Demographic attributes of respondents were compiled for descriptive purposes only in the analysis of data.
Sampling Procedures

A letter (Appendix H) was mailed to 22 program coordinators from conveniently selected diabetes patient education programs in the United States (Appendix I). The letter advised program coordinators of the nature of the study followed by a request to forward foot care patient education materials, teaching outlines or protocols, or, instruments used in the assessment/provision of foot care knowledge for elderly people with diabetes. Assurances of confidentiality were noted in the letter as the emphasis was on foot care content, not the source from which information was derived.

Diabetes education programs were selected by the investigator with effort to sample from regions of the country consistent with those from which diabetes nurse educators were obtained. In addition, attempt was made to sample programs of varying institutional size.

Instrumentation

No specified instrument was utilized in this portion of the study. Program coordinators were simply asked to forward any materials related to the purpose of the study. Any materials obtained served as the data source.

Human Subjects Concerns

As with diabetes nurse educators and elderly subjects, a waiver for signed consent was included in the petition granted by the Human Subjects Review Committee.

Compilation of Data

Materials obtained from diabetes education program coordinators were qualitatively reviewed by the investigator. Data perceived to represent key bits of information related to foot care
behavior and/or knowledge were identified and compiled. These statements were assigned a numerical code to differentiate data from other content sources.

D. Content Derived from Literature Review

A search of the literature was requested from the Health Science Library, Wright State University School of Medicine, Dayton, Ohio. The literature search request focused on identifying articles primarily related to clinical practice/application of diabetes foot care knowledge as they may apply to elderly people and, then, any diabetes age group. The search did include a request for research based articles inclusive of foot care as a dimension of inquiry. This aspect of the study obviously did not require Human Subject concern.

Compilation of Data

Materials obtained were reviewed by the investigator for qualitative analysis of content. Basic principles of foot care were identified and compiled separately from other content domain sources of information. Each bit of information was assigned a numerical code to represent data derived from the literature.

PHASE II - DEVELOPMENT OF THE FOOT CARE KNOWLEDGE TEST

Card Sorting Process

Each foot care behavior response obtained from diabetes nurse educators and elderly people with diabetes was typed on three separate 3x5 unruled index cards. One side contained the behavior response with the opposite side stamped and detailed as appropriate to represent the information as outlined in Table 2.
Table 2

CODING FORMAT STAMPED ON 3X5 CARDS

<table>
<thead>
<tr>
<th>Response Code:______________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNE__________  REG_________  EPD__________</td>
</tr>
<tr>
<td>B_____________  K_____________  R#__________</td>
</tr>
</tbody>
</table>

Response Code represented the numerical code assigned each foot care behavior response; DNE denoted the response was obtained from a diabetes nurse educator; REG was coded 1 to 6 to represent the region of the country from which the educator respondent was located; EPD denoted the behavior response was derived from an elderly person with diabetes; B indicated the response was a foot care behavior; K indicated the response was a foot care knowledge item; and, R# represented the rank value of the foot care behavior response (coded 1-8 for diabetes educators and 1-4 for elderly subjects).

Due to the volume of data derived from respondents, only foot care behaviors were typed and coded as just described. Foot care knowledge response items obtained from diabetes educators were simply compiled corresponding to the code representing their respective foot care behavior response and, the rank value of the behavior.

Three separate sets of cards containing foot care behavior responses were ultimately produced. One set of cards was mailed to each of a three member panel of judges reflecting diabetes experts, all of whom had previously consented to participating in this phase of the study. Two members were diabetes clinical nurse specialists--masters prepared in nursing, certified in diabetes education, with more than 5 years of diabetes experience, and employed in large hospital based settings (>500 bed size capacity) located in the midwest portion of the United
States. The third panel member was a podiatrist with specialization in diabetes foot care whose practice was also located in the midwest.

Included with the cards was a cover letter describing the nature of the study followed by instructions to read each foot care behavior response and place it in one of six 8 1/2 x 11 envelopes. The envelopes were numbered 1 through 6 representing a foot care content category with its respective definition. Determination of the foot care content categories was accomplished by review of materials derived from the literature and diabetes education programs in which major areas of content was identified. The investigator developed the categorical definitions. The categories and their definitions were submitted to two diabetes clinical nurse specialists for review and comment. Based on their feedback, refinement or modification of terms were made to produce the categories and definitions ultimately used for the purposes of this study. The content categories and their definitions are listed in Table 3.
Table 3

FOOT CARE CONTENT CATEGORIES - DEFINITIONS

<table>
<thead>
<tr>
<th>Category</th>
<th>Label</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Footwear - Shoes</td>
<td>The use and/or maintenance of any item designed as a hard outer covering for the foot.</td>
</tr>
<tr>
<td>2</td>
<td>Footwear - Socks, Stockings, Hosiery</td>
<td>The use and/or maintenance of any item designed as a cloth or woven covering for the foot or leg.</td>
</tr>
<tr>
<td>3</td>
<td>Foot Emergencies</td>
<td>The care and treatment of an acute physical trauma or insult to the foot or leg.</td>
</tr>
<tr>
<td>4</td>
<td>Foot/Nail Care</td>
<td>Routine measures undertaken daily/regularly to maintain the integrity of the skin and toenails of the foot.</td>
</tr>
<tr>
<td>5</td>
<td>General Health Measures</td>
<td>Any general activity designed to promote or optimize health status as a direct or indirect measure to avert problems associated with the feet.</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>Statements that do not reflect appropriate foot care knowledge or behavior, or, statements not able to categorize in any of the previously designated categories.</td>
</tr>
</tbody>
</table>

Judges were asked to place in category 6 any foot care behavior response not perceived to represent content in any of the first five categories. Furthermore, judges were instructed to suggest a content category, if any, that would best reflect a behavior response placed in category 6. In addition, judges were invited to clarify, correct, or otherwise proffer comment with regard to any foot care behavior presented to them. Judges were asked to complete the card sorting process within one month with measures provided them to facilitate convenient return of data. All three judges completed the card sorting process and returned the data within the one month time period.
Compilation of Card Sorting Data

Upon return of data, agreement of categorization of foot care behaviors across judges was determined using "0" or "1" to indicate, respectively, nonplacement or placement of behavior response per judge in each of the designated categories. As such, for each category, a three digit index resulted to reflect how, combined, all three judges categorized a foot care behavior. Table 4 describes each of the eight possible three digit codes used to denote agreement of behavior response categorization across judges.

Table 4

CODING INDEX TO DENOTE CATEGORIZATION
OF FOOT CARE BEHAVIOR RESPONSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>All 3 judges agree, response belongs in the category</td>
</tr>
<tr>
<td>110</td>
<td>Judges 1 &amp; 2 agree, judge 3 does not agree, response belongs in the category</td>
</tr>
<tr>
<td>101</td>
<td>Judges 1 &amp; 3 agree, judge 2 does not agree, response belongs in the category</td>
</tr>
<tr>
<td>011</td>
<td>Judges 2 &amp; 3 agree, judge 1 does not agree, response belongs in the category</td>
</tr>
<tr>
<td>100</td>
<td>Judge 1 agree, judges 2 &amp; 3 do not agree, response belongs in the category</td>
</tr>
<tr>
<td>010</td>
<td>Judge 2 agrees, judges 1 &amp; 3 do not agree, response belongs in the category</td>
</tr>
<tr>
<td>001</td>
<td>Judge 3 agrees, judges 1 &amp; 2 do not agree, response belongs in the category</td>
</tr>
<tr>
<td>000</td>
<td>All 3 judges agree, response does not belong in the category</td>
</tr>
</tbody>
</table>

Data was compiled in this manner for all foot care behaviors combined, then, by sample group-diabetes educators and elderly subjects. Regardless of the manner of compilation, it was evident to note which foot care behaviors yielded agreement for category placement across all three judges (i.e., behavior responses coded "111"). It was equally evident to note which behaviors yielded agreement by all three judges regarding nonplacement of behaviors in any one content category (i.e., behaviors coded "000").
Analysis of Data

The D-L Test of Agreement (Deridian & Lewis, 1986) was used to determine content by category. In this method, the number of behavior responses reflecting agreement across all three judges regarding placement (responses coded "111") and nonplacement (responses coded "000") were totaled per category and divided by the total number of foot care behavior responses to yield level of agreement represented as a percent value. The following formula reflects this analytical process:

\[
\% \text{ category agreement} = \frac{\text{Responses coded "111"}}{\text{Total number of foot care behavior responses}} + \frac{\text{Responses coded "000"}}{\text{Total number of foot care behavior responses}}
\]

A minimum level of agreement of 70% was used as the criteria for analysis and use of information for test item construction. Levels of agreement were calculated for data reflecting all subjects combined, and, by sample groups. Only data derived from diabetes educators, however, was used to support construction of the foot care knowledge test.

Information derived from the D-L Test of Agreement using elderly subjects' data, and, information from literature review and diabetes education program coordinators served to qualitatively support outcomes from diabetes nurse educators.

Upon completion of analysis by D-L Test Agreement, each diabetes nurse educator response coded "111" was identified and compiled with their corresponding rank value. Foot care content categories were identified from highest level of agreement obtained to lowest (as noted in percent value). Emphasis, however, was on determining the perceived level of importance of content as indicated by the rank values attributed to foot care behavior responses. As such, the
rank value of behaviors coded "111" were summed then averaged to yield rank value of content categories. As foot care behaviors were to be listed in order of importance with 1 representing the most important, the lower the rank value, the more important the category. Though categorical rankings as derived from diabetes nurse educators were considered of primary interest for test item construction, category rankings for all subjects combined and by sample group were calculated.

For each diabetes educator response coded "111" per category, its corresponding item(s) related to foot care knowledge were identified and compiled to derive a comprehensive pool of information to use for test item construction. Foot care behavior with corresponding foot care knowledge data proved to be an enormous pool of information. As such, the categories ranked as the two most important areas of foot care content were used primarily to construct the foot care knowledge test.

Construction of the Foot Care Knowledge Test

Using data from the top two ranking foot care content categories, fifty-one multiple-choice fixed response test items were drafted. These items were submitted to two diabetes education experts for review and commentary. Their feedback resulted in the draft of a 25 item knowledge test by consolidating items apparent in content similarity and, or, by eliminating items redundant in nature.

Ultimately, 25 items were constructed to represent test of foot care knowledge in elderly people with diabetes. Each item was comprised of a stem followed by four possible answers, one of which was correct. Literature sources were used to assist in achieving item construction consistent with a multiple-choice format (Berk, 1984; Gronlund, 1982; Jacobs, 1974; Reid & Haladyna, 1982; and Tuckman, 1988).
In addition, a second section of the instrument was devised for the purpose of obtaining demographic attributes of respondents as well as other information, particularly from elderly respondents with diabetes. Demographic attributes included such items as whether a respondent had been diagnosed with diabetes; highest level of schooling completed; age in years; and, gender. Information sought particularly from elderly subjects with diabetes included duration of diabetes; mode of treatment; previous diabetes education experience (including diabetes foot care education); and, indices of subjects' perception of such variables as diabetes self-care importance and ability as well as that specifically related to foot care.

Knowledge test items, in their final draft form (including instruction statements) were analyzed primarily for readability level using the RightWriter software computer program (RightSoft, Inc., 1989). With regard to readability, the objective was to construct an instrument consistent with a 4th to 7th grade reading level. Analysis revealed the knowledge test was consistent with a 3rd grade level (Appendix J).

The complete instrument was submitted to the two diabetes clinical nurse specialists who participated in the D-L Test of Agreement card sorting process, and, two elderly people with diabetes (one male and one female, each between the age of 60-75 years of age). These individuals were asked to read the instrument and comment with regard to ease of reading, including clarity of instructions. In addition, elderly subjects were asked to complete the instrument to determine length of time required for completion.

Feedback received from the diabetes experts indicated that the knowledge test appeared easy to read and consistent with indices related to an elderly person's knowledge of foot care. The two elderly subjects provided similar feedback indicating that approximately 20 minutes was required to complete the entire instrument.

Originally, the intent was to print the instrument not only in large, bold face type on white paper, but to place items only on the front side of the page versus front and back. This method
was thought to better allow for ease and flow of completing the instrument. However, the amount of paper required and the cost associated with printing the document as such was substantial per knowledge test. Therefore, a prototype of the test using large, bold type print on both sides of the paper was drafted. Specific large type instructions were placed at the bottom of each page directing the respondent to either "go to the next page," or, "go to the back of the page." The test was again resubmitted to the two elderly subjects with diabetes for review and comment with regard to ease of flow in completing the test. Their feedback was positive for this two-sided print approach with further comment that highlighting the instructions on the bottom of the page would be further helpful in assuring that a respondent was aware content was being presented on both sides of the paper.

The final form of the foot care knowledge test was then drafted and submitted for printing for purposes of administration in the next phase of the study. As printing could not include highlighting the instructions as suggested by the elderly subjects, each knowledge test was highlighted by hand using a yellow marker. In addition, the statement on the front page of the knowledge test instructing subjects to "circle only one answer" was also highlighted as was the same statement in the instructions section immediately preceding the first foot care test item. The final version of the knowledge test can be found in Appendix K.

PHASE III - PSYCHOMETRIC EVALUATION OF THE INSTRUMENT

To evaluate the psychometric properties of the foot care knowledge test, the instrument was administered to two sample groups. One group was comprised of elderly people with diabetes; the other group consisted of elderly people without diabetes. The following sections describe the sampling, data collection, and statistical analysis methods.
Sampling Procedures

Elderly subjects with and without diabetes were solicited from the following sources: 1.) The Ohio State University Diabetes Clinic; 2.) Dayton Area Diabetes Association; 3.) Senior Citizen Center of Dayton; 4.) Life Care Alliance Home and Health Care Agency; and, 5.) The Ohio State University Atherosclerosis/General Medical Clinic. Eligibility for participation in those subjects with diabetes was based on the following criteria:

1. age 60-75 years;
2. diagnosed with diabetes without exclusion based on mode of treatment for metabolic control, or, duration of the disease;
3. actively involved in daily self-care management of their health; and,
4. able to speak and comprehend the English language.

Participation for those subjects without diabetes was based on the following criteria:

1. age 60-75 years;
2. no previous history/diagnosis of diabetes;
3. actively involved in self-care management of their health;
4. able to speak and comprehend the English language; and,

Subjects with and without diabetes were obtained using either of two methods—direct mail survey, and verbal solicitation.

Mail Survey

Subjects with diabetes who were participants in the OSU Diabetes Clinic foot care program were identified from a listing of patients which included their name, address, and age. Those individuals who met the criteria for age were identified and mailed a cover letter describing the nature of the study (Appendix L), measures of confidentiality, and assurances that
participation/nonparticipation would not influence their medical care provided by the clinic. Means to contact the investigator with any questions were also included in the text of the letter. Subjects were provided a pre-addressed stamped envelope for convenience of return of the knowledge test. Knowledge tests were numerically coded to identify not only the data source, but each respective subject for the purposes of follow-up. The names and coding scheme for this aspect of the study is known only to the investigator with records being maintained by same.

Subjects were instructed to complete and return the knowledge test within one week. As this particular group of subjects was the focus of test-retest for psychometric evaluation of test stability, subjects were advised in the cover letter that they may be selected to receive and complete the knowledge test a second time.

One week after mailing the knowledge test, a reminder letter to all subjects was sent (Appendix M). Those subjects returning the instrument were mailed the knowledge test again accompanied by a cover letter advising them of the nature/purpose of retesting along with a request to complete and return the instrument within one week. A pre-addressed, stamped envelope was provided to subjects for the purpose of convenient return of the knowledge test. Subjects responding within a five week time frame were those subjects whose data were used for the purposes of this study.

**Verbal Solicitation**

Subjects with or without diabetes were verbally solicited for participation from each of the data sites identified previously. Subjects at the OSU Diabetes Clinic, and, the Atherosclerosis/General Medicine Clinic were solicited with the assistance of the diabetes clinical nurse specialist who had been apprised of the nature and purpose of the study, a review of the foot care knowledge test, criteria for subject participation, and measures for subject assurances regarding anonymity of data. The nurse was advised that a waiver for the need to obtain written informed consent from subjects
had been obtained (see next section on Human Subject Concerns). As such, a subject's completion of the knowledge test constituted consent.

The clinical nurse specialist agreed to provide subjects with the option of completing the knowledge test at the time of solicitation, or, return the questionnaire via pre-addressed stamped envelope provided for convenience of return. The nurse specialist was provided with measures to contact the investigator with any questions with instructions to provide this same contact information to subjects should they wish to address any questions/comments to the investigator regarding any aspect of the study. All subjects from the clinic who agreed to participate in the study completed the instrument at the time of administration.

Subjects from the Dayton Area Diabetes Association were solicited via attendance at a regularly scheduled support group meeting. At the beginning of the meeting, the participants were apprised of the nature of the study and measures of anonymity regarding responses. Subjects were given the option of completing the instrument on site, or, returning the test using a pre-addressed stamped envelope made available for convenient return. All subjects at this data collection site elected to complete the instrument at the time of solicitation.

Subjects derived from the Senior Citizens Center of Dayton were solicited at a community nutrition site as part of a health fair program. The investigator was provided a table which afforded potential subjects the opportunity to discuss the nature and purpose of the study. Subjects who agreed to complete the instrument were also afforded the opportunity to complete it on site, or, return the test in a pre-addressed stamped envelope. All subjects derived from this data collection site elected to complete the instrument at the time of administration. Furthermore, most subjects inquired as to their test score. As such, the investigator was invited to present to the participants a brief lecture on diabetes foot care using knowledge test items as a source of lecture content. Subjects who completed the instrument were then provided with correct answers by item. As the presentation came after data collection had been completed, it was not possible to
provide subjects who had completed the instrument with their particular test as tests were not
coded or marked in any way to personally identify any one respondent. Respondents, therefore,
did not have an opportunity to change responses. Furthermore, no other tests were
administered after the presentation had been given.

Subjects from Life Care Alliance were verbally solicited in two ways. The investigator attended
a diabetes support group meeting sponsored by the organization and explained parameters of
the study important for subjects' determination to participate. The test was then administered to
subjects who agreed to participate. As with other subjects, they were given the opportunity to
complete the test on site or return it by mail. All subjects obtained in this manner completed the
instrument on site.

The investigator also coordinated with the Director of Nursing the use of home care and clinic
nurses as resources for administration of the instrument. The investigator was invited to attend a
staff meeting of nursing personnel in which the nature and purpose of the study was described to
them along with criteria for patient participation. The foot care knowledge test was reviewed with
the staff and questions concerning test completion instructions were addressed and clarified.
Attention was given to the importance of informing subjects that their responses were
anonymous and that participation/nonparticipation would not influence the health care services
provided by the organization. Information on how to contact the investigator was provided to the
staff with instructions to provide this same information to subjects if requested in order to address
any questions/comments regarding any aspect of the study. It was agreed that effort would be
made to have subjects complete the knowledge test at the time of administration with tests
returned collectively to the investigator. As such, nursing staff were provided with letter size pre-
addressed stamped envelopes for the collective return of ten instruments per envelope. As with
all other data collection sites, subjects who were obtained from solicitation by nursing staff
personnel completed the instrument at the time of administration. However, subjects solicited in this manner were also afforded the opportunity to complete the instrument and return it by mail.

**Sample Size**

A minimum of 125 subjects with diabetes and 125 subjects without diabetes (total n=250) was the size of the sample estimated for the purposes of this study. An n=250 would best address issues related to analysis of foot care knowledge test items while accommodating an effect size of .6 (assuming a valid and reliable instrument), a level of significance of .05 for a one-tailed t-test, and a power of .80 considered "good" for psychometric evaluation of an instrument (Cohen, 1977). Considering only effect size of .6, a .05 level of significance, and a power of .80, the minimum n per group required was 50 for a total n=100. Efforts were geared, however, to obtain an n=125 per sample group.

**Human Subjects Concerns**

Permission to conduct this phase of the study was sought and obtained from the Human Subjects Review Board at The Ohio State University. In addition, as subjects were being accessed from the clinic system at The Ohio State University Hospital, concurrent permission was sought and granted from the Nursing Research Committee at University Hospital, The Ohio State University (Appendix N).

Initially this phase of the study was approved by Human Subjects with the condition that informed written consent be obtained from each elderly subject participating in the study. The Committee was repetitiously requesting a waiver for the need to obtain consent in such manner as the nature of the study and the data derived from subjects was not perceived to represent any psychological, social, legal, or otherwise harmful risk/consequence. With the use of mail survey, it was perceived that elderly subjects may have difficulty fully comprehending a written description
of the study plus instructions for consent and, therefore, inhibit possible participation. Upon review of the petition resubmitted to Human Subjects, a waiver for the need to obtain written consent was obtained (Appendix 0).

With the exception of subjects derived from the OSU Diabetes Clinic foot care program, respondents were anonymous. Each knowledge test received was assigned a numerical code for identification purposes. However, subjects were not asked to provide any means of personal identification when completing the instrument.

The identification code assigned to OSU foot care program participants was designed to correspond to their name and address strictly for mail survey follow-up purposes. As previously stated, names of these participants were known, and are being maintained, solely by the investigator.

Compilation of Data

Upon receipt of a foot care knowledge test from the data collection sites, each test was reviewed primarily to determine eligibility of respondents based on age. Secondly, tests were reviewed to assure that respondents had identified themselves as either having, or not having, diabetes. Tests in which respondents did not identify themselves accordingly were removed from the data set. Those respondents deemed eligible to participate then were assigned a numerical code plus a second code to identify the respective site from which the data were derived. The final coding scheme constructed can be found in Appendix P.

Knowledge test items were coded Q1 through Q25 to represent each respective item on the instrument. As a subset of the data would reflect responses obtained from retest subjects, test items were correspondingly coded Q26 through Q50 as well so that responses obtained on retest could be distinguished from those obtained from first test administration. For respondents who were not retest subjects, Q26 through Q50 were coded "M" for missing.
In addition, questions contained in the "Background Information" section of the instrument were also coded to represent each respective item of inquiry. Depending on the type of respondent (diabetes vs. no diabetes) some responses in the "Background" section were requested, or, not required. Accordingly, the coding scheme was designed to reflect data "not required" as in the case of select items not requiring a response from a subject without diabetes. It was for example, conceivable that subjects with diabetes would be requested to respond to an item but would elect not to answer the question. As such, the coding scheme allowed for identifying a "true missing" response in which information from the subject was sought but the subject did not provide an answer to a question.

Additionally, the coding scheme included two variables identified as "SCORE 1" and "SCORE 2" which represented, respectively, the total number of correct responses on the knowledge test for all subjects, then, retest subjects only.

Data derived from the knowledge test and background information section of the instrument was coded using the Statistix (SX) computer software statistical program. Once transcribed, data were converted to an ASCII file and loaded for analysis purposes using the Statistical Analysis System (SAS) software program package.
CHAPTER IV

RESULTS, INTERPRETATION AND DISCUSSION OF THE DATA

This chapter presents the results of the study. Results will be presented by each respective phase of the study. The results are followed by a section presenting an interpretation and discussion of the results obtained.

RESULTS OF THE STUDY

PHASE I - DETERMINATION OF CONTENT DOMAIN
A. Diabetes Nurse Educators

Characteristics of the Sample

Of the ninety diabetes nurse educators selected for study participation, 64 (71%) responded by returning the questionnaire. Seventeen of the respondents returned questionnaires indicating ineligibility and/or unwillingness to participate resulting in 47 eligible participants, or, 52% of the original 90 subjects. Table 5 describes eligible respondents by region of the country.
Table 5

DIABETES NURSE EDUCATOR RESPONDENTS

BY REGION - NUMBER AND PERCENT

<table>
<thead>
<tr>
<th>REGION</th>
<th>n</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>19%</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>17%</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>22%</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>20%</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>17%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>47</td>
<td>100%</td>
</tr>
</tbody>
</table>

Respondents averaged 7 years in diabetes education, 18 years in nursing and most reported having been certified in diabetes education. Twenty-eight (61%) reported a bachelor's degree as their highest level of education with the largest number (35%) reporting employment in a hospital with 100-299 bed size capacity. Table 6 describes the background information obtained from respondents.
Table 6

BACKGROUND INFORMATION - DIABETES NURSE EDUCATORS

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
<th>( \bar{x} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified Diabetes Educator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>33</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diploma</td>
<td>6</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Associate's</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Bachelor's</td>
<td>28</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Master's</td>
<td>9</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Doctorate</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Years in Diabetes Education</td>
<td></td>
<td>7.03</td>
<td></td>
</tr>
<tr>
<td>Years in Nursing</td>
<td></td>
<td>17.91</td>
<td></td>
</tr>
<tr>
<td>Employer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital &gt; 700 beds</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Hospital 500-699 beds</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Hospital 300-499 beds</td>
<td>11</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Hospital 100-299 beds</td>
<td>16</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Hospital &lt;100 beds</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Public Health/Home Care</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Physician Office</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>College/University</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Table 7 describes the diabetes education services provided by diabetes nurse educator respondents. As noted, 47% indicated "outpatient" as their primary practice setting for diabetes education; 38% stated "inpatient" as their primary practice setting with 9% listing "other" which included home health care, public health/school, and private consultant. Three educators indicated both inpatient and outpatient as their primary practice setting. Forty-two percent reported offering a formal diabetes education program with the larger percent indicating the provision of this service on an outpatient basis. Of those offering a diabetes education program,
respondents reported an average of 14% of diabetes class time was devoted to teaching foot care. The percent of time ranged from a minimum 2% to a maximum of 60% of class time.

Ninety-six percent reported offering one-to-one teaching sessions as part of their diabetes education program in which respondents reported providing an average of 275 sessions within the previous year. The number of sessions ranged from 10/year to 1500/year. Respondents offering one-to-one teaching sessions indicated that approximately 50% of their sessions included some teaching of foot care with only an average of 11% of these sessions devoted solely to the provision of diabetes foot care.

Table 7

<table>
<thead>
<tr>
<th>DIABETES EDUCATION SERVICES PROVIDED BY DIABETES NURSE EDUCATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice Setting</td>
</tr>
<tr>
<td>Inpatient</td>
</tr>
<tr>
<td>Outpatient</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Offer - formal Education Classes</td>
</tr>
<tr>
<td>Yes - Inpatient</td>
</tr>
<tr>
<td>Yes - Outpatient</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Offer Inpatient/Outpatient</td>
</tr>
<tr>
<td>One-To-One Teaching Sessions</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>
As this study focused on instrumentation designed for elderly people with diabetes, respondents were asked to indicate the age range of patients to whom they provided service. Table 8 describes this distribution which reflects that the largest percentage of respondents reported service to patients in the 60-75 year range.

Table 8

<table>
<thead>
<tr>
<th>Age Group</th>
<th>mean %</th>
<th>min</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60 years of age</td>
<td>37.22</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>60-75 years of age</td>
<td>46.52</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>&gt;75 years of age</td>
<td>15.72</td>
<td>1</td>
<td>40</td>
</tr>
</tbody>
</table>

Foot Care Behavior Responses

The request for diabetes nurse educators to list up to eight foot care behaviors perceived important for elderly people to enact in regular care of the feet yielded 346 response items. Not all of the 47 respondents listed the maximum eight behaviors. Behaviors were requested in order of importance with number one representing the most important foot care behavior. These data were compiled to reflect each respective response, the numerical code assigned the response, and the rank value of the response as designated by the educator. Table 9 exemplifies the compilation of these data in the manner just described.
### Table 9

**EXAMPLE OF COMPILATION OF DATA**  
**FOOT CARE BEHAVIOR RESPONSES**  
**DIABETES NURSE EDUCATORS**

<table>
<thead>
<tr>
<th>Numerical Code</th>
<th>Rank Value</th>
<th>Foot Care Behavior Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>1</td>
<td>Look at feet daily.</td>
</tr>
<tr>
<td>901</td>
<td>2</td>
<td>Care for feet daily, e.g., wash apply lotion when indicated etc.</td>
</tr>
<tr>
<td>902</td>
<td>3</td>
<td>Wear only well-fitting footwear.</td>
</tr>
<tr>
<td>903</td>
<td>4</td>
<td>Check shoes before putting them on.</td>
</tr>
<tr>
<td>904</td>
<td>5</td>
<td>Always wear something on feet (not just socks or knit booties).</td>
</tr>
<tr>
<td>905</td>
<td>6</td>
<td>Know when to call the doctor with problem on feet (remember you're not bothering him).</td>
</tr>
<tr>
<td>906</td>
<td>7</td>
<td>Stop self-surgery. No cutting on corns, hard toenails, etc.</td>
</tr>
<tr>
<td>907</td>
<td>8</td>
<td>No heating pads, hot water soaks, etc.</td>
</tr>
</tbody>
</table>

Responses were obtained from subjects representing each region of the country from which educators were sampled. Table 10 reflects the number of foot care behaviors generated by respondents' region of the country.
Table 10

FOOT CARE BEHAVIOR RESPONSES BY
REGION OF THE COUNTRY

<table>
<thead>
<tr>
<th>Region</th>
<th>Respondents n</th>
<th>Responses n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>64</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>58</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>79</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>64</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>59</td>
</tr>
</tbody>
</table>

Overall, respondents were fairly evenly distributed by region with the exception of region 2 in which only 3 of 15 educators sampled responded to the survey. As such, this region of the country reflects the smallest number of foot care behavior responses.

Foot Care Knowledge Responses

Diabetes educators were asked to list up to three bits of foot care knowledge taught to elderly patients to directly correspond with each of the foot care behaviors identified previously. A total of 890 foot care knowledge responses were generated. Not all respondents listed the maximum three bits of foot care knowledge--in some cases, no foot care knowledge items were listed while in other cases, respondents elected to provide more than the amount requested. All knowledge responses generated were included in the compilation of the data.

Each foot care knowledge response was assigned the same numerical code and rank value corresponding to its respective foot care behavior. Table 11 exemplifies the manner in which these data were compiled.
<table>
<thead>
<tr>
<th>BEHAVIOR CODE</th>
<th>RANK VALUE</th>
<th>KNOWLEDGE RESPONSE</th>
</tr>
</thead>
</table>
| 900           | 1          | 1. Take off shoes at end of day (possibly) more often.  
2. Look at bottom feet (use mirror), in between toes, at heel, look for red areas, blisters, white blanched areas, etc.,  
3. If noted, check corresponding site in shoes. |
| 901           | 2          | 1. Be sure feet are washed with luke-warm water and mild soap daily (check temperature with wrist or elbow).  
2. Be sure to dry thoroughly with soft towel gently, especially between toes.  
3. Apply mild lotion to dry, rough areas (e.g., heels), not between toes. |
| 902           | 3          | 1. Wear reasonably well-fitting shoes if possible. No style extremes (open toes, high heels, etc.).  
2. Should be comfortable first time but break in slowly (only few hours each day worn). |
| 903           | 4          | 1. Always feel inside of shoes before putting on. Look for objects that may have fallen inside.  
2. Feel inside for rough spots, holes, etc., that you may not notice.  
3. If you notice a red spot, white spot or blister on your foot, check that shoe for a trouble spot then fix it or discard shoe. |
| 904           | 5          | 1. Never go barefoot, even at home.  
2. Wear slippers with stiff soles for protection.  
3. Don't go barefoot at beach, etc. |
| 905           | 6          | 1. Always call the doctor if develop sore, cut, corn, etc., that is bothersome or won't heal.  
2. Be aware your feet are delicate and a potential problem area--never postpone calling and try self-treatment.  
3. Call immediately if any signs of infection, draining, warm to touch, swelling, etc. |
B. Elderly People with Diabetes

Characteristics of the Sample

Twenty-three elderly people with diabetes responded to the survey. Table 12 describes the subjects' demographic attributes. They averaged almost eleven years with diabetes with duration of the disease ranging from 6 months to 38 years. Twelve respondents utilized insulin for glucose control with 8 reporting diet therapy and 7 indicating oral agents as their forms of treatment. Number of respondents based on mode of treatment reflects a value greater than twenty-three. This resulted due to the fact that some respondents indicated the use of more than one form of treatment modality.

The greatest percentage of respondents were female with 95% of subjects reporting their highest level of education at the high school level or above.

Table 12

<table>
<thead>
<tr>
<th>DEMOGRAPHIC ATTRIBUTES</th>
<th>ELDERLY PEOPLE WITH DIABETES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Age in years</td>
<td>23</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
</tr>
<tr>
<td>Male</td>
<td>7</td>
</tr>
<tr>
<td>Education completed</td>
<td></td>
</tr>
<tr>
<td>&lt;8th grade</td>
<td>0</td>
</tr>
<tr>
<td>Some high school</td>
<td>1</td>
</tr>
<tr>
<td>H.S. graduate</td>
<td>7</td>
</tr>
<tr>
<td>Some college/technical</td>
<td>8</td>
</tr>
<tr>
<td>College graduate</td>
<td>6</td>
</tr>
<tr>
<td>Duration of diabetes (yrs.)</td>
<td>10.93</td>
</tr>
<tr>
<td>Mode of treatment</td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>12</td>
</tr>
<tr>
<td>Oral Hypoglycemics</td>
<td>7</td>
</tr>
<tr>
<td>Diet Only</td>
<td>8</td>
</tr>
</tbody>
</table>
Foot Care Behavior Responses

In response to Part A of their survey, respondents provided 89 foot care behaviors. Subjects were asked to list four foot care behaviors perceived important for an older adult with diabetes to perform in regular care of the feet. Not all respondents provided the maximum number of behaviors. Behavior responses were requested in order of importance with number one being the most important. Elderly subjects were not requested to provide data reflective of foot care knowledge.

Like that for diabetes nurse educators, each foot care behavior provided by elderly subjects were assigned a numerical code and ascribed the rank value of importance according to the order in which the data was listed. This information was compiled separately, but in the same manner, as that reflective of nurse educator data as seen in Table 9.

C. Diabetes Nurse Educators

Twelve responses from 22 diabetes education program coordinators were received in response to the inquiry for foot care policies, protocols, teaching assessment or documentation materials. One document received was an instrument used to assess patient diabetes knowledge which was inclusive of foot care. A follow-up call to the respondent indicated that no structured methodology was employed to evaluate its efficacy as an index of knowledge. Three responses included patient education materials used to support diabetes foot care education. Some of the literature was the same and derived from resources made available by representatives from the diabetes commercial industry. Two respondents provided teaching protocols for foot care education programs.

In addition to these respondents, the investigator did receive copies of diabetes knowledge tests which included at least one item related to foot care. These copies were the result of an
informal conversation with a health professional involved in the design and evaluation of the instruments.

All materials received were reviewed solely by the investigator. Key concepts thought to support the purpose of the study were selected and compiled by numerical code. Thirty-four items were selected with each assigned a numerical code; no rank value was attributed to these items.

D. Content Derived From Literature Review

Thirty-six items were identified from literature sources which had been derived from literature search. Some of the material was reflective of research based articles as the search focused on the identification of such materials. One source of information was a section in a health professional textbook related to foot care; another source was a clinical article written for nurses which focused on foot care.

Like statements derived from diabetes education program materials, these items were assigned a numerical code and compiled without rank value assigned to them.

PHASE II - DEVELOPMENT OF THE FOOT CARE KNOWLEDGE TEST

Card Sorting Process

The three member panel of diabetes experts (i.e., judges) each received a total of 435 foot care behavior responses each typed separately on 3x5 white, unruled index cards. The number of behavior responses represented the 346 and 89 responses obtained from diabetes nurse educators and elderly subjects combined. Within the requested one month time period, each of the judges returned the cards sorted into the six envelopes representing the five foot care content categories, and, a sixth category marked "Other."
As the data were received, the category assigned per judge for each respective response was noted and compiled along with response data already reflective of its numerical code and rank value. Table 13 reflects the manner in which these data were compiled for analysis. This manner of compilation was done for responses derived from both diabetes nurse educators and elderly subjects.

Table 13

EXAMPLE
CATEGORY ASSIGNMENT BY JUDGE
FOOT CARE BEHAVIORS - ALL SUBJECTS

<table>
<thead>
<tr>
<th>Numerical Code</th>
<th>Rank Value</th>
<th>Foot Care Behavior Response</th>
<th>Category Assignment by Judge</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>1</td>
<td>Look at feet daily.</td>
<td>4  4  4</td>
</tr>
<tr>
<td>901</td>
<td>2</td>
<td>Care for feet daily, e.g., wash and apply lotion when indicated.</td>
<td>4  4  4</td>
</tr>
<tr>
<td>902</td>
<td>3</td>
<td>Wear only well-fitting footwear.</td>
<td>1  1  1</td>
</tr>
<tr>
<td>903</td>
<td>4</td>
<td>Check shoes before putting them on.</td>
<td>1  1  4</td>
</tr>
<tr>
<td>904</td>
<td>5</td>
<td>Always wear something on feet (not just socks or knit booties).</td>
<td>1  4  4</td>
</tr>
<tr>
<td>905</td>
<td>6</td>
<td>Know when to call the doctor with problem on feet (remember you're not bothering him).</td>
<td>4  3  3</td>
</tr>
<tr>
<td>906</td>
<td>7</td>
<td>Stop self-surgery. No cutting on corns, hard nails, etc.</td>
<td>3  4  4</td>
</tr>
<tr>
<td>907</td>
<td>8</td>
<td>No heating pads, hot water soaks, etc.</td>
<td>5  4  5</td>
</tr>
</tbody>
</table>

Analysis of Data: D-L Test of Agreement

To determine percent agreement across judges regarding placement of a behavior response in any one foot care content category, all foot care behaviors were compiled by
numerical code. The symbol "0" was ascribed to a behavior if the response had not been placed by a judge in a category; the behavior was ascribed a "1" if it had been placed in a category. This coding index was used for each response respective of each category. The result, as exemplified in Table 14, was a three digit index for each response per category. Data were compiled accordingly for all foot care behaviors combined, for data derived from diabetes nurse educators only, and then for foot care behavior responses derived from elderly subjects only.

Table 14

EXAMPLE
CODING INDEX FOR D-L TEST OF AGREEMENT

<table>
<thead>
<tr>
<th>Foot Care Behavior Response Code</th>
<th>Foot Care Content Category Code</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>701</td>
<td>100</td>
<td>000</td>
<td>000</td>
<td>010</td>
<td>001</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>702</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>703</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>100</td>
<td>011</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>704</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>705</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>706</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>707</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>708</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>709</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>111</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>710</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>711</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>110</td>
<td>000</td>
<td>000</td>
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</tr>
<tr>
<td>712</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>713</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>714</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>715</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>716</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>717</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>718</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>110</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>719</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>110</td>
<td>001</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>720</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>010</td>
<td>001</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>721</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>722</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>723</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>724</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>725</td>
<td>000</td>
<td>000</td>
<td>000</td>
<td>111</td>
<td>000</td>
<td>000</td>
<td></td>
</tr>
</tbody>
</table>
To determine percent level of agreement per category, the number of responses coded "000" and "111" were summed then divided by total number of behavior responses to yield percent agreement. Table 15 reflects the levels of agreement obtained per category for all subjects combined.

Table 15

PERCENT LEVEL OF AGREEMENT
FOOT CARE BEHAVIORS BY CATEGORY
ALL SUBJECTS COMBINED

<table>
<thead>
<tr>
<th>Foot Care Content Category</th>
<th>Total Responses n</th>
<th>&quot;000&quot; Responses n</th>
<th>&quot;111&quot; Responses n</th>
<th>Total Agreements</th>
<th>Percent Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>435</td>
<td>365</td>
<td>42</td>
<td>407</td>
<td>.9356</td>
</tr>
<tr>
<td>2</td>
<td>435</td>
<td>415</td>
<td>13</td>
<td>428</td>
<td>.9839</td>
</tr>
<tr>
<td>3</td>
<td>435</td>
<td>394</td>
<td>17</td>
<td>411</td>
<td>.9448</td>
</tr>
<tr>
<td>4</td>
<td>435</td>
<td>134</td>
<td>193</td>
<td>327</td>
<td>.7517</td>
</tr>
<tr>
<td>5</td>
<td>435</td>
<td>302</td>
<td>46</td>
<td>343</td>
<td>.8000</td>
</tr>
<tr>
<td>6</td>
<td>435</td>
<td>405</td>
<td>0</td>
<td>405</td>
<td>.9310</td>
</tr>
</tbody>
</table>

As evidenced by the data, percent level of agreement ranged from 75% for category 4 to 98% for category 2. The data were then separated to reflect levels of agreement by sample groups. Table 16 reflects percent agreement by category for foot care behavior responses derived from diabetes nurse educators.
Table 16

PERCENT LEVEL OF AGREEMENT
FOOT CARE BEHAVIORS BY CATEGORY
DIABETES NURSE EDUCATORS

<table>
<thead>
<tr>
<th>Foot Care Content Category</th>
<th>Responses n</th>
<th>Total &quot;000&quot; Behaviors</th>
<th>Total &quot;111&quot; Behaviors</th>
<th>Total Agreements</th>
<th>Percent Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>346</td>
<td>293</td>
<td>29</td>
<td>322</td>
<td>.9306</td>
</tr>
<tr>
<td>2</td>
<td>346</td>
<td>333</td>
<td>9</td>
<td>342</td>
<td>.9884</td>
</tr>
<tr>
<td>3</td>
<td>346</td>
<td>314</td>
<td>15</td>
<td>329</td>
<td>.9509</td>
</tr>
<tr>
<td>4</td>
<td>346</td>
<td>99</td>
<td>158</td>
<td>257</td>
<td>.7427</td>
</tr>
<tr>
<td>5</td>
<td>346</td>
<td>237</td>
<td>35</td>
<td>272</td>
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</tr>
<tr>
<td>6</td>
<td>346</td>
<td>323</td>
<td>0</td>
<td>323</td>
<td>.9335</td>
</tr>
</tbody>
</table>

These data reflect percent agreement ranging from 74% for category 4 to 99% for category 2.

Analysis was conducted then using only foot care behavior responses derived from elderly subjects. The percent levels of agreement are outlined in Table 17.
Table 17

PERCENT LEVEL OF AGREEMENT
FOOT CARE BEHAVIORS BY CATEGORY
ELDERLY PEOPLE WITH DIABETES

<table>
<thead>
<tr>
<th>Foot Care Content Category</th>
<th>Responses</th>
<th>Total &quot;000&quot; Behaviors</th>
<th>Total &quot;111&quot; Behaviors</th>
<th>Total Agreements</th>
<th>Percent Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>89</td>
<td>72</td>
<td>13</td>
<td>85</td>
<td>.9551</td>
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<tr>
<td>2</td>
<td>89</td>
<td>82</td>
<td>4</td>
<td>86</td>
<td>.9663</td>
</tr>
<tr>
<td>3</td>
<td>89</td>
<td>80</td>
<td>2</td>
<td>82</td>
<td>.9213</td>
</tr>
<tr>
<td>4</td>
<td>89</td>
<td>37</td>
<td>33</td>
<td>70</td>
<td>.7865</td>
</tr>
<tr>
<td>5</td>
<td>89</td>
<td>65</td>
<td>11</td>
<td>76</td>
<td>.8539</td>
</tr>
<tr>
<td>6</td>
<td>89</td>
<td>82</td>
<td>0</td>
<td>82</td>
<td>.9213</td>
</tr>
</tbody>
</table>

As with the data for all subjects combined and for diabetes nurse educators, elderly subjects' foot care behaviors in category 4 received the lowest value of percent agreement while category 2 received the highest.

Once levels of agreement were determined, emphasis was placed on analyzing categories based on their rank value of importance. Only data derived from diabetes nurse educators would serve as the basis for test item construction. All educator derived foot care behaviors receiving "111" agreement across all three judges were identified and compiled by category with their respective rank value. The rank values of behaviors were simply summed and divided by the total number of behaviors per category to yield a mean rank value of category importance. Table 18 describes the number of "111" behavior responses generated by category, sum of rank value, and mean rank value for each respective category. As educators listed
behaviors in order of importance with 1 being the most important, the category with the lowest mean rank value represented the category perceived of greatest importance.

**Table 18**

**MEAN RANK VALUE BY CATEGORY**
**DIABETES NURSE EDUCATORS**

<table>
<thead>
<tr>
<th>Foot Care Content Category</th>
<th>Behavior Responses</th>
<th>Sum</th>
<th>Mean Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28</td>
<td>138</td>
<td>4.86</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
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<td>5.11</td>
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<tr>
<td>3</td>
<td>15</td>
<td>87</td>
<td>5.80</td>
</tr>
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<td>4</td>
<td>158</td>
<td>523</td>
<td>3.31</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>211</td>
<td>6.03</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

As the data reflect, category 4 (Foot/Nail Care) was ranked the highest in level of importance followed by category 1 (Footwear-Shoes), category 2 (Footwear-Socks, Stockings, Hosiery), category 3 (Foot Emergencies), and category 5 (General Health Measures). No foot care behaviors received total agreement across all three judges for placement in category 6 (Other).

A total of 245 (71%) of the original 346 foot care behaviors derived from diabetes educators received category placement agreement across all three judges. These behaviors corresponded with 627 foot care knowledge items, or, approximately 71% of the original 890 foot care knowledge items generated. The greatest percent of behavior responses and, subsequently, foot care knowledge items were in category 4 in which 158 behaviors corresponded with 410 knowledge items. As category 4 was the highest ranked category in order
of importance, and due to the volume of data available for test item construction, only the top two categories in terms of mean rank value were selected for primary use in construction of the foot care knowledge test. Consequently, category 4 and category 1 representing 186 foot care behaviors with 476 corresponding foot care knowledge items received focus of attention in construction of the foot care test.

As reported in Chapter III, ultimately a 25 item, multiple choice, fixed response test was designed to represent foot care knowledge in elderly people with diabetes.

PHASE III - PSYCHOMETRIC EVALUATION OF THE INSTRUMENT

Characteristics of the Sample

A total of 205 elderly people participated in this phase of the study--102 with diabetes, 103 without diabetes. Table 19 describes demographic attributes of the sample.

Table 19

DEMographic Attributes
ELDERLY SUBJECTS - PHASE III

<table>
<thead>
<tr>
<th></th>
<th>All Subjects</th>
<th>Diabetes</th>
<th>No Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>205</td>
<td>102 (50%)</td>
<td>103 (50%)</td>
</tr>
<tr>
<td>Mean age</td>
<td>66</td>
<td>68 ± 4.54</td>
<td>67 ± 4.88</td>
</tr>
<tr>
<td>Female</td>
<td>125 (61%)</td>
<td>57 (56%)</td>
<td>68 (67%)</td>
</tr>
<tr>
<td>Male</td>
<td>79 (39%)</td>
<td>45 (44%)</td>
<td>34 (33%)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;8th grade</td>
<td>12 (6%)</td>
<td>5 (5%)</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>some high school</td>
<td>41 (20%)</td>
<td>22 (22%)</td>
<td>19 (17%)</td>
</tr>
<tr>
<td>high school grad.</td>
<td>66 (33%)</td>
<td>34 (33%)</td>
<td>32 (31%)</td>
</tr>
<tr>
<td>some college/tech school</td>
<td>41 (20%)</td>
<td>19 (17%)</td>
<td>22 (21%)</td>
</tr>
<tr>
<td>college grad.</td>
<td>41 (20%)</td>
<td>22 (22%)</td>
<td>19 (18%)</td>
</tr>
</tbody>
</table>
Subjects were equally distributed by sample group—diabetes versus no diabetes. By group, they were also similar in mean age, and, across highest levels of education completed. In each sample group, women comprised the largest percent of respondents with women with diabetes representing the largest percent of total respondents.

Subjects with diabetes were queried as to their duration of diabetes, diabetes treatment modality, and previous attendance at diabetes education classes. Subjects responding "Yes" to the last item of inquiry were further asked to indicate how long ago they attended classes, and, if information provided in any of the classes included information regarding foot care. Table 20 describes responses obtained from subjects responding to these items of inquiry.

Table 20

DIABETES/DIABETES EDUCATION HISTORY
ELDERLY SUBJECTS WITH DIABETES

<table>
<thead>
<tr>
<th>Variable of Inquiry</th>
<th>n</th>
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</thead>
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<td>Duration of diabetes</td>
<td></td>
<td></td>
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<tr>
<td>&lt;5 years</td>
<td>16</td>
<td>16</td>
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<tr>
<td>5 - 10 years</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>55</td>
<td>56</td>
</tr>
<tr>
<td>Treatment Modality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Oral agent</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Diet only</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Insulin &amp; oral agent</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Attended Diabetes Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>72</td>
<td>73</td>
</tr>
<tr>
<td>No</td>
<td>27</td>
<td>27</td>
</tr>
</tbody>
</table>
The greatest percentage of respondents with diabetes reported duration of the disease of more than 10 years with the use of oral hypoglycemic agent therapy as the treatment modality reported by 42% of subjects. Seventy-two percent of subjects indicated they had previously attended diabetes education classes ranging from 1 to 20 years ago (x=4.43 ± 3.72). Of those subjects who reported previous diabetes education class attendance, 85% (n=61) indicated that the classes had included information about foot care.

Subjects with diabetes were also asked to rate their perception across several variables from 1 (very poor) to 5 (very good). Subjects' mean rating of their understanding of diabetes = 3.83 ± .81; understanding of diabetes control = 3.9 ± .79; understanding diabetes foot care = 3.87 ± .81; and, ability to care for feet = 4.00 ± .72. Rating of perceived importance of diabetes foot care was scaled from 1 (not important) to 4 (very important). Mean rating of this variable of inquiry = 3.8 ± .47. These results indicated that respondents tended to rate their perceptions just below "good" for the first four of these items and just short of "very important" for the last of these questions.

Five sites were utilized for data collection. Thirty-six percent (n=73) of subjects were derived from Life Care Alliance; 30% (n=61) from OSU Atherosclerosis/General Medicine Clinic; 27% (n=55) from OSU Diabetes Clinic Foot Care Program; 5% (n=11) from Dayton Senior Citizens Center; and, 2% (n=5) from the Dayton Area Diabetes Association. As would be expected, all subjects from the OSU Diabetes Clinic Foot Care Program had diabetes. Three subjects (60%) derived from the Dayton Area Diabetes Association had diabetes, two subjects (40%) did not. Of the 11 subjects from the Dayton Senior Citizens Center, 27% (n=3) had diabetes; 73% (n=8) did not have diabetes. Thirty-seven percent (n=27) of the Life Care Alliance subjects had diabetes with 63% (n=46) reporting no history of diabetes. Twenty-five percent of subjects from the OSU General Medicine Clinic reported a history of diabetes with 75% (n=46) indicating no diagnosis of diabetes.
The following sections present results corresponding with respective research objectives/hypotheses proffered to guide this study.

**Research Objective: to establish psychometric indices of reliability.**

Two measures were employed to address reliability of the foot care knowledge test—internal consistency and stability.

Measure of internal consistency was obtained utilizing the Kuder-Richardson 20 formula (KR20). For all subjects with and without diabetes, responses to each item on the test were coded to represent dichotomous data with either "1" to indicate correct answer to the item, or, "0" to represent an incorrect response to the test question. In cases where no response to a test item, or, more than one response to a test item was given, the item was coded "0" to represent an incorrect response. Analysis yielded a KR20 = .7999, or .80, with a standard error of measurement = 1.69.

To measure the stability of the instrument over time, all respondents derived from the OSU Diabetes Clinic Foot Care Program (n=55) were mailed the foot care knowledge test two weeks after receipt of their response to the first administration of the instrument. Seventy-three percent (n=40) of these subjects returned the instrument following second administration. Total score obtained on the first test (coded SCORE1) was correlated with total score obtained on the second test administration (coded SCORE2) to yield a test-retest correlation of \( r = .61 \) based on the Pearson product correlation coefficient.

Table 21 describes test item to total score correlation for all subjects combined, for subjects with diabetes, and then for subjects without diabetes. Examination of the data reveals that all correlations with the exception of one (test item #9 - subjects with diabetes) were positive correlations. Furthermore, all correlations for all subjects combined were significant at the .05 level with correlations ranging from .14 (test item #9) to .61 (test item #18).
For subjects with diabetes correlations ranged from -.05 (test item #9) to .63 (test items #17 and #18). The correlations between test items #9, #5, and #19 failed to achieve significance at the .05 level with #19 (r = .20) just short of statistical significance. All other correlations were statistically significant, most at the .0001 level.

For subjects without diabetes, correlations ranged from .15 (test item #15) to .59 (test item #18). All correlations were positive with the size of the correlations, in general, less than those achieved on the two prior analyses. Correlations were all statistically significant at the .05 level with the exception of #15 with the majority of correlations significant at the .0001 level.

Table 21
ITEM-TO-TOTAL CORRELATIONS

<table>
<thead>
<tr>
<th>Test Item</th>
<th>All Subjects n=206</th>
<th>Subjects With Diabetes n=102</th>
<th>Subjects Without Diabetes n=103</th>
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</thead>
<tbody>
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<td>r</td>
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</tbody>
</table>

*N.S. @ p<.05
Research Objective: to establish psychometric index of the instrument's construct validity by testing the following hypotheses:

1. the foot care knowledge test will be comprised of items factored into two major content areas:

   To test this hypothesis, factor analysis was employed. With data from all subjects combined, responses to test items were coded for analysis representative of dichotomous data. As factor analysis is predicated on the correlation between test items, the correlation matrix was generated based on the phi coefficient with resultant analysis based on principal factor analysis -- an interacted factor extraction method. The analysis approach was that of confirmatory vs. exploratory in that the research hypothesis directed inquiry that would test the presence of a two factor solution. Between item correlations are presented in Table 22.
Table 22

FACTOR ANALYSIS

PARTIAL CORRELATION MATRIX

<table>
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</table>
These correlations are partial correlations representing the unique correlation between any one test item with another test item after removing the effect of any correlation with other test items. An initial measure of test item homogeneity is to examine the partial correlation matrix to note values near zero regardless of the sign of the correlation. In the matrix noted in Table 22, partial correlations ranged from .0002 (test item #15 by the test item #2) to .26 (test item #10 by test item #5).

To further support test item homogeneity and provide consistency with results obtained from the partial correlation matrix, Kaiser's overall measure of sampling adequacy = (MSA) .7950. Using the index of .5000 as the minimum criterion to reflect test item homogeneity (Guttman, 1954), the overall MSA value meets this criteria suggesting that the variables are "adequate" for factor analysis and, the variables have a high degree of correlation as a composite. Table 23 describes the MSA values by test item.
Table 23

MEASURE OF SAMPLING ADEQUACY
AND
INITIAL COMMUNALITY ESTIMATES
BY TEST ITEM
ALL SUBJECTS COMBINED

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</table>

*All values > .5000
Total MSA = .7950

Individual MSA values ranged from .5051 for test item #9 to .8723 for test item #20. These results suggest that the test items have an "adequate" degree of homogeneity conducive for factor analysis.
With MSA values determined, squared multiple correlations (SMC) were then determined to represent initial communality estimates per test item. These estimates, or SMC's, represent the proportion of variance for any one test item that is common with all other items in the correlation matrix. These data are also described in Table 23 by corresponding MSA values. The correlations ranged from .11 (test item #15) to .42 (test item #18). Test item #9 with the lowest MSA value also had the second lowest level of communality estimate.

With communality estimates placed in the diagonal of the matrix, eigenvalues were then generated. Total eigenvalue = 6.0055 with a mean = .2402. Table 24 describes eigenvalue obtained, difference, proportion of variance by variable, and cumulative variance.
Table 24

EIGENVALUES
TOTAL = 6.0055
MEANS = .2402

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<th>Eigenvalue</th>
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<th>Proportion</th>
<th>Cumulative</th>
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* Eigenvalue >1.000
** Cumulative proportion ≥75%
*** Cumulative proportion ≥100%

Using eigenvalues ≥1.00 as criterion for number of factors within the model, only one factor appears evident. Using proportion of variance as the criterion (@ ≥ 75%), the data
suggests a two factor solution. The SAS factor analysis program automatically defaults to the 100% variance criterion. As such, the data suggest a 5 factor solution model.

To test the hypothesis of a two factor solution, the data were subjected to orthogonal varimax rotation specifying a two factor model. The rotated factor pattern loadings are described in Table 25.

Table 25

FACTOR LOADINGS
AND
FINAL COMMUNALITY ESTIMATES

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* Factor 1
** Factor 2
Examination of the data would suggest that the first fourteen items load on Factor 1 with the next ten items loading on Factor 2. The last item (item #9) does not appear to load significantly on either of the two factors. Though the higher loading value is associated with Factor 2.

Using a factor loading criterion of .3, the pattern matrix reveals several items would load on both factors. For example, items #23, #18, and #21 receive factor loading indices of .3 or higher for both factors. Additionally, several items warrant attention to dual loading as their index approaches the .3 criterion level, or, loading indices were essentially similar in value.

Utilizing the highest factor loading to determine item placement within 0 factor, the first 14 items load on factor 1 and yield a final communality estimate = 2.982107. The remaining 11 items load on factor 2 and yield a final communality estimate = 1.753369. Total estimate for both factors combined = 4.735476 (4.74). Factor 1 accounts for 63% of the common variance in this two factor solution with factor 2 representing 37% of the variance in this model.

Table 26 presents data reflecting the summary of communality estimates -- initial and final.
Table 26

SUMMARY
INITIAL AND FINAL COMMUNALITY ESTIMATES

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<th>Test Item</th>
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<th>Difference</th>
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<td>15</td>
<td>0.1130</td>
<td>0.1164</td>
<td>+0.0034</td>
</tr>
<tr>
<td>16</td>
<td>0.3161</td>
<td>0.2729</td>
<td>-0.0432</td>
</tr>
<tr>
<td>17</td>
<td>0.3440</td>
<td>0.3265</td>
<td>-0.0175</td>
</tr>
<tr>
<td>18</td>
<td>0.4187</td>
<td>0.4129</td>
<td>-0.0058</td>
</tr>
<tr>
<td>19</td>
<td>0.1810</td>
<td>0.0961</td>
<td>-0.0849</td>
</tr>
<tr>
<td>20</td>
<td>0.2730</td>
<td>0.2954</td>
<td>+0.0224</td>
</tr>
<tr>
<td>21</td>
<td>0.2372</td>
<td>0.2092</td>
<td>-0.0280</td>
</tr>
<tr>
<td>22</td>
<td>0.3307</td>
<td>0.3195</td>
<td>-0.0112</td>
</tr>
<tr>
<td>23</td>
<td>0.2683</td>
<td>0.2360</td>
<td>-0.0323</td>
</tr>
<tr>
<td>24</td>
<td>0.2510</td>
<td>0.1196</td>
<td>-1.314</td>
</tr>
<tr>
<td>25</td>
<td>0.1592</td>
<td>0.0744</td>
<td>-0.0848</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6.005508</td>
<td>4.735476</td>
<td>1.270032</td>
</tr>
</tbody>
</table>

As noted in the table, all but two indices of communality estimate decreased in the final two factor solution model. Total estimate decreased from approximately 6.01 to 4.74 indicating that less variance is accounted for by the two factor model (rotated) than the initial unrotated factor pattern. The two factor model appears, then, to generally represent less variance predictability for most of the test items. For example, for test item #1, approximately 22% of the variance in this item is predictable in a linear regression considering the remaining 24 test items in the equation.
With an hypothesized two factor model, variance decreased to approximately 20%. Only for test items #15 and #20 did a two factor model increase variation prediction with improvement of <1% and 2% respectively.

Though only two items represented an increase in variance predicted by a two factor model, in general, proportion of variance lost appeared to be minimal. Decreases in proportion of variance ranged from less than 1% to a maximum of 13% (test item #24). Only three items reflected decreased levels greater than 10%; fourteen items decreased in variance by values of 5% or less.

Table 27 and 28 present foot care knowledge test items with their respective correct answers grouped by factors. A corresponding column identifies those items that represent dual loading based on the .3 criterion level, or, similar values of factor loading.
Table 27

FOOT CARE TEST ITEMS
GROUPED BY FACTOR LOADINGS

FACTOR 1

<table>
<thead>
<tr>
<th>FACTOR 1 - TEST ITEMS</th>
<th>DUAL LOADING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Routine foot care includes: washing feet with mild, soapy water.</td>
<td>*</td>
</tr>
<tr>
<td>22. If you cut your foot: wash and clean the cut as soon as possible.</td>
<td>*</td>
</tr>
<tr>
<td>20. If you have a blister on your foot: gently wash the blister and bandage it.</td>
<td>*</td>
</tr>
<tr>
<td>10. Avoid using lotion on feet that contain alcohol.</td>
<td>*</td>
</tr>
<tr>
<td>16. To take good care of toenails: file them smooth along curve of the toe.</td>
<td>*</td>
</tr>
<tr>
<td>4. To care for your feet: wash and pat feet dry with towel.</td>
<td>*</td>
</tr>
<tr>
<td>1. To care for your feet you should: look at feet daily for redness and sores.</td>
<td>*</td>
</tr>
<tr>
<td>11. A better type of shoe to wear is one made of: leather – to let feet &quot;breathe&quot;.</td>
<td>*</td>
</tr>
<tr>
<td>23. To treat dry, cracked foot skin: use lotion to moisturize the skin.</td>
<td>*</td>
</tr>
<tr>
<td>3. Apply lotion to each of the following areas of the foot except: between the toes.</td>
<td>*</td>
</tr>
<tr>
<td>13. A sign of foot infection may be skin that is: red and warm.</td>
<td>*</td>
</tr>
<tr>
<td>8. To better care for feet: avoid going barefoot any time.</td>
<td>*</td>
</tr>
<tr>
<td>5. Use lotion on feet to keep skin: smooth and moist.</td>
<td>*</td>
</tr>
<tr>
<td>2. The most important part of caring for feet is: look at your feet everyday.</td>
<td>*</td>
</tr>
</tbody>
</table>
Table 28

FOOT CARE TEST ITEMS
GROUPED BY FACTOR LOADINGS

<table>
<thead>
<tr>
<th>FACTOR 2 - TEST ITEMS</th>
<th>DUAL LOADING</th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Proper care of toenails includes all of the following except: cut nails shorter</td>
<td>*</td>
</tr>
<tr>
<td>than end of toes.</td>
<td></td>
</tr>
<tr>
<td>17. When trimming toenails do each of the following except: remove ingrown toenails.</td>
<td>*</td>
</tr>
<tr>
<td>12. It is best to buy new shoes: late in the afternoon when feet tend to swell.</td>
<td></td>
</tr>
<tr>
<td>14. To help keep feet warm at night, use which of the following: wool socks.</td>
<td></td>
</tr>
<tr>
<td>21. To care for a foot callous: use a pumice stone to remove the skin.</td>
<td>*</td>
</tr>
<tr>
<td>15. Which of the following are signs of poor blood flow?: cool, pale, swollen feet.</td>
<td></td>
</tr>
<tr>
<td>7. If it is hard for you to see your feet: have family/friends check them for you</td>
<td></td>
</tr>
<tr>
<td>regularly.</td>
<td></td>
</tr>
<tr>
<td>19. To care for toenails: sock hard thick nails to make them easier to trim.</td>
<td></td>
</tr>
<tr>
<td>24. If you notice a corn on a toe: see your medical or foot doctor for treatment.</td>
<td>*</td>
</tr>
<tr>
<td>25. Which of the following is less likely to cause a skin problem?: cotton placed</td>
<td></td>
</tr>
<tr>
<td>between the toes.</td>
<td></td>
</tr>
</tbody>
</table>

As noted six foot care test items appear to load on either factor 1 or factor 2. Examination of the items that comprise each respective factor presents a challenge in interpretation for the
purpose of factor labeling. For example, 3 items on factor 2 deal with care of toenails, and, as such, are grouped together. However, item #16 on factor 1 is a nail care related item yet it distinctly loads on factor 1 versus factor 2 (see Table 25). Though the hypothesis of a two factor model was tested, it would not appear that the items on the foot care knowledge test represent two distinct content categories. Considering the scree plot of eigenvalues and, the >1.000 eigenvalue criterion for determination of the number of factors, these indices suggest a one factor model. As such, the test items would appear to intercorrelate and represent one domain of homogenous content.

Research Objective: to establish psychometric index of the instrument's construct validity by testing the following hypothesis:

2. elderly people with diabetes will score significantly higher on the foot care knowledge test than elderly people without diabetes:

To test this hypothesis, the t-test procedure (one-tailed) with independent samples was used based on the assumption that variances in scores were equal across sample groups. The hypothesis of equal variances failed to be rejected based on $F = 1.30$, degrees of freedom of 102,101 and probability of .1852. Using the pooled variance estimate, foot care test scores of subjects with diabetes were found to be significantly higher than test scores of subjects without diabetes. Table 29 describes the outcome of this analysis.
Table 29

SUMMARY DATA

FOOT CARE KNOWLEDGE TEST SCORES FOR ELDERLY SUBJECTS WITH DIABETES AND ELDERLY SUBJECTS WITHOUT DIABETES

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Mean of Scores</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 With Diabetes</td>
<td>102</td>
<td>17.11</td>
<td>5.00</td>
<td>23.00</td>
<td>4.29</td>
<td>3.8635</td>
<td>.0001*</td>
</tr>
<tr>
<td>2 Without Diabetes</td>
<td>103</td>
<td>14.66</td>
<td>5.00</td>
<td>23.00</td>
<td>4.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Research Objective: to establish psychometric index of the instrument's construct validity by testing the following hypothesis:

3. elderly people with diabetes who attended diabetes education classes will score significantly higher on the foot care knowledge test than subjects with diabetes who reported no diabetes class attendance:

Seventy-two subjects with diabetes reported diabetes class attendance with 27 having reported no such attendance (missing=3). As the assumption of equal variances was rejected (F=1.86, DF=26, 71, p<.0423), the one tailed t-test using the separate variance estimate was employed to test difference in mean foot care test scores between these two subgroups. Subjects who reported diabetes class attendance were found to score significantly higher on the foot care knowledge test than subjects who did not attend diabetes education classes. Table 30 describes the summary of analyses.
Table 30

SUMMARY DATA
FOOT CARE KNOWLEDGE TEST SCORES FOR SUBJECTS ATTENDING DIABETES
EDUCATION CLASSES VERSUS SUBJECTS WITH NO DIABETES CLASS ATTENDANCE

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean of Scores</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Diabetes Classes</td>
<td>72</td>
<td>17.83</td>
<td>7.00</td>
<td>23.00</td>
<td>3.73</td>
<td>2.5008</td>
<td>.0169*</td>
</tr>
<tr>
<td>2 No Diabetes Classes</td>
<td>27</td>
<td>15.15</td>
<td>5.00</td>
<td>23.00</td>
<td>5.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Subjects with diabetes who reported diabetes education class attendance were further asked to indicate if information received in class included information about foot care. Of the 72 subjects reporting class attendance, 61 reported receiving foot care information in class while 11 stated classes did not include foot care knowledge. Analysis using the one tailed t-test for independent groups revealed the variance between these two subgroups was unequal (F=2.76, DF=10,60, p<.0143). With the separate variance estimate as index of measure, there was no significant difference in mean of test scores between diabetic subjects who received foot care knowledge in diabetes class versus those subjects who attended diabetes classes in which no foot care information was provided. Table 31 describes the outcome of this analysis.
Table 31

FOOT CARE KNOWLEDGE TEST SCORES FOR SUBJECTS ATTENDING DIABETES CLASSES WITH FOOT CARE INFORMATION VERSUS SUBJECTS ATTENDING DIABETES CLASSES WITHOUT FOOT CARE INFORMATION

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean of Scores</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Classes with Foot Care Information</td>
<td>61</td>
<td>18.25</td>
<td>9.00</td>
<td>23.00</td>
<td>3.24</td>
<td>1.6094</td>
<td>.0675*</td>
</tr>
<tr>
<td>2 Classes with No Foot Care Information</td>
<td>11</td>
<td>15.55</td>
<td>7.00</td>
<td>23.00</td>
<td>5.39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*N.S. p < .05

Research Objective: to establish psychometric index of the instrument's construct validity by testing the following hypothesis:

4. elderly subjects with diabetes from the OSU Diabetes Clinic Foot Care program will score significantly higher on foot care knowledge test than elderly subjects with diabetes who were not program participants:

To further explore the construct validity of the foot care knowledge test, subjects participating in the OSU Foot Care Program were hypothesized to score significantly higher on the knowledge test than all other subjects with diabetes. This hypothesis was based on the premise that the OSU Foot Care Program involved a concentrated foot care education program, and, as such, subjects would be likely to have acquired foot care knowledge as opposed to other subjects with diabetes not exposed to such information. Fifty-five subjects
were OSU program participants; 47 subjects with diabetes were not. Results of t-test analysis are described in Table 32.

Table 32

SUMMARY DATA
FOOT CARE KNOWLEDGE SCORES FOR OSU FOOT CARE SUBJECTS VERSUS ALL OTHER SUBJECTS WITH DIABETES

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean of Scores</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55</td>
<td>18.75</td>
<td>11.00</td>
<td>23.00</td>
<td>2.97</td>
<td>4.585</td>
<td>.001</td>
</tr>
<tr>
<td>OSU Foot Care Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>47</td>
<td>15.21</td>
<td>5.00</td>
<td>23.00</td>
<td>4.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non OSU Foot Care Subjects with Diabetes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

This analysis was based on separate variance estimate as the one tailed t-test with independent samples revealed variances were unequal (F=2.43, DF=46, 54, p<.0019). OSU foot care program participants did score significantly higher on the foot care knowledge test than all other subjects with diabetes.

To further explore construct validity using OSU foot care program participants as a known group one tailed t-test was again employed to test the hypothesis that OSU foot care subjects would score significantly higher on the foot care knowledge test than subjects without diabetes. Separate variance estimate (F=2.63, DF=102,54, p<.0001) revealed that OSU foot care subjects
did score significantly higher on the foot care knowledge test than subjects without diabetes. These results are exemplified in Table 33.

Table 33

SUMMARY DATA
FOOT CARE KNOWLEDGE SCORES FOR OSU FOOT CARE SUBJECTS VERSUS SUBJECTS WITHOUT DIABETES

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean of Scores</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 OSU Foot Care Subjects</td>
<td>55</td>
<td>18.75</td>
<td>11.00</td>
<td>23.00</td>
<td>2.97</td>
<td>6.6243</td>
<td>.0001*</td>
</tr>
<tr>
<td>2 Subjects Without Diabetes</td>
<td>103</td>
<td>14.66</td>
<td>3.00</td>
<td>23.00</td>
<td>4.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Further analysis with OSU foot care subjects as a known group involved testing the hypothesis that their knowledge test scores would be significantly higher than all other subjects, with and without diabetes, combined. Table 34 exemplifies results of the one tailed t-test analysis (separate variance, F=2.45, DF=149,54, p<.0002) indicating failure to reject this hypothesis. OSU foot care subjects scored significantly higher on the knowledge test than all other subjects combined.
Table 34

SUMMARY DATA
FOOT CARE KNOWLEDGE SCORES FOR OSU FOOT CARE SUBJECTS
VERSUS ALL OTHER SUBJECTS COMBINED

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean of Scores</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSU Foot Care Subjects</td>
<td>55</td>
<td>18.75</td>
<td>11.00</td>
<td>23.00</td>
<td>2.97</td>
<td>7.2091</td>
<td>.0001*</td>
</tr>
<tr>
<td>All Other Subjects</td>
<td>150</td>
<td>14.78</td>
<td>3.00</td>
<td>23.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Research Objective: to evaluate the difficulty level of each item on the foot care knowledge test:

Item difficulty reflects the percentage of respondents who answered an item correctly. To obtain difficulty level per item, the number of respondents who answered the item correctly is divided by the total number of respondents who tried to answer the item. All subjects (n=205) were considered to have "tried to answer" each item. As such, for any item in which a subject either provided no answer, or, provided more than one answer, the item was coded to reflect an incorrect answer. Table 35 presents results of item difficulty analysis with percent values rounded to the nearest whole number.
Table 35

FOOT CARE KNOWLEDGE TEST ITEM DIFFICULTY
ALL SUBJECTS COMBINED
n=205

<table>
<thead>
<tr>
<th>Foot Care Test Item</th>
<th>Number Respondents Who Answered Test Item Correctly</th>
<th>Item Difficulty %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>182</td>
<td>89***</td>
</tr>
<tr>
<td>2</td>
<td>114</td>
<td>56**</td>
</tr>
<tr>
<td>3</td>
<td>143</td>
<td>70**</td>
</tr>
<tr>
<td>4</td>
<td>147</td>
<td>72***</td>
</tr>
<tr>
<td>5</td>
<td>123</td>
<td>60**</td>
</tr>
<tr>
<td>6</td>
<td>172</td>
<td>84***</td>
</tr>
<tr>
<td>7</td>
<td>122</td>
<td>60**</td>
</tr>
<tr>
<td>8</td>
<td>126</td>
<td>62**</td>
</tr>
<tr>
<td>9</td>
<td>46</td>
<td>22*</td>
</tr>
<tr>
<td>10</td>
<td>122</td>
<td>60**</td>
</tr>
<tr>
<td>11</td>
<td>188</td>
<td>92***</td>
</tr>
<tr>
<td>12</td>
<td>76</td>
<td>38*</td>
</tr>
<tr>
<td>13</td>
<td>115</td>
<td>57**</td>
</tr>
<tr>
<td>14</td>
<td>157</td>
<td>77***</td>
</tr>
<tr>
<td>15</td>
<td>115</td>
<td>57**</td>
</tr>
<tr>
<td>16</td>
<td>123</td>
<td>60**</td>
</tr>
<tr>
<td>17</td>
<td>112</td>
<td>55**</td>
</tr>
<tr>
<td>18</td>
<td>127</td>
<td>62**</td>
</tr>
<tr>
<td>19</td>
<td>120</td>
<td>59**</td>
</tr>
<tr>
<td>20</td>
<td>155</td>
<td>77***</td>
</tr>
<tr>
<td>21</td>
<td>102</td>
<td>50**</td>
</tr>
<tr>
<td>22</td>
<td>135</td>
<td>66**</td>
</tr>
<tr>
<td>23</td>
<td>155</td>
<td>77***</td>
</tr>
<tr>
<td>24</td>
<td>149</td>
<td>73***</td>
</tr>
<tr>
<td>25</td>
<td>121</td>
<td>59**</td>
</tr>
</tbody>
</table>

* test item <40% difficulty
** test item between 40-70% difficulty
*** test item >70% difficulty

Results of the analysis revealed that items ranged in level of difficulty from 22% (test item #9) to 92% (test item #11). For all test items combined, level of difficulty averaged 64%. Fifteen items fell within the 40% to 70% range of difficulty with eight items above this range and two items below it. Of the eight items above the range, two were within five percentage points above 70%;
three were within ten points; one item was within fifteen points; one item within twenty points; and, the remaining item was twenty-two points above 70% value.

Of the two items below 40% level of difficulty, one item was two percentage points below this level with the remaining item eighteen points below the value.

Examination of the data revealed that all 205 subjects provided one answer to only one of the test questions--item #8. For all other test items, either data was "missing" in which no answer to the item was given, or, more than one answer was given. The lowest number of respondents to a test item = 193 (items #16 and #21) reflecting the fact that 94% of the subjects provided one answer to each test item as instructed. On average, 97% of subjects provided one answer per test item.

**Research Objective:** to evaluate the discriminating power of each item on the foot care knowledge test:

Discriminatory power of an item is its ability to distinguish high test scorers from low test scorers. By numerical code, subjects were listed in descending order from maximum score achieved on the test to lowest score obtained. With a total n = 205, subjects were divided into three groups: top 1/3 scorers, middle 1/3 scorers, and lower 1/3 scorers. With n reflective of an odd number, division by three groups did not yield groups of equal size. The top 1/3 group n = 69, middle 1/3 n = 68, and low 1/3 n = 68. Data also reflected whether subjects did or did not have diabetes, and, their respective data collection site. Using only top 1/3 and low 1/3 data, Table 36 describes the outcomes achieved regarding the discriminating power of each foot care knowledge test item. Results were obtained by dividing n of top 1/3 who got the item right by n of top 1/3 plus n of low 1/3 who got the item right.
Table 36

DISCRIMINATING POWER OF FOOT CARE KNOWLEDGE TEST ITEMS

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Top 1/3 Correct n (%)</th>
<th>Low 1/3 Correct n (%)</th>
<th>Total Correct n (%)</th>
<th>Discriminating Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>69 (100)</td>
<td>50 (74)</td>
<td>119 (87)</td>
<td>.58</td>
</tr>
<tr>
<td>2</td>
<td>44 (64)</td>
<td>27 (40)</td>
<td>71 (52)</td>
<td>.62</td>
</tr>
<tr>
<td>3</td>
<td>61 (88)</td>
<td>32 (47)</td>
<td>93 (68)</td>
<td>.66</td>
</tr>
<tr>
<td>4</td>
<td>62 (90)</td>
<td>32 (47)</td>
<td>94 (67)</td>
<td>.66</td>
</tr>
<tr>
<td>5</td>
<td>49 (71)</td>
<td>37 (54)</td>
<td>86 (63)</td>
<td>.57</td>
</tr>
<tr>
<td>6</td>
<td>67 (97)</td>
<td>42 (62)</td>
<td>109 (80)</td>
<td>.62</td>
</tr>
<tr>
<td>7</td>
<td>58 (84)</td>
<td>23 (39)</td>
<td>81 (59)</td>
<td>.72</td>
</tr>
<tr>
<td>8</td>
<td>54 (78)</td>
<td>29 (43)</td>
<td>83 (61)</td>
<td>.65</td>
</tr>
<tr>
<td>9</td>
<td>22 (32)</td>
<td>11 (16)</td>
<td>33 (24)</td>
<td>.67</td>
</tr>
<tr>
<td>10</td>
<td>59 (86)</td>
<td>20 (29)</td>
<td>79 (58)</td>
<td>.75</td>
</tr>
<tr>
<td>11</td>
<td>68 (99)</td>
<td>52 (76)</td>
<td>120 (88)</td>
<td>.57</td>
</tr>
<tr>
<td>12</td>
<td>38 (55)</td>
<td>13 (19)</td>
<td>51 (37)</td>
<td>.75</td>
</tr>
<tr>
<td>13</td>
<td>51 (74)</td>
<td>20 (29)</td>
<td>71 (52)</td>
<td>.72</td>
</tr>
<tr>
<td>14</td>
<td>63 (91)</td>
<td>40 (59)</td>
<td>103 (75)</td>
<td>.61</td>
</tr>
<tr>
<td>15</td>
<td>48 (70)</td>
<td>27 (40)</td>
<td>75 (55)</td>
<td>.64</td>
</tr>
<tr>
<td>16</td>
<td>58 (84)</td>
<td>21 (31)</td>
<td>79 (58)</td>
<td>.73</td>
</tr>
<tr>
<td>17</td>
<td>61 (88)</td>
<td>13 (19)</td>
<td>74 (54)</td>
<td>.82</td>
</tr>
<tr>
<td>18</td>
<td>63 (91)</td>
<td>16 (24)</td>
<td>79 (58)</td>
<td>.80</td>
</tr>
<tr>
<td>19</td>
<td>53 (77)</td>
<td>27 (40)</td>
<td>80 (58)</td>
<td>.66</td>
</tr>
<tr>
<td>20</td>
<td>63 (91)</td>
<td>35 (52)</td>
<td>98 (72)</td>
<td>.64</td>
</tr>
<tr>
<td>21</td>
<td>57 (83)</td>
<td>16 (24)</td>
<td>73 (53)</td>
<td>.78</td>
</tr>
<tr>
<td>22</td>
<td>63 (91)</td>
<td>25 (37)</td>
<td>88 (64)</td>
<td>.72</td>
</tr>
<tr>
<td>23</td>
<td>65 (94)</td>
<td>36 (53)</td>
<td>101 (74)</td>
<td>.64</td>
</tr>
<tr>
<td>24</td>
<td>61 (88)</td>
<td>33 (49)</td>
<td>94 (69)</td>
<td>.65</td>
</tr>
<tr>
<td>25</td>
<td>56 (81)</td>
<td>30 (44)</td>
<td>86 (63)</td>
<td>.65</td>
</tr>
</tbody>
</table>

Discriminating power of test items ranged from .57 (items #5 and #11) to .82 (item #17). All power indices were positive values indicating that for each test item, the greater percent of high test scorers responded correctly than did low test scorers.

Total foot care knowledge test scores represented in the top 1/3 group ranged from 23 to 18. Within this group, nine subjects obtained a score of 23; eight scored 22; fourteen scored 21;
eighteen scored 20; sixteen scored 19; and, 4 scored 18 on the test. Sixty-five percent (n=45) of the top 1/3 were subjects with diabetes, 35% (n=24) did not have diabetes.

Of those subjects with diabetes, 45% (n=31) were respondents derived from the OSU Diabetes Clinic Foot Care Program who also tended to score highest within this group of top scorers. Twenty-eight percent (n=19) of the group were subjects derived from OSU General Medicine Clinic of which 15 were subjects without diabetes. Twenty-five percent (n=17) of the top 1/3 group were derived from Life Care Alliance Home Care Agency of which 9 did not have diabetes and 8 did report history of the disease. Only one subject within the top 1/3 was derived from the Dayton Area Diabetes Association and Dayton Senior Citizen Center respectively.

The greatest percent of top 1/3 scorers responded incorrectly to item #9--only 32% (n=22) of 69 subjects responded correctly, 68% responded incorrectly. For no other test item were there more subjects responding incorrectly than correctly. The greatest percent of subjects responded correctly to item #1--in fact, all 69 subjects in the top 1/3 group answered this test item correctly. For only item #9 did less than 50% of the subjects respond to any one respective test item incorrectly.

In the lower 1/3 group, 60% (n=41) of the subjects did not have diabetes, 40% (n=27) did have diabetes. Total foot care knowledge test scores represented in the lower 1/3 group ranged from 15 to 3. Four subjects scored 15; eleven scored 14; six scored 13; ten scored 12; nine scored 11; three scored 10 and 9 respectively; four scored 8; nine scored 7; three scored 6 and 5 respectively; two scored 4; and, one subject scored 3 on the test.

The largest percent of low 1/3 respondents were derived from Life Care Alliance (n=32) of which 20 (63%) were subjects without diabetes. Twenty-two subjects were derived from OSU General Medicine Clinic; 73% of these subjects did not have diabetes, 27% did. Eight subjects were derived from the Dayton Senior Citizen Center of which five reported no diabetes, three subjects indicated a history of the disease. Five subjects were respondents from the OSU Foot
Care Program—all of which had diabetes. The remaining subject in the low 1/3 group was derived from the Dayton Area Diabetes Association.

As opposed to the top 1/3 group in which at least one item received 100% correct response rate, no item received such level in the low 1/3 group. The highest percent correct response was obtained for item #11 in which 76% (n=52) of the group answered this item correctly. Like the top 1/3 group, item #9 had the lowest correct response rate (16% of subjects answered the item correctly). For 18 of the 25 foot care knowledge test items, no more than 50% of the low 1/3 group answered the items correctly.

Discriminating power of an item is closely related to its index of difficulty. The easier an item (i.e., higher percent value difficulty), the less able an item may be in discriminating top 1/3 test scorers from low 1/3 test scorers. Table 37 presents results of both item difficulty and discriminating power analyses by item. Examination of the data reveals that items #11 and #1 received the highest percent value of difficulty indicating that the items were the "easiest" to answer across both top and low 1/3 groups. The level of difficulty for these items (92% and 89% respectively) were associated with discriminating powers of .57 and, 58.
Table 37

FOOT CARE KNOWLEDGE TEST
ITEM DIFFICULTY AND DISCRIMINATING POWER OF THE ITEM

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Item Difficulty</th>
<th>Discriminating Power of the Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>89%</td>
<td>.58</td>
</tr>
<tr>
<td>2</td>
<td>56%</td>
<td>.62</td>
</tr>
<tr>
<td>3</td>
<td>70%</td>
<td>.66</td>
</tr>
<tr>
<td>4</td>
<td>72%</td>
<td>.66</td>
</tr>
<tr>
<td>5</td>
<td>60%</td>
<td>.57</td>
</tr>
<tr>
<td>6</td>
<td>64%</td>
<td>.62</td>
</tr>
<tr>
<td>7</td>
<td>60%</td>
<td>.72</td>
</tr>
<tr>
<td>8</td>
<td>62%</td>
<td>.65</td>
</tr>
<tr>
<td>9</td>
<td>22%</td>
<td>.67</td>
</tr>
<tr>
<td>10</td>
<td>60%</td>
<td>.75</td>
</tr>
<tr>
<td>11</td>
<td>92%</td>
<td>.57</td>
</tr>
<tr>
<td>12</td>
<td>38%</td>
<td>.75</td>
</tr>
<tr>
<td>13</td>
<td>57%</td>
<td>.72</td>
</tr>
<tr>
<td>14</td>
<td>77%</td>
<td>.61</td>
</tr>
<tr>
<td>15</td>
<td>57%</td>
<td>.64</td>
</tr>
<tr>
<td>16</td>
<td>60%</td>
<td>.73</td>
</tr>
<tr>
<td>17</td>
<td>55%</td>
<td>.82</td>
</tr>
<tr>
<td>18</td>
<td>62%</td>
<td>.80</td>
</tr>
<tr>
<td>19</td>
<td>59%</td>
<td>.66</td>
</tr>
<tr>
<td>20</td>
<td>77%</td>
<td>.64</td>
</tr>
<tr>
<td>21</td>
<td>50%</td>
<td>.78</td>
</tr>
<tr>
<td>22</td>
<td>66%</td>
<td>.72</td>
</tr>
<tr>
<td>23</td>
<td>77%</td>
<td>.64</td>
</tr>
<tr>
<td>24</td>
<td>73%</td>
<td>.65</td>
</tr>
<tr>
<td>25</td>
<td>59%</td>
<td>.65</td>
</tr>
</tbody>
</table>

Research Objective: to evaluate the effectiveness of distracters per item on the foot care knowledge test:

Using the top 1/3 and low 1/3 test score respondents, each test item was examined for distracter effectiveness. An effective distracter is an incorrect response choice that a greater number of low 1/3 test scorers select versus top 1/3 respondents. For each test item, data was compiled for analysis in the manner exemplified in Table 38.
Table 38

EXAMPLE
EFFECTIVENESS OF DISTRACTERS

Test item 1. To care for your feet you should:

*Denotes correct response

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Missing: 0</th>
<th>69</th>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 1/3</td>
<td>69</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>69</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Low 1/3</td>
<td>50</td>
<td>2</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>50</td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

The frequency of responses were noted for each of the possible four choices available for selection per item. Some respondents did not provide answer(s) to each test item, or, provided more than one answer to a test question. In the former situation, the test item was coded "missing"; in the latter, the test item was coded "incorrect." Items coded in either fashion were included in the total reflective of incorrect responses per item.

For no test item did the low 1/3 scorers select the correct response in number greater than top 1/3 scorers. For test item #5, a slightly greater number of top 1/3 scorers selected distracter "C" versus low 1/3 scorers (14 vs. 12) though the largest percent of correct responses were derived from subjects in the top 1/3 group. For item #23, one respondent in each of the score groups selected distracter "D" with the greater percent of low 1/3 scorers selecting distracters "A" and "B" as opposed to respondents in the top 1/3 group.
INTERPRETATION AND DISCUSSION OF RESULTS

This section discusses the results of the study with primary focus on validity and reliability of the foot care knowledge test.

Validity - Content

Twenty-five multiple choice items comprised an instrument constructed to measure foot care knowledge in elderly people with diabetes. In accordance with scaling models as proffered by Nunnally (1978), the knowledge test was designed as a means of scaling people by categorizing subjects into two groups--those who have foot care knowledge versus those who do not.

The ability of an instrument to scale people as such is contingent upon two elements--validity and reliability. These two elements represent important attributes of instrumentation as defined within the scope of psychometric theory.

In this study, validity (i.e., the ability of an instrument to measure what it is purported to measure) was addressed within the confines of essentially three types: 1.) content; 2.) face; and, 3.) construct. Content validity was primarily ascertained by survey of diabetes nurse educators regarding their perception of foot care knowledge and behavior considered important for elderly people with diabetes to possess and enact, respectively, with regard to care of the feet. Endeavors to capture the foot care content domain as perceived by diabetes educators relied upon mail survey methodology. This approach has both advantages and disadvantages. One advantage is that mail survey allows one to potentially access a large number of subjects without expenditure of resources such as would be required by direct interview. In this study, 90 diabetes nurse educators were conveniently sampled, with a response rate to the survey of 71% (n = 64.
Seventeen of the returned questionnaires were not eligible for use resulting in data available from 52% (n=47) of the subjects available. A 71% response rate is acceptable in terms of response rates cited by Dillman (1978) in explication of this "Total Design Method" as it relates to mail survey methodology. Dillman (1978) does state, however, that response rates tend to decrease as variations of the total design method are employed (pg. 21). In attempt to survey content domain, this study employed attributes of Dillman's methodology (e.g., personalized cover letter, return stamped envelopes, reminder cards) but did not extend into full methodology as described by him. This may account for the fact that only 3 of 15 subjects from the Southeast region (region 2) of the country responded. This limited number may have influenced the scope and/or nature of content sampled as input from this region was not equally represented in the data. Of the 346 foot care behaviors generated, 22 were derived from region 2 whereas the other 5 regions accounted for responses ranging from 57-79. In addition, no specific endeavors were undertaken to select other names of diabetes educators from this region in lieu of such low return rate. As such, the content domain sampled is limited in what was defined as the Southeast region of the United States.

Efforts at enhancing, or optimizing, representation of the content domain, however, was achieved by geographic stratified sampling of diabetes educators. This effort was largely achieved in that, at least, all regions of the country were represented in the final content analysis of the data. Of the 346 foot care behaviors generated, 245 were ultimately categorized into respective foot care content areas with only one category (category 2 - Footwear: Socks, Stockings, Hosiery) from region 2 being the only category in which no foot care behavior response was represented. Total behavior responses categorized by region ranged from a minimum of 63% (region 6 - Northwest) to a maximum of 78% (region 3 - North Central). As such, foot care content data reflected geographic representation of the United States.

Efforts to complement data derived from educators was exemplified in survey of a convenience sample of elderly people with diabetes, literature review, and survey of conveniently
sampled diabetes education program coordinators. These sources were not included for the purposes of test item construction. Information derived from these sources, however, was used to qualitatively support information obtained from diabetes educators.

Data obtained from elderly subjects, however, were subjected to card-sorting methodology and analysis by D-L Test of Agreement though, again, the outcome of this analysis was not considered for use in test item construction. It is of interest to note that both diabetes educators and elderly subjects ranked category 4 (Foot/Nail Care) as the most important area related to care of the feet. Table 39 describes the categorical rankings obtained by sample groups.

Table 39

FOOT CARE CONTENT CATEGORIES - MEAN RANK VALUE
BY SAMPLE GROUP

<table>
<thead>
<tr>
<th>Category</th>
<th>Diabetes Nurse Educators</th>
<th>Elderly People With Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># Responses</td>
<td>Sum</td>
</tr>
<tr>
<td>1</td>
<td>28</td>
<td>138</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>46</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>87</td>
</tr>
<tr>
<td>4</td>
<td>158</td>
<td>523</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>211</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank Order</th>
<th>Rank Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 4</td>
<td>Category 4</td>
</tr>
<tr>
<td>Category 1</td>
<td>Category 2</td>
</tr>
<tr>
<td>Category 2</td>
<td>Category 5</td>
</tr>
<tr>
<td>Category 3</td>
<td>Category 1</td>
</tr>
<tr>
<td>Category 5</td>
<td>Category 3</td>
</tr>
<tr>
<td>Category 6</td>
<td>Category 6</td>
</tr>
</tbody>
</table>

Beyond the first ranked content area, categorical rankings differed by sample group. Of interest is that diabetes educators ranked category 5 (General Health Measures) last among five
content areas whereas elderly subjects ranked this category as the third most important area of foot care behaviors. In addition, as the two top ranking categories as determined by diabetes educators were used for test item construction, category 1 was ranked second most important by this group whereas elderly people ranked this area as fourth most important. Elderly people ranked category 2 as the second most important area related to foot care behavior.

Though of qualitative interest, this outcome derived from elderly people was based on a sample size of twenty-three subjects which, furthermore, was derived from a convenience sample of accessible subjects all located within one state in the Midwest portion of the country. A larger and appropriate sample size reflecting similar distribution across the country as that of diabetes educators may yield different outcomes. The difference in rankings, however, may suggest that further inquiry into differences in perception between diabetes health care providers and patients in this area of self-care education, or any other area of teaching/learning, may exist and, possibly account for some degree of explanatory power within the realm of patient nonadherence to prescribed therapeutic regimens.

Acknowledgment of this conclusion is predicated on the assumption that the foot care content categories defined for this study are, in fact, reflective of the domain by which to appropriately, thoroughly, and succinctly define foot care knowledge. The categories, along with their respective definitions, were developed by this investigator with input from other diabetes educators for validation purposes. It is these categories by which foot care knowledge was defined, and, subsequently used for further statistical analysis. The categories, as defined, warrant attention.

Attention is directly to the fact that the D-L Test of Agreement served as the primary means of establishing content validity. Results of this analysis for diabetes nurse educator data yielded indices of agreement ranging from 74% (category 4) to approximately 99% (category 2). Deridian and Lewis (1986) proffer their formula for inter-rater agreement based on a level of at least 80% agreement. For the purposes of this study, the minimum level deemed acceptable for
content validity purposes was established at 70% due to the exploratory nature of the study, and, for as much as this study represented an original attempt to scale foot care knowledge for diabetes patient use. All results obtained for diabetes nurse educators met the minimum criteria of 70%, however, the range of level of agreement appear wide. Of particular interest is that the content category receiving the highest ranking of importance (category 4) received the lowest level of agreement. As much as category 4 received the highest number of “agreements,” it also received the highest number of “disagreements” as well. However, of the “agreements” for placement of a foot care behavior response in category 4, these responses reflected high ranking of importance as perceived by respondents. As perceived by this sample of diabetes educators, Foot/Nail Care is the most important aspect of foot care behavior. The lower level of agreement may be reflective of several factors: 1.) the foot care content category definition may not have been specific enough for comparable interpretation by the panel of diabetes experts conducting the card sorting process; 2.) the foot care behavior responses may not have been clearly stated to adequately provide the panel of experts sufficient information for better categorical assignment; 3.) the categorical definition may have been too broad in scope in that it embodied both care of the skin and care of the nails; and, 4.) based upon the makeup of the panel of experts, agreements outcomes may vary in that members of one discipline may perceive/interpret responses difficulty from other disciplines.

Further inquiry would warrant attention to each of these factors with primary consideration given to the third possibility stated above. Qualitative review of the foot care behavior responses obtained revealed that subjects provided, at times within the confines of one statement, data reflective of both skin and nail care. It is conceivable that such statements would pose a problem for any one, or all three, diabetes experts in that "preventive" skin/nail care measures were considered under the auspices of category 5 - General Health Measures which embodied foot care activities “designed to promote or optimize health status as a direct or indirect measure to avert problems associated with the feet.” As such, a separate content category for nail care alone
and one for skin care alone would warrant consideration as opposed to a category such as "General Health Measures." The intent of providing a category such as category 5 was to capture activities such as self-monitoring of blood glucose which could, conceivably, be considered a measure indirectly supportive of foot care. Instead of category 5 as defined for the purposes of this study, this investigator would recommend that category 4 be demarcated specifically for skin care, category 5 be demarcated specifically for nail care, with any other type of response not deemed appropriate for placement in this categorical structure be placed in one category simply marked "Other."

Nonetheless, this study employed the use of five content categories as defined with attainment of agreement regarding foot care content within the specified 70% level of agreement across all categories. As such, the research objective of establishing content validity was met. The resultant data yielded a large pool of information, which, even within the confines of "foot care," revealed distinct, separate bodies of information which support test item construction. The establishments of content validity is critical in the development of instruments designed within the realm of cognition (Walz, Strickland, & Lenz, 1991). Such instruments require composition of items reflective of the content domain in which this type of validity is largely reflective of test construction developmental efforts. Sampling the content domain can result in a large amount of data and/or test items from which a subset of data/items can be used to represent the content area. Such is what occurred in this study with the voluminous data set generated from Phase I of the study. It was the volume of data available that led to the decision to focus test item construction using data from the two highest ranking categories in terms of importance as perceived by diabetes nurse educators.

Validity - Face

The objective of establishing face validity of the instrument was addressed via review of the knowledge test by both diabetes experts and elderly people with diabetes. Nunnally (1978)
briefly attends to this form of validity, and, confines it within the scope of content validity. He simply states that the instrument constructed should appear to measure what it is purposed to measure. Burns & Grove (1967) support face validity also within the scope of content validity stating the "expert" validity involves evaluation of an instrument by experts in the field of inquiry. As such, effort toward establishment of face validity was met as diabetes experts were included in review of the final version of the constructed knowledge test. Waltz, Strickland, & Lenz (1991) define face validity more within the scope of how an instrument appears to the lay person who is the target of measurement. As an instrument appears to measure what it is purposed to measure, the lay person is more apt to respond to the instrument which may have some effect on response rate. In this study, face validity, as judged by elderly subjects with diabetes, may have enhanced response rate as they suggested highlighting (by yellow marker) instructions that directed respondents to test items on both front and back of the pages. In conclusion, the research objective of establishing face validity of the foot care knowledge test was met.

Validity - Construct

The third type of validity addressed in this study was that of construct validity. Nunnally (1976) describes three aspects to this form of validity one of which is to specify the content domain. This aspect, as noted from the previous discussion, was addressed. The remaining aspects involve 1.) how well, and to what degree, instrument items correlate to represent the construct of interest; and, 2.) the correspondence of an instrument with other constructs in which one would expect to see a relationship. In the former, factor analysis represents a means of establishing construct validity; in the latter, known groups (i.e., criterion groups) technique exemplifies an endeavor to address this aspect of validity. Both these processes were employed in this study which were proffered within the scope of directional hypotheses regarding expected outcomes. A discussion of factor analysis will be followed by discussion related to known groups analyses.
Factor Analysis

Principal factor analysis was employed to test the hypothesis that the foot care knowledge test was comprised of two factors representing the two top ranking foot care content categories as derived from the D-L Test of Agreement. The analysis was confirmatory in nature versus exploratory. However, results of the two factor model did not strongly suggest the presence of a two factor solution.

Various criteria exist to determine the number of factors to extract from an analysis to represent the data of interest (Hair, Anderson, & Tatham, 1987). Depending on the criteria used (e.g., eigenvalues, scree plot, proportion), final factor solutions may vary. As such, there exist no one definitive answer to the question of number of factors to extract. Upon final rotation of the pattern matrix, factor loadings can be used to support the final solution model. However, one or more items on a given instrument may "load" on multiple factors further complicating the derivation of a simple factor structure. Whereas the availability of statistical computer programs have allowed more ready access to use of factor analysis techniques, the question of number of factors to extract remains undefined and highly subjective.

In this study, factor analysis yielded, at best, a complicated picture. Using any given criteria for the number of factors to extract to represent the foot care test items, the number of factors evidently inherent in the test ranged from one to five. With the hypothesis that the test was comprised of two factors, this investigator concludes that the hypothesis was not supported.

Several aspects of the analysis, however, warrant attention as they may, in fact, represent support of the construct validity of the test. The type of factor analysis approach used in the study (common factors vs. principal components) was selected as this approach relies, initially, on a reduced matrix representing the correlations between items. The reduced matrix is derived from partial correlations between variables. Any two items, then, are correlated after removing the effects of all other variables on both items (Munro, Visintainer, & Page, 1986). The correlation
index is examined for the residual relationship between the variables. Ideally, with this approach, test items should initially represent correlations as close to zero indicating that two test items do not highly correlate without the effect of all other test items in the equation. Examination of the partial correlation matrix lends support to this outcome as correlations ranged from .0002 (negligible) to .26 (low). This suggests that, as a whole, test items "hang together" in representing a homogenous construct.

Kaiser's measure of sampling adequacy (MSA) is a concomitant index to support construct homogeneity. Stewart (1981) suggests that Kaiser's MSA "may be the best" of the methods available to determine the extent to which test items (i.e., variables) belong together. Kaiser & Rice (1974) offer the following scheme as an index by which to judge the homogeneity of test items based on MSA values:

<table>
<thead>
<tr>
<th>MSA VALUE</th>
<th>INTERPRETATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>.90 +</td>
<td>MARVELOUS</td>
</tr>
<tr>
<td>.80 +</td>
<td>MERITORIOUS</td>
</tr>
<tr>
<td>.70 +</td>
<td>MIDDLING</td>
</tr>
<tr>
<td>.60 +</td>
<td>MEDIocre</td>
</tr>
<tr>
<td>.50 +</td>
<td>MISERABLE</td>
</tr>
<tr>
<td>&lt;.50</td>
<td>UNACCEPTABLE</td>
</tr>
</tbody>
</table>

Considering this scheme, the foot care knowledge test items appeared to represent a composite of items indicative of a single construct as the test items as a whole yielded on MSA value of .79 (.80). Individual test items can be examined using this same scheme and interpreted accordingly for their unique contribution toward construct validity. All test items yielded MSA values >.50, however, test item #9 barely achieved this index with a value = .5051 (.51). All other items were at levels of .60 and higher. In fact, over 50% of the test items had MSA values >.80. As individual items with low MSA values may act to decrease total test MSA, these items can be removed from the test with the resultant matrix recomputed for both partial correlations and measures of sampling adequacy. Such would be the recommendation of this investigator that
test item #9 be removed from the test and the data reexamined for resulting indices of test homogeneity.

Another aspect of the factor analysis employed in this study lends support to construct validity. The scree plot of eigenvalues clearly denoted the presence of a one factor model. A one factor model suggests that all test items comprise a composite indicative of the construct of measurement. This, along with the above discussion related to MSA values, warrants attention to construct validity of the knowledge test when coupled with the use of the roots criterion for determination of the number of factors.

The roots criterion (Gorsuch, 1974) provides an approximation of the number of factors and is based on the use of eigenvalues >1.00. Only one eigenvalue yielded an index >1.00, which, according to the principle of this criterion, would suggest a one factor model.

Cattell (1966) suggests, however, that the scree plot be used as an indicator of number of factors as it represents the plot of roots with ready, visual evidence of specific factors. Such evidence is seen by the location of root(s) distinctly separate from the pool of variables such as that which was evident in the scree plot of eigenvalues. Cattell & Vogelman (1977) suggest that the scree plot may represent an even more accurate criterion for determination of the number of factors to extract in a model solution than the use of the roots criterion (i.e., eigenvalues >1.00). Nonetheless, the scree plot of eigenvalues obtained in this study suggested the presence of a one factor model. Stewart (1981) recommends that a combination of approaches be used to determine the number of factors with indication that both the roots criterion and the scree plot appear to yield a reliable index of determination.

With this investigator's conclusion that factor analysis did not support the presence of a two factor model but rather one factor, the results obtained from factor loading patterns following rotation would seem to lend additional support to this conclusion. The pattern presented a complex factor loading composite of test items. In support of the hypothesis, review of test items for interpretation should have clearly demarcated items in accordance with the two categories
which were to have comprised the content of the instrument (Lo Bianco-Wood & Haber, 1990). This was not the case. Six items exhibited dual loading patterns, and, qualitative review of items left no clear demarcation of two content categories. This outcome would not support the presence of two content categories, however, it would suggest, again, that test items comprised one content domain—being just "foot care." Though interpretation of factor loading patterns in highly subjective (Hair, Anderson & Tatham, 1987; Munro, Visintainer & Page, 1986), greater ease in identifying two factors would have been expected in support of the hypothesis proffered to guide the establishment of construct validity of this foot care knowledge test.

One district possibility for the outcomes obtained from factor analysis is that not only does the knowledge test represent "foot care" as one content domain, but test items may not clearly represent the two content categories used to construct the knowledge test. In fact, review of the items suggests the latter as likely. For example, item #7 queries the subject to indicate which of four choice responses is the most appropriate to the stem of the item stating "If it is hard for you to see your feet." The stem itself does not appear to directly relate to either category 4 - Foot/Nail Care nor to category 1 - Footwear: Shoes. The response choices do not reflect appropriate options within these categories either. As such, though the item relates to foot care, it does not specifically relate to the content categories proffered for primary use in test item construction.

Another example is test item #13. The stem of this item focuses on ascertaining one's ability to exemplify knowledge related to signs/symptoms of infection though the last part of the stem focuses on assessment of the skin as the means by which to determine the possibility of foot infection. Infection, as a pathosiological dimension is related to foot care, but does not specifically fall within the intended scope of the two categories used for test item construction. Similar criticism can be rendered as it relates to items #9, 15, 20, 22, and possibly 25.

In as much as the endeavor was to construct a knowledge test reflective of two content categories, it would appear that the test was comprised of items reflective of a broader scope of the content domain. The conclusion that the instrument comprised a one factor dimension of foot
care is supported by the realization that test items embodied a more generalized defined construct of foot care knowledge.

**Known Groups Analyses**

Further indices of construct validity were established using known groups (i.e., criterion groups) as these groups were hypothesized to possess the attribute of foot care knowledge. In this study, known groups and groups to which they were compared included: 1.) subjects with diabetes vs. subjects without diabetes; and, 2.) subjects with diabetes who received diabetes and/or specific foot care education vs. subjects with diabetes who did not receive such education. The one-tailed t-test for independent samples was employed to test each of these hypotheses.

With regard to the first hypothesis, subjects with diabetes obtained a mean score on the foot care knowledge test = 17.12 with a standard deviation = 4.23; subjects without diabetes mean score = 14.66 with a standard deviation = 4.83. The values obtained for standard deviations indicated there was less error in sampling distributions and, hence, failure to reject the statistical null hypothesis that the groups were equal. As such, the pooled variance formula was used to test the research hypothesis that the difference in mean scores between the groups was significantly different. The mean score of subjects with diabetes was significantly higher than the mean score of subjects without diabetes (p<.0001). Construct validity of the foot care knowledge test was met using this analytic approach.

With regard to the second hypothesis, several subquestions were set forth to address this. The first question set forth was that subjects with diabetes who attended diabetes education classes would score significantly higher on the knowledge test than subjects with diabetes who did not attend classes. The variance between these two groups was not equal as the mean of scores for diabetes class attendees = 17.83 with a standard deviation = 3.73; mean score for non-diabetes class attendees = 15.15 with a standard deviation = 5.09. The difference in standard deviations may reflect the reason for unequal variances as increases in standard deviation
increase the error term in the analysis (Munro, Visintainer & Page, 1986; Shott, 1990). Furthermore, the size of the sample groups in this analysis warrants attention as the first group $n = 72$ with the second group $n = 27$. This difference in group sample size may also contribute to the error term as it relates to the null hypothesis of equal sampling distributions (Munro, Visintainer & Page, 1986). With variances between the groups unequal, the separate variance formula was then used to test the hypothesis with results indicating that diabetes class attendees did score significantly higher on the foot care knowledge test than non-diabetes class attendees ($p < .0169$).

Construct validity was further tested with the hypothesis that those subjects who attended diabetes class and reported receiving foot care knowledge would score significantly higher on the foot care knowledge test than those diabetes class attendees who reported receiving no foot care knowledge. This research hypothesis using the one-tailed $t$-test for independent samples was rejected. There was no significant difference in the mean of scores between these two groups.

Of note again is the contribution that variance (as indicated by standard deviations) and sample size may have contributed to this outcome. The standard deviation for the criterion group = 3.24 with the comparison group = 5.39. Furthermore, the group which comprised those who received foot care knowledge in class consisted of 61 subjects while the group who did not receive such information consisted of 11 people. Both aspects of variance may contribute to the finding of no significant difference between mean of test scores as increases in standard deviations and decreases in sample size both contribute to increased variability with the result being less likely of finding significant differences between the groups (Munro, Visintainer & Page 1986). With the possibility of larger error in sampling distribution, a larger sample size is needed to yield a larger difference in mean scores to better assure that the results of the analysis, in fact, reflect any true/real difference in scores. To yield effective interpretation of this outcome, future study would warrant attention to equating the criterion and comparison group on sample size.
A stronger index of construct validity was supported by recognizing subjects who participated in the OSU Diabetes Foot Care Program as a group known to have received the variable of interest in this study—foot care knowledge. The one-tailed t-test for independent samples indicated that the mean of scores for OSU Foot Care Program subjects (18.75, S.D. = 2.97) was significantly higher than the mean of scores for diabetes subjects who were not program participants (mean = 15.21, S.D. 4.64); subjects who did not have diabetes (mean = 14.66, S.D. 4.83); and, for all subjects (with and without diabetes) combined (mean = 14.78, S.D. = 4.73). Each of the findings was based on the separate variance formula for t-test analysis as for each test, variances between the groups were not equal. For each of these analyses, again, the difference in both standard deviations and sample size for comparative purposes may have contributed to standard error warranting the use of the more conservative separate t-test.

Using the separate t-test, each of the hypotheses appear to support construct validity of the foot care knowledge test using OSU Foot Care subjects as a criterion group in which the attribute of inquiry is postulated to exist in higher degree than any of the comparison groups. Waltz, Strickland & Lenz (1991) state that the criterion group analysis approach is a means of establishing construct validity of an instrument. In particular, they define this approach within the scope of "decision validity." This type of validity exemplifies the extent to which one makes decisions derived from the scores obtained on a measurement scale (pg. 237). In this study, one would "decide" that subjects do, or do not, have diabetes foot care knowledge based on the score obtained on the knowledge test. The ability to make such a decision is contingent on the construct validity of the test such that it represents the construct of interest as determined by the use of a criterion group known to possess the construct "with a high level of confidence" (pg. 245).
Validity: Item Analysis - Discriminating Power

Though not preferred per se within the confines of construct validation of the foot care knowledge test, indices of results obtained from item analyses of the test lend support to its validity. In this study, three measures of item analysis were employed: 1.) discriminating power of the item; 2.) item difficulty; and, 3.) effectiveness of response choice distracters.

Discriminating power of an item is the degree to which it demarcates people who possess the construct of interest versus those who do not (Chiselli, Campbell & Zedeck, 1981; Nunnally, 1978). To categorize people as such, the index of discriminating power of an item should be positive and as close to the value of 1.00. A positive value indicates that a greater proportion of people who scored high on the test answered an item correctly than low test scorers. The value of 1.00 represents a relative index of the strength of the item's power to discriminate the two groups. Note that an item may yield a high numerical value but be associated with a negative sign. This would occur in the instance where a greater proportion of low test scorers answered an item correctly than did high test scorers. In this example, the item retains a high index of discriminating power but not in the direction supportive of the item's validity. One would not expect a test item that measures "knowledge" to measure knowledge in people, who in total score, do not possess the knowledge being measured.

In this study, all indices of discriminating power were positive and ranged in value from .57 to .82. With the preceding discussion related to known groups analyses, it is of interest to note that 45% of the high scorers had diabetes. Conversely, 60% of low test scorers did not have diabetes with 40% reporting diagnosis of the disease. To note is that of those subjects with diabetes in the low test scoring group, less than 10% (n = 5) were OSU Foot Care Program participants. These findings correspond to the known group analyses supporting construct validity which yielded significantly higher test scores in OSU subjects, and, subjects who had diabetes.
Particular attention was focused on item #9 as it failed to load significantly on either of the two factors in factor analysis. The discriminating power of this item (.67) was not the lowest value obtained across all test items though it was the one item in which both high and low test scorers marked incorrectly in greater proportion than any other item. It would appear that this item yields positive discriminating power though it is not an easy item (see proceeding discussion on item difficulty) nor does it account for a significant proportion of variance in the two factor solution as derived from factor analysis.

In total, the research objective of establishing the discriminating power of the test was met as, combined, the foot care knowledge test yielded indices reflective of its ability to discriminate high versus low test scorers. Furthermore, the results of this analysis lend additional support to construct validity of the test as more subjects from the OSU program and more subjects with diabetes comprised the greatest percent of high test scorers. In this respect, the discriminating power of an item relates directly with validity of an instrument inasmuch as the test is able to classify people on the construct of interest (Waltz, Strickland & Lenz, 1991).

**Validity: Item Analysis - Item and Test Difficulty**

Item difficulty is an index of the percentage of people who correctly answered a test item (Ghiselli, Campbell & Zedeck, 1981). As with item discriminatory power, the research objective was to evaluate the difficulty level of each test item with indices ranging from 40-70% considered acceptable values. The higher the percent value, the easier an item is to answer; conversely, the lower the percent value, the more difficulty an item to answer correctly.

In this study, item difficulty ranged from 22% to 92% with item #9 obtaining the lowest percent level (i.e., the most difficult item to answer correctly). Both high and low test scorers answered this item incorrectly more so than any other test item though high test scorers answered the item correctly in greater proportion than low test scorers. This finding accounts for the positive discriminating power associated with the item. However, a secondary analysis of the data revealed
that, for all respondents combined (n = 195; missing = 10), a greater percent of subjects without diabetes (28%, n = 27) answered this item correctly than did subjects with diabetes (19%, n = 19). Of those subjects responding to this item correctly, 59% did not have diabetes, 41% did have diabetes. A Chi-square test of independence revealed that there was no significant difference in score obtained on this test item between those subjects with diabetes and those without diabetes ($x^2 = 6.152$, df=3, prob.<.104).

Item #9 asked subjects to indicate which, of four choices, was correct in preventing foot problems. The correct answer was to "maintain ideal body weight" as opposed to rubbing antiseptic cream on feet every day, having feet checked by a doctor at least once a year; and, following a monthly foot care program at home. Approximately 43% of subjects with diabetes (n = 42) indicated that following a monthly foot care program at home was the correct response. This response was also the one chosen by most subjects without diabetes (36%, n = 35). Review of the item suggests that the correct answer was so distinctly different in nature from the other choice options let alone the other items on the test. The correct response was derived from a general diabetes knowledge test constructed for people with non-insulin dependent diabetes. The distracters for this item were modified and intended to reflect what was considered obvious error in foot care principles. For example, a person with foot care knowledge would know not to rub antiseptic cream on feet daily; that feet should be checked more frequently than once a year; and, that proper foot care involves a daily home routine, not a monthly one. Getting this item correct, then, was almost by default in that a subject was required to know what not to do as opposed to knowing what to do in care of the feet. A qualitative review of the other test items does not appear to follow this same format in presentation of distracters. Furthermore, going back and reviewing the information derived from sources used to define the foot care content domain did not reveal "maintaining ideal body weight" as an index directly associated with foot care. This investigator would have expected that the distracter "having your doctor check your feet at least once a year" would have attracted more respondents than "follow a monthly foot care program at
home." The reason being that it is conceivable for one to interpret the statement that a "doctor" checks feet would be more consistent with the recommendation that several parameters of diabetes care should be done at least yearly, by a physician (e.g., eye examinations, renal function tests).

Only one other test item achieved a difficulty index <40% that being item #12 which achieved a difficulty index of 38%. This index, however, was associated with a discriminating power of .75—fairly high in classifying subjects with foot care knowledge vs. subjects without knowledge using values obtained for top and low 1/3 test scorers. For all subjects combined, however, a slightly higher percent of respondents answered this item incorrectly. Item #12 queried subjects with the stem stating "it is best to buy new shoes." Two of the response options reflected a time of day (early in the morning vs. later in the afternoon) with the remaining two options reflecting features of shoes (size and/or open-toed). Thirty-nine percent (39%) of subjects selected the distracter "large enough for feet to move back and forth" with 38% selecting the correct response choice. Review of this secondary analysis further revealed that a higher percentage of subjects with diabetes answered this item incorrectly than did subjects without diabetes (45% vs. 33%). More subjects with diabetes indicated that it is best to buy new shoes "large enough for feet to move back and forth" as opposed to "late in the afternoon when feet tend to swell." Chi-square test for independence was not significant ($x=7.065$, df=3, prob.<.070).

Considering that high test scorers tended to respond to this item correctly than low test scorers, the outcome related in that respect is satisfactory. However, when considering the sample of diabetes subjects combined, the results are somewhat disheartening. A qualitative review of the content domain revealed multiple examples of data reflective of information advising people with diabetes as to the appropriate time to day to purchase anew pair of shoes—that being later in the day due to the fact that feet will tend to be their largest due to swelling and the effects of gravity. From the content domain, one would assume that this principle of foot care is readily available to
the diabetes patient population. Results in response to this test item would suggest possibly otherwise.

Nonetheless, for item #12 the distracters are inconsistent in nature and may have accounted for the slightly decreased value in difficulty index. Response options consistent in either time of day or physical properties of the shoe itself would be better in modifying the item. Such modification, however, would have to be re-examined for its effect on discriminatory power as this item had significantly ability to categorize subjects.

The easiest item was item #11--99% of the top 1/3 group answered correctly with 76% of the low test scorers combined answered the item correctly with the item associated with discriminating power of .57. This power index was the lowest achieved (tied with item #5). This level of power is inversely related to item difficulty in that as an item is easier to answer, the less able it is to discriminate between subjects (Ghiselli, et al, 1986). Upon secondary analysis, this item reflects the fact that 96% of subjects with diabetes and 93% of subjects without diabetes answered the item correctly (95% of subjects combined). A review of the item suggests that the concept of wearing leather shoes is widespread regardless of having or not having diabetes. Furthermore, the correct response option may have had more choice appeal as the other three types of shoes (nylon, plastic, and vinyl) are not commonly used footwear products.

As a note, for the top 1/3 test scorers, item #1 was the easiest to answer though, for all subjects combined, it yielded a difficulty index of 89% with a discriminating power of .58. All top 1/3 test scorers answered this item correctly which occurred with no other knowledge test item. For all subjects with diabetes, 94% answered this item correctly; 84% of subjects without diabetes responded correctly. Chi-square did yield a significant difference between groups considering all subjects combined ($x=8.321, df=3$, prob.<.04).

Though test items were individually evaluated for index of difficulty, the mean difficulty level can be used to evaluate the research objective. For this test, the mean level of difficulty = .64 which is within the 40-70% range deemed acceptable. Ghiselli, et al (1981) state that it may be
unrealistic to expect all items to achieve difficulty levels within 40-70% range. They indicate that a scale may be comprised of items that exemplify values above and below this range but that an average of difficulty index may be used to evaluate the effectiveness of comprising an instrument with an appropriate level of difficulty. As such, though not all test items were within the acceptable range of difficulty, the overall mean value was and, as such, indicates that the instrument in total, represents a scale of measurement "not too easy" and "not too hard." Coupled with data derived from discriminating power of the items and test, construct validity of the instrument is supported with results derived from analysis of item difficulty.

Ghiselli, et al (1981) present only one range of values for interpretation of item difficulty. Waltz, et al (1991) suggest that in a multiple choice format with four response choices in which guessing may be involved in responding, the average difficulty level, as determined by the halfway point between change and 1.00, be considered. Guessing may have been involved as a means of test item response in this study. As such, the average difficulty index would = .65, which, this foot care knowledge test closely approximated.

Validity: Effectiveness of Distracters

An effective distracter is an incorrect response choice that low test scorers tend to select as opposed to high test scorers. Consistent with results obtained for discriminating power and item difficulty, distracters were generally effective in their role of attracting respondents who tended to score low on the foot care knowledge test. Explication of instances in which, as a whole, subjects without diabetes tended to select correct response choices in greater percentage than subjects with diabetes have been presented and discussed. In general, the foot care knowledge test items were comprised of effective distracters. Several items warrant attention to modification of response choices as they would appear to be inconsistent in nature with other choice options.
Reliability - Internal Consistency

Two types of reliability were calculated to examine psychometric index of the foot care knowledge test—internal consistency and test-retest.

Internal consistency form of reliability is most commonly used with cognitive measures which are concerned with the performance of a sample group of subjects across test items representing a variable of interest (Waltz, et al, 1991). Responses to test items represent dichotomous data with the resultant index of reliability based on the phi coefficient (Ferguson, 1981). As such, the internal consistency form of reliability is an index of the intercorrelations between test items and is considered a test of homogeneity (Ferguson, 1981). With only one administration of the test, scores obtained are considered to represent scores that individuals might be expected to obtain on a large, repeated number of parallel forms of the test. Furthermore, the items used to derive test scores are assumed to be drawn from a large pool/population of test items representing the construct or attribute of interest (Ferguson, 1981). As such, the definition of the content domain is of great importance in constructing a test designed to measure an attribute such as foot care knowledge. Without due attention to defining content domain by which to sample items, items may be constructed that do not accurately measure the construct of interest. As such, inherent in psychometric theory is the concept of standard error of measurement.

Standard error of measurement represents the difference between true score and observed score (LoBiondo-Wood & Haber, 1990). As a sample of individuals is typically used to measure a construct of interest, standard error reflects the standard deviation of the sampling distribution on the test items used for measurement. With increased variance in observed scores comes an increase in standard deviation with a resulting increase in error variance as well (Ferguson, 1981). To yield an acceptable reliability coefficient, a test should accurately measure
the construct of interest. Doing so minimizes the error term and influences the variation in observed scores.

In this study, the measure of internal consistency employed to ascertain the reliability coefficient of the foot care knowledge test was the Kuder-Richardson 20 formula. This test yielded a value of .7999 (.80) with a standard error of measurement = 1.69 considering all subjects combined. The reliability coefficient is high, particularly considering that .6 - .7 was the range preferred as acceptable for initial test development (Nunnally, 1978). The mean of test scores = 15.87 with a standard deviation = 4.68. The standard deviation may account for the degree of error measurement obtained in this analysis which was fairly decent considering, again, the early developmental stage of the foot care knowledge test.

Reliability coefficient is influenced by a number of factors such as the distribution of scores (Ferguson, 1981). With a skewed distribution, and depending on the degree to which the distribution is skewed, the coefficient obtained may be lower in value. The distribution of scores obtained on the foot care test = -.72 indicating that the scores reflected on the test tended to be distributed slightly higher than would be expected on a normal curve. As previously noted, subjects with diabetes scored significantly higher on the test than subjects without diabetes. The scores obtained by subjects with diabetes may account for the negatively skewed distribution.

As the KR20 formula for reliability is essentially an index of test item homogeneity, one would expect that item-to-total score correlations would support the coefficient value obtained by exhibiting positive and, at least, modest correlation indices. In this study, 22 of the test items yielded item-to-total score correlations of .30 (moderate association) and higher. None of the correlations were negative and all correlations were statistically significant, even the lowest correlation obtained (item #9 @ .14 indicating a low correlation). As such, the foot care knowledge test appears to represent a composite of items homogenous in construct. Higher coefficient values usually provide evidence that the test, as a whole, is measuring a single attribute (Ferguson, 1981).
The results obtained from item-to-total score correlations reflective of test item homogeneity is consistent with results obtained from factor analysis. This is not surprising in light of the conclusion that the knowledge test comprised only one common factor vs. two, and, the partial correlations between items were negligible to low when the effect of all other items were removed from the equation. Combined, these results suggest that any one item on the test acts to indicates score obtained on any other test item (Waltz, et al, 1991).

In conclusion, the research objective of establishing the internal consistency of the foot care knowledge test was met.

Reliability - Test Re-test

A second index of reliability relates to the stability of the foot care knowledge test over time. With subjects derived from the OSU Foot Care Program administered the test a second time, stability of the instrument = .61 based on the Pearson correlation coefficient. The coefficient obtained represents a moderate correlation between total scores obtained on test administration #1 and administration #2 (Munro, Visintainer, Page, 1986). Several factors may account for this. One is memory in that subjects may recall responses to their first test administration and simply provide the same response again (LoBlondo-Wood & Harber, 1990; Ferguson, 1981; Waltz, et al, 1991; Burns & Grove, 1987). As such, the reliability coefficient may be artificially high. Secondly, environmental factors may have influenced the responses on either test administration (Ferguson, 1981). For example, subjects were assumed to have provided responses without input from others thereby reflecting foot care knowledge of the intended subject. With the methodology employed in this study, there was no control over this at all. Subjects were free to consult family members or friends, even give the instrument factors which may have positively or negatively influenced the scores obtained include such things as the general health of the subject at the time of test completion--a subject fatigued/tired may respond to the instrument quite differently when not in such a state. Furthermore, tests of achievement
represent measurement of a changing construct over time. The stability of the construct is suspect, particularly when test administration conditions are not, or cannot, be controlled.

Another concern is that, though the test-retest coefficient may be high, this index of reliability does not account for poor sampling of the construct of interest (Nunnally, 1978). Test-retest can simply reflect a high correlation between test scores representing poorly sampled/constructed knowledge items as much as well and soundly sampled/constructed items. Test-retest yields no support for construct validity of an instrument per se. In this study, however, evidence exists that items on the foot care knowledge test represented the foot care content domain, and, furthermore, represented the construct of inquiry.

In conclusion, the research objective of evaluating the psychometric index of reliability of the foot care knowledge test was met. Both indices of internal consistency and test-retest stability revealed the knowledge test had a high degree of reliability.
CHAPTER V

SUMMARY

This section summarizes the results of the research project. Limitations of the study with recommendations for further inquiry are included.

Summary

Twenty-five multiple, forced-choice response items comprised an instrument designed to measure foot care knowledge. These items were derived from an initial process of sampling, identifying, and defining the content of domain representative of foot care knowledge as it related to elderly people with diabetes. With foot care defined within the scope of five content areas, the two highest ranking categories perceived important by a sample of diabetes nurse educators were used to construct test items representative of the construct of interest. The test items were initially hypothesized to represent foot care knowledge as defined within these two content categories. Subsequent analyses to test for construct validity of the test did not support the hypothesis of a test comprised of two categories. However, analyses supported the validation of the instrument as a composite of items representing one general domain—that being the construct of simply foot care knowledge. Construct validity of the test was further supported by findings reflecting its ability to yield significantly higher test scores across several criterion groups postulated to possess, with confidence, foot care knowledge.

Further validation of the test was achieved by indices of item analyses. Items on the instrument were found to positively discriminate and, hence, classify subjects according to
whether respondents did, or did not have, foot care knowledge. Additional analysis indicated that
distracters were effective in that subjects who attained low test scores selected these incorrect
response choices in greater proportion than subjects with high test scores. Furthermore, the foot
care knowledge test yielded an acceptable index of both individual, and, total item difficulty.

Psychometric index of the instrument's reliability was evaluated and found to yield high
coefficient indices across both aspects of internal consistency and test-retest stability. Measure
of internal consistency supported the findings of construct validity as it related to the composite of
items reflective of a homogenous construct. This was evidenced by moderate to strong item-to-
total score correlations.

The overall purpose of this study was to develop a reliable and valid instrument to
measure foot care knowledge in elderly people with diabetes. Incorporating three phases of
design and implementation consistent within the scope of psychometric theory, the purpose of
the study, as stated, was met.

Limitation of the Study

Though the purpose of the study was met, several factors warrant attention as they may
limit the extrapolation of findings to the larger population of elderly people with diabetes.

The means by which the content domain was obtained relied on convenience sampling of
diabetes nurse educators, elderly people with diabetes, and diabetes education program
coordinators. Convenience sampling of an accessible population threatens the external validity of
the study thereby affording only cautious generalizations to individuals/groups outside the
parameters of the sampled groups. External validity is further threatened by the use of
nonrandom sampling procedures. Unique attributes of the sampled groups may account for the
data and/or results derived as opposed to measures of true variance across focal areas of study
inquiry. In particular, all data derived from implementation of Phase III of the study (psychometric
evaluation of the instrument) was obtained from subjects confined to what could, in general, be
defined as the Midwest portion of the United States. Furthermore, development of the foot care
knowledge test was not considerate of any particular demographic subject attribute other than
age. As such, factors related to, for example, cultural/ethnic elements as they may affect cognitive
measurement of this nature were not used, nor considered, in item construction or data analyses.

Another sampling factor that presents limitations to this study is that, along with
nonrandom sampling, subjects were self-selected. Though Human Subjects Concerns
addressed the right of subjects to voluntarily participate in the study, subjects who elected to
participate may represent a unique subgroup of respondents potentially markedly different from
the larger population from which they were derived.

Additional limitations of the study are evidenced by the fact that, for a large percentage of
subjects, no control over conditions governing test administration were exercised. Realistically, it
would be difficult to obtain such control. However, the lack of it, nonetheless, predisposes study
outcomes to threats related to internal validity. One may only assume that data derived from the
study was reflective of an individual's perceptions and/or foot care knowledge and not that of
family or friends. Furthermore, one can only assume, as in the case of test-retest reliability, that
subjects completing the second test did so under similar circumstances or conditions
(physiological and/or environmental) as in the first administration of the test.

Another limitation is that one can only assume that subjects responding to the
questionnaires and/or foot care knowledge test were able to speak and comprehend the English
language. Though this attribute was identified as a criteria for participation, no means of assessing
for this was designed in the study protocol. Again, index of this subject attribute was contingent
upon the respondent. and though the instrument was designed to correspond to a third grade
reading level, completion of the instrument does not represent an index of the literacy level of any
one respondent.
Implications for Future Research

Endeavors at establishing validity and reliability are imperative if the intent to use a measurement scale, such as the foot care knowledge test, is for clinical practice purposes (Waltz & Strickland, 1989). As this study was founded on the issue of questioning study outcomes regarding patient nonadherence to prescribed diabetes regimens without valid and reliable indices of diabetes knowledge, this study represents initial endeavors at validation of one area of interest—foot care. Further study would involve the use of a valid measurement scale such as this one for predictive purposes. For example, one could use the knowledge test to determine its ability to predict foot related complications (outcome processes). Predictive ability of an instrument holds great merit in focusing clinical attention to the needs of diabetes patients as it relates to teaching self-care of the feet. Such attention to education of the patient who lacks appropriate foot care knowledge may effect the diagnosis, onset, and/or severity of foot related problems in this population of patients. Furthermore, the instrument can be used as the foundation of identifying patients requiring foot care knowledge for the purpose of effecting positive health outcomes with the focus being on assessment of the economic impact of such outcomes as it relates to health care expenditures in both equipment, supplies and personnel. As the foot care knowledge test exhibited validity, specifically “decision” validity as defined by Waltz, et al (1991), the use of the instrument in this manner would assist health care personnel “decide” that a patient does, or does not, have appropriate knowledge to effect prescribed outcomes.

Further inquiry would focus on the assessment of the reliability and validity of the instrument across specified populations such as those defined by different age groups and different ethnic/cultural populations. Of particular need is to address research endeavors using
minority populations as these groups exhibit greater prevalence and/or incidence of diabetes and its related complications.

The foot care knowledge test could be used in a multi-dimensional analysis of factors that may contribute to adherence to prescribed therapeutic diabetes regimens. As the review of literature for this study indicated, numerous studies have incorporated patient non-adherence/noncompliance with prescribed regimens using a wide range of variables such as social support and effects of educational intervention programs. Results vary yielding, at times, discrepant outcomes. This investigator maintains the original premise that the evaluation of any educational intervention designed to effect patient adherence must incorporate a valid and reliable measure of patient knowledge.

Diabetes continues to represent a condition managed largely by the self-care endeavors of the person who lives with it. The ability of an individual to manage diabetes is contingent upon their receipt of self-care knowledge. Other factors certainly influence one's ability to enact self-care behaviors associated with effecting glucose control. However, research that suggests factors yielding nonsignificant explanatory power without consideration of a patient's knowledge of self-care skill and behavior fails to address measurement of patient knowledge as a critical variable in accounting for study outcomes.

With management of diabetes largely dependent on the patient's enactment of self-care behaviors, diabetes nurse educators continue to represent the single largest group of health care professionals responsible for the provision of patient self-care knowledge. This holds true whether nursing care is provided via bedside care, home care nursing, or by specialization in a clinical role. As such, the outcome measurement of nursing intervention as it relates to the provision of such knowledge is highly relevant within the scope of this profession. This study represents an endeavor to establish a line of inquiry into one aspect of nursing education of the patient with diabetes foot care.
References


APPENDICES
RELATIVE TO
CHAPTER III
APPENDIX A

Request for Membership List
American Association of Diabetes Educators
Dear Kate,

As you know, I have successfully completed my doctoral candidacy exams at Ohio State University. I am now involved in conducting my dissertation research which involves the development of a foot care knowledge test for use with elderly people with diabetes.

One aspect of my study involves a national survey of diabetes nurse educators. The purpose of the survey is to gather data related to what practitioners in the field perceive to be important foot care content to teach elderly patients. To obtain the subjects, I would like to utilize the list of nurse educators who are active members of AADE. I hereby request permission to obtain and use this list. I understand the list can be generated by zip code by state at least would be most helpful.

I understand AADE charges $25.00 for membership lists. If payment is required prior to generating the list, please let me know. Otherwise, payment will be processed at Ohio State immediately upon receipt of invoice.

Thank you for your time in consideration of my request. Best wishes. Look forward to seeing you in Las Vegas.

Sincerely,

Nel Martinez, MS, RN, CDE
Doctoral Candidate
College of Nursing
APPENDIX B

Diabetes Nurse Educator Letter
June 15, 1990

Diabetes Nurse Educator, RN
Title
Hospital
Street Address
City, State Zip Code

Dear Name of Educator,

Patient noncompliance with prescribed regimens remains a significant problem in diabetes care today. Noncompliance lends to the prevalence of diabetes complications such as those related to the feet in elderly people. The elderly represent a continuing challenge to educators as yearly, an increasing number of older adults are diagnosed with diabetes.

To better understand noncompliance, it is important to have valid and reliable measures of the patient's knowledge acquired through the teaching process. I am conducting a study in an endeavor to construct a valid and reliable instrument to measure one important aspect of self-care in elderly people with diabetes—foot care knowledge. As a diabetes nurse educator, you have been randomly selected for participation in this study. As the study relates to elderly people (age 60-75 years), I am seeking educators whose practice includes service to this age group. If you do not meet this criteria, simply indicate so on the questionnaire and return it in the envelope provided. No other involvement on your part is required and I thank you for your attention to this point.

If you do meet the criteria, your participation is voluntary and involves about 30 minutes to complete the enclosed questionnaire and return it in the envelope provided. The questionnaire has been coded solely for response rate purposes. Your responses are confidential and will be anonymously reported with all other responses received. If you wish to receive a summary of findings upon completion of the study, please indicate so at the end of the questionnaire.

I appreciate your effort in support of this study. Your expertise will help address one of the most challenging complications for older adults with diabetes. If you have any questions, feel free to call me (513-293-6115). I look forward to hearing from you.

Sincerely,

Nel Martinez, MS,RN,CDE
College of Nursing
APPENDIX C

Diabetes Nurse Educator Survey
Foot Care in Elderly People with Diabetes

Diabetes Nurse Educator Survey

This survey is designed to assess what you perceive to be important elements of foot care to teach elderly people with diabetes. If you provide service to patients aged 60-75 years, complete the survey and return it using the envelope provided. If you do not service this age group, please indicate so below and return the survey as well. Thank you for your help with this project.

☐ not eligible to participate - survey returned
PART A - FOOT CARE BEHAVIOR
This section of the questionnaire is designed to identify what you perceive to be important behaviors for elderly people to perform on a regular basis to care for their feet. List up to 8 specific patient self-care behaviors in order of importance with number 1 being the most important behavior.

1.

2.

3.

4.

5.

6.

7.

8.
PART B - FOOT CARE KNOWLEDGE

This section of the questionnaire is designed to identify what you perceive to be important foot care knowledge elderly people with diabetes need to have to enact the self-care behaviors you listed in Part A. For each of the behaviors in Part A, list up to 3 content items you think important to teach elderly patients.

Behavior #1
1.
2.
3.

Behavior #2
1.
2.
3.

Behavior #3
1.
2.
3.

Behavior #4
1.
2.
3.
Behavior #5
1.

2.

3.

Behavior #6
1.

2.

3.

Behavior #7
1.

2.

3.

Behavior #8
1.

2.

3.
PART C - BACKGROUND INFORMATION - Please answer each of the following questions.

Q-1. In what setting do you primarily practice diabetes education?
   (check only one box)
   □ 1. Inpatient
   □ 2. Outpatient
   □ 3. Other: Please specify __________________________________

Q-2. Do you offer a formal (series of classes) diabetes education program?
   (check all that apply)
   □ 1. YES - Inpatient
   □ 2. YES - Outpatient
   □ 3. NO - No formal group classes

   If YES, considering the time spent in group classes as 100%, please estimate what percent of group class time is devoted to teaching foot care.
   ___________________% 

Q-3. Do you offer either inpatient or outpatient one-to-one teaching sessions as part of your diabetes education program? (check only one box)
   □ 1. YES - Please answer sections A-C
   □ 2. NO - Skip to Question 4

   A. If YES, please estimate the number of one-to-one teaching sessions you personally provided during the past year.
      ___________________ sessions
   
   B. Realizing that you may cover multiple diabetes topics in any given one-to-one teaching session, please estimate what percent of your sessions during the past year included some teaching of foot care?
      ___________________% 

   C. Of those sessions that included some teaching on foot care, on average, what percent of those sessions were devoted solely to teaching diabetes foot care?
      ___________________% 

Q-4. Please estimate the percent of your diabetic patients that fall in each of the following age categories:
   (total should equal 100%)

      _____ >75 years of age
      _____ 60 - 75 years of age
      _____ <60 years of age
Q-5. Are you certified in diabetes education? (check only one box)

☐ 1. YES
☐ 2. NO

Q-6. What is your highest level of education? (check only one box)

☐ 1. Diploma in Nursing
☐ 2. Associate degree
☐ 3. Bachelor degree
☐ 4. Master's degree
☐ 5. Doctorate

Q-7. How many years have you been providing diabetes education?

__________ years

Q-8. How many years have you spent in nursing?

__________ years

Q-9. In what type of institution are you primarily employed?

(check only one box)

☐ 1. Hospital >700 beds
☐ 2. Hospital 500 - 699 beds
☐ 3. Hospital 300 - 499 beds
☐ 4. Hospital 100 - 299 beds
☐ 5. Hospital <100 beds
☐ 6. Public Health/Home Care Agency
☐ 7. Physician Office
☐ 8. Private Practice
☐ 9. College/University
☐ 10. Other. Please specify ________________

Q-10. Upon completion of the study, do you wish to receive a summary of findings?

(check only one box)

☐ 1. YES
☐ 2. NO

THANK YOU

PLEASE RETURN THE QUESTIONNAIRE IN THE ENVELOPE PROVIDED
APPENDIX D

Reminder Card - Diabetes Nurse Educators
Reminder Card  
Phase I

Date

Last week a questionnaire regarding elderly patient foot care knowledge and behavior was mailed to you. Your name had been randomly selected from the active membership list of the American Association of Diabetes Educators.

If you have already completed the questionnaire and returned it to me, my sincere thanks for doing so. If not, I would appreciate it if you would do so today. Because the survey was sent to a small number of diabetes nurse educators, it is very important that your responses be included in the study.

If by some chance you did not receive the questionnaire, please call me collect, (513) 293-6115, and I will get another one in the mail to you. Thank you again for your participation in this study.

Sincerely,

Nel Martinez, MS, RN, CDE
Ohio State University
APPENDIX E

Follow-Up Letter - Diabetes Nurse Educators
July 17, 1990

Name of Educator, RN
Title
Hospital
Street Address
City, State Zip Code

Dear Name of Educator:

Approximately four weeks ago, you received a questionnaire about what you perceive to be the most important things elderly people with diabetes should do and know about taking care of their feet. As of today I have not received your completed questionnaire.

Your response is very important especially since only a small number of diabetes educators were given the questionnaire to complete. In case your questionnaire has been misplaced, I have enclosed another copy of it. I would greatly appreciate it if you would take the time today to complete the questionnaire and return it to me in the envelope provided.

Thank you for your time and help in this study. I look forward to hearing from you.

Sincerely,

Nel Martinez, MS, RN, CDE
College of Nursing
The Ohio State University
APPENDIX F

Human Subjects Committee Approval

169
With regard to the employment of human subjects in the proposed research protocol:

90B0093 DEVELOPMENT OF A FOOT CARE KNOWLEDGE TEST FOR ELDERLY PEOPLE WITH DIABETES, Elizabeth M. Burns, Nelda C. Martinez, Life Span Process

THE BEHAVIORAL AND SOCIAL SCIENCES REVIEW COMMITTEE HAS TAKEN THE FOLLOWING ACTION:

_____ APPROVED

X  APPROVED WITH CONDITIONS*

_____ DISAPPROVED

_____ WAIVER OF WRITTEN CONSENT GRANTED

* Conditions stated by the Committee have been met by the Investigator and, therefore, the protocol is APPROVED.

It is the responsibility of the principal investigator to retain a copy of each signed consent form for at least four (4) years beyond the termination of the subject's participation in the proposed activity. Should the principal investigator leave the University, signed consent forms are to be transferred to the Human Subjects Review Committee for the required retention period. This application has been approved for the period of one year. You are reminded that you must promptly report any problems to the Review Committee, and that no procedural changes may be made without prior review and approval. You are also reminded that the identity of the research participants must be kept confidential.

Date: May 25, 1990  Signed: [Signature]

(Chairperson)

HS-025B (Rev. 3/85)
APPENDIX G

Diabetes Foot Care Patient Survey Form
The purpose of this questionnaire is to find out what you think are the most important things people with diabetes should do to take care of their feet.

Please answer each of the items in this questionnaire and return it in the envelope provided.

Your time to complete this survey is greatly appreciated. With your help, diabetes educators can improve foot care for people with diabetes.

If you have any questions, please call or write to me:

Nel Martinez, MS, RN, CDE
1041 Yorkshire Place
Dayton, Ohio 45419
513-293-6115
Part A - TAKING CARE OF YOUR FEET

In the spaces below, write down the four (4) most important things you think someone with diabetes should do to take care of their feet. Write them down in order of importance with number 1 being the most important.

1. 

2. 

3. 

4. 
Part B - BACKGROUND INFORMATION

Q - 1. How long have you had diabetes? ________ years

Q - 2. Which of the following do you use to control your diabetes?  
   (Check all that apply)
   □ 1. Take insulin shots
   □ 2. Take a pill / tablet
   □ 3. Follow a diet only

Q - 3. How much schooling have you completed?  (Check only one box)
   □ 1. Less than 8th grade
   □ 2. Some high school
   □ 3. High school graduate
   □ 4. Some college or technical school
   □ 5. College graduate

Q - 4. How old are you? ________ years

Q - 5. Sex:
   □ 1. Male
   □ 2. Female
APPENDIX H

Diabetes Education Program Coordinator Letter
June 8, 1990

Dear Name,

I am conducting a study designed to evaluate a test to measure foot care knowledge in elderly people with diabetes. The overall purpose of the study is to better understand patient noncompliance with prescribed diabetic regimens by developing valid and reliable measures of patient knowledge. The first phase of the study involves identifying major teaching content categories for one of the most important aspects of self-care in elderly people with diabetes—foot care knowledge. It includes a national survey of foot care teaching protocols and/or guidelines used by major diabetes education programs such as yours. I am writing to you today to request a copy of any teaching guidelines/protocols related to foot care that you use in your program to educate elderly people with diabetes.

Your program was one of a few selected for participation in this study. Your participation is voluntary and any materials received from you will be anonymously reported with all other responses received. I have enclosed a return envelope for your convenience in forwarding materials.

I would greatly appreciate your help with this study. If you have any questions, please feel free to call or write to me. I can be reached at the following:

1041 Yorkshire Place
Dayton, Ohio 45419
513-293-6115

Thank you for your time in consideration of my request. Sharing your expertise will help address one of the most challenging complications for older adults with diabetes. I look forward to hearing from you.

Sincerely,

Nel Martinez, MS, RN, CDE
College of Nursing
APPENDIX I

Diabetes Education Program List
Phase I

Diabetes Education Programs

University of Chicago Hospital & Clinic
Diabetes Research and Training Center
Chicago, Illinois

University of Miami - Diabetes Unit
Miami, Florida

Indiana University
Diabetes Research and Training Center
Indianapolis, Indiana

Yale New Haven Hospital
New Haven, Connecticut

University of California - San Diego
Diabetes Center
San Diego, California

University of California
Davis Medical Center
Sacramento, California

University of Tennessee
Medical Center
Knoxville, Tennessee

University of Oklahoma
Tulsa Medical College
Tulsa, Oklahoma

University of Cincinnati
Diabetes Education Center
Cincinnati, Ohio

University of Alabama - Birmingham
Diabetes Hospital
Birmingham, Alabama

Joslin Diabetes Center
Boston, Massachusetts

International Diabetes Center
Minneapolis, Minnesota
Washington University
Diabetes Education Center
St. Louis, Missouri

Diabetes Care Center
Fresno, California

University of Michigan
Diabetes Research and Training Center
Ann Arbor, Michigan

Henry Ford Hospital
Detroit, Michigan

Albert Einstein College of Medicine
Bronx, New York

National Institute of Health Clinic
Bethesda, Maryland

Vanderbilt University
Diabetes Research and Treatment Center
Nashville, Tennessee

University of Utah
University Hospital
Salt Lake City, Utah

Diabetes Clinic
Ohio State University Hospitals
Columbus, Ohio

Veterans Administration Center
Seattle, Washington
APPENDIX J

Summary - RightWriter Analysis of Foot Care Knowledge Test
FOOT CARE KNOWLEDGE TEST

INSTRUCTIONS: BELOW ARE QUESTIONS ABOUT CARING FOR YOUR FEET. READ EACH QUESTION CAREFULLY AND CIRCLE WHAT YOU THINK IS THE RIGHT ANSWER. CIRCLE ONLY ONE ANSWER. IF YOU ARE NOT SURE, CIRCLE WHAT YOU THINK MAY BE THE RIGHT ANSWER.
1. **Proper care of toenails includes all the following **except:  
   A. Cut nails after bathing when nails are soft.  
   B. Cut nails even with the top of toes.  
   C. Cut nails shorter than end of toes.  
   D. Cut nails with clippers/nail scissors.

2. **If you cut your foot:**  
   A. Bandage the cut and check it in several days.  
   B. Clean the cut with alcohol to prevent infection.  
   C. Wash and clean the cut as soon as possible.  
   D. Wash the foot and apply iodine to the cut.

3. **Avoid using lotion on feet that contains:**  
   A. Alcohol.  
   B. Cornstarch.  
   C. Moisturizer.  
   D. Talcum powder.

4. **To care for a foot callous:**  
   A. Cut away the hard skin with nail scissors.  
   B. Soak foot in warm water and peel away the skin.  
   C. Use a mild foot remedy to remove the skin.  
   D. Use a pumice stone to remove the skin.

5. **To help keep feet warm at night, use which of the following?**  
   A. Electric blanket.  
   B. Heating pad.  
   C. Hot water bottle.  
   D. Wool socks.

6. **To care for your feet you should:**  
   A. Look at feet daily for redness or sores.  
   B. Rub feet daily with alcohol.  
   C. Soak feet daily in hot water.  
   D. Use iodine on cuts or sores.

7. **The most important part of caring for feet is:**  
   A. Keep skin germ free with alcohol.  
   B. Look at your feet every day.
C. SOAK FEET EVERY DAY.
D. USE LOTION ON FEET TO KEEP SKIN MOIST.

8. IF YOU HAVE A BLISTER ON YOUR FOOT:
A. APPLY A HEATING PAD TO THE BLISTER.
B. GENTLY BREAK THE BLISTER AND PUT IODINE ON IT.
C. GO BAREFOOT AS MUCH AS POSSIBLE UNTIL THE BLISTER HEALS.
D. GENTLY WASH THE BLISTER AND BANDAGE IT.

9. WHICH OF THE FOLLOWING IS LESS LIKELY TO CAUSE A SKIN PROBLEM?
A. COTTON PLACED BETWEEN THE TOES.
B. SOCKS WITH SMALL HOLES.
C. TOES THAT OVERLAP EACH OTHER.
D. A SMALL WRINKLE IN A SHOE LINING.

10. IF YOU NOTICE A CORN ON A TOE:
A. PUT TAPE OVER IT SO IT WON'T RUB AGAINST YOUR SHOE.
B. SEE YOUR MEDICAL OR FOOT DOCTOR FOR TREATMENT.
C. TRIM IT SO IT WON'T RUB AGAINST YOUR SHOE.
D. USE A CORN REMOVER AVAILABLE FROM A LOCAL DRUG STORE.

11. APPLY LOTION TO EACH OF THE FOLLOWING AREAS OF THE FOOT EXCEPT:
A. BETWEEN THE TOES.
B. BOTTOM OF THE FEET.
C. SIDES OF THE FEET.
D. TOP OF THE FEET.

12. TO HELP PREVENT FOOT PROBLEMS:
A. RUB ANTISEPTIC CREAM ON YOUR FEET EVERY DAY.
B. HAVE YOUR DOCTOR CHECK YOUR FEET AT LEAST ONCE A YEAR.
C. FOLLOW A MONTHLY FOOT CARE PROGRAM AT HOME.
D. MAINTAIN AN IDEAL BODY WEIGHT.

13. TO TREAT DRY, CRACKED FOOT SKIN:
A. APPLY FOOT POWDER TO KEEP SKIN SMOOTH.
B. Soak feet to get moisture into the skin.
C. Use lotion to moisturize the skin.
D. Wear nylon socks or hose to keep skin moist.

14. To care for your feet:
A. Apply iodine to skin cuts.
B. Clean away skin germs with alcohol.
C. Wash and pat feet dry with towel.
D. Wash feet daily in hot, soapy water.

15. To care for toenails:
A. Check nails at least once a month for signs of infection.
B. Cut nails that have grown into the skin around the toe.
C. Peel dry, rough nails to keep them from catching on socks or hose.
D. Soak hard, thick nails to make them easier to trim.

16. Use lotion on feet to keep skin:
A. Clean.
B. Free from infection.
C. Smooth and dry.
D. Smooth and moist.

17. When trimming toenails, do each of the following except:
A. Remove ingrown toenails.
B. Trim nails even with the end of toe.
C. Trim nails to make corners smooth and round.
D. Use nail clippers/nail scissors.

18. A sign of foot infection may be skin that is:
A. Cracked and dry.
B. Pale and dry.
C. Red and warm.
D. Moist and cool.

19. Routine foot care includes:
A. Feeling dry, cracked skin so that scabs don't form.
B. Rubbing feet with alcohol to clean away germs.
C. SOAKING FEET DAILY IN HOT WATER TO HELP BLOOD FLOW.
D. WASHING FEET WITH MILD, SOAPY WATER.

20. WHICH OF THE FOLLOWING ARE SIGNS OF POOR BLOOD FLOW?

A. COOL, PALE, SWOLLEN FEET.
B. DRY, COOL, WRINKLED SKIN.
C. MOIST, PALE, WRINKLED SKIN.
D. WARM, RED, SWOLLEN FEET.

21. TO TAKE GOOD CARE OF TOENAILS:

A. CLEAN THEM WITH ALCOHOL TO PREVENT INFECTION.
B. CUT INGROWN TOENAILS AS SHORT AS POSSIBLE.
C. FILE THEM SMOOTH ALONG CURVE OF THE TOE.
D. SOAK THEM DAILY IN HOT WATER TO KEEP THEM SOFT.

22. IT IS BEST TO BUY NEW SHOES:

A. EARLY IN THE MORNING BEFORE FEET SWELL.
B. LATE IN THE AFTERNOON WHEN FEET TEND TO SWELL.
C. LARGE ENOUGH FOR FEET TO MOVE BACK AND FORTH.
D. WITH OPEN TOES SO THAT FEET CAN "BREATHE".

23. A BETTER TYPE OF SHOE TO WEAR IS ONE MADE OF:

A. LEATHER—TO LET FEET "BREATHE".
B. NYLON—TO KEEP FOOT SKIN SMOOTH.
C. PLASTIC—TO KEEP MOISTURE IN THE FOOT.
D. VINYL—TO KEEP ROUGH FIBERS FROM SCRATCHING SKIN.

24. TO BETTER CARE FOR FEET:

A. GO BAREFOOT ONLY WHEN AT HOME.
B. CHECK THE INSIDES OF SHOES AT LEAST ONCE A WEEK.
C. AVOID GOING BAREFOOT ANY TIME.
D. USE SANDALS IN SUMMER TO KEEP FEET FROM GETTING TOO HOT.

25. IF IT IS HARD FOR YOU TO SEE YOUR FEET:

A. HAVE YOUR DOCTOR CHECK THEM AT LEAST ONCE A YEAR.
B. HAVE FAMILY OR FRIENDS CHECK THEM FOR YOU REGULARLY.

C. CHECK FOR PAIN TO KNOW IF YOU HAVE A FOOT PROBLEM.
D. SOAK FEET 45-60 MINUTES DAILY TO PREVENT PROBLEMS.

<<** SUMMARY **>>

Overall critique for: C:\WP50\test#3.
Output document name: C:\WP50\test#3.OUT

READABILITY INDEX: 2.62

4th 6th 8th 10th 12th 14th
/
* SIMPLE | ---- GOOD ---- | COMPLEX

Readers need a 3rd grade level of education.

The Flesch Index for this document is: 91.293

The Fog Index for this document is: 5.344

STRENGTH INDEX: 0.87

0.0 0.5 1.0
/****|****|****|****|****|****|****|****|****|****|

WEAK  STRONG

The writing has a strong style.

DESCRIPTIVE INDEX: 0.21

0.1 0.5 0.9 1.1
/****|****|****|****|****|****|****|****|****|****|

TERSE  NORMAL  WORDY

The use of adjectives and adverbs is normal.

JARGON INDEX: 0.97

The writing contains a good deal of jargon.

SENTENCE STRUCTURE RECOMMENDATIONS:

3. Most sentences start with nouns.
   Try varying the sentence starts.

<< WORDS TO REVIEW >>

Review this list for negative words (N), jargon (J), colloquial words (C), misused words (M), misspellings (?), or words which your reader may not understand (?).

A.(?) 25  D.(?) 25
B.(?) 25  D.(?) 25
C.(?) 25  D.(?) 25
antiseptic(?) 1 barefoot(?) 3
clippers(?) 2 cornstarch(?) 1
<table>
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<th>Frequency</th>
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<tr>
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</table>

<< END OF WORDS TO REVIEW LIST >>
<<** END OF SUMMARY **>>
APPENDIX K

Foot Care Knowledge Test
INSTRUCTIONS
This is a test about caring for your feet. Read each question carefully and CIRCLE what you think is the right answer. Circle only one answer. If you are not sure, circle what you think may be the right answer.

THANK YOU
CIRCLE ONE ANSWER FOR EACH OF THE FOLLOWING QUESTIONS.

1. TO CARE FOR YOUR FEET YOU SHOULD:
   A. Look at feet daily for redness or sores.
   B. Rub feet daily with alcohol.
   C. Soak feet daily in hot water.
   D. Use iodine on cuts or sores.

2. THE MOST IMPORTANT PART OF CARING FOR FEET IS:
   A. Keep skin germ free with alcohol.
   B. Look at your feet every day.
   C. Soak feet every day.
   D. Use lotion on feet to keep skin moist.

3. APPLY LOTION TO EACH OF THE FOLLOWING AREAS OF THE FOOT EXCEPT:
   A. Between the toes.
   B. Bottom of the feet.
   C. Sides of the feet.
   D. Top of the feet.

4. TO CARE FOR YOUR FEET:
   A. Apply iodine to skin cuts.
   B. Clean away skin germs with alcohol.
   C. Wash and pat feet dry with towel.
   D. Wash feet daily in hot, soapy water.

5. USE LOTION ON FEET TO KEEP SKIN:
   A. Clean.
   B. Free from infection.
   C. Smooth and dry.
   D. Smooth and moist.

6. ROUTINE FOOT CARE INCLUDES:
   A. Peeling dry, cracked skin so that scabs don't form.
   B. Rubbing feet with alcohol to clean away germs.
   C. Soaking feet daily in hot water to help blood flow.
   D. Washing feet with mild, soapy water.

7. IF IT IS HARD FOR YOU TO SEE YOUR FEET.
   A. Have your Doctor check them at least once a year.
   B. Have family or friends check them for you regularly.
   C. Check for pain to know if you have a foot problem.
   D. Soak feet 45-60 minutes daily to prevent problems.
15. WHICH OF THE FOLLOWING ARE SIGNS OF POOR BLOOD FLOW?
A. Cool, pale, swollen feet.
B. Dry, cool, wrinkled skin.
C. Moist, pale wrinkled skin.
D. Warm, red, swollen feet.

16. TO TAKE GOOD CARE OF TOENAILS:
A. Clean them with alcohol to prevent infection.
B. Cut ingrown toenails as short as possible.
C. File them smooth along curve of the toe.
D. Soak them daily in hot water to keep them soft.

17. WHEN TRIMMING TOENAILS, DO EACH OF THE FOLLOWING EXCEPT:
A. Remove ingrown toenails.
B. Trim nails even with the end of toe.
C. Trim nails to make corners smooth and round.
D. Use nail clippers/nail scissors.

18. PROPER CARE OF TOENAILS INCLUDES ALL THE FOLLOWING EXCEPT:
A. Cut nails after bathing when nails are soft.
B. Cut nails even with the top of toes.
C. Cut nails shorter than end of toes.
D. Cut nails with clipper/nail scissors.

19. TO CARE FOR TOENAILS:
A. Check nails at least once a month for signs of infection.
B. Cut nails that have grown into the skin around the toe.
C. Peel dry, rough nails to keep them from catching on socks or hose.
D. Soak hard, thick nails to make them easier to trim.

20. IF YOU HAVE A BLISTER ON YOUR FOOT:
A. Apply a heating pad to the blister.
B. Gently break the blister and put iodine on it.
C. Go barefoot as much as possible until the blister heals.
D. Gently wash the blister and bandage it.

21. TO CARE FOR A FOOT CALLOUS:
A. Cut away the hard skin with nail scissors.
B. Soak foot in warm water and peel away the skin.
C. Use a mild foot remedy to remove the skin.
D. Use a pumice stone to remove the skin.

©1991 Martinez
GO TO THE BACK OF THE PAGE
BACKGROUN INFORMATION

CIRCLE ONE ANSWER TO THE FOLLOWING QUESTIONS.

1. Do you presently have diabetes?
   1. YES -- GO ON TO QUESTION #2
   2. NO -- SKIP TO QUESTION #10

2. How long have you had diabetes?
   1. less than 5 years
   2. 5 - 10 years
   3. more than 10 years

3. What do you do to control your diabetes? (Circle all that apply)
   1. take insulin shot
   2. take a pill/tablet
   3. follow a diet only.

4. Have you ever attended diabetes education classes?
   1. YES
   2. NO

   If YES, how long ago did you attend classes? ________ years

   If YES, did any of the classes include information about foot care?
   1. YES
   2. NO

5. How would you rate your understanding of diabetes?
   (circle one answer only)
   1. VERY POOR
   2. POOR
   3. FAIR
   4. GOOD
   5. VERY GOOD

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GO TO THE BACK OF THE PAGE →
APPENDIX L

Ohio State Foot Care Program Patient Letter to Participate
June 28, 1991

Name of Foot Care Program Patient
Street Address
City, State Zip code

Dear (name of patient):

As a patient in the OSU Diabetes Foot Care Program, your help in a study of foot care knowledge is being sought. We are asking if you would take about 20 minutes of your time to complete the enclosed foot care knowledge test. Completing the test is voluntary—it is your choice to participate or not. If you choose not to participate, the health care services you receive from OSU will not be affected in any way.

If you choose to complete the test, please return it in the pre-addressed stamped envelope as soon as you possibly can within the coming week. The information we get from all patients who complete the test will be put together in one report. You, as an individual, will not be identified in any way when reporting the results of the study.

Part of the study also involves asking some patients in the foot care program to repeat the test in about 2 weeks. As such, you may be receiving another copy of the test at that time. If you are one of those chosen, we would appreciate it if you would complete the test again and return it to us.

Thank you for your help. Foot care is a big part of diabetes care. Your help in this study would greatly increase our ability to help adults with diabetes prevent, or better treat, foot related problems. If you have any questions, please feel free to call one of us using the phone numbers below. We look forward to hearing from you.

Sincerely,

Nel Martinez, MS, RN, CDE
College of Nursing
513-293-6115 (call collect)

Dr. Elizabeth Burns
College of Nursing
614-292-4647
APPENDIX M

Ohio State Foot Care Program Patient Follow-Up Reminder Letter
Reminder Letter - OSU Clinic Patients
Phase III

Date
Name
Address
City, State  Zip Code

Dear Name,

About a week ago I mailed a foot care knowledge test to you asking your help by completing it and returning it to me. As of today, I have not received your questionnaire. If you decided not to participate in the study, please check the box on the front of the knowledge test and return it to me. This will help avoid having you receive any future notices.

If you decided to participate but have not completed the questionnaire, I would appreciate it if you would do so today and return it to me.

Your response is very important. Only a limited number of people with diabetes were mailed the questionnaire. I look forward to hearing from you.

Sincerely,

Nel Martinez, MS, RN, CDE
College of Nursing
APPENDIX N

Ohio State University Hospitals Division of Nursing
Research Committee Approval
BEHAVIORAL AND SOCIAL SCIENCES
HUMAN SUBJECTS REVIEW COMMITTEE
THE OHIO STATE UNIVERSITY

Research Involving Human Subjects

ACTION OF THE REVIEW COMMITTEE

With regard to the employment of human subjects in the proposed research protocol:

90B0093 DEVELOPMENT OF A FOOT CARE KNOWLEDGE TEST FOR ELDERLY PEOPLE WITH DIABETES, Elizabeth M. Burns, Nelda C. Martinez, Life Span Process

THE BEHAVIORAL AND SOCIAL SCIENCES REVIEW COMMITTEE HAS TAKEN THE FOLLOWING ACTION:

X APPROVED

APPROVED WITH CONDITIONS*

DISAPPROVED

X WAIVER OF WRITTEN CONSENT GRANTED

* Conditions stated by the Committee have been met by the Investigator and, therefore, the protocol is APPROVED.

It is the responsibility of the principal investigator to retain a copy of each signed consent form for at least four (4) years beyond the termination of the subject's participation in the proposed activity. Should the principal investigator leave the University, signed consent forms are to be transferred to the Human Subjects Review Committee for the required retention period. This application has been approved for the period of one year. You are reminded that you must promptly report any problems to the Review Committee, and that no procedural changes may be made without prior review and approval. You are also reminded that the identity of the research participants must be kept confidential.

Date: June 25, 1991  Signed (Chairperson)

HS-025B (Rev. 8/90)
APPENDIX O

Human Subjects Approval to Waive Written Consent
THE OHIO STATE UNIVERSITY HOSPITALS
DIVISION OF NURSING

CLINICAL NURSING INVESTIGATION COMMITTEE

Action Report of the Committee Review

RESEARCH PROPOSAL TITLE: Development of a Foot Care Knowledge Test for Elderly People with Diabetes

<table>
<thead>
<tr>
<th>PRINCIPAL INVESTIGATOR(S)</th>
<th>POSITION TITLE</th>
<th>AFFILIATION &amp; ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nelda C. Martinez MS, RN, CDE</td>
<td>Doctoral Candidate</td>
<td>College of Nursing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Home: 1041 Yorkshire Pl. Dayton, OH 45419</td>
</tr>
</tbody>
</table>

THE COMMITTEE HAS TAKEN THE FOLLOWING ACTION:

- [ ] APPROVED
- [X] APPROVED WITH CONDITIONS *
- [ ] DISAPPROVED

* Conditions stated by the committee have been met (will be met) by the Investigator and, therefore, the protocol is approved.

It is the responsibility of the Principal Investigator(s) to report any problems to the Clinical Nursing Investigation Committee. NO PROCEDURAL CHANGES MAY BE MADE WITHOUT PRIOR REVIEW AND APPROVAL FROM THE COMMITTEE.

DATE: 6/14/90
SIGNED: [Signature]
Chairperson

DATE: 6/15/90
SIGNED: [Signature]
Administrator, Nursing Service

cc: Original to Principal Investigator
File
Director of Nursing Department
Administrator, Nursing Service

pjacnicare
RESEARCH PROTOCOL:

AMENDMENT

90B0093 DEVELOPMENT OF A FOOT CARE KNOWLEDGE TEST FOR ELDERLY PEOPLE WITH DIABETES, Elizabeth M. Burns, Nelda C. Martinez, Life Span Process

presented for review by the Behavioral and Social Sciences Review Committee to ensure proper protection of the rights and welfare of the individuals involved with consideration of the methods used to obtain informed consent and the justification of risks in terms of potential benefits to be gained. The Committee action was:

X APPROVED

DEFERRED*

APPROVED WITH CONDITIONS*

DISAPPROVED

NO REVIEW NECESSARY

*CONDITIONS/COMMENTS:

Request to amend the protocol to include waiver of written consent for Phases II and III was administratively APPROVED.
APPENDIX P

Coding Scheme
## Coding Scheme
### Phase III

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ID</strong> Subject's identification code</td>
<td>001 - 100 = OSU FCP PTS</td>
</tr>
<tr>
<td></td>
<td>101 - 200 = DADA</td>
</tr>
<tr>
<td></td>
<td>201 - 300 = SCC DAYTON</td>
</tr>
<tr>
<td></td>
<td>301 - 400 = LCA</td>
</tr>
<tr>
<td></td>
<td>401 - 500 = OSU OTHER</td>
</tr>
</tbody>
</table>

**SCORE 1** Number of correct items on foot care knowledge test - all cases
Minimum score = 0, maximum score = 25.

**SCORE 2** Number of correct items on foot care knowledge test - retest cases only; all other cases not retested indicated by "M".
(Minimum score = 0, maximum score = 25).

**Q1 and Q26**
To care for your feet you should:

1. A. Look at feet daily for redness or sores.
2. B. Rub feet daily with alcohol.
3. C. Soak feet daily in hot water.
4. D. Use iodine on cuts or scores.

**Q2 and Q27**
The most important part of caring for feet is:

1. A. Keep skin germ free with alcohol.
2. B. Look at your feet every day.
3. C. Soak feet every day.
4. D. Use lotion on feet to keep skin moist.

**Q3 and Q28**
Apply lotion to each of the following areas of the foot except:

1. A. Between the toes.
2. B. Bottom of feet.
3. C. Sides of the feet.
4. D. Top of the feet.

**Q4 and Q29**
To care for your feet:

1. A. Apply iodine to skin cuts.
2. B. Clean away skin germs with alcohol.
3. C. Wash and pat feet dry with towel.
4. D. Wash feet daily in hot, soapy water.
Q5 and Q30
Use lotion on feet to keep skin:

1 = A. Clean.
2 = B. Free from infection.
3 = C. Smooth and dry
*4 = D. Smooth and moist.

Q6 and Q31
Routine foot care includes:

1 = A. Peeling dry, cracked skin so that scabs don’t form.
2 = B. Rubbing feet with alcohol to clean away germs.
3 = C. Soaking feet daily in hot water to help blood flow.
*4 = D. Washing feet with mild, soapy water.

Q7 and Q32
If it is hard for you to see your feet:

1 = A. Have your doctor check them at least once a year.
*2 = B. Have family or friends check them for you regularly.
3 = C. Check for pain to know if you have a foot problem.
4 = D. Soak feet 45-60 minutes daily to prevent problems.

Q8 and Q33
To better care for feet:

1 = A. Go barefoot only when at home.
2 = B. Check in insides of shoes at least once a week.
*3 = C. Avoid going barefoot any time.
4 = D. Use sandals in summer to keep feet from getting too hot.

Q9 and Q34
To help prevent foot problems:

1 = A. Rub antiseptic cream on your feet every day.
2 = B. Have your doctor check your feet at least once a year.
3 = C. Follow a monthly foot care program at home.
*4 = D. Maintain an ideal body weight.

Q10 and Q35
Avoid using lotion on feet that contains:

*1 = A. Alcohol
2 = B. Cornstarch
3 = C. Moisturizer
4 = D. Talcum Powder

Q11 and Q36
A better type of shoe to wear is one made of:

*1 = A. Leather - to let feet “breathe.”
2 = B. Nylon - to keep foot skin smooth.
3 = C. Plastic - to keep moisture in the foot.
4 = D. Vinyl - to keep rough fibers from scratching skin.
Q12 and Q37
It is best to buy new shoes:

1 = A. Early in the morning before feet swell.
*2 = B. Late in the afternoon when feet tend to swell.
3 = C. Large enough for feet to move back and forth.
4 = D. With open toes so that feet can "breathe."

Q13 and Q38
A sign of foot infection may be skin that is:

1 = A. Cracked and dry.
2 = B. Pale and dry.
*3 = C. Red and warm.
4 = D. Moist and cool.

Q14 and Q39
To help keep feet warm at night, use which of the following?

1 = A. Electric blanket.
2 = B. Heating pad.
3 = C. Hot water bottle.
*4 = D. Wool socks.

Q15 and Q40
Which of the following are signs of poor blood flow?

*1 = A. Cool, pale, swollen feet.
2 = B. Dry, cool, wrinkled skin.
3 = C. Moist, pale, wrinkled skin.
4 = D. Warm, red, swollen feet.

Q16 and Q41
To take good care of toenails:

1 = A. Clean them with alcohol to prevent infection.
2 = B. Cut ingrown toenails as short as possible.
*3 = C. File them smooth along curve of the toe.
4 = D. Soak them daily in hot water to keep them soft.

Q17 and Q42
When trimming toenails, do each of the following except:

*1 = A. Remove ingrown toenails.
2 = B. Trim nails even with the end of toe.
3 = C. Trim nails to make corners smooth and round.
4 = D. Use nail clippers/nail scissors.

Q18 and Q43
Proper care of toenails includes all the following except:

1 = A. Cut nails after bathing when nails are soft.
2 = B. Cut nails even with the top of toes.
*3 = C. Cut nails shorter than end of toes.
4 = D. Cut nails with clipper/nail scissors.
Q19 and Q44
To care for toenails:

1 = A. Check nails at least once a month for signs of infection.
2 = B. Cut nails that have grown into the skin around the toe.
3 = C. Peel dry, rough nails to keep them from catching on socks or hose.
*4 = D. Soak hard thick nails to make them easier to trim.

Q20 and Q45
If you have a blister on your foot:

1 = A. Apply a heating pad to the blister.
2 = B. Gently break the blister and put iodine on it.
3 = C. Go barefoot as much as possible until the blister heals.
*4 = D. Gently wash the blister and bandage it.

Q21 and Q46
To care for a foot callous:

1 = A. Cut away the hard skin with nail scissors.
2 = B. Soak foot in warm water and peel away the skin.
3 = C. Use a mild foot remedy to remove the skin.
*4 = D. Use a pumice stone to remove the skin.

Q22 and Q47
If you cut your foot:

1 = A. Bandage the cut and check it in several days.
2 = B. Clean the cut with alcohol to prevent infection.
3 = C. Wash and clean the cut as soon as possible.
*4 = D. Wash the foot and apply iodine to the cut.

Q23 and Q48
To treat dry, cracked foot skin:

1 = A. Apply foot powder to keep skin smooth.
2 = B. Soak feet to get moisture into the skin.
*3 = C. Use lotion to moisturize the skin.
4 = D. Wear nylon socks or hose to keep skin moist.

Q24 and Q49
If you notice a corn on a toe:

1 = A. Put tape over it so it won’t rub against your shoe.
*2 = B. See your medical or foot doctor for treatment.
3 = C. Trim it so it won’t rub against your shoe.
4 = D. Use a corn remover available from a local drug store.

Q25 and Q50
Which of the following is less likely to cause a skin problem?

*1 = A. Cotton placed between the toes.
2 = B. Socks with small holes.
3 = C. Toes that overlap each other.
4 = D. A small wrinkle in a shoe lining.
SITE DATA COLLECTION SITE

1 = OSU FOOT CARE PROGRAM
2 = DAYTON AREA DIABETES ASSOC.
3 = DAYTON SENIOR CITIZENS CTR.
4 = LIFE CARE ALLIANCE/COLUMBUS
5 = OSU/OTHER

V1 Do you presently have diabetes?
1 = YES -- Go on to question #2
2 = NO -- Skip to question #10

V2 How long have you had diabetes?
1 = less than 5 years
2 = 5 to 10 years
3 = more than 10 years
8 = not required information -- subject does not have diabetes.
M = true missing -- subject has diabetes but did not provide information.

V3 What do you do to control your diabetes?
1 = take insulin shot
2 = take a pill/tablet
3 = follow a diet only
4 = insulin & pill/tablet
5 = insulin & diet
6 = pill/tablet & diet
7 = insulin, pill/tablet, & diet
8 = not required information -- subject does not have diabetes.
M = true missing -- subject has diabetes but did not answer this question.

V4 Have you ever attended diabetes education classes?
1 = Yes
2 = No
8 = not required information -- subject does not have diabetes.
M = true missing -- subject has diabetes but did not answer this question.

V5 If yes (to question V4), how long ago did you attend classes?
# years entered
8 = not required information -- subject either does not have diabetes, or, subject answered NO to question V4.
M = true missing -- subject has diabetes and answered YES to V4, but, did not answer this question.

V6 If yes (to question V4), did any of the classes include information about foot care?
1 = Yes
2 = No
8 = not required information -- subject either does not have diabetes, or, subject answered NO to question V4.
M = true missing -- subject has diabetes and answered YES to V4, but, did not answer this question.
V 7 How would you rate your understanding of diabetes?
1 = very poor
2 = poor
3 = fair
4 = good
5 = very good
8 = not required information--subject does not have diabetes.
M = true missing--subject has diabetes but did not answer this question.

V 8 How would you rate your understanding of how diabetes is controlled?
1 = very poor
2 = poor
3 = fair
4 = good
5 = very good
8 = not required information--subject does not have diabetes.
M = true missing--subject has diabetes but did not answer this question.

V 9 How would you rate your understanding of diabetes foot care?
1 = very poor
2 = poor
3 = fair
4 = good
5 = very good
8 = not required information--subject does not have diabetes.
M = true missing--subject has diabetes but did not answer this question.

V 10 How would you rate the importance of diabetes foot care?
1 = not important
2 = somewhat important
3 = important
4 = very important
8 = not required information--subject does not have diabetes.
M = true missing--subject has diabetes but did not answer this question.

V 11 How would you rate your ability to care for your feet?
1 = very poor
2 = poor
3 = fair
4 = good
5 = very good
8 = not required information--subject does not have diabetes.
M = true missing--subject did answer this question.

V 12 How much schooling have you completed?
1 = less than 8th grade
2 = some high school
3 = high school graduate
4 = some college/technical school
5 = college graduate
M = true missing--subject did answer this question.
V13  How old are you?
   # year of age entered
V14  Sex:
   1 = female
   2 = male
   M = true missing--subject did not answer this question.