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Denollet, Johan

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EMOTIONAL DISTRESS AND FATIGUE IN CORONARY HEART DISEASE: THE GLOBAL MOOD SCALE (GMS)

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Johan Denollet

Center of Cardiac Rehabilitation, University Hospital of Antwerp, Antwerp, Belgium

Address for correspondence:

Johan Denollet
UZA - Cardiale Revalidatie
Wilrijkstraat, 10
B-2650 Edegem
BELGIUM

Telephone: 00 32-3-829.11.11 ext. 1941
Fax: 00 32-3-829.05.20

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Running title: EMOTIONAL DISTRESS AND FATIGUE IN CHD
SYNOPSIS
Evidence indicates that emotional distress has a long-term impact on morbidity and mortality in patients with coronary heart disease (CHD), and that symptoms of depression, fatigue, and reduced energy may identify high-risk patients. This study was designed to (1) devise a sound and practical measure of emotional distress in CHD patients, (2) examine the relationship between emotional distress and fatigue following CHD, and (3) examine changes in emotional distress as a function of cardiac rehabilitation. A sample of 478 men with CHD (mean age = 57.8 ± 8.7 y) filled out questionnaires 3-6 weeks following a myocardial infarction (N=110), bypass surgery (N=302), or coronary angioplasty (N=66). Statistical analyses of 56 Dutch mood terms were used to produce the 20-item Global Mood Scale (GMS) which measures negative affect - characterized by fatigue and malaise - as well as positive affect - characterized by energy and sociability - in patients with CHD. The GMS was found to be a reliable scale (α>.90; r>.55 over a 3-month period), and correlations with existing measures of emotional functioning and self-deception indicated its convergent and discriminant validity. Most important, fatigue was not related to cardiorespiratory fitness in a subset of 140 patients, but clearly was associated with negative affect. Consistent with the self-efficacy model, scores on the GMS mood scales improved significantly as a function of rehabilitation (p<.0001). Although symptoms of emotional distress are easily explained away by situational factors, previous research suggests that failure to recognize the clinical significance of these symptoms in CHD patients may result in the delay of much needed intervention. The current findings suggest that the GMS is a theoretically and psychometrically sound measure of emotional distress in CHD patients, and that this scale is sufficiently sensitive to assess change.
INTRODUCTION

A growing body of evidence indicates that, apart from biomedical correlates of disease severity, psychosocial variables may be related to morbidity and mortality in patients with coronary heart disease (CHD). High levels of life stress (Ruberman et al., 1984), use of sedatives (Wilkund et al., 1988), depression (Ahern et al., 1990; Silverstone, 1990; Ladwig et al., 1991), psychological stress symptoms (Frasure-Smith, 1991), and somatic manifestations of emotional distress (Shekelle et al., 1991) have been associated with an increased long-term risk for reinfarction and cardiac mortality among post-myocardial infarction patients. Depression has also been associated with increased morbidity and mortality in arrhythmia patients (Kennedy et al., 1987) and patients with angiographically documented CHD (Carney et al., 1988). The similarity of results of these studies suggests that, whether psychological stress is inferred from life circumstances or from symptoms of distress, the negative emotions involved may have a major long-term impact in CHD patients (Frasure-Smith, 1991). Moreover, several physiological precursors of sudden death may be promoted by emotional distress (Kamarck & Jennings, 1991).

Unfortunately, symptoms of emotional distress are non-specific of a cardiac disease. Emotional distress may, in fact, be associated with cardiologic complaints but not actual CHD (e.g., Watson & Pennebaker, 1989). Conversely, research also suggests that depression may be predictive of CHD (e.g., Booth-Kewley & Friedman, 1987) and mortality (e.g., Murphy et al., 1987). Hence, the role of emotional distress in the development of CHD remains controversial.

**Emotional distress and fatigue.** Emotional experience is characterized by two dominant dimensions: negative and positive affect (Watson & Tellegen, 1985). Although the terms negative and positive might suggest that these emotional factors are opposites, they are in fact largely independent dimensions which have quite different correlates and score distributions. Negative affect is a dimension of distress that is associated with health complaints and mental stress, while positive affect is a dimension of energy that is associated with activity and social engagement (Watson & Pennebaker, 1989). Positive affect displays a normal distribution of scores between individuals, the scores being spread across a broad range of moderate values; negative affect scores, in contrast, tend to cluster together in a small range of low values. Moreover, negative affect scores are not likely to change within individuals, but instead tend to remain at a fairly constant low level (Watson & Tellegen, 1985; Zevon & Tellegen, 1982).

Many patients with CHD may, however, deny negative moods (Ahern et al., 1990), but rather may complain about feelings of fatigue (Alonzo et al., 1975; Hurst et al., 1990). In the general population, fatigue is highly associated with emotional distress, and adults who experience any psychological problems are at much higher risk of feeling fatigue than those who are free from psychological problems (Chen, 1986). Research suggests that fatigue is a potential premonitory symptom of myocardial infarction and sudden death (Alonzo et al., 1975; Appels & Mulder, 1988). Reduced energy and disengagement from activities (i.e., low positive affect) may also be related to
cardiac arrest and mortality in patients with CHD (Ahern et al., 1990). Most important, emotional distress following CHD is not related to the severity of cardiac disorder (Schleifer et al., 1989), but predominantly is a function of the individual's general tendency to experience distress (Denollet, 1991 & 1992; Denollet & De Potter, 1992).

Assessment of emotional distress. Since most cardiac patients are not psychiatric patients, traditional psychometric scales may be burdensome for CHD patients to complete. In this study, common mood terms were therefore selected to comprise a measure of emotional distress that may be perceived as being relevant to patients with CHD. Ideally, this scale also had to be sensitive to changes in emotional distress as a function of intervention. Although cardiac rehabilitation programs may reduce mortality (O'Connor et al., 1989), research largely failed to document a psychological effect of these programs (Blumenthal et al., 1988; Taylor et al., 1986). This is an unexpected finding because rehabilitation enhances the patient's perceived control (Krantz, 1980) which is closely related to his or her emotional status (Litt, 1988). However, research on the recovery process is hindered by the lack of standardized instruments that are relevant to patients with CHD (Krantz, 1980). In view of the central role of emotional distress in recovery from CHD, the purposes of this study are three-fold: (1) to devise a theoretically and psychometrically sound measure of emotional distress in CHD, (2) to examine the relationship between distress, fatigue, and objectively assessed fitness, and (3) to examine changes in emotional distress as a function of cardiac rehabilitation.

METHOD

Subject population. A sample of 478 men with CHD (mean age=57.8 years, SD=8.7) was drawn from four hospitals: the University Hospital of Antwerp (N=284), the Middelheim (N=105) and Sint Jozef (N=16) hospitals in Antwerp, and the Maria's Voorzienigheid hospital (N=73) in Kortrijk (a Belgian town which is about 100 kilometers from Antwerp). Subjects of the University Hospital were referred by their cardiologist or general practitioner to the cardiac rehabilitation program of this hospital; subjects from the other hospitals either participated in home-based cardiac rehabilitation (Middelheim hospital) or had no access to a rehabilitation program and received standard medical care alone (Sint Jozef and Maria's Voorzienigheid hospitals). All subjects agreed to participate in the study and filled out questionnaires at 3-6 weeks after one of the following coronary events: acute myocardial infarction N=110, coronary artery bypass surgery N=302, or percutaneous transluminal coronary angioplasty N=66.

The Antwerp rehabilitation program. The factors that determine the presence of patients on this program are largely a function of the attitude of cardiologists and general practitioners towards cardiac rehabilitation. The Antwerp rehabilitation program lasts 3 months and includes exercise training, psychosocial group interventions, and individual counseling. The exercise program comprises 36 sessions of one hour each: 24 sessions (3 x week) of exercising on different apparatus (bicycle, treadmill, etc.) while being monitored on ECG, and 12 sessions (2 x week) of
aerobic exercise and ball games in a sports hall, this time without ECG-monitoring. The psychosocial program comprises 6 group sessions of two hours each (1 x week) with patients and spouses, and aims at health education, modification of risk factors, and communication about CHD. Individual medical, dietary, and psychosocial counseling offers the opportunity to tailor the rehabilitation program to the needs of each individual patient.

Global Mood Scale (GMS). Since all subjects were native speakers of Dutch (the present study was conducted in the Dutch-speaking part of Belgium), this language was used to assess subjective mood states. A list of 56 Dutch mood terms was devised to reflect the two-dimensional model of mood (Watson & Tellegen, 1985). Statistical analyses on a subsample of 205 subjects were used to produce an intermediate scale comprising 16 negative and 16 positive mood terms. This scale was administered to a second subsample, and the following criteria were used to devise the final scale: mood terms with high (1) endorsement frequency, (2) factor loading, and (3) internal consistency were retained; mood terms with a substantial loading on both negative and positive affect dimensions were deleted. Since samples of less than 20 descriptors may not provide an adequate representation of the two-dimensional mood space (Watson & Tellegen, 1985), the final version of the GMS comprises 10 negative and 10 positive mood terms that are commonly reported by male patients with CHD. The respondent is asked to rate on a 5-point scale (ranging from not at all to extremely) the extent to which he/she has experienced each mood state lately. An English translation of the GMS is given in the Appendix.

Measures of emotional distress. In order to examine the extent the GMS correlates with already accepted measures of emotional distress, a subset of 445 patients completed an abbreviated version of the Profile of Mood States (POMS, Wald & Mellenbergh, 1990), the State-Trait Anxiety Inventory (STAI, Van Der Ploeg et al., 1980), and the Heart Patients Psychological Questionnaire (HPPQ, Erdman et al., 1986). The fatigue, depression, tension, and anger subscales of the abbreviated POMS (Wald & Mellenbergh, 1990) were predicted to correlate positively with the GMS Negative Affect dimension, while the vigor subscale was predicted to correlate positively with the GMS Positive Affect dimension. The state subscale of the STAI (Van Der Ploeg et al., 1980), and the well-being subscale of the HPPQ (Erdman et al., 1986) tap a broad range of pleasant as well as unpleasant mood states (Watson et al., 1988); therefore, these subscales were predicted to load on both affect dimensions of the GMS.

Measure of self-deception. The Marlowe-Crowne scale (Crowne & Marlowe, 1960) was used to assess the self-deceptive factor that underlies defensiveness (Gur & Sackeim, 1979). Although the Marlowe-Crowne scale was originally developed as a measure of social desirability, later evidence indicates that this scale measures itself an individual difference variable which is related to unconscious defensiveness and social adjustment (Lane et al., 1990; McCrae & Costa, 1983). Most important, coronary patients who have a high score on the Marlowe-Crowne scale tend to remain unaware of unpleasant emotional realities (Denollet, 1991). Since self-deception is a
global personality trait that is largely independent of negative affect and positive affect dimensions (Denollet, 1992; Denollet & De Potter, 1992), this measure of defensiveness was predicted to be largely unrelated to the GMS scores.

**Cardiorespiratory fitness.** The results of a sign- or symptom- limited exercise test at 6 weeks after the coronary event were obtained in a subset of 140 patients. The WATT level (European standard for work capacity) was predicted to be largely unrelated to the GMS scores.

**Sensitivity to change.** To examine the sensitivity of the GMS to changes in affect as a function of cardiac rehabilitation, a subset of 120 patients (mean age 56.3 ± 8.2; myocardial infarction N=55, bypass surgery N=48, coronary angioplasty N=17) filled out again the GMS at 3 months after the first assessment. Sixty patients received standard medical care at the hospital of Kortrijk, while 60 patients completed the Antwerp rehabilitation program. Between July 1989 and December 1990, 11 out of 125 patients dropped out of this 3-month program which includes exercise training and psychosocial counseling. The 60 selected rehabilitation patients did not differ from the 54 remaining patients regarding their emotional response to the program.

**Statistical analyses.** The frequency distribution of the Dutch mood terms was calculated in order to isolate terms with a high endorsement rate. Multivariate analyses (Mardia et al., 1979) were used for the development of the GMS. Item level factor analysis (principal components with varimax rotation) was performed to examine the dimensional structure of mood terms, and the scree plot (Cattell, 1966) was used to decide on the optimum number of factors to retain. Cronbach's á was used to obtain internal-consistency estimates of reliability. Test-retest reliability over a 3-month period was examined in a subset of 60 subjects receiving standard medical care. Pearson's correlations and scale level factor analysis were used to examine the validity of the GMS, and its descriptive characteristics were outlined. Changes in emotional distress were analyzed by repeated measures MANOVAs with program (rehabilitation vs. control) as between-subjects factor and time (entry vs. end score) as within-subjects factor.

**RESULTS**

**FIGURE 1 Two-dimensional model of affect.** Factor analysis of the 20 items comprising the GMS indicated a marked 'elbow' that inflects at the 3th factor (Figure 1). This finding confirms the existence of two dominant dimensions in self-reported affect that accounted for 43% and 18% of the total variance. Succeeding factors are much smaller and roughly similar in size. The 3th, 4th, and 5th factor, for example, only explained 6%, 5%, and 3% of the total variance, respectively. Moreover, two out of three items comprising the 4th factor also had substantial loadings on the 1th factor, while four out of six items comprising the 3th and 5th factors also had substantial loadings on the 2th factor (i.e., factor loadings in the range of .35 to .55). Of course, the two-dimensional model is not competitive with, but rather is complementary to, multifactorial models of affect (Watson & Clark, 1992; Watson & Tellegen, 1985).
TABLE 1  Negative Affect and Positive Affect subscales of the GMS. Most mood terms were marked positively (i.e., score>0) in at least 50% of the cases, which suggests their relevance to CHD patients (Table 1). Negative affect was predominantly characterized by terms reflecting fatigue/malaise, while positive affect was characterized by terms of energy/activity. Factor analysis indicated that these mood terms are relatively pure markers of either negative or positive affect: items had a substantial loading on one factor but a much lower loading on the other. Cronbach's α (>0.90) and corrected item-total correlations (>0.50) indicated a high level of internal consistency for both negative and positive mood terms. Items were therefore summed to comprise Negative Affect and Positive Affect subscales (range 0-48). The reliability of these subscales over a 3-month period was .66 and .57, respectively (N=60). In general, these findings suggest that the GMS is a sound measure of negative and positive affect in CHD.

TABLE 2  Relationship to emotional distress, defensiveness, and fitness. The correlation of -.39 among the Negative and Positive Affect subscales indicated that they shared only 15% of their variance (Table 2, left side). This figure does not suggest a bipolar relation between negative and positive mood states in CHD. The correlations among the GMS Negative Affect subscale and the fatigue, depression, and tension subscales of the abbreviated POMS (Wald & Mellenbergh, 1990) indicated that fatigue was closely related to emotional distress in the current sample of CHD patients. Likewise, almost 80% of the variance in the GMS Positive Affect subscale could be explained by a psychological state of vigor. Conversely, the Negative and Positive Affect subscales were largely independent of defensiveness (i.e., 1% of shared variance with the self-deception scale). Factor analysis with varimax rotation clearly identified the a priori conceptualized negative affect, positive affect, and self-deception dimensions (Table 2, right side). As predicted, the transient distress and well-being scales loaded on both dimensions of the mood space. These findings revealed a remarkably consistent pattern of convergent and discriminant validity. Most important, cardiorespiratory fitness as measured by stress testing was neither related to the Negative (r=-.02) or Positive (r=.05) Affect subscales of the GMS, nor to the Fatigue (r=-.04) or Vigor (r=.01) subscales of the abbreviated POMS.

TABLE 3  Distribution of GMS scores. The Negative Affect and Positive Affect subscales were neither related to age [F(1,476)=0.98 and 1.22, respectively, p>.30], nor to medical category [F(2,475)=1.21 and 0.48, respectively, p>.30]. As could be expected, the mean Negative Affect score was much lower than the mean Positive Affect score (Table 3). The standard deviations of both subscales were large enough to provide an acceptable distribution of scores. The 20th, 40th, 60th, and 80th percentiles were used to divide the observed distributions into 5 categories. Intense negative moods occur infrequently in normal subjects (Clark & Watson, 1991); however, only frequently endorsed mood terms were selected to comprise the GMS subscales. Therefore, differences in distribution between extrapolated GMS and POMS scores of negative affect (both ranging from 0 to 100) were examined. The POMS score of negative affect was extrapolated from the depression, tension, and anger subscales of the abbreviated POMS (Wald & Mellenbergh,
The extrapolated mean GMS score of negative affect (=23.7) was significantly higher than that of the POMS (=16.4) \[F(1,444)=75.93, p<.0001\].

Moreover, the GMS displayed a relatively normal clustering of negative affect scores (kurtosis=0.65), whereas the POMS displayed a peaked distribution of low negative affect scores (kurtosis=3.04). These findings suggest the possibility that CHD patients may perceive the GMS as being more relevant than traditional measures to describe their negative mood state.

**TABLE 4 Sensitivity to change.** There was no significant difference between the 60 rehabilitation and 60 control subjects with reference to age, medical category, or GMS scores at baseline. Repeated measures MANOVA indicated that changes in GMS scores over a 3-month period were significantly different as a function of rehabilitation \[F(1,118)=5.68 \text{ and } 6.21, \text{ respectively, } p<.05\]. Rehabilitation subjects reported a significant decrease in negative affect, and a significant increase in positive affect (Table 4). In contrast, control subjects did not report significant changes in affect. These findings suggest the sensitivity to change of the GMS.

**DISCUSSION**

This study demonstrates that the model of negative and positive affect that was primarily observed in U.S. college students (Watson & Tellegen, 1985; Watson et al., 1988) is equally applicable to Belgian men with CHD. Fatigue was not related to cardiorespiratory fitness, but clearly was a marker of negative affect. Correlations among the GMS and frequently used distress scales indicated that negative affect explained up to 50% of the variance in complaints of fatigue. Likewise, fatigue in the general population is closely correlated with depression (e.g., Ray, 1991). A state of depression, which is typically characterized by a combination of high negative affect and low positive affect (Clark & Watson, 1991), may be a significant precursor of cardiac arrest and mortality among CHD patients (Ahern et al., 1990; Carney et al., 1988; Kennedy et al., 1987; Ladwig et al., 1991; Silverstone, 1990). Accordingly, low levels of vigor - a good marker of positive affect in the current study - were found to predict coronary events in CHD patients (Ahern et al., 1990). The finding that emotional distress was not related to physical fitness is consistent with the observation that the relationship between emotional distress and morbidity/mortality among CHD patients is independent of objective measures of disease severity and physical condition (e.g., Ahern et al., 1990; Frasure-Smith, 1991; Ruberman et al., 1984). This implies that vulnerability to emotion-related complications of CHD cannot be inferred from standard medical diagnosis, and thus requires specific psychological assessment.

With reference to this issue, the research reported here has a number of limitations. The GMS scales still need to be validated on an English-speaking population and the results of this study need to be replicated. Moreover, the lack of data indicating the prediction of outcomes such as coronary events makes it impossible to determine whether the dimensions assessed by the GMS are, in fact, those which are most important. Prospective studies are needed to evaluate the ability of the GMS to assess emotion-related mortality in CHD populations. Albeit beyond the scope of this
paper, recent studies suggest that silent myocardial ischemia and platelet activation are involved in the long-term impact of emotional distress in CHD patients (Grignani et al., 1991; Krantz et al., 1991). When the coronary endothelium is damaged, platelet-derived serotonin that normally elicits vasodilatation in smooth coronary vessels instead may cause vasoconstriction (Golino et al., 1991). Since platelet activation is associated with emotional distress, this finding may help to elucidate the mechanism by which emotional distress contributes to coronary events in CHD patients (Dimsdale, 1991; Markovitz & Matthews, 1991).

The ability to regulate one's own mood is also an important prerequisite for maintaining a positive self-appraisal of one's own health status (Croyle & Uretsky, 1987). Emotional distress therefore may slow recovery from CHD (e.g., Pancheri et al., 1978). Evidence suggests, for instance, that emotional distress is associated with failure to adhere to exercise therapy (Blumenthal et al., 1982a) and failure to return to work (Denollet & De Potter, 1992) in CHD populations. Psychological factors even seem to be stronger determinants of poor adaptation to CHD than disease severity (Wiklund et al., 1984). Most important, CHD patients who report high levels of emotional distress in the hospital or during the weeks following discharge are also likely to experience distress later in their life (Denollet & De Potter, 1992; Frasure-Smith, 1991). These findings stress the need for adequate measurement of emotional distress in CHD.

The current results suggest that the GMS is a reliable and valid measure of emotional distress in CHD populations. Factor analysis provided direct evidence for the two-factor model of affect undergirding its development (Watson & Tellegen, 1985). The GMS was also found to be a homogeneous (≥.90) and relatively stable (≥.55 over a 3-month period) scale, and correlations with existing measures of emotional distress indicated its convergent validity. Conversely, the GMS was largely unrelated to self-deception. However, something more is required than mere psychometric soundness to establish that the GMS has theoretical value. The GMS is not a competitor with existing measures of mood such as the POMS or the Multiple Affect Adjective Check List (MAACL, Zuckerman & Lubin, 1965), but rather is complimentary to them. Given the overlap of the GMS with measures that are widely used in psychological research, it is important to provide a clear rationale for the development of this new mood scale.

First, the GMS - unlike the POMS or MAACL - was devised on the basis of the two-factor model of mood (Watson & Tellegen, 1985), and with a medical population in mind. Despite their multifactor solutions, the high interscale correlations of both the POMS and the MAACL suggest that a more parsimonious set of factors may exist. In fact, factor analysis of the POMS in two samples of cancer patients (Guadagnoli & Mor, 1989), and the MAACL in one sample of undergraduate students (Gotlib & Meyer, 1986) revealed the presence of two major components reflecting negative and positive affect. While negative affect accounts for most of the overlap among self-ratings of depressive and anxious symptomatology, the relative absence of positive mood is critical in distinguishing depression from anxiety (Clark & Watson, 1991). Since
depression appears to be detrimental to recovery from CHD (e.g., Ahern et al., 1990), the ability to reliably assess positive affect may be a promising feature of the GMS. Although other scales that measure negative and positive affect already exist (e.g., Watson et al., 1988), they were not designed for medical patients (Guadagnoli & Mor, 1989).

Second, the GMS and POMS differed in their threshold for endorsement of negative mood terms. As a consequence, scores on the negative mood scales of the GMS and POMS are differentially distributed. The high kurtosis of the POMS could be argument for using this scale, since higher scores are likely to indicate very distressed individuals. However, the low mean POMS scores at baseline may leave little room for improvement as a function of treatment. Accordingly, studies that used the POMS on a test-retest basis revealed mixed evidence for the psychological effects of exercise (Blumenthal et al., 1982b; Hughes et al., 1986). Because of the infrequent occurrence of intense negative moods in normal subjects (Clark & Watson, 1991), only frequently endorsed mood terms were retained to comprise the Negative Affect subscale of the GMS. This scale has a relatively normal clustering of scores, and appears to be sensitive to change due to sufficiently high scores at baseline. Albeit largely inconsistent with previous research (Blumenthal et al., 1988; Taylor et al., 1986), the change in GMS scores as a function of treatment supports the theoretical notion that cardiac rehabilitation enhances perceived control (Krantz, 1980) which in turn may reduce emotional distress (Litt, 1988). Multidimensional rehabilitation may, in fact, improve the emotional status of CHD patients (Dracup et al., 1991). The current findings should be interpreted cautiously because a quasi-experimental design was used. Since cardiac rehabilitation may be a life-saving intervention (O'Connor et al., 1989), random assignment of CHD patients to rehabilitation and control groups is of questionable ethical value (Blodgett & Pekarik, 1987). The lack of significant differences on demographic or dependent variables at baseline suggests the appropriateness of the control group.

Third, short and easily repeatable measures are lacking in research on recovery from CHD. Measures such as the POMS have a relatively long administration time (Guadagnoli & Mor, 1989), and may be burdensome for nonclinical populations to complete (King et al., 1986). The more burdensome the scale, the greater likelihood of it not being completed or being answered illegitimately, which in turn can undermine a study (Gallacher & Smith, 1989). The GMS therefore is appealing in its practicality: the measure is brief, easy to administer, and may be perceived as being immediately relevant to CHD patients. Moreover, interpretation of scores is aided by scale norms.

Symptoms of fatigue and general malaise are easily explained away by overwork, psychological stress, aging, or other situational factors; as a consequence, the overall response of patients and the medical community to these symptoms is that they are 'manageable' or that a period of 'wait and see' is appropriate (Alonzo et al., 1975). In contrast, accumulating evidence indicates that failure to recognize emotional distress in CHD patients may result in the delay of much needed
intervention (e.g., Frasure-Smith, 1991). Apart from treatment of standard risk factors (i.e., smoking, hypertension, hyperlipidemia), CHD patients can benefit from help in dealing with their problems (Wiklund et al., 1988). Reductions in mortality associated with a stress monitoring program and cardiovascular medication trials may, in fact, fall within the same range (Frasure-Smith, 1991). In addition, research suggests that feelings of exhaustion (Appels & Mulder, 1988) and depression (Booth-Kewley & Friedman, 1987) may be associated with the development of CHD. Although this is a controversial and speculative point, it raises the possibility that intervention programs aiming at the prevention of CHD in middle-aged subjects (De Backer et al., 1988) may benefit from the appropriate assessment of emotional distress. On the whole, the current findings suggest (1) that the GMS is a reliable, valid, and practical measure of emotional distress in CHD populations, (2) that fatigue is largely unrelated to physical fitness but rather is a good marker of negative affect in patients recovering from CHD, and (3) that the GMS is sufficiently sensitive to assess changes in emotional distress.
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APPENDIX: THE GLOBAL MOOD SCALE
Below are a number of words that describe different feelings and emotions. Please read each item carefully and then circle the appropriate number next to that word. Indicate to what extent you have felt this way lately. Please use the following scale to record your answers.

<table>
<thead>
<tr>
<th>Number</th>
<th>Word</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>= NOT AT ALL</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>= A LITTLE BIT</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>= MODERATELY</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>= QUITE A BIT</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>= EXTREMELY</td>
<td></td>
</tr>
</tbody>
</table>

To what extent have you felt this way lately:

1. **Wearied** → 0 1 2 3 4
2. **Active** → 0 1 2 3 4
3. **Worn out** → 0 1 2 3 4
4. **Dynamic** → 0 1 2 3 4
5. **Bright** → 0 1 2 3 4
6. **Helpless** → 0 1 2 3 4
7. **Hard-working** → 0 1 2 3 4
8. **Feeble** → 0 1 2 3 4
9. **Lively** → 0 1 2 3 4
10. **Physically weak** → 0 1 2 3 4
11. **Listless** → 0 1 2 3 4
12. **Tired** → 0 1 2 3 4
13. **Enterprising** → 0 1 2 3 4
14. **Relaxed** → 0 1 2 3 4
15. **Insecure** → 0 1 2 3 4
16. **Sociable** → 0 1 2 3 4
17. **Cheerful** → 0 1 2 3 4
18. **Fatigued** → 0 1 2 3 4
19. **Weakened** → 0 1 2 3 4
20. **Self-confident** → 0 1 2 3 4
REFERENCES


### Table 1  ENDORSEMENT FREQUENCY, FACTOR STRUCTURE, AND INTERNAL CONSISTENCY OF NEGATIVE AFFECT AND POSITIVE AFFECT SUBSCALES (N=478).

<table>
<thead>
<tr>
<th>NEGATIVE AFFECT</th>
<th>Endorsement Frequency</th>
<th>Factor Analysis*</th>
<th>Internal†</th>
<th>POSITIVE AFFECT</th>
<th>Endorsement Frequency</th>
<th>Factor Analysis*</th>
<th>Internal†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Factor Analysis</strong></td>
<td>Internal Consistency</td>
<td></td>
<td></td>
<td><strong>Factor Analysis</strong></td>
<td>Internal Consistency</td>
</tr>
<tr>
<td>Weekened</td>
<td>71%</td>
<td>.82</td>
<td>-.17</td>
<td>.79</td>
<td>Sociable</td>
<td>91%</td>
<td>.07</td>
</tr>
<tr>
<td>Tired</td>
<td>65%</td>
<td>.88</td>
<td>-.12</td>
<td>.84</td>
<td>Bright</td>
<td>90%</td>
<td>.06</td>
</tr>
<tr>
<td>Fatigued</td>
<td>64%</td>
<td>.88</td>
<td>-.17</td>
<td>.86</td>
<td>Lively</td>
<td>89%</td>
<td>-.23</td>
</tr>
<tr>
<td>Physically weak</td>
<td>62%</td>
<td>.86</td>
<td>-.12</td>
<td>.82</td>
<td>Cheerful</td>
<td>89%</td>
<td>-.20</td>
</tr>
<tr>
<td>Feeble</td>
<td>58%</td>
<td>.80</td>
<td>-.09</td>
<td>.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearied</td>
<td>55%</td>
<td>.85</td>
<td>-.16</td>
<td>.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insecure</td>
<td>51%</td>
<td>.53</td>
<td>-.22</td>
<td>.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listless</td>
<td>43%</td>
<td>.70</td>
<td>-.21</td>
<td>.69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worn out</td>
<td>37%</td>
<td>.85</td>
<td>-.11</td>
<td>.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helpless</td>
<td>32%</td>
<td>.59</td>
<td>-.19</td>
<td>.56</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mean endorsement frequency</th>
<th>mean factor analysis</th>
<th>Cronbach's alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>=54%</td>
<td>I=8.60</td>
<td>á=.94</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mean endorsement frequency</th>
<th>mean factor analysis</th>
<th>Cronbach's alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>=87%</td>
<td>II=3.55</td>
<td>á=.91</td>
</tr>
</tbody>
</table>

* Principal components analysis with varimax rotation; loadings of mood terms assigned to a factor are presented in boldface.
† Corrected item-total correlations.
Table 2  Intercorrelation matrix and factor analysis of the GMS, POMS, STAI, HPPQ and MC scales (N=445).

<table>
<thead>
<tr>
<th></th>
<th>Intercorrelation Matrix *</th>
<th>Factor Analysis †</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.</td>
<td>3.</td>
</tr>
<tr>
<td>GMS 1. Negative Affect</td>
<td>-.39</td>
<td>.92</td>
</tr>
<tr>
<td>2. Positive Affect</td>
<td>-</td>
<td>-.36</td>
</tr>
<tr>
<td>POMS 3. Fatigue</td>
<td>-</td>
<td>.63</td>
</tr>
<tr>
<td>4. Depression</td>
<td>-</td>
<td>.75</td>
</tr>
<tr>
<td>5. Tension</td>
<td>-</td>
<td>.69</td>
</tr>
<tr>
<td>6. Anger</td>
<td>-</td>
<td>-.14</td>
</tr>
<tr>
<td>7. Vigor</td>
<td>-</td>
<td>-.44</td>
</tr>
<tr>
<td>STAI 8. Transient Distress</td>
<td>-</td>
<td>-.66</td>
</tr>
<tr>
<td>HPPQ 9. Well-Being</td>
<td>-</td>
<td>.23</td>
</tr>
<tr>
<td>MC 10. Self-Deception</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Eigenvalues = 5.11 1.49 1.09

GMS denotes Global Mood Scale; POMS: Profile of Mood States (Dutch adaptation); STAI: State-Trait Anxiety Inventory; HPPQ: Heart Patients Psychological Questionnaire; MC: Marlowe-Crowne scale.

* Correlations >.16: p<.001, correlations >.10: p<.01.
† Principal components with varimax rotation; loadings $> 0.40$ are underlined; loading of scales assigned to a factor are presented in boldface.
Table 3 DESCRIPTIVE CHARACTERISTICS OF THE NEGATIVE AFFECT AND POSITIVE AFFECT SUBSCALES OF THE GMS (N=478).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Interpretation of Raw Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>9.5 (8.7)</td>
<td>7</td>
<td>0 - 1</td>
</tr>
<tr>
<td>Positive Affect</td>
<td>19.4 (8.3)</td>
<td>20</td>
<td>0 - 11</td>
</tr>
</tbody>
</table>

Standard deviations appear in parentheses; GMS denotes Global Mood Scale.
Table 4  Mean entry and end negative affect and positive affect GMS scores for rehabilitation and control subjects (N=120).

<table>
<thead>
<tr>
<th></th>
<th>Negative Affect</th>
<th>Positive Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entry Score</td>
<td>End Score</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>8.9 (8.3)</td>
<td>5.4 (7.1)</td>
</tr>
<tr>
<td>(N=60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>8.6 (7.8)</td>
<td>8.0 (8.0)</td>
</tr>
<tr>
<td>(N=60)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard deviations appear in parentheses; GMS denotes Global Mood Scale; entry score: mean score within six weeks after the coronary event; end score: mean score three months after the initial assessment; F: repeated measures analysis of variance (df=1,59).
LEGEND TO FIGURE 1

Scree plot showing the eigenvalues of the first 10 principal factors that were identified in the list of 20 mood terms comprising the GMS.
Dr. M. Fisher, Editor
Psychological Medicine
Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AF
ENGLAND

Dear Dr. Fisher,

Re: "Emotional distress and fatigue in coronary heart disease: The Global Mood Scale (GMS)"

I wish to thank you for your letter of 27 May enclosing reviewers comments on the above manuscript. I do appreciate that you would be willing to consider the present paper for publication in Psychological Medicine. I am indebted to the anonymous reviewers for their constructive comments and I am convinced that the manuscript is now improved by the revision you recommended.

I am in agreement with most of the comments of the reviewers and therefore have corrected the paper in a fashion that deals with the various issues raised by them. My responses to these comments are detailed in the attached sheets.

I hope that this revision of my manuscript meets the various points raised by your referees and that you therefore would be willing to consider this study for publication in Psychological Medicine. Please find enclosed 4 copies of the revised manuscript.

Address for correspondence:      Yours sincerely,

Johan Denollet
UZA - Cardiale Revalidatie
Wilrijkstraat, 10
B-2650 Edegem
BELGIUM     Telephone: 00 32-3-829.11.11 (ext. 1941)     Fax: 00 32-3-829.05.20
Responses to Comments of Reviewer # 1.

Your point regarding the fact that patients with non-cardiac disorder experience fatigue on exercise is well taken. I agree that the statement that "as a rule, fatigue due to CHD is related to effort, whereas fatigue related to emotional distress is constantly present" can be questioned. Therefore, this statement is now deleted (page 3, 4th paragraph).

Page 3, 2th paragraph, first line: the word 'unspecific' is now deleted and replaced by 'non-specific'. 
Responses to Comments of Reviewer # 2.

Specific comments

1. Reference to Kroenke et al. 1988 is deleted, and reference is now made to the population based survey of Chen (1986) on page 3, 4th paragraph, lines 2-6: "in the general population, fatigue is highly associated with emotional distress, and adults who experience any psychological problems are at much higher risk of feeling fatigue than those who are free from psychological problems"

2. The reference following the statement that "cardiac patients are not psychiatric patients" on page 4, 2th paragraph, first line, is deleted.

3. The Method section now includes a paragraph which describes the cardiac rehabilitation program somewhat more in detail (page 4, last paragraph). The selection of the subject sample is now described in the last two paragraphs of page 4.

4. I rather suspect that, in the context of cardiac rehabilitation, the Marlowe-Crowne scale is not a social desirability measure but instead is a measure of an individual difference variable which is related to defensiveness and social adjustment. This is now stated in the Method section (page 5, last paragraph), and the work of Gur & Sackeim (1979), Lane et al. (1990), and McCrae & Costa (1983) are cited because these studies provide evidence for the latter contention.

5. The extraction of two factors is now discussed more in detail in the Results section, page 6, last paragraph. I agree that the number of factors to retain in a factor solution is an important issue; nonetheless, the present findings are in complete agreement with the Watson & Tellegen (1985) paper which describes positive and negative affect as two dominant dimensions of emotional experience.

6. Page 11, lines 6-8: it is now stated that "feelings of exhaustion (Appels & Mulder, 1988) and depression (Booth-Kewley & Friedman, 1987) may be associated with the development of CHD"

7. The exact P values are now incorporated in the 5th and 9th columns of Table 4, page 22.
Responses to Comments of Reviewer # 3.

1. I agree that the final sentence of the third paragraph on page 3 was hard to understand. In fact, this sentence referred to (1) the distribution of positive and negative affect scores between individuals, as well as (2) the change in negative affect scores for one individual over time. This is now more clearly stated on page 3, 3th paragraph, lines 7-11. Reference has now also been made to the work of Zevon & Tellegen (1982) to further document both contentions.

2. Mention has now been made to the fact that "since all subjects were native speakers of Dutch ( ... ), this language was used to assess subjective mood states" , page 5, second paragraph, lines 1-3. The fact that the GMS given in the appendix is an English translation of the questionnaire used is now clearly stated in the last sentence of this paragraph.

3. Page 4, 3th paragraph, line 4: "about 100 kilometers from Antwerp".

4. The Methods section now includes references to Mardia et al. (1979) and Cattell (1966) in the description of multivariate analysis and use of the scree plot (page 6, 4th paragraph, lines 2 and 5, respectively).

5. Mention is now made to the total variance explained by the 3th, 4th, and 5th factor, respectively. Mood terms that loaded on these factors also displayed, however, substantial loading on one of the first two factors. The extraction of factors is discussed more in detail on page 6, last paragraph, lines 4-10.

6. Page 7, last paragraph, line 7. The statement that "negative affect scores tend to remain at a constant low level" is now deleted and is replaced by the statement that "intense negative mood terms occur infrequently in normal subject (Clark & Watson, 1991)".
Dear Dr. McLaughlan,

Please find enclosed a signed copyright form concerning my paper 'Emotional distress and fatigue in coronary heart disease: the Global Mood Scale (GMS)'.

In response to the additional questions that you posed in your letter, I hereby send you the following details.

References.
1. Cattell (1966). This reference may be replaced by the following reference:


2. Denollet (1992). This paper has been accepted for publication. There are no more details available.

Yours sincerely,

Johan Denollet
UZA - Cardiale Revalidatie
Wilrijkstraat, 10
B-2650 Edegem
BELGIUM

Johan Denollet