Development and Preliminary Testing of the Biopsychosocial Prognosis Scale for Coronary Artery Bypass Grafting

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ABSTRACT

Background: The present study attempted to develop a self-report scale called Biopsychosocial Prognosis Scale for Coronary Artery Bypass grafting (BIPROSCAB) that measured patients’ prognosis in an integrated manner, a month after they had undergone coronary artery bypass grafting (CABG). Method: The development and preliminary testing of the psychometric properties of BIPROSCAB followed five phases involving 450 patients in total. Results: Findings gave rise to a 25-item scale which was subjected to an exploratory factor analysis using principal component analysis with varimax rotation. A 9-factor structure emerged, and the factors were named post-CABG affect state, post-CABG anxiety, post-CABG physical pain, discomfort in surgical sites, worry about return to normalcy, discomfort in the leg, CABG bio-social by-products, constraints in socializing, and infection and interference to routine life. The reliability, validity, and usability of BIPROSCAB were also analyzed. Conclusion: BIPROSCAB is a reliable, valid, and useful multidimensional self-report scale for measuring and evaluating the impact of medical treatment and psychosocial intervention in patients after CABG.

Key words: Biopsychosocial, coronary artery bypass grafting, exploratory factor analysis, prognosis, self-report scale

INTRODUCTION

Conditions such as coronary artery disease (CAD) which are characterized by chronicity and need for self-care create an imperative to understand the patient’s experience in addition to the medical status. Coronary artery bypass grafting (CABG) is an invasive surgery for CAD to graft blood vessels onto blocked coronary arteries and restore blood supply to the heart. The immediate post-CABG scenario tends to be challenging as patients experience intense pain and fatigue, and yet are required to strictly adhere to advice concerning medication, diet and exercise. Vital to determining the effectiveness of treatment and the need for any further intervention is prognosis estimation. Prognosis is the predicted trajectory and outcome of a disease or medical procedure. Review consultations after CABG
must ideally include a comprehensive assessment of the biopsychosocial state of the patient.

Appraisal of prognosis offers valuable information concerning the patient’s future prospects. For instance, the ability to return to work after CABG has been associated with physiological status as well as psychosocial aspects reported by patients. Psychological factors such as anxiety and depression can interfere with the course of recovery after CABG. During the first month after CABG, complications, irritability, irregularities in biological functions, and fears are prevalent among patients. Subsequent to hospital discharge, therefore, a multifaceted, subjective assessment becomes necessary for appropriate remedy or intervention. An insight into the patient’s emotional experience would allow for collaborative care. To the best of our knowledge, besides the 10-point rating scale for pain, self-report psychosocial tools are seldom administered to patients in Indian hospitals.

In light of the above review, we inferred the need for a multidimensional scale to examine prognosis after CABG through the patient’s self-report. The aim was to construct and assess the psychometric properties of a new scale measuring the prognosis of patients after CABG in an integrated manner, and to evaluate its usability.

**PHASE 1: ITEM WRITING**

We considered four sources of information while developing items for the new scale. First, we undertook a review of recent scientific literature that documented the typical symptoms and experiences of patients during the month after CABG. Next, we referred to existing instruments such as the Coronary Revascularisation Outcome Questionnaire for CABG (CROQ-CABG) for the construction of items and response format. We also conducted case studies with 10 patients who had undergone CABG for in-depth information about their symptoms and experiences during the month following surgery. Furthermore, we consulted medical professionals from the field of cardiothoracic surgery to identify and name the criteria that they considered while evaluating prognosis of patients a month after CABG. Thus, based on these primary and secondary sources, we initially wrote 47 items for use with patients.

**PHASE 2: CONTENT EVALUATION**

We presented the 47-item form to a panel of five experts (three medical doctors and two health psychologists) to assess its content validity. Each expert was to indicate on a checklist whether the items were “Relevant” or “Not relevant.” We identified absolute agreement among the experts as the criterion for content validation. Twenty-five items were retained for preliminary testing, and the measure containing these 25 items was labeled “Biopsychosocial Prognosis Scale for Coronary Artery Bypass grafting (BIPROSCAB).”

**ETHICAL CONSIDERATIONS**

Before commencement of testing, the study protocol was approved by the institutional ethics committee at the University of Hyderabad. In each phase described hereunder, informed consents were obtained from participants.

**PHASE 3: PRELIMINARY ESTABLISHMENT OF RELIABILITY AND VALIDITY FOR BIOPSYCHOSOCIAL PROGNOSIS SCALE FOR CORONARY ARTERY BYPASS GRAFTING**

In the third phase, we conducted a study with patients who underwent CABG to assess the initial reliability and validity of the 25-item BIPROSCAB by means of internal consistency and exploratory factor analysis (EFA).

**Methods**

**Participants**

We adopted the multi-stage sampling method. Hospitals and doctors formed the first and second units of the sample, respectively, and patients composed the final unit. Five private hospitals in Hyderabad city that gave written permission for the study were included, and informed consent was sought from cardiothoracic surgeons for involving their patients in the study. Patients who had undergone an elective CABG were approached. Typically, this referred to patients who were visiting the hospital for their second medical review after surgery. Thus, we included 200 patients with a mean age of 53.7 years (standard deviation [SD] = 8.5). The sample included 82% men and 18% women. Participants had attended school (64%) and college (19.5%), or were nonliterate (16.5%). The sample consisted of employed persons (39.5%), farmers (15.5%), retired persons (17.5%), businessmen (14.5%), homemakers (11%), and unemployed persons (2%).

**Measure**

The newly developed scale, BIPROSCAB, aimed to assess the patient’s level of prognosis a month after CABG. It had 25 items that examined the participant’s biophysical symptoms (e.g., I noticed swelling in both my feet) and psychosocial experiences (e.g., I missed my social life) following surgery. We used a 5-point
rating scale for the response format (1 = Very Often, 5 = Never). The total score ranged between 25 and 125. The higher the score, the better was the prognosis.

Procedure
Patients who satisfied the eligibility criteria and were willing to participate in the study were individually requested to complete BIPROSCAB. For nonliterate participants, the investigator read out the items and wrote down the participant’s responses. The duration of assessment lasted 15–20 min. The participant’s demographic and medical details were also recorded.

Results
Response pattern for Biopsychosocial Prognosis Scale for Coronary Artery Bypass grafting
Table 1 presents the means, SDs, frequencies, and percentages of scores for the 25 items. The mean scores for the items ranged between 2.91 (item 7) and 4.83 (item 14). In terms of the frequency distribution of scores, 24 of the 25 items had the highest frequency of participants against the scale score of 5. Item 7 (I experienced some uneasiness in my chest), however, had the highest frequency of participants against the scale score of 1. On the whole, the distribution of scores across items showed a consistent and a homogeneous pattern [Table 1].

Reliability analysis
Cronbach’s alpha, establishing reliability, was found to be .73, which met the recommended benchmark. [9]

Exploratory factor analysis
We applied EFA using the principal component analysis extraction method with varimax rotation. Initially, we examined whether the data had satisfied the assumptions for EFA. Bartlett’s Test of Sphericity was found to be significant (p < 0.001), while Kaiser-Meyer-Olkin measure of sampling adequacy (0.72) was observed to be satisfactory.

For the purpose of extracting factors, we used two criteria—the scree plot [Figure 1] and Kaiser’s eigenvalue > 1 [Table 2]. Based on these criteria, nine factors emerged which explained a total of 60.10% of the variance. Ten iterations were needed for the factor structure to converge. The factor loading was set at >0.30. In Table 2, factor loadings from the rotated component matrix are given alongside communalities. As all the items had communality values >0.30, all the 25 items were retained. For any item that loaded >0.30 on more than one factor, it was considered a part of the factor where it loaded the highest and was theoretically meaningful [Figure 1 and Table 2].

We, next, named each factor after having examined the respective items therein. Factor 1 which accounted for 16.14% of variance was termed “Post-CABG affect state.” The items here dealt with mood and worry (e.g., I felt very sad and low). Factor 2 which explained 7.71% of the variance was called “Post-CABG anxiety.” The items in this factor involved symptoms characterizing anxiety (e.g., I felt my heartbeat going fast). Factor 3 which contributed 6.66% of variance was labeled “Post-CABG physical pain.” The items were related to surgical and general pains in the body (e.g.,

Figure 1: Scree plot in exploratory factor analysis of Biopsychosocial Prognosis Scale for Coronary Artery Bypass grafting

Table 1: Means, standard deviations, frequencies, and percentages of scores for Biopsychosocial Prognosis Scale for Coronary Artery Bypass grafting

| Item number | Mean (SD) | Scale |
|-------------|----------|-------|
|             | 1 (%)    | 2 (%) | 3 (%) | 4 (%) | 5 (%) |
| 1           | 3.42 (1.80) | 58 (29.0) | 18 (9.0) | 13 (6.5) | 4 (2.0) | 107 (53.5) |
| 2           | 4.45 (1.33) | 23 (11.5) | 3 (1.5) | 4 (2.0) | 1 (0.5) | 169 (84.5) |
| 3           | 4.42 (1.31) | 19 (9.5) | 9 (4.5) | 6 (3.0) | 1 (0.5) | 165 (82.5) |
| 4           | 4.79 (0.87) | 9 (4.5) | 1 (0.5) | 1 (0.5) | 1 (0.5) | 188 (94.0) |
| 5           | 3.32 (1.67) | 56 (28.0) | 11 (5.5) | 24 (12.0) | 31 (15.5) | 78 (39.0) |
| 6           | 4.31 (1.31) | 17 (8.5) | 8 (4.0) | 22 (11.0) | 2 (1.0) | 151 (75.5) |
| 7           | 2.91 (1.82) | 84 (42.0) | 10 (5.0) | 25 (12.5) | 3 (1.5) | 78 (39.0) |
| 8           | 4.32 (1.47) | 29 (14.5) | 5 (2.5) | 3 (1.5) | 0 | 163 (81.5) |
| 9           | 4.60 (1.02) | 8 (4.0) | 5 (2.5) | 16 (8.0) | 1 (0.5) | 170 (85.0) |
| 10          | 4.27 (1.29) | 15 (7.5) | 10 (5.0) | 27 (13.5) | 3 (1.5) | 145 (72.5) |
| 11          | 3.14 (1.90) | 81 (40.5) | 7 (3.5) | 14 (7.0) | 0 | 98 (49.0) |
| 12          | 3.44 (1.88) | 68 (34.0) | 8 (4.0) | 7 (3.5) | 2 (1.0) | 115 (57.5) |
| 13          | 3.10 (1.89) | 82 (41.0) | 8 (4.0) | 13 (6.5) | 3 (1.5) | 94 (47.0) |
| 14          | 4.83 (0.73) | 5 (2.5) | 1 (0.5) | 6 (3.0) | 0 | 188 (94.0) |
| 15          | 3.86 (1.72) | 48 (24.0) | 4 (2.0) | 12 (6.0) | 1 (0.5) | 135 (67.5) |
| 16          | 4.46 (1.22) | 17 (8.5) | 2 (1.0) | 16 (8.0) | 3 (1.5) | 162 (81.0) |
| 17          | 4.70 (0.77) | 3 (1.5) | 4 (2.0) | 8 (4.0) | 21 (10.5) | 164 (82.0) |
| 18          | 4.36 (1.33) | 21 (10.5) | 4 (2.0) | 15 (7.5) | 2 (1.0) | 158 (79.0) |
| 19          | 3.10 (1.82) | 74 (37.0) | 12 (6.0) | 22 (11.0) | 4 (2.0) | 88 (44.0) |
| 20          | 4.51 (1.16) | 14 (7.0) | 3 (1.5) | 15 (7.5) | 3 (1.5) | 165 (82.5) |
| 21          | 3.30 (1.89) | 76 (38.0) | 3 (1.5) | 12 (6.0) | 4 (2.0) | 105 (52.5) |
| 22          | 4.57 (0.87) | 6 (3.0) | 2 (1.0) | 9 (4.5) | 39 (19.5) | 144 (72.0) |
| 23          | 4.63 (1.01) | 10 (5.0) | 1 (0.5) | 15 (7.5) | 2 (1.0) | 172 (86.0) |
| 24          | 4.74 (0.94) | 10 (5.0) | 2 (1.0) | 3 (1.5) | 1 (0.5) | 184 (92.0) |
| 25          | 4.37 (1.28) | 19 (9.5) | 3 (1.5) | 17 (8.5) | 8 (4.0) | 153 (76.5) |

SD – Standard deviation
I had pain in the chest where they had cut for surgery). Factor 4 which explained 5.99% of the variance was referred as “Discomfort in surgical sites.” The items here concerned uneasiness in the operated leg and chest (e.g., I experienced numbness in the surgical sites in the leg/arm). Factor 5 which accounted for 5.51% of the variance was considered as “Worry about return to normalcy.” The items explored the uncertainty and limitation experienced regarding one’s ability to resume normal life (e.g., I found some difficulty in walking normally). Factor 6 which contributed 5.24% of variance was identified as “Discomfort in the leg.” The items in this factor measured postsurgical problems in the operated legs (e.g., I noticed swelling in both my feet). Factor 7 which explained 4.69% of variance was termed “CABG bio-social by-products.” The items here dealt with the potentially negative effects of surgery that involve one’s significant others and wound complications (e.g., My family/friends put restrictions on me because of surgery). Factor 8 which accounted for 4.12% of variance was called “Constraints in socializing.” The items explored the challenge to pursue one’s routine social life and one’s reaction to this situation (e.g., I missed my social life). Factor 9 which contributed 4.03% of variance was labeled “Infection and interference to routine life.” The items in this factor related to serious wound complication after surgery and the hurdles to pursuing routine life activity (e.g., It was strenuous to bathe or dress myself).

We investigated the preliminary internal consistency of the nine factors or subscales [Table 2]. The Cronbach’s alpha values ranged between 0.18 and 0.71 for the factors. Nonetheless, based on the factor loadings which were above .30, all the factors showed ample convergent validity. For verifying the discriminant validity of the factors, we used the factor-based scale approach to generate factor scores and then the intercorrelations were found out. The results presented in Table 3 indicate that there was no high correlation between the factors (r ranged from -0.06 to 0.42), suggesting the presence of discriminant validity [Table 3].
Using one-way repeated measures ANOVA, we looked at the differences across the nine factor-based scale scores. A significant difference was found across the scores, $F(8, 1592) = 563.78, p < 0.001$. Post hoc analyses (Bonferroni) revealed that the mean scores of Factor 1 or “Post-CABG affect state” ($M = 18.19, SD = 3.24$), Factor 2 or “Post-CABG anxiety” ($M = 19.85, SD = 4.56$), Factor 3 or “Post-CABG physical pain” ($M = 10.97, SD = 3.33$), and Factor 6 or “Discomfort in the leg” ($M = 7.17, SD = 2.65$) each differed significantly ($p < 0.001$) from the mean scores of the other eight factors. The mean scores of Factor 4 or “Discomfort in surgical sites” ($M = 9.29, SD = 3.80$), Factor 5 or “Worry about return to normalcy” ($M = 9.21, SD = 2.07$), Factor 7 or “CABG bio-social by-products” ($M = 9.35, SD = 1.39$), Factor 8 or “Constraints in socializing” ($M = 9.19, SD = 1.66$), and Factor 9 or “Infection and interference to routine life” ($M = 9.01, SD = 1.73$) were each significantly different ($p < 0.001$) from the means scores of Factors 1, 2, 3, and 6 only.

**PHASE 4: ESTABLISHMENT OF VALIDITY**

For the objective of investigating the construct validity of BIPROSCAB, we conducted the fourth phase of the study. Theoretically, psychological distress, anxiety, and depression are known to interfere negatively with prognosis after CABG. Hence, we used the Hospital Anxiety and Depression Scale (HADS) along with the newly developed BIPROSCAB to establish discriminant validity by means of assessing the relationships between overall psychological distress and prognosis, anxiety and prognosis, and depression and prognosis.

**Methods**

**Participants**

By means of multi-stage sampling as followed in Phase 3, hospitals, doctors and patients were included as three units of the sample. As reported previously, permission and informed consent had been obtained from hospitals and doctors, respectively. A sample of 150 outpatients (82% men and 18% women) who had been subjected to CABG a month earlier was recruited. The mean age was 56.3 years (SD = 7.6). The educational qualification included those who completed school level education (35.3%), school dropouts (30%), graduation and above (28.7), or were nonliterate (6%). Participants included employed persons (37.4%), retired persons (24.7%), business persons (14%), homemakers (13.3%), farmers (5.3%), laborers (3.3%), and unemployed persons (2%).

**Measures**

BIPROSCAB: This newly developed scale, described under Phase 3, was administered. The internal consistency of the scale in this sample ($n = 150$) was found to be 0.72.

HADS: This 14-item scale was used to evaluate the level of anxiety and depression experienced in the preceding week. HADS had a 4-point scale ranging between 0 and 3 (responses varied item to item). There were two subscales of 7 items each measuring anxiety (e.g., Worrying thoughts go through my mind) and depression (e.g., Have I lost interest in my appearance). The 14 items together indicated the level of overall psychological distress. The score range for the whole scale was between 0 and 42; the subscale scores were in the range of 0–21. The internal consistency of the anxiety and depression subscales was found to be 0.83 and 0.82 respectively. In this sample ($n = 150$), the internal consistency of HADS (anxiety) was 0.55 and of HADS (depression) was 0.66. The permission to use HADS was purchased from GL Assessment, UK.

**Procedure**

Patients visiting the hospital for outpatient consultation were contacted, and the newly developed BIPROSCAB was administered.
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Results
We correlated the total prognosis score and the nine factor-based scale scores from BIPROSCAB with the scores of overall psychological distress, anxiety, and depression obtained from HADS [Table 4]. There were significant negative correlations between overall psychological distress and the total prognosis score as well as all the nine factors. Anxiety was significantly and negatively correlated with the total prognosis score and all factors except CABG bio-social by-products. The total prognosis and seven factor scores (post-CABG affect state, post-CABG anxiety, post-CABG physical pain, worry about a return to normalcy, discomfort in the leg, constraints in socializing, and infection and interference to routine life) each had significant negative correlations with depression. The overall scale of BIPROSCAB and its factors, thus, exhibited discriminant validity, particularly based on the significant negative correlations with overall psychological distress [Table 4].

Phase 5: Assessment for Usefulness of Biopsychosocial Prognosis Scale for Coronary Artery Bypass Grafting

The fifth and final phase that assessed the usefulness of BIPROSCAB compared the patients’ obtained scores on the scale with the time they took to return to normal routine after surgery.

Methods
Participants
The multi-stage sampling method with hospitals, doctors, and patients forming three sample units was adopted as explained in the preceding phases. We approached 100 patients who had been subjected to CABG in the preceding month from four hospitals where permissions were obtained previously. The participants had a mean age of 55.3 years (SD = 7.6). This sample had 79% men and 21% women. The levels of educational qualification were completed schooling (37%), school dropout (25%), graduation (16%), nonliteracy (12%), and post-graduation (10%). There were employed persons (32%), retired persons (22%), business persons (17%), homemakers (13%), farmers (8%), laborers (5%), and unemployed persons (3%).

Procedure
BIPROSCAB was administered to patients who were visiting doctors for the second review, a month after CABG. Approximately, five months after surgery, we followed these patients up over telephone and enquired about the duration they needed to resume their normal routine activities. The duration was recorded in terms of the number of weeks.

Results
Using product-moment correlations, we calculated the correlation coefficients between prognosis scores (on BIPROSCAB) and return to normal routine [Table 5]. There was a significant negative correlation between the total prognosis score and return to normal routine activities, $r(98) = -0.34, p < 0.01$. This suggested a trend wherein a higher total prognosis score on BIPROSCAB was related to a relatively quicker return to normal routine while a lower total prognosis score was related to a relatively slower return. In respect of factor-based scale scores, return to normalcy had significant negative relationships with three factors (post-CABG affect state, post-CABG anxiety, and CABG bio-social by-products) [Table 5].

Discussion
Our objective was to develop a self-report multidimensional measure that assessed, through a

| Table 4: Correlations between nine factor-based scale scores of Biopsychosocial Prognosis Scale for Coronary Artery Bypass grafting and Hospital Anxiety and Depression Scale scores |
|-----------------------------------------------|-----------------|-----------------|-----------------|
| Total prognosis                          | 104.43 (11.41)  | -0.71***        | -0.62***        | -0.54***        |
| Post-CABG affect state                    | 19.32 (1.44)    | -0.63***        | -0.57***        | -0.47***        |
| Post-CABG anxiety                         | 20.12 (3.60)    | -0.56***        | -0.52***        | -0.40***        |
| Post-CABG physical pain                   | 11.41 (2.85)    | -0.47***        | -0.44***        | -0.34***        |
| Discomfort in surgical sites              | 9.64 (3.82)     | -0.21**         | -0.29***        | -0.08           |
| Worry about return to normalcy            | 8.69 (1.94)     | -0.57***        | -0.35***        | -0.56***        |
| Discomfort in the leg                     | 8.19 (2.22)     | -0.33***        | -0.24**         | -0.30***        |
| CABG bio-social by-products               | 9.22 (1.37)     | -0.18*          | -0.13           | -0.16           |
| Constraints in socializing                | 9.60 (1.00)     | -0.35***        | -0.26**         | -0.31***        |
| Infection and interference to routine life| 8.23 (1.99)     | -0.29***        | -0.22**         | -0.25**         |
| Mean (SD)                                 | -               | 4.13 (3.44)     | 1.85 (1.90)     | 2.27 (2.32)     |

*p < 0.05, **p < 0.01, ***p < 0.001. CABG – Coronary artery bypass grafting; SD – Standard deviation
biopsychosocial lens, the prognosis of patients who had undergone CABG. The analyses for initial psychometric properties of BIPROSCAB revealed that the scale which emerged with a 9-factor structure had acceptable reliability, validity, and usability.

Out of the nine factors, four (post-CABG affect state, post-CABG anxiety, worry about return to normalcy, and constraints in socializing) were found to be psychosocial in nature, two (CABG bio-social by-products, and infection and interference to routine life) were noted to be bio-social in nature, and only three (post-CABG physical pain, discomfort in surgical sites, and discomfort in the leg) were seen to be purely bio-physiological. This suggests the significance of psychosocial aspects for measuring prognosis. The use of such an instrument captures the dynamism of symptoms, moods, and interpersonal issues from the patient’s perspective.

Across five phases of the study, BIPROSCAB exhibited preliminary acceptable levels of internal consistency reliability and construct validity. The finding that prognosis had significant negative correlations with overall psychological distress, anxiety, and depression was similar to trends reported in the empirical literature. This reflects the influence psychological distress exerts on convalescence. The significant negative relationship between prognosis and return to normal routine in this study, which was also evidenced earlier, testifies to the application value of BIPROSCAB. The scale serves as a quick and economical measure that can point out the speed of patients’ functional recovery. Further, the comprehensive scale may be useful for understanding and resolving instances where the patient’s resumption of normal routine is delayed despite the biomedical criteria indicating “good prognosis.”

### Implications

The newly developed BIPROSCAB can be employed to measure prognosis holistically and dimensionally. It allows health professionals to gauge the efficacy of their treatment and intervention in addressing the individual needs of patients of CABG. Its utility extends to screening, diagnostics, and research. BIPROSCAB, therefore, can emerge as an aid to foster patient-centered and patient-driven healthcare.

### CONCLUSION

BIPROSCAB is a reliable, valid, and useful multidimensional self-report scale for measuring and evaluating the impact of medical treatment and psychosocial intervention in patients after CABG. The overall scale has the strength of psychometric integrity with acceptable reliability, thus making it fit to assess prognosis based on the composite score. The factor-wise assessment may be considered after using confirmatory factor analysis and establishing adequate reliability coefficients for each of the final factors.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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