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Functional Prognosis of Dizziness in Older Adults in Primary Care: A Prospective Cohort Study

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ABSTRACT

Objectives: To investigate the 6-month functional prognosis of dizziness in older adults in primary care, to identify important predictors of dizziness-related impairment, and to construct a score to assist risk prediction.

Design: Prospective cohort study with 6-month follow-up.

Setting: Twenty-four primary care practices in the Netherlands.

Participants: Four hundred seventeen older adults (mean age 78.5, range 65–95, 74% female) presenting consecutively to primary care with dizziness.

Measurements: Tests, including history and physical and additional examination, previously selected by an international expert panel and based on an earlier systematic review, were performed. The main outcome measure was 6-month dizziness-related impairment score measured using the Dizziness Handicap Inventory.

Results: Follow-up was complete for 92% of participants. Although 61% of participants experienced less impairment at 6 months, 130 participants (34%) showed persistent dizziness-related impairment. Factors most predictive of dizziness-related impairment at 6 months were onset of dizziness at least 6 months before inclusion, standing still as a dizziness-provoking circumstance, trouble with walking or (almost) falling (associated symptom), polypharmacy, absence of diabetes mellitus, presence of anxiety or depressive disorder, and impaired functional mobility. A score was constructed using these predictors to estimate the functional prognosis of dizziness at 6 months.

Conclusion: A score based on the presence of easily obtainable clinical information facilitates identification of older adults in primary care with poor functional prognosis of their dizziness without exactly knowing the cause(s) of their dizziness. Clinical management might be most effective by treating factors that can be influenced, such as polypharmacy, anxiety and depression, and functional mobility.

Dizziness is a common symptom, especially in older adults. Annual consultation rates for dizziness in primary care increase from 8% for individuals aged 65 and older to 18% for those aged 85 and older.[1, 2] Moreover, two-thirds of older adults presenting with dizziness experience chronic dizziness, with complaints persisting or recurring for more than 6 months.[3-5] Not only is dizziness in elderly adults common, it also tends to be multicausal, resulting from defects in different organ systems simultaneously.[6] Individuals without a diagnosis account for 20% to 40% of all individuals presenting with dizziness in primary care.[7-9] Even if specific diseases are revealed, they cannot always be treated effectively.[10]

Dizziness can be a great burden for older adults, resulting in serious impairment in daily functioning, falls, social isolation, and eventually nursing home admission.[5, 10, 11] Despite the need to gain more insight into the prognosis of dizziness, few prospective studies have investigated the course of dizziness and dizziness-related impairment in individuals in primary care, and none of these provided information on older adults.[12-14] This study aimed to determine the functional prognosis of dizziness in older adults in primary care after 6 months of follow-up. In addition, the aim was to identify predictors of persisting impairment due to dizziness and to construct a risk score for use in primary care using information collected in clinical practice.

METHODS

Study Design and Participants

This study is part of the Dizziness in Elderly Patients Study. Details of participant population and data collection have been published previously.[15, 16] Briefly, in a prospective observational cohort study of individuals aged 65 and older presenting consecutively with dizziness in primary care, 417 from 45 primary care physicians (PCPs) in 24 Dutch practices were followed up for 6 months.

Because dizziness in elderly adults mostly reflects a multifactorial problem, and symptoms are often nonspecific, the definition of dizziness included a giddy or rotational sensation, a feeling of imbalance, light-headedness, and a sensation of impending faint as reported by consulting patients. Criteria for exclusion were inability to speak Dutch or English, significant cognitive impairment, corrected visual acuity of less than 3/60 for the best eye, inability to communicate verbally, and wheelchair dependency. Participants completed questionnaires at inclusion and 6 months after the index consultation. The medical ethics committees of the two academic medical centers involved approved the study. All participants provided written informed consent.

Outcome: Dizziness-Related Impairment

The outcome was defined as dizziness-related impairment, assessed using the validated Dutch version of the Dizziness Handicap Inventory (DHI),[17, 18] a self-report questionnaire designed to quantify the effect of dizziness originating in the vestibular system[17] but that has frequently been used for individuals with dizziness of any cause.[19-23] The DHI is the most commonly used and accepted questionnaire to quantify the effect of dizziness and has been translated into many languages.[18, 23-29] The questionnaire contains 25 items covering functional, emotional, and physical subscales. “Yes” scores 4 points, “sometimes” 2 points, and “no” 0 points. DHI scores range from 0 to 100, with higher scores indicating greater perceived disability,

and a DHI score of 30 has been used as cutoff for substantial impairment.[23, 30] An unfavorable outcome was therefore defined a DHI score greater than 30 at 6 months.

Potential Predictors of Dizziness-Related Impairment

In a three-round Delphi procedure, 16 international experts representing dizziness-relevant medical specialties selected 21 tests as potentially contributing to the diagnostic process in older adults presenting with dizziness to a PCP. The tests included four elements of patient history, 11 measurements on physical examination, and six additional diagnostic tests.[15] In addition to these tests, data were collected on demographic variables, and functional mobility was measured using the validated Timed Up and Go Test,[31] in which a participant rises from an arm chair, walks 3 m, turns, returns, and sits down again. Functional mobility is impaired if it takes more than 20 seconds to finish this procedure.

In the baseline data set, 0.2% of the data were missing. To minimize bias, these missing data were imputed using the iterative chained equations method in STATA/SE 10.0 (StataCorp, College Station, TX). The details of this procedure have been published previously.[6]

Eighty-seven variables resulted from these tests and measurements, from which 33 candidate predictors concerning demographic and lifestyle factors, characteristics of dizziness, data on relevant diagnoses and drugs, baseline DHI score, and information about relevant conditions or tests (e.g., orthostatic hypotension, functional mobility, Dix-Hallpike test) were selected.[32] This clinical selection process was based on plausibility of relationship to the effect of dizziness, prevalence in the study population between 10% and 90%, and a Spearman correlation coefficient comparing these candidate predictors between −0.50 and 0.50.

Statistical Analysis

The distribution of DHI scores at baseline and 6-month follow-up and differences in DHI scores between baseline and follow-up were described. DHI score at 6 months was dichotomized at the predefined cutoff, with greater than 30 considered high and 30 or less low.

Loss to Follow-Up and Imputation

The predictability of loss to follow-up was explored using all possible subset and stepwise logistic regression techniques. Next missing data at follow-up were imputed using the regression method in SPSS 18 (SPSS Inc., Chicago, IL), using DHI score at baseline and the 32 other variables. To minimize bias, five data sets with imputed scores were created, and these data sets were combined into one large data set.

Identification of Predictors for Impairment Due to Dizziness at 6 Months

First bivariate Pearson correlations of the DHI score at 6 months and all 33 candidate predictors were calculated to assess predictive performance of each variable separately. Next, backward logistic regression was applied to investigate the predictability of the dichotomous DHI scores at 6 months, once with and once without the DHI score at baseline added to this set. For stability reasons, backward regression was conducted in each of 1,500 bootstrap samples from the combined imputed data set. The selection criterion (*P*-remove) was set at .05. The model without the DHI score at baseline is described.

Construction of the Final Risk Prediction Model and Score

From the models selected in the bootstrap samples, variables were retained for a final model if they were selected in at least 67% of the 1,500 bootstrap samples. The parameters of this model were then estimated in the five imputation samples, and Rubin's rules[33, 34] were applied to obtain pooled estimates and their standard errors. Odds ratios and their confidence intervals (CIs) were calculated from these. The average regression weights were also calculated for each variable over all (1,500) bootstrap samples (B_m)[35] and the regression weights of the (7) variables selected in the final model (B_s). For comparison reasons, weighted sum scores (based on the above-mentioned B_s) and simple sum scores (based on simply counting the number of predictors present in a particular individual) were both calculated.

Finally, the calibration of the final model was evaluated by comparing the observed and estimated outcome probabilities for all values of the simple sum score. The fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test, and the ability of the simple sum score model to identify individuals with an unfavorable course of dizziness was estimated using the area under the receiver operating characteristic (ROC) curve (AUC).

Results

From July 2006 to January 2008, 417 older adults presenting consecutively with dizziness in primary care were enrolled (Table 1). As expected, most participants presented not with one clear-cut type of dizziness but with two or more subtypes of dizziness.[6] Follow-up data were available for 385 participants (92.3%) at 6 months (Table S1). Reasons for loss to follow-up were death (n = 17, 4.1%), refusal to participate (n = 10, 2.4%), and moving to an unknown destination (n = 5, 1.2%). Participants with and without follow-up did not differ in baseline characteristics (Table S1). Sensitivity analysis did not identify significant differences in results with and without the 32 participants lost to follow-up. Furthermore, the fact that DHI score at baseline, which was by far the best predictor of DHI score at 6-month follow-up (Table S2), did not play a role in predicting mortality, suggested that loss to follow-up due to mortality (53%) was not related to the outcome, so imputation was allowed. Accordingly, the outcome variable were imputed for the 8% incomplete cases.

[TABLE 1]

DHI Scores

At baseline, the median DHI score was 34 (interquartile range (IQR) 22–50); at 6 months the median DHI score was 24 (IQR 8–44), and 56 participants (15%) had a score of 0 (Figure 1). In addition, 130 participants (34%) showed persistent dizziness-related impairment, with DHI scores greater than 30 at baseline and 6 months.

[FIGURE 1.]

Mean change in DHI scores between baseline and 6 months was 7.5 ± 19.2 (Figure 2). According to findings of a previous study,[23] the cutoff point of a clinically meaningful change in DHI between baseline and 6 months was set at ± 12. At follow-up, 116 participants (30%) experienced more dizziness-related impairment than at baseline, of whom 46 (12%) had a clinically relevant increase (Δ DHI score ≥

12); 236 participants (61%) experienced less impairment, of whom 136 (35%) had a clinically relevant decrease (Δ DHI score ≥ −12).

[FIGURE 2.]

Predictors of Dizziness-Related Impairment

Dizziness Handicap Inventory (DHI) score at baseline was omitted from the final model, because the DHI is not a clinical instrument and does not deliver suggestions for clinical interventions. In addition, by using the DHI as a candidate predictor (DHI score at baseline) and as an outcome (DHI score at 6 months), it became the best predictor and overruled other relevant predictors. Finally, predictors retained in the final logistic model were onset of dizziness (≥ 6 months before at baseline), dizziness provoked by standing still, trouble walking or (almost) falling (associated symptom), polypharmacy (≥ 5 medications), no diabetes mellitus, anxiety and depressive disorder, and (impaired) functional mobility measured using the Timed Up and Go Test (Table [2]).

[TABLE 2]

Prediction Models with Sum Scores

The model with simple sum scores performed as well as the model with weighted sum scores, indicating that little information is lost by using the simple sum score. Therefore, and because it is easier to use, only the model with the simple sum scores is presented.

The Hosmer–Lemeshow test (P = .10) confirmed the significant match of observed and expected simple sum scores and as such the predictive power of the final model. The AUC of the final model was 0.80 (95% CI = 0.75–0.84). Table [3]. and the ROC curve show the ability of the simple sum score model to identify individuals with an unfavorable course of dizziness, especially for sum scores of 4 and higher (see also Figure S2).

[TABLE 3]

DISCUSSION

Summary of Main Findings

In this study of the 6-month functional prognosis of dizziness in older adults in primary care, nearly two of three experienced less impairment at follow-up than at baseline, only one in 10 had a substantial increase in impairment, and four in 10 experienced impairment at 6 months. Seven factors predicted an unfavorable course: chronic dizziness (onset at baseline ≥ 6 months before), standing still as a dizziness-provoking circumstance, trouble walking or (almost) falling as an associated symptom, polypharmacy, absence of diabetes mellitus, having an anxiety or depressive disorder, and impaired functional mobility. These all refer to easily obtainable clinical information, and with this instrument, clinicians can identify individuals with the poorest functional prognosis. Clinicians can choose an acceptable cutoff score, depending on their desire to be sensitive or specific.

Comparison with Other Research

This is the first prognostic study of the course and related impairment of dizziness in older adults in primary care. Consistent with this study, the three earlier studies on the prognosis of dizziness in primary care reported a mainly favorable prognosis after 3 to 18 months.[12-14]

More complicated is the comparison of prognostic factors in this study and those identified in the above-mentioned studies. First, there were differences in age and sampling procedures in the populations studied. Furthermore, there was no uniform set of predictors, the studies used different approaches to building a prognostic model, and because of differences in sample size (n = 117,[12] n = 98,[13] n = 247,[14] and n = 417 (present study)), they had different statistical power to detect prognostic associations. Nonetheless, significant findings are consistent. For example, all four studies reported adverse prognostic factors to include anxiety and, in agreement with the current study, two of the other studies[12, 13] reported impaired mobility as an adverse prognostic factor. Finally, one study[12] found that long duration of dizziness (>1 year) was an adverse prognostic factor, as in the current study (>6 months).

Two other predictors were found for persistent dizziness—polypharmacy and the absence of diabetes mellitus—neither of which has been previously reported. Given the often-described relationship between dizziness and medications,[10, 11, 36-40] it is not surprising that polypharmacy was identified as a predictor of a persistent effect of dizziness. The finding that diabetes mellitus is not a predictor of a poor outcome is not obvious. An explanation might be that individuals with diabetes mellitus consult their PCPs more often than those without (because in the Netherlands almost all individuals with diabetes mellitus are in a chronic care program). In that sense, diabetes mellitus is a marker for attentive medical care, and not having diabetes mellitus could increase the chance of receiving less medical attention. Furthermore, predictors of an unfavorable course of dizziness found in the psychiatric and mobility domain merit comment. The relationship between anxiety or depression and the severity and prognosis of dizziness might be circular: dizziness provokes anxiety and depression, and anxiety or depression (and some pharmacological treatments) may provoke dizziness. The exact causative relation is less important. The fact that psychiatric illness (or the pharmacological treatment of these illnesses) independently predicts a worse prognosis of dizziness makes an evaluation of possible comorbid psychiatric illness in older adults essential, as is an evaluation of medication. Next, two of the three predictors in the mobility domain (trouble with walking (as associated symptom) and impaired functional mobility) might be interrelated, although both are identified as independent predictors of a worse prognosis. In that sense, it might be expected that interventions such as exercise and physical therapy positively influence both factors. The third mobility predictor, standing still as a dizziness-provoking circumstance, might indicate disturbances in the autonomous nerve system, as can often be found in older adults, especially for example, when using medication for cardiovascular disorders.

Strengths and Limitations

An important strength of this study is the comprehensive assessment of candidate predictors by choosing variables from a broad spectrum of the diagnostic process, including demographic data, history, physical examination, and diagnostic tests. Nonetheless, some potential predictors may have been missed. For example, self-rated health, or dependency in instrumental activities of daily living (IADLs) were

not included.[12, 13] The data set was almost complete, and the sampling procedure ensured the inclusion of consecutive patients to avoid selection bias. In contrast with earlier studies, older adults were focused on, and finally, an initial sample size of 417 participants and 385 at follow-up enabled robust analyses.

Three of the six diagnostic factors associated with a high dizziness-related impairment in a former cross-sectional study[32] are similar to the seven prognostic factors found in this study: onset of dizziness 6 months or more before, presence of anxiety or depressive disorder, and impaired functional mobility. This indicates that the same clinical information used to identify individuals who suffer most from their dizziness at present can also be used to identify those who will suffer most in the future. In other words, individuals on whom their dizziness has the greatest effect now will be the individuals with the poorest dizziness prognosis.

Although the score of 30 and higher to mark substantial effect of dizziness is frequently used, it has been validated only once in a study on the Norwegian DHI (DHI N, AUC 0.89).[23] In addition, that study was the first to determine the responsiveness of the DHI. The optimal threshold value for detecting change was found to be a difference in DHI scores of ±12, and although of great importance and the best threshold value available to detect change, this has not been validated.

Treatment during the 6 months of follow-up was left to the discretion of the treating physicians. Therefore the results reflect the prognosis of dizziness in a usual care setting. Some individuals might have recovered because of medical or nonmedical interventions, but because 69% of the included participants had experienced dizziness for longer than 6 months at inclusion, and 85% of the participants presented with more than one subtype of dizziness, it is unlikely that easy-to-manage diseases will contribute much to the results. Randomized controlled trials are needed in homogeneous groups of participants to assess the effect of treatment.

Implications for Clinical Practice and Future Research

This study identified predictors indicating which older adults will suffer most from their dizziness after 6 months without knowing the precise cause(s) of their dizziness. Given the relatively benign prognosis of chronic dizziness and with this relatively simple risk prediction model, clinicians should focus on impairment-reduction strategies in older adults who are at greatest risk of a poor functional prognosis of dizziness. Consistent with previous[10] recommendations, the findings of the current study suggest that clinical management might be most effective when treating factors that can be influenced, such as anxiety and depression, polypharmacy, and functional mobility. Future research is needed to determine whether these interventions are effective in reducing dizziness-related impairment.

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The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

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TABLES AND FIGURES

Table 1. Baseline Characteristics of 417 Dizzy Older Adults in Primary Care

Characteristic	Value
Female, n (%)	307 (74)
Age, mean (range)	78.5 (65–95)
Medical history, n (%)	
Cardiovascular disease	205 (49)
Hypertension	239 (57)
Diabetes mellitus	78 (19)
Neurologic disease	145 (35)
Psychiatric disease	142 (34)
Onset of dizziness, months, n (%)	
< 6	128 (31)
≥ 6	289 (69)
Dizziness subtype, n (%)[a]	
Disequilibrium	360 (86)
Presyncope	302 (72)
Vertigo	259 (62)
Atypical	146 (42)
Number of dizziness subtypes per participant, n (%)	
1	62 (15)
2	115 (28)
3	152 (36)
4	88 (21)

[a] Adds up to more than 100%, because most participants described more than one subtype.

Figure 1. Dizziness Handicap Inventory (DHI) scores at baseline and 6-month follow-up.

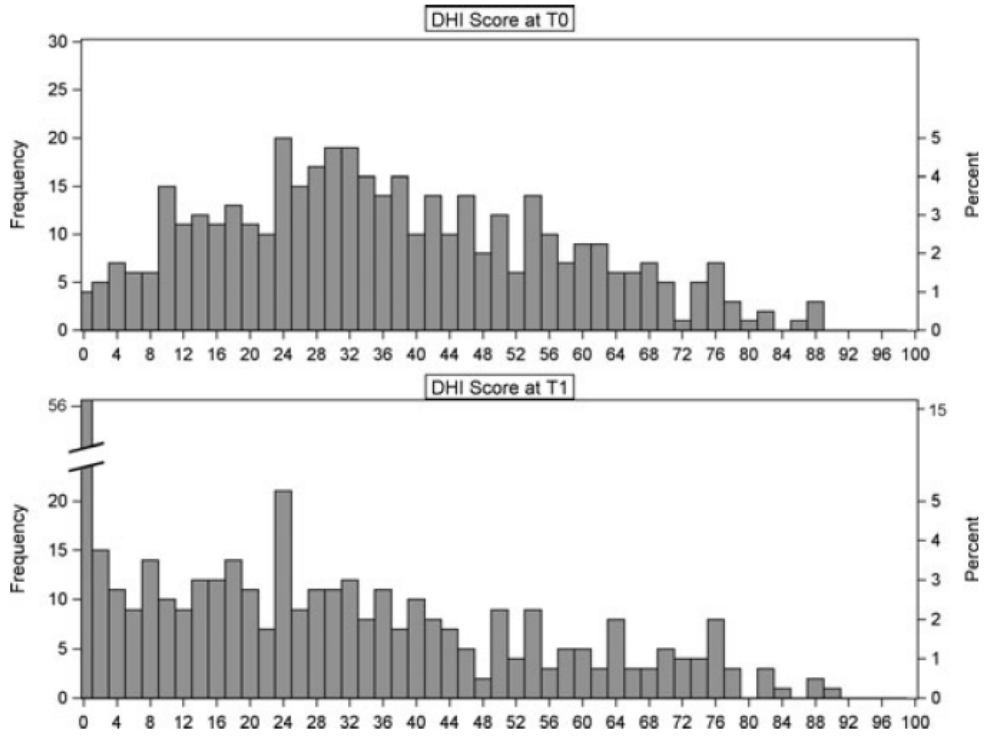

Figure 2. Differences in Dizziness Handicap Inventory (DHI) scores between baseline (T0) and 6 months (T1).

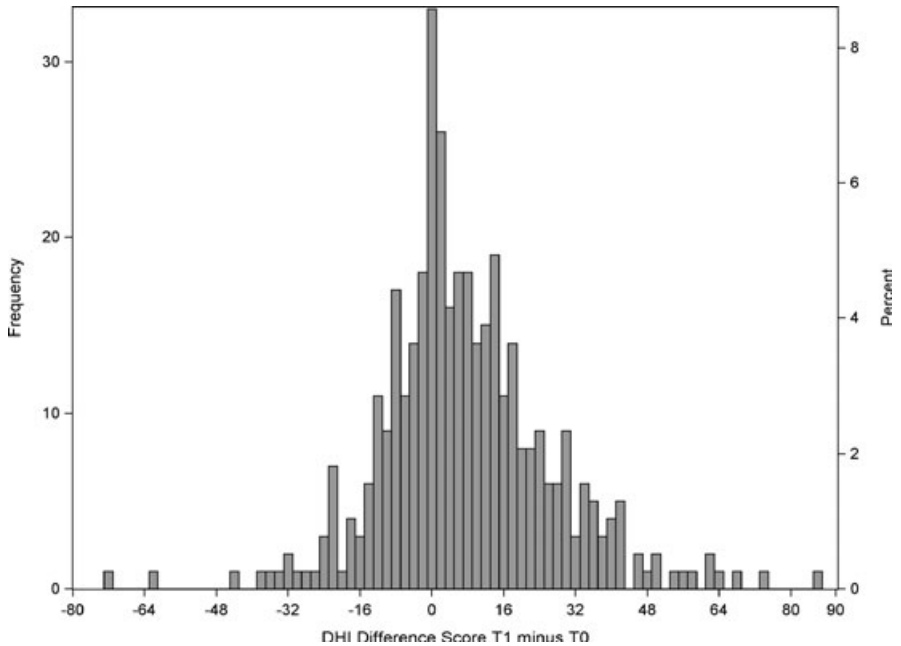

Table 2. Predictors of Moderate to Severe Dizziness-Related Impairment in Older Adults in Primary Care at 6 Months

Predictor	Prevalence in the Study Population, %	Average Regression Weight Over All Bootstrap Samples (B_m)	Regression Weight in Selected Model[a] (B_s)	*P*-Value (B_s)	Pooled Odds Ratio (95% Confidence Interval) (n = 417)
Chronic dizziness ($\geq$ 6 months)	69	1.14	1.04	< .001	2.83 (1.57–5.10)
Standing still (provoking circumstance)	24	0.76	0.74	.007	2.09 (1.20–3.65)
Trouble with walking or (almost) falling (associated symptom)	50	0.88	0.83	.001	2.30 (1.38–3.84)
Polypharmacy ($\geq$ 5 drugs)	42	0.82	0.93	< .001	2.53 (1.51–4.23)
(No) Diabetes mellitus[b]	81	0.93	0.97	.001	2.64 (1.38–5.07)
Anxiety or depressive disorder	22	0.94	0.99	.004	2.69 (1.49–4.84)
Impaired functional mobility (Timed Up and Go Test)	60	0.76	0.82	.001	2.28 (1.39–3.75)
Constant			–3.72		

With dichotomous Dizziness Handicap Inventory score as the dependent variable, with scores from 0 to 30 (mild effect of dizziness) = 0 and 31 to 100 (moderate to severe effect of dizziness) = 1. Stepwise backward logistic regression analysis, bootstrap 1,500×, $\alpha = 0.05$. Only variables selected in $\geq$1,000 of the 1,500 bootstrap samples were retained for the final model and presented as predictors in this table.

[a] Averaged from or pooled across five imputed databases.

[b] (No) Because the inverse relation of this variable is presented.

Table 3. Estimated Probability and Odds Ratio of an Unfavorable Course of Dizziness in Older Adults in Primary Care at 6 Months Corresponding to the Sum Scores

Simple Sum Score[a]	Probability of Unfavorable Course at 6 Months	Odds Ratio
0	0.03	0.03
1	0.05	0.05
2	0.14	0.16
3	0.28	0.39
4	0.49	0.96
5	0.70	2.33
6	0.85	5.67
7	0.93	13.29

[a] Based on simply counting the number of predictors present in a particular participant.