



Development of a Multidimensional Scale of Family Expressed Emotion (MS-FEE) for Type 2 Diabetes Mellitus outpatients

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Abstract: Family expressed emotion (FEE) affects self-management in people with Type 2 Diabetes Mellitus (T2DM), but a measurement instrument based on the Indonesian cultural context has yet to be made available. This study aims to develop a self-report FEE scale for individuals with Type 2 Diabetes Mellitus, involving 229 participants in Yogyakarta, Indonesia. The items were developed from five dimensions of expressed emotion (EE) and selected through expert validation and construct validity testing using confirmatory factor analysis (CFA). The results showed that the five-correlated factor model was the best fit (CFI = .959, TLI = .948, RMSEA = .042, SRMR = .050, BIC = 9,283.594). The reliability coefficients obtained using McDonald's ω were acceptable, ranging from .603 to .761, apart from emotional over-involvement, which only scored .569. MIMIC-based DIF analysis by gender flagged 1 item ($\beta = .220$), indicating that women had higher endorsement, while other items were invariant. The findings confirm that FEE is multidimensional, especially in communities with a collectivist culture. The practical implication is that the scale can be used in clinical assessment and family-based interventions to enhance the self-management of T2DM patients in Indonesia.

Keywords: Diabetes Mellitus; family expressed emotion; health psychology; psychometrics; scale development

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Introduction

The global prevalence of Diabetes Mellitus (DM) continues to increase. Among the productive age population (20 to 79 years), the estimated prevalence of DM in 2021 was 10.5%, affecting around 536.6 million people (Sun et al., 2022). This figure is expected to increase to 12.2% by 2045, impacting approximately 783.2 million people. The prevalence of DM in Indonesia is relatively high (International Diabetes Federation, 2021), with the country ranked fifth in the world in terms of the number of DM sufferers, with a prevalence rate of 11.7% in 2023 in the population aged over 15. This figure increased from the prevalence in 2018 of 10.9%. Amongst DM sufferers, the majority (90-95%) fall under Type 2 DM classification (Badan Kebijakan Pembangunan Kesehatan - Kemenkes RI, 2024).

DM is a chronic disease characterized by disorders in carbohydrate, protein, and fat metabolism because of a lack of insulin hormone production. In some cases, there is no disorder in insulin hormone production, but the body cannot make use of the insulin produced effectively (Alberti & Zimmet, 1998; WHO, 1999). Currently, while DM is incurable, it is preventable and manageable. Even in Type 2 DM (T2DM), individuals can experience a state of remission indicated by normal blood sugar levels, thus requiring no treatment (Rothberg et al., 2024).

Successful treatment of T2DM relies on self-management efforts (Maina et al., 2023), which require behavioral changes on the part of the patients (American Diabetes Association, 2022). Self-management in those with DM can include aspects of treatment, health monitoring, and lifestyle (Cox & Gonder-Frederick, 1992; Glasgow et al., 2004), achieved through collaborative efforts involving doctors, health workers, the patient and individuals related to the patient, such as their family (Dineen-Griffin et al., 2019; Puzhakal et al., 2025).

In Indonesia, as a country with a collectivist society, family involvement plays an important role in the self-management of individuals with T2DM. The family can provide support for patients' compliance with diabetes care management (Safaruddin & Permatasari, 2022; Trisnadewi & Suniyadewi, 2022; Zeren & Canbolat, 2023). Family involvement not only relates to treatment; the family, together with health workers, need to collaborate in planning patient self-management to enable healthy living behaviors. This can lead to improved health conditions and well-being of patients (American Diabetes Association, 2022). Therefore, studies of T2DM need to include elements of family involvement.

Expressed emotion (EE) is a concept that refers to family relationships, which can play a role in the self-management of T2DM patients. It was first proposed by Brown, Birley, and Wing in 1972 in their study of the recovery of schizophrenic patients (Leff & Vaughn, 1985). EE relates to the intensity of emotions shown by individuals who are close to or who care for patients. It includes the expression of the emotions, attitudes and behaviors of others, such as family members or caregivers, towards individuals with certain conditions (Leff & Vaughn, 1985), and is characterized by high intensity in protecting, maintaining, giving attention to, bothering and criticizing the individual (Hooley, 1985; Kavanagh, 1992; van Humbeeck et al., 2002).

Based on the results of Brown's (1985) initial research, EE related to five aspects of interpersonal relationships in the family is divided into two groups: positive and negative aspects. The negative aspects of EE include critical comments (CC), hostility (H), and emotional overinvolvement (EOI), while the positive aspects consist of positive remarks (PR) and warmth (W).

Negative family comments towards patients can contain criticism, including unpleasant

comments directed at individuals with certain conditions (Leff & Vaughn, 1985). Besides statements made, critical comments can also involve the use of rising intonation, volume, or tempo of speech or conversation, which can show frustration or unpleasantness (Vaughn & Leff, 1976). However, to distinguish these from hostility, the scope of critical comments is limited to individual behavior (van Humbeeck et al., 2004).

The behavioral expression of critical comments such as rejection, belong to the dimension of hostility. This is a form of family criticism that expresses a complete rejection of patients (Leff & Vaughn, 1985). It is how family members caring for them express their belief that they are the source of the problem (Wearden, Tarrier, & Davies, 2000); the patient may receive criticism directed at them personally, rather than at what they do (van Humbeeck et al., 2004). Hostility can also include expressions of dislike towards individuals (Calam & Peters, 2006), while emotional over-involvement includes excessively intrusive behavior directed at patients (Leff & Vaughn, 1985) or overprotective behavior. Such behavior also includes expressions of pity, and the belief that the patient is dependent on family to perform their daily tasks (Mohapatra & Rath, 2013). This dimension includes excessive emotional responses; self-sacrifice and over-protective behavior; excessive concern; and dramatization (Calam & Peters, 2006).

On the other hand, positive appraisal is a statement of support and appreciation for the patient (Leff & Vaughn, 1985), it can be expressed both verbally and nonverbally (Butler et al., 2019). Such appraisal can include positive expressions such as pride, acceptance or appreciation for the patient (Leff & Vaughan, 1985b). Warmth is defined as an empathetic attitude that shows concern, and may include expressions of concern, understanding or enjoyment (Leff & Vaughn, 1985).

EE has been found to be a predictor of relapse and health conditions. Previous studies have found that schizophrenic patients returning from hospital and then living with families with high negative EE had a higher relapse rate than those who lived with other people (Brown, 1985; Leff & Vaughn, 1985). This finding was replicated by many other studies in various countries, which indicated that high negative EE had a significant correlation with relapse, while positive EE showed no correlation (Avraam et al., 2022; Butzlaff & Hooley, 1998; Hooley, 2007). Therefore, subsequent EE research focused on negative EE only, including critical comment, hostility and emotional over-involvement (Leff & Vaughn, 1985).

Similar to the situation of schizophrenic patients, several studies have found evidence that high negative EE can play a role in the condition of patients with various other mental disorders (Endreddy et al., 2024; Hooley, 2007; Okasha et al., 1994), as well as chronic physical diseases such as diabetes (Lister et al., 2016; Wearden, Tarrier, Barrowclough, et al., 2000). Hooley (2007) argues that relapse occurs because patients perceive EE as a stressor, which disrupts neural activity related to a particular psychopathology. Critical aspects of EE (such as critical comments) have been found to play a role in controlling blood sugar levels (Klausner et al., 1995; Koenigsberg et al., 1993) and metabolism in people with DM (Liakopoulou et al., 2001), where higher criticism is generally associated with poorer metabolic control. Another study found that a lack of support accompanied by high negative EE was associated with poor glucose control in adolescents with Type 1 DM (Eray et al., 2017). Similarly, Helz and Templeton (1990) found that the level of EE in the family influences glucose control. A further study found that high aspects of hostility from the father's side were associated with worse glycemic control (Worrall-Davies et al., 2002). Research has also found a negative impact of partners displaying high negative EE on the management of Type 2 DM in

terms of diet, physical activity, and attitudes towards the disease experienced (Lister et al., 2016; Wearden, Tarrier, Barrowclough, et al., 2000). Based on these findings, it can be concluded that there is an indication that family dynamics, through EE, play a role in DM management.

However, several studies have found indications of differences in the role of EE in certain cultures (Aguado et al., 2024). A preliminary study by Hasanat (2010), which involved a focus group discussion (FGD) with ten patients with Diabetes Mellitus found evidence of different concepts of EE in societies with collectivist cultures. In contrast to the context of individualistic societies, the findings indicated that the EE dimension of excessive emotional involvement (EOI) had a positive impact on self-management. When the family is worried, patients will be more careful in making self-management efforts. They may view this type of concern, although possibly excessive, as a form of positive attention. Patients can even view one of the negative dimensions of EE, critical comments (CC), as constructive input. Some studies have also found EOI to be a predictor of the good condition of individuals with Diabetes Mellitus (Stevenson et al., 1991). Consistent with Bhugra and McKenzie's findings (2003), criticism and similar concerns are not viewed by communities with collectivist cultures as pathological or personally targeted in the same way as in Western individualist societies; instead, they are seen as a normal response. Similarly, Subandi (2011) found that schizophrenic patients in Java, Indonesia, perceived high maternal EOI and CC as a form of affection.

Consequently, researchers have begun to focus on the positive aspects of EE. Some have found that the dimension can act as a protective factor against relapse (Avraam et al., 2022). Tarrier et al. (2004) reported that positive comments were associated with fewer suicidal ideations. In addition, O'Brien et al. (2009) reported that positive comments were associated with problem-solving skills and constructive behavior. Butler et

al. (2019) conducted a systematic review of the relationship between positive EE and psychosis, finding evidence of a relationship between positive EE and social functioning. Warmth and positive comments were found to be good predictors of life satisfaction. In addition, a study revealed that high EE perceived by individuals elicited schema changes that could to post-traumatic growth (Dirik & Göcek-Yorulmaz, 2018).

The EE construct was initially measured by G. W. Brown and Rutter (1966) using the Camberwell Family Interview (CFI) on the basis of five related dimensions. The CFI is used to collect information on various aspects of schizophrenia patients, such as their medical history, daily activities, current functioning and problems, and relationship quality (Brown & Rutter, 1966; Vaughn & Leff, 1976). While it is the most widely used instrument, measuring EE through the CFI has shortcomings, especially because it needs a considerable time to administer (Aguado et al., 2024) and a high level of resources (van Humbeeck et al., 2004). Due to these limitations, some studies have developed shorter forms of EE measurements based on the CFI dimensions, or have measured it through self-report methods. These include the Five-minute Speech Scale (FMSS), the Family Attitude Scale (FAS), the Expressed Emotion (EE) Scale, the Level of Expressed Emotion (LEE) Scale, the Family Questionnaire (FQ), the Brief Dyadic Scale of Expressed Emotion (BDSEE), the E5, and the Adjective Checklist.

However, the eight measures do not encompass all the dimensions of EE first posited by Leff and Vaughn (1985). For example, the FMSS only covers three dimensions: critical comments, hostility, and excessive emotional involvement (Leeb et al., 1991; Magaña et al., 1986). Moreover, the FMSS has been found to have less fit with CFI in categorizing individuals with EE in the low score category (Calam & Peters, 2006; Magaña et al., 1986). While the FAS only includes two dimensions, critical comments and hostility

(Kavanagh et al., 1997), other research has identified a three-factor model (Yu et al., 2016), making this measure less robust in terms of theoretical concepts. The EES encompasses only two dimensions, critical/hostile comments and excessive emotional involvement; however, it does sufficiently fit with the CFI in categorizing low and high scores (Duman et al., 2013). However, this study was based on small samples. On the other hand, Akhtar and Bano (2021) developed the Parental Expressed Emotion Scale (P-EES) based on the five dimensions of CFI. Their study produced a valid and reliable P-EES measuring instrument with 31 items covering five dimensions, similar to the CFI. The FQ also only includes two dimensions of EE, criticism and excessive emotional involvement (Wiedemann et al., 2002). Similarly, the BDSEE only includes three dimensions of EE, perceived criticism, excessive emotional involvement and warmth (Medina-Pradas et al., 2011). The latest measurement, the Structured Interview for the Assessment of Expressed Emotion (E5), developed by Muela-Martinez et al. (2021) also includes three dimensions of EE, criticism, hostility and excessive emotional involvement. However, this measurement does not correlate with the CFI. In the early development of EE measurement, one instrument revealed negative and positive aspects, namely the Adjective Checklist (Friedmann & Goldstein, 1993). The instrument uses self-rating, designed to measure family perception by asking members about how they feel about schizophrenic patients. The checklist includes 20 adjectives, 10 of which are negative, and 10 positives. The tool is less well known and has not been widely used (Wearden, Tarrier, Barrowclough, et al., 2000).

In addition to the above measurements, there is also an EE measurement with a different structure from that of the CFI, namely the LEE (Level of Expressed Emotion) scale. Cole and Kazarian (1988) developed the scale based on four EE factors: intrusiveness, emotional response,

attitude toward illness, and tolerance/expectation. However, there is no strong evidence of the validity of the LEE structure factor, as the construct structure has been rarely tested (e.g., Pastryk & Kots, 2022), while other studies have found evidence of LEE having a structure factor different from the underlying theory (e.g., Aguado et al., 2024; Gerlsma et al., 1992). Therefore, the psychometric evidence of the EE factor structure of this scale is not robust enough, and there is no consensus on the number of EE factors.

According to the EE measurement studies reviewed above, it can be concluded that although EE was originally proposed to consist of five factors, most studies have examined only three of these. The two factors from the positive dimension, warmth and positive remarks, have been largely excluded. This was not due to a lack of evidence regarding the EE structure, but because these two factors were found to be weak predictors of negative health outcomes. However, several recent studies have found evidence that these factors are in fact, good predictors of health outcomes. By incorporating cultural aspects or assuming, contrary to the original proposal, that the two factors function as protective, rather than risk, factors for health outcomes, researchers have demonstrated that they are significant contributors to health outcomes. Therefore, our study includes all five EE factors, rather than focusing solely on its negative dimension.

Although previous research has documented both positive and negative roles of expressed emotion (EE) across health conditions, no EE measure has yet been tailored to individuals with T2DM. Most research has developed EE measures for mental illness (e.g., Duman et al., 2013; Koutra et al., 2014; Medina-Pradas et al., 2011; Ng et al., 2019; Schmidt et al., 2016; Sepúlveda et al., 2014) while studies of chronic physical illness have been limited to dementia (e.g., Liu et al., 2024; Yu et al., 2016). Furthermore, many studies exploring EE in the context of chronic physical illness have not

aimed to develop EE measures (e.g., Dogan et al., 2020; Pastryk et al., 2021; Tarrier et al., 2002). A similar trend was also found in EE research of diabetes patients. Although many studies have examined EE in the context of Diabetes, they have not adapted EE measures; instead, they have used an established instrument with modifications to assess EE. Wearden, Tarrier, Barrowclough et al. (2000) modified the CFI to be more suitable for assessing EE in diabetes patients, but did not provide valid evidence for the modification of the inventory.

Furthermore, although an early reference to an adaptation of the CFI for families of adolescents with diabetes was reported by Sensky et al. (1991), the publication could not be located for review and appears to be only cited as a secondary source. To our knowledge, no subsequent studies have documented the development, adaptation, or validation of an EE measure specifically for diabetes populations.

This study, therefore, develops a family expressed emotion (FEE) scale for the T2DM context using a literature-informed and empirical approach to establish robust theoretical and structural validity. Consistent with the Standards for Educational and Psychological Testing (AERA et al., 2024), we delineated and assessed multiple sources of validity evidence: 1) evidence based on test content via expert review and cognitive debriefing to ensure domain coverage and clarity; 2) evidence based on internal structure through confirmatory factor analyses and model comparisons, prioritizing a five-correlated-factors solution while examining alternatives (e.g., bifactor), to evaluate dimensionality and item functioning; and 3) reliability estimates (e.g., coefficient omega) alongside checks for potential differential item functioning where relevant. Importantly, the developed instrument retains the five original EE dimensions, encompassing both negative and positive aspects; the inclusion of warmth and positive remarks is theoretically

warranted, given their potential protective role in family processes that support chronic disease self-management in T2DM.

Our study makes several contributions to the literature on EE and health outcomes. First, unlike most previous studies that have focused primarily on the three negative dimensions of EE, critical comments, hostility, and emotional over-involvement, this study incorporates all five established EE dimensions, including the often-overlooked positive aspects of warmth and positive remarks. This comprehensive approach offers a more nuanced understanding of how the family's emotional climate may impact chronic illness management. Second, by explicitly considering the potential protective role of positive EE dimensions in the context of T2DM, the study broadens theoretical perspectives that have traditionally emphasized the negative effects of EE. Finally, the research represents the first attempt to develop and validate an EE measure specifically tailored for individuals with T2DM in Indonesia, thereby extending the cross-cultural applicability and contextual relevance of EE assessment in non-Western health settings.

The study, therefore, aims to develop and validate an FEE scale tailored for individuals with T2DM. Specifically, the objectives were to: 1) construct and refine items representing both positive and negative dimensions of expressed emotion relevant to the T2DM context; 2) establish content validity through expert review and cognitive debriefing to ensure clarity and domain relevance; and 3) evaluate the internal structure, reliability and construct validity of the FEE scale using confirmatory factor analyses and related psychometric assessments. Based on these objectives, the study aimed to develop a theoretically grounded and psychometrically sound measure of family expressed emotion that captures the complex interpersonal dynamics influencing diabetes self-management.

Methods

Participants

The study involved two groups of participants: 1) panelists for the content validity assessment during the scale development phase, and 2) patients with T2DM as the main study respondents. The content validity panel comprised ten experts, six physicians and four psychologists, who evaluated the initial item pool for relevance and clarity using the item-content validity index (I-CVI).

The main study respondents were 229 outpatients recruited from two major hospitals in

Yogyakarta City and Sleman Regency over a six-month period. Eligibility criteria included: a) diagnosed with T2DM for at least one year; b) undergoing routine nursing care; c) aged between 40 and 75; d) living with a partner or nuclear family; and e) not experiencing serious complications such as kidney failure or amputation. Data collection was conducted directly, with trained enumerators providing explanations of the study, obtaining informed consent, and assisting participants who required help completing the questionnaire.

Table 1

Summary of Research Participants (N = 229)

Variable	N	%	% Cum
Sex			
Male	116	51%	51%
Female	113	49%	100%
Age (M = 59.754; SD = 7.340)			
44 - 50	27	12%	12%
51 - 60	97	42%	54%
60 - 70	87	38%	92%
> 70	18	8%	100%
Level of Education			
No schooling	4	2%	2%
Elementary school	25	11%	13%
Junior high school	34	15%	28%
Senior high school	92	40%	68%
Diploma	25	11%	79%
Undergraduate/postgraduate (S1/S2/S3)	45	19%	98%
No information given	4	2%	100%
Years of Illness (M = 4.729; SD = 6.364)			
1-5 years	72	31%	31%
6 - 10 years	98	43%	74%
11 - 20 years	46	20%	94%
> 20 years	11	5%	99%
No information given	1	0%	100%
Employment status			
Housewife	61	27%	27%
Private employee	14	6%	33%
Retired	82	36%	69%
Civil servant	16	7%	76%
Unemployed	2	1%	76%
Other	45	20%	96%
No information given	9	4%	100%

Of the 229 respondents, 116 (51%) were male, and 113 (49%) were female, with ages ranging from 44 to 82 ($M = 59.75$, $SD = 7.34$). The largest age groups were 51–60 (42%) and 60–70 (38%). Almost half of the participants had completed high school education ($n = 95$, 40%). The duration of illness ranged from 1 to 27 years ($M = 4.73$, $SD = 6.36$), with 43% ($n = 98$) having suffered from T2DM for 6–10 years and 31% ($n = 72$) for 1–5 years. In terms of occupational status, the largest group were retirees (36%), followed by housewives (27%), and others (20%), including teachers, lecturers, farmers, tailors, traders, and laborers. A summary of the participants' demographic characteristics is presented in Table 1.

Instrument

The Family Expressed-Emotion Scale is a self-report scale developed by the researchers to measure the perception of those with Type 2 Diabetes Mellitus of the emotional responses of family members. The scale was developed based on the theory proposed by Leff and Vaughn (1985), which includes five dimensions: critical comments, hostility, emotional over-involvement, positive remarks, and warmth.

At the beginning of the development of this instrument, the scale consisted of 36 items, including eight critical comment dimension items, four hostility dimension items, eight emotional over-involvement dimension items, eight positive remark dimension items, and eight warmth dimension items. The scores for the respondents' rating of each item ranged from 1 (very not appropriate) to 5 (very appropriate).

Each item was a statement that completed the statement stem "My husband/wife/family member...". Examples of items from the scale included "... blames me when my blood sugar levels rise" representing the critical comment dimension; "... seems anxious if I forget to take my medicine", representing the emotional over-involvement dimension; "thinks I'm lazy", representing the

hostility dimension; "... feels proud if I follow a prescribed diet", representing the positive comment dimension; and "... is happy to accompany me to exercise", representing the warmth dimension.

Statistical Analysis

All analyses in the study were conducted using RStudio (R. Core Team, 2023). Missing data were present in the demographic variables (see Table 1); they were reported but not handled. No missing data were found in the Family Expressed Emotion Scale responses; therefore, no handling of missing data was required for the main measurement variables.

The analysis followed four sequential steps. First, content validity analysis was conducted to evaluate the relevance of each item to the intended construct. An expert panel comprising six physicians and four psychologists, selected for their clinical and research expertise in Type 2 Diabetes Mellitus and family dynamics, reviewed the initial 36-item pool. The panelists rated the relevance of each item using a 4-point scale (1 = not relevant, 2 = slightly relevant, 3 = moderately relevant, 4 = highly relevant). The item-level content validity index (I-CVI) was calculated as the proportion of experts rating the item as 3 or 4, and the scale-level content validity index (S-CVI) was computed to assess overall content adequacy. Following Davis (1992), items with an I-CVI value of $\geq .80$ were considered to have acceptable content validity and were retained for subsequent psychometric evaluation.

Second, item selection based on factor loadings and residual correlations was conducted using a five-correlated factor model in confirmatory factor analysis (CFA). Model fit was evaluated using CFI, TLI, RMSEA, and SRMR, with cut-off criteria based on the recommendations of Hu and Bentler (1999). The Bayesian information criterion (BIC) was also used, with lower values indicating a better fit (McDonald, 2013). Items

with standardized factor loadings below .40, substantial cross-loadings, or high residual correlations were considered for removal. This process reduced the scale to 16 items.

Third, measurement model comparison was performed to determine the most appropriate factor structure. Nine theoretically and empirically grounded models, including unidimensional, higher-order, two-factor, four-factor, five-factor, and bi-factor models, were tested to evaluate whether more parsimonious alternatives could adequately represent the data without sacrificing fit. Model comparisons were based on goodness-of-fit indices and BIC values, with theoretical coherence as an additional criterion.

Fourth, differential item functioning (DIF) analysis by gender was conducted using the MIMIC (multiple indicators multiple causes) model (Hauser & Goldberger, 1971). The MIMIC approach was chosen because it allows for the simultaneous estimation of latent constructs and the direct effects of grouping variables on item responses, without splitting the sample into subgroups, making it more parsimonious and statistically efficient for the available sample size (Woods, 2009). Compared to Multi-group CFA (MGCFA), which tests invariance hierarchically across configural, metric, and scalar levels, the MIMIC model focuses on identifying item-level bias while controlling for the latent trait. MGCFA is more suitable when assessing full measurement invariance, but requires substantially larger and balanced samples per group and can yield unstable results under sample size constraints (Finch, 2005; Wu & Estabrook, 2016).

Given the study objective to detect item-level bias and balanced gender distribution in a moderate-sized total sample, the MIMIC model was deemed the most appropriate method for the analysis. Accordingly, we targeted uniform DIF, defined in the MIMIC framework as the direct effects of gender on individual items while

controlling for the latent trait (Chun et al., 2016; Woods, 2009).

Results

Validity Evidence based on Test Content

Ten expert judges conducted the content validation of the instrument, comprising six internal medicine specialists and four hospital-based psychologists. All the panelists had extensive academic backgrounds and professional experience related to Type 2 Diabetes Mellitus care and family psychosocial support. The internal medicine specialists were senior clinicians in tertiary hospitals, with clinical and managerial roles in diabetes outpatient services and multidisciplinary care teams. The psychologists were experienced practitioners in hospital-based mental health services, specializing in family therapy, adjustment to chronic illness, and patient education, with experience in both individual and group interventions. This diverse expertise enabled the panel to critically evaluate the clarity, relevance, and representativeness of each item in relation to the construct of expressed emotion.

Content validity was assessed using the item-level content validity index (I-CVI), calculated according to Davis' guidelines (1992). Twenty-six items met the cut-off criterion and were retained without change, while one item with an I-CVI of .70 was retained with revision to improve clarity and contextual appropriateness. The remaining nine items (I-CVI range: .60–.70, excluding the revised item) did not meet the cut-off and were earmarked for removal.

Examples of items that did not meet the cut-off included statements such as “*Menghargai usaha saya untuk minum obat teratur* (Appreciating my effort to take medication regularly)” (I-CVI = .60), “*Mencemaskan saya jika lupa ‘ngecek’ kadar gula darah saya* (Worrying about me if I forget to check my blood sugar level)” (I-CVI = .60), and “*Tidak bisa*

tidur ikut memikirkan diet yang saya lakukan (Having trouble sleeping from worrying about the diet I'm following)" (I-CVI = .60). In general, items with low I-CVI scores tended to be those that: 1) were perceived as overlapping in meaning with other items; 2) contained wording that could be interpreted ambiguously by patients; or 3) reflected behaviors less directly observable by family members, reducing their perceived relevance. These patterns informed the decision-making process for item deletion before psychometric evaluation.

Descriptive Statistics

Table 2 displays a summary of the descriptive statistics of each item of the developed instrument. In terms of the average, almost all items tended to be answered with option 3 ("Neutral"), as seen from the mean approaching a score of 3, while several items, such as 02, 06, 08, 17, 21 and 22, tended to be answered with "Not Appropriate", as indicated by the mean approaching a score of 2. Items 05, 10, 19, 26 and 27 were usually assessed as "Appropriate", with a score of 4. Analysis showed that the participants selected all five response options for each item (range: .009 to .681), apart from item 10's score of 1. Furthermore, one item had skewness above > 2, namely item 19 (skewness = 13.601), while the other items were within the range of values of -2 to +2, indicating that the data distribution could be considered normal (Kim, 2013). These results implied the use of the maximum likelihood mean-adjusted (MLM) estimator with Satorra-Bentler scaled chi-squared (Satorra & Bentler, 1994) to conduct a CFA analysis.

Item Selection

According to the goodness of fit indices shown in Table 3, the initial 27-item five-correlated factor model indicated inadequate model fit, with CFI = .811 and TLI = .789, falling below the .90 threshold, and RMSEA = .066 and SRMR = .073, which

exceeded the recommended .06 cut-off ($\chi^2_{(314)} = 631.144, p < .001$).

Inspection of the standardized factor loadings revealed that four items did not meet the minimum recommended loading of .40 and were consequently removed from the model. These items were "*Dengan senang hati menemani saya berolah raga* (Gladly accompanying me when I exercise)", "*Menganggap saya tidak patuh nasihat dokter* (Considering me disobeying the doctor's advice)", "*Memuji saya pada waktu saya mampu menjalankan diet yang disarankan dokter* (Praising me when I comply with the diet recommended by the doctor)", and "*Merasa bangga jika saya rutin berolah raga* (Feeling proud if I exercise regularly)". Items in this category generally reflected behaviors or expressions that were situational and potentially less stable indicators of the underlying expressed emotion construct, making them less likely to consistently capture the intended dimension across the respondents.

Additionally, modification index analysis identified seven items, 05, 16, 22, 28, 31, 18 and 17, with high residual correlations with other items. For instance, "*Mengkritik cara saya mengatur makanan* (Criticizing my diet)" and "*Mengatur jenis makanan yang boleh saya konsumsi* (Controlling the types of food I am allowed to eat)" overlapped conceptually with other retained items on dietary control, while "*Memarahi saya ketika saya memakan/meminum yang manis-manis* (Scolding me when I eat or drink sweet things)" paralleled other items on criticism related to food choices. Similarly, "*Menyindir saya jika hanya duduk-duduk seharian, tidak berolah raga* (Making sarcastic remarks when I sit around all day without exercising)" shared content with other items capturing disapproval of inactivity. Items in this category typically differed only in surface context or wording from retained items, providing minimal additional variance while inflating residual correlations.

Following the removal of these 11 items, the revised 16-item model demonstrated substantially improved fit (CFI = .959, TLI = .948, RMSEA = .042, SRMR = .050; $\chi^2_{(94)} = 131.752$, $p =$

.006), indicating satisfactory alignment with the observed data. The refined model was subsequently retained for comparison with other theoretically plausible measurement models.

Table 2

Descriptive Statistics of Items and Proportions of Response Options

Item	Mean	SD	Skewness	Proportions of Response Options				
				1	2	3	4	5
item 01	3.699	0.913	-0.899	.013	.140	.114	.603	.131
item 02	2.214	1.040	0.978	.218	.559	.039	.157	.026
item 03	3.131	1.214	-0.135	.074	.345	.066	.406	.109
item 04	3.585	0.986	-0.918	.031	.166	.096	.603	.105
item 05	3.952	0.727	-1.032	.009	.035	.131	.646	.179
item 06	2.546	1.215	0.573	.175	.472	.057	.227	.070
item 07	3.354	1.113	-0.638	.070	.201	.127	.511	.092
item 08	2.240	0.941	1.161	.148	.638	.066	.122	.026
item 09	3.297	1.127	-0.272	.031	.328	.066	.467	.109
item 10	4.057	0.656	-1.091	.000	.048	.044	.712	.197
item 11	3.620	1.026	-0.684	.013	.214	.066	.555	.153
item 12	3.646	0.889	-0.940	.013	.144	.122	.624	.096
item 13	3.659	0.963	-0.639	.009	.166	.140	.528	.157
item 14	3.092	1.198	0.069	.048	.410	.061	.362	.118
item 15	3.616	0.937	-1.034	.031	.131	.127	.616	.096
item 16	3.070	1.061	-0.029	.035	.367	.148	.393	.057
item 17	2.454	1.057	0.807	.127	.555	.100	.175	.044
item 18	3.445	1.040	-0.668	.035	.218	.105	.550	.092
item 19	3.987	2.785	13.063	.022	.074	.109	.655	.135
item 20	3.323	1.239	-0.384	.079	.262	.074	.428	.157
item 21	2.402	1.037	0.825	.135	.576	.070	.188	.031
item 22	2.336	1.054	0.949	.166	.563	.083	.144	.044
item 23	3.734	1.019	-0.876	.022	.162	.070	.555	.192
item 24	3.908	0.764	-1.213	.009	.066	.092	.677	.157
item 25	3.638	0.966	-0.719	.017	.153	.148	.537	.144
item 26	4.022	0.740	-1.344	.009	.052	.052	.681	.205
item 27	3.983	0.800	-1.213	.009	.070	.066	.642	.214

Table 3

Goodness of Fit Indices for the Five-correlated Factor Model

Model	Items	χ^2	df	p	CFI	TLI	RMSEA	SRMR	BIC
Initial	27	631.144	314	<.001	.811	.789	.066	.073	16,654.120
Revised	16	131.752	94	.006	.959	.948	.042	.050	9,283.594

Model Comparison

In conducting the model comparisons, eight alternative measurement models were evaluated to ensure that the retained structure of the Family Expressed Emotion (FEE) Scale was supported by both theoretical and empirical evidence. Although EE was originally conceptualized as comprising five distinct factors, critical comments, hostility, emotional over-involvement, positive remarks and warmth (Leff & Vaughn, 1985), previous research has proposed several alternative structures. For example, the single-factor model was tested to examine the possibility that all items reflect a unidimensional EE construct, as might be expected if the dimensions are closely correlated (Ng et al., 2019). The four-factor model, which combines critical comments and hostility into one factor, was considered based on empirical findings that these two dimensions often overlap in conceptual meaning and observed correlations (Koutra et al., 2014; Magaña et al., 1986; Sepúlveda et al., 2014). A two-factor model was also tested, grouping the dimensions into negative EE (critical comments, hostility, emotional over-involvement) and positive EE (warmth, positive remarks), reflecting valence-based classifications found in previous studies (Medina-Pradas et al., 2011). Higher-order models were included to explore whether the first-order dimensions could be explained by broader latent factors. A bi-factor model was tested to assess the presence of a general EE factor alongside specific dimensions, enabling the interpretation of both total and subscale scores (Reise, 2012). Comparing these theoretically grounded alternatives allowed the evaluation of whether a more parsimonious structure could adequately represent the data without compromising fit, in line with best practices in psychometric validation (Furr, 2021).

The analysis results presented in Table 4, that the five-correlated factor model provided the best balance between statistical fit (CFI = .959, TLI = .948, RMSEA = .042, SRMR = .050) and theoretical

coherence, although the four-factor and bi-factor models also showed satisfactory fit. Based on the BIC values and conceptual alignment with the original EE theory, the five-factor model was retained as the most parsimonious and theoretically robust representation of the construct in this context. The findings indicate that the original five-correlated factor structure remains the most appropriate representation of EE in this context, supporting its use for subsequent reliability and DIF analyses.

In terms of factor loading, the five-correlated factor model showed that all items met the criterion of above .40 (see Table 5). The items were distributed across five theoretically defined factors: critical comments, hostility, emotional over-involvement, positive remarks and warmth. For the critical comments factor, loadings ranged from .562 to .775, reflecting moderate to strong associations with the latent construct. The hostility factor, comprising two items, showed loadings of between .510 and .810, indicating acceptable to high item discrimination. The emotional over-involvement factor, with three items, had loadings from .447 to .621, representing adequate contributions, despite being the lowest range among the dimensions. The positive remarks factor demonstrated the highest and most consistent loadings (.627 to .785), suggesting strong cohesion within this dimension. Finally, the warmth factor, consisting of four items, displayed a wider loading range (.431 to .727), indicating variability in item-construct relationships, yet still within acceptable limits for psychometric adequacy. These results collectively support the convergent validity of the scale and the distinctiveness of each of the EE dimensions.

In contrast, the bifactor model revealed that the general factors representing negative and positive dimensions tended to show lower loadings, with several items falling below .40 (See Appendix 4 on the Model 8). It indicates that the general factors were not well represented across

items, despite the overall model demonstrating acceptable fit indices. Such results suggest that the bifactor structure may not adequately capture the distinctiveness of the EE dimensions in this context. Taken together, these findings strengthen the consideration of the five-correlated factor

model as the most appropriate and best-fitting representation of the construct in our study. In addition, the results collectively support the convergent validity of the scale and the distinctiveness of each of the EE dimensions.

Table 4
Goodness of Fit Indices

Model	χ^2	df	p	CFI	TLI	RMSEA	SRMR	BIC
Single-factor	433.790	104	<.001	.645	.590	.118	.120	9,531.297
Five-correlated factors	131.752	94	.006	.959	.948	.042	.050	9,283.594
Four-correlated factors	158.030	98	<.001	.935	.921	.052	.059	9,288.137
Second-order	335.340	100	<.001	.746	.696	.101	.166	9,454.579
Third-order	199.286	98	<.001	.891	.866	.067	.099	9,329.393
Fourth-order	199.286	97	<.001	.890	.864	.068	.099	9,334.827
Two-correlated factors	267.844	103	<.001	.822	.793	.084	.106	9,370.782
Bi-factor	98.676	77	.049	.977	.964	.035	.040	9,342.891

Note: χ^2 = chi-squared, df = degree of freedom, p = significance value, CFI = comparative fit indices, TLI = Tucker-Lewis Indices, RMSEA = Root Mean Square of Error Approximation, SRMR = Standardized Root Mean of Residual

Table 5
Standardized Factor Loading and Variance Error of the Five-correlated Factor Model

Item	Factor Loading		Variance Error	
	λ	SE	φ	SE
Critical Comments				
Item 02	.775	.053	.399	.082
Item 06	.618	.078	.618	.096
Item 03	.562	.060	.684	.068
Hostility				
Item 08	.810	.081	.343	.131
Item 21	.510	.084	.740	.085
Emotional Over-Involvement				
Item 09	.621	.058	.614	.072
Item 01	.447	.070	.800	.062
Item 14	.564	.069	.682	.078
Positive Remarks				
Item 18	.648	.059	.580	.077
Item 24	.785	.049	.384	.076
Item 05	.689	.078	.525	.107
Item 25	.627	.066	.607	.082
Warmth				
Item 23	.431	.068	.814	.059
Item 27	.727	.047	.472	.068
Item 10	.725	.048	.474	.070
Item 26	.619	.060	.617	.075

Note: λ = chi-squared, φ = variance error, SE = standard error.

Omega Reliability

The reliability of the measurement was estimated using the McDonald's omega formula (2013). The analysis results shown in Table 6 indicate that the positive remarks dimension has a satisfactory value of above .70. The critical comments, hostility and warmth dimensions showed omega coefficients above .60, which are still acceptable (Hair et al., 2018). However, the

emotional over-involvement dimension had an omega coefficient of .569, below .60, probably because this dimension only comprised two items. In addition, hierarchical omega estimated from a second-order model indicated an overall scale reliability (ω_h) of .623. Taken together, these findings suggest that the instrument demonstrates overall acceptable internal consistency for research purposes.

Table 6*Omega and Alpha Ordinal Reliability*

Dimension	ω
Critical Comments	.638
Hostility	.603
Emotional Overinvolvement	.569
Positive Remarks	.761
Warmth	.693

Note: ω = McDonald's omega reliability

Table 7*Summary of DIF Detection of the Measurement Items*

Item	β	SE	z	SE
Critical Comments				
Item 02	.098	.080	1.226	.220
Item 06	-.115	.064	-1.789	.074
Item 03	.030	.061	0.481	.631
Hostility				
Item 08	-.109	.065	-1.675	.094
Item 21	7.721	5.017	1.539	.124
Emotional Over-Involvement				
Item 09	.043	.080	0.539	.590
Item 01	.076	.066	1.145	.252
Item 14	-.096	.067	-1.433	.152
Positive Remarks				
Item 18	-.069	.057	-1.206	.228
Item 24	.096	.054	1.785	.074
Item 05	.004	.054	0.074	.941
Item 25	-.056	.051	-1.096	.273
Warmth				
Item 23	.220	.060	3.673	<.001
Item 27	-.113	.059	-1.926	.054
Item 10	.013	.059	0.210	.829
Item 26	-.016	.059	-.268	.789

Note: β = standardized regression coefficient, SE = standard error, reference level = male

Differential Item Functioning

Differential item functioning analysis was also added to establish whether each item had a different function based on gender. The analysis was conducted using the MIMIC model, with the male gender as the reference level. The results of the analysis (see Table 7) show that most items function similarly for both genders. However, item 23 was identified as having DIF, as its significance value was below .05.

The results of the analysis showed a standardized regression coefficient (β) value of .220, indicating that women tended to agree with the statement in the item. The wording of this item was *"Offering to take me to get my blood sugar checked."*

Discussion

The study aimed to develop and evaluate the psychometric properties of a self-report FEE instrument contextualized for people with Type 2 Diabetes Mellitus in Indonesia. The final scale consisted of 16 items representing five dimensions of EE: critical comments, hostility, emotional over-involvement, positive remarks, and warmth. The results of the CFA analysis showed that the five-factor model with intercorrelated factors was the best model, with all factor loadings showing satisfactory values. In addition, the bi-factor model also showed good fit values supporting the interpretation of both the total score and the scores per dimension. The findings also show that only one item indicated DIF based on gender. Therefore, in general, the scale showed good invariance based on this factor.

The findings corroborate the evidence that the EE construct is multidimensional and cannot be reduced to a single-factor dimension. This is consistent with the initial theory of EE proposed by Leff and Vaughn (1985), which identified five dimensions for measuring it. In line with this, recent studies, such as those conducted by Akhtar

and Bano (2021) also show that the five-factor model has an acceptable goodness of fit value. In addition, studies have consistently developed multidimensional models that only involve certain dimensions of EE (Medina-Pradas et al., 2011; Ng et al., 2019; Schmidt et al., 2016). Our findings provide strong evidence that EE is a complex construct, in line with its original conceptualization.

It was also found that CC and hostility can be considered as the same dimension, as indicated by the satisfactory fit index and statistics in the four-factor model, which combined the CC and hostility dimensions. These findings explain why the hostility dimension is considered to play a minor role in predicting relapse, and tends to increase the predictive power of the CC dimension rather than being an independent predictor (Leff & Vaughn, 1985). Similar to this assumption, many studies also consider the two dimensions to be the same, leading to the development of EE measurements with two dimensions, CC and EOI (e.g., Koutra et al., 2014; Leeb et al., 1991; Magaña et al., 1986; Sepúlveda et al., 2014; Uehara et al., 1999). However, this alternative structure demonstrated a comparatively weaker fit; consequently, it is better to recommend the five-factor as the preferred framework for measuring EE, while the four-factor model may be appropriate in limited contexts to increase its practicality, such as rapid screening. Nevertheless, the four-factor model measure should be used with caution due to potential loss of nuance.

Unlike the majority of EE studies that focus on three dimensions of EE, which are considered good predictors of relapse (Butzlaff & Hooley, 1998; Hooley, 2007), the measurement tool used in this study included all the original dimensions of EE, as those that are not considered good predictors of relapse—warmth and positive remarks—can still explain the dynamics of family relationships in individuals with chronic illness. Leff and Vaughn (1985) themselves asserted that the warmth

dimension can predict relapse in Schizophrenia, but requires certain conditions in the other dimensions to serve as a predictor. The more complex nature of warmth as a predictor of relapse means it is not included in the EE index. Currently, research indicates that warmth tends to be a positive predictor of health conditions, acting as a protective factor against relapse in Schizophrenia (Butler et al., 2019; López et al., 2004; Ma et al., 2021), as well as promoting good social functioning and life satisfaction (Butler et al., 2019). Additionally, research has found that the positive remarks dimension is a predictor of higher life satisfaction in patients with Schizophrenia (Butler et al., 2019). These findings even lead to the assumption that EE has the potential to serve as a protective factor rather than a risk factor for specific health conditions.

The CFA results confirm that the warmth and positive remarks dimensions are part of the EE construct, and therefore, they need to be taken into account in its measurement. The exclusion of these in some studies was not due to a lack of psychometric evidence supporting both dimensions as part of EE; rather, it was based on considerations of the usefulness of the measurement. Many studies aim to simplify the measurement, focusing mainly on dimensions widely recognized as playing a role in predicting relapse. Research has found that the warmth dimension is a predictor of relapse and health conditions, especially in certain cultural contexts. López et al. (2004), for example, found warmth to be a strong predictor of relapse (as a protective factor) in Mexican-American communities. Therefore, this study incorporated these two dimensions to achieve a more comprehensive and contextual understanding, particularly in collectivist cultures such as Indonesia, where support is often expressed through emotional involvement and expressions of appreciation.

The EOI subscale in this study demonstrated lower internal consistency than other EE

dimensions. This pattern is consistent with previous research, which has indicated that EOI is particularly sensitive to cultural norms regarding family involvement and caregiving (Singh et al., 2013; Subandi, 2011). Such cultural variability may lead to heterogeneous interpretations of EOI items, reducing internal consistency. Moreover, previous work has shown that EOI tends to be a weaker predictor of health outcomes compared to other EE dimensions and that the predictive validity of EE measures can improve when the EOI subscale is modified or removed (Singh et al., 2013). Such findings suggest that the lower reliability observed in this study may reflect genuine cross-cultural variability in the construct, underscoring the need for culturally informed item development and validation in future research.

Furthermore, previous research has shown that EOI levels can fluctuate in response to situational stressors or contextual changes (Santos et al., 2001). Therefore, such variability in how individuals experience and express EOI may contribute to greater heterogeneity in item responses, which in turn can lower internal consistency estimates.

Understanding this study requires acknowledging the cultural differences between the individualistic West, where EE originated, and collectivist Indonesia. In more individualistic Western cultures, critical comments and emotional overinvolvement can be interpreted as a form of intrusion and violation of personal boundaries (Hooley, 2007). In contrast, in Indonesia, emotional involvement can be interpreted as a form of concern and a sense of moral responsibility between family members. Hasanat (2010) and Bhugra and McKenzie (2003) confirm that expressions such as criticism or intense involvement from patients' families can be interpreted positively in collectivist cultures, especially in chronic illness care. For this reason,

future research should consider cultural aspects of EE, especially how each factor is perceived by individuals in a certain culture.

In the DM-2 care context, these cultural dynamics are particularly relevant because family support plays a critical role in disease management. Comments or reminders regarding healthy lifestyles provided by family members are not always perceived as pressure; they can be interpreted as a sign of affection. This is reflected in the finding that negative dimensions, such as emotional over-involvement, do not always correlate with distress, but can coexist with positive expressions such as warmth. For example, families with higher warmth scores tended to express less CC and had higher EOI scores than families with lower warmth. Such a condition leads to families with high warmth having more adaptive coping and higher well-being scores than those with low warmth (Avraam et al., 2022). Other cross-cultural studies support these findings. Jenkins (1991), for example, showed that in the Indian family context, criticism is often interpreted as a sign of affection. Similarly, Phillips et al. (2002) found that emotional over-involvement in China can strengthen family cohesion and provide a sense of security. Therefore, according to Subandi (2011), the impact of EE on individuals depends on how they perceive the EE they receive.

In addition, the findings of this study suggest that the EE measurement tool developed was relatively stable across genders. However, the DIF analysis revealed that some items, especially those related to diet and exercise, were more often agreed with by men, while women more often agreed with items reflecting receiving help or support in daily activities. These findings suggest that gender roles in the family influence Type 2 DM patients' perceptions of emotional expression, which is in line with the study by Trief et al. (2003) who found that women more often viewed support from partners as a form of emotional

closeness, while men responded to supervision more as pressure on their autonomy. Revenson et al. (2016) and Helgeson and Lepore (2004) also showed that gender role norms influence how individuals respond to emotional support, with women tending to accept protective support, while men may feel uncomfortable with forms of support they perceive as controlling.

Meanwhile, the DIF observed for the item "Offering to take me to get my blood sugar checked" may also be partly explained by gender caregiving norms. In many contexts, preventive health accompaniment is more commonly undertaken by women, which could influence how the respondents interpreted and endorsed this item. This interpretation is consistent with descriptive findings from a meta-analysis of EE-related studies, showing a 5.6% greater likelihood of female participation and a predominance of female companions at 79.4% (Wolff & Roter, 2011). While these figures do not directly establish a causal link to the DIF observed in our data, they suggest that the behavior described in the item may be more strongly associated with female caregiving roles, potentially contributing to differential item functioning across gender groups. Similar findings have been reported in several other studies. Barzallo et al. (2024) found that although there was no difference in the amount of time invested in caregiving, female caregivers reported performing more household caregiving tasks. Meanwhile, Skinner and Sogstad (2022) found that female caregivers were more likely to provide personal care, whereas males tended to only offer practical assistance.

From a measurement perspective, the identification of such DIF patterns has important implications for the interpretation of MS-FEE scores. Although the overall factor structure remains stable, differences in item endorsement driven by gender role norms indicate that part of the variance in scores may reflect sociocultural

expectations rather than pure differences in the underlying expressed emotion construct. As a result, direct comparison of raw scores between men and women, particularly on dimensions containing DIF items, should be approached with caution. Researchers and practitioners should be aware that higher or lower scores in one gender group may not solely represent true differences in emotional expression, but could also be influenced by how gendered expectations shape the perception and reporting of certain behaviors. When gender comparisons are of primary interest, adjustments such as removing or statistically controlling for DIF-affected items, or complementing quantitative scores with qualitative data, may be warranted to enhance fairness and validity in interpretation.

Consequently, the interpretation of EE cannot be separated from the cultural and gender contexts. These differences in perception not only reflect individual differences, but also the product of social structures and role expectations within the family.

The findings support the five-factor model of EE as originally proposed. Therefore, all five factors should be considered in clinical practice. Professionals addressing EE-related issues in clinical settings are encouraged to target all five factors, rather than solely focusing on the negative dimensions. This broader approach can facilitate more effective health management by enabling practitioners to reduce the impact of negative factors while simultaneously fostering the positive ones. However, when resources are limited, a simplified structure may be used by combining the critical comments (CC) and hostility dimensions into a single one. Finally, EE assessment should be conducted with careful consideration of cultural and gender contexts. The findings indicate that expressions of EE are not always perceived uniformly as positive or negative; perceptions can vary depending on cultural background and

gender. In conclusion, incorporating the full five-factor model into both assessment and intervention can enhance the relevance and effectiveness of clinical interventions such as family counseling and psychoeducation.

In summary, the study contributes both theoretically and practically to the understanding and measurement of EE in the context of T2DM. In theoretical terms, it reinforces the conceptualization of EE as a multidimensional construct encompassing both risk and protective elements, highlighting the importance of considering warmth and positive remarks alongside the negative dimensions. This finding offers a foundation for future investigations into the adaptive functions of positive EE. Practically, the validated Family Expressed Emotion (FEE) scale provides clinicians and researchers with a culturally adapted and psychometrically sound tool for assessing EE in individuals with T2DM in Indonesia. Its use can inform interventions aimed at improving family communication, enhancing self-management, and tailoring psychoeducational programs.

Although the study makes an important contribution to the development of a culturally relevant EE measurement tool, several limitations need to be noted. First, only participants from urban hospitals in Yogyakarta were included, who may differ socially and culturally from other areas, thus restricting the generalizability of the findings. This limitation suggests the need for replication in more diverse cultural and demographic contexts. Second, the study found DIF on several items, but it did not examine differences across other relational groups, such as marital status, education or type of family relationship. These factors may influence how individuals understand and respond to emotional expressions. Future research should consider such factors when developing EE measures. Third, the study did not include health outcomes variables. Therefore, future studies should also examine the longitudinal stability of EE

and explore its associations with behavioral and clinical outcomes to further establish predictive validity. Addressing these issues will strengthen both the theoretical generalizability and the practical utility of EE assessment in health psychology.

Future research should also broaden the range of participants geographically and socioculturally, extending beyond the scope of this research to include rural areas and/or different regions with varying cultural norms. Such cross-regional research would allow for the examination of whether the factor structure of EE remains consistent across cultures, or is influenced by regional or cultural contexts. In addition, longitudinal studies are needed to assess the stability of EE scores. Such studies would allow examination of whether EE represents a stable (trait) or an unstable characteristic (state). This approach would help address the reliability issues in EE measurement. Furthermore, investigating how EE relates to other psychological measures, including subjective well-being, relationship fulfillment, family conflict, and emotion regulation strategies, is necessary. A more thorough analysis of DIF-indicated items is necessary for future development or revision. Finally, it is important for future cross-cultural studies to confirm that cultural adaptation in EE measurement includes linguistic, conceptual and relational aspects, so that the instrument captures culturally relevant

expressions of emotional involvement. Integrating these approaches will enhance the cultural sensitivity of EE research.

Conclusion

The study has developed and evaluated the psychometric properties of a self-report family expressed-emotion (FEE) measurement tool contextualized for people with Type 2 Diabetes Mellitus (T2DM) in Indonesia. The analysis results suggest that a five-factor model, including critical comments, hostility, emotional over-involvement, positive remarks and warmth, is the best structural representation of the EE construct in this context. The findings confirm that EE is multidimensional and that positive dimensions, such as warmth and positive remarks, also make important contributions in describing the dynamics of emotional relations within families, especially in collectivist societies.

Besides showing internal structure validity and reliability, the scale also showed measurement invariance across genders, with some item differences reflecting gender roles and family perceptions. These results confirm that emotional expression cannot be separated from the cultural and social contexts in which it occurs. Therefore, the scale offers a culturally relevant tool for assessing emotional experiences in families living with people with T2DM in Indonesia.[]

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Author Contribution Statement

Nida Ul Hasanat: Conceptualization; Investigation; Methodology; Resources; Writing Original Draft; Writing, Review & Editing. **Ramadhan Dwi Marvianto:** Data Curation; Formal Analysis; Methodology; Visualization; Writing Original Draft; Writing, Review & Editing. **Alfan Fahri Rifqi As Sidqi:** Project

Administration; Resources; Writing Original Draft; Writing, Review & Editing. **Anke Karl:** Methodology; Writing, Review & Editing.

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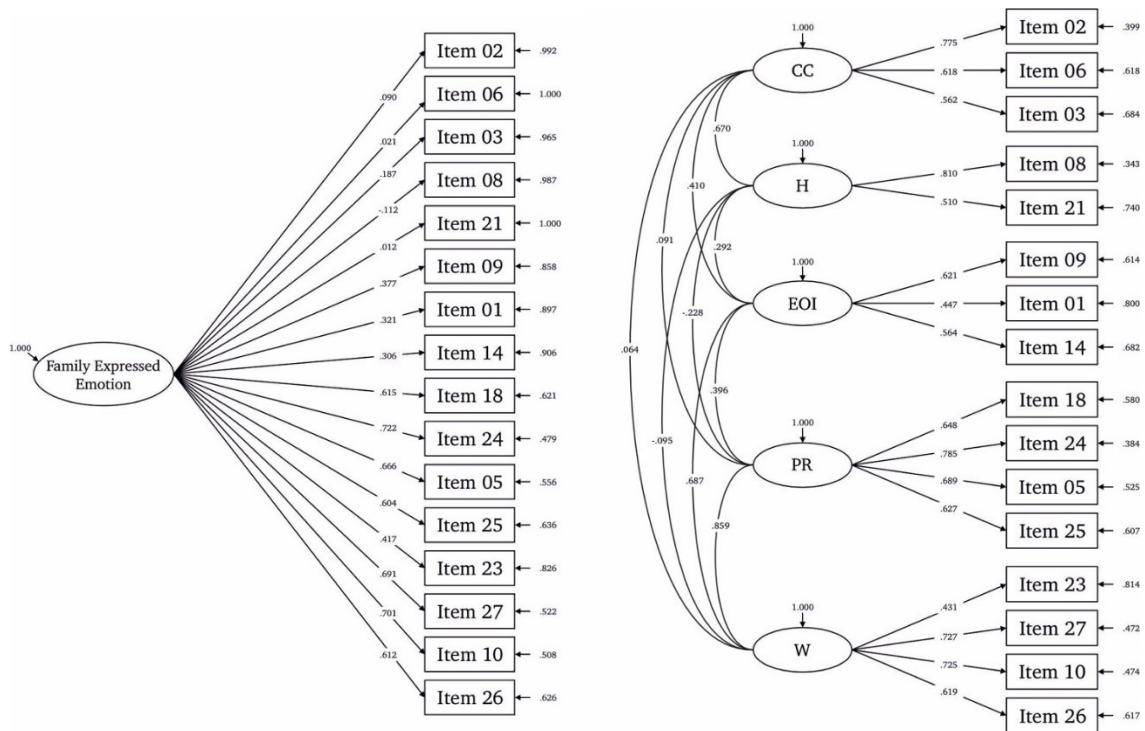
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Appendixes

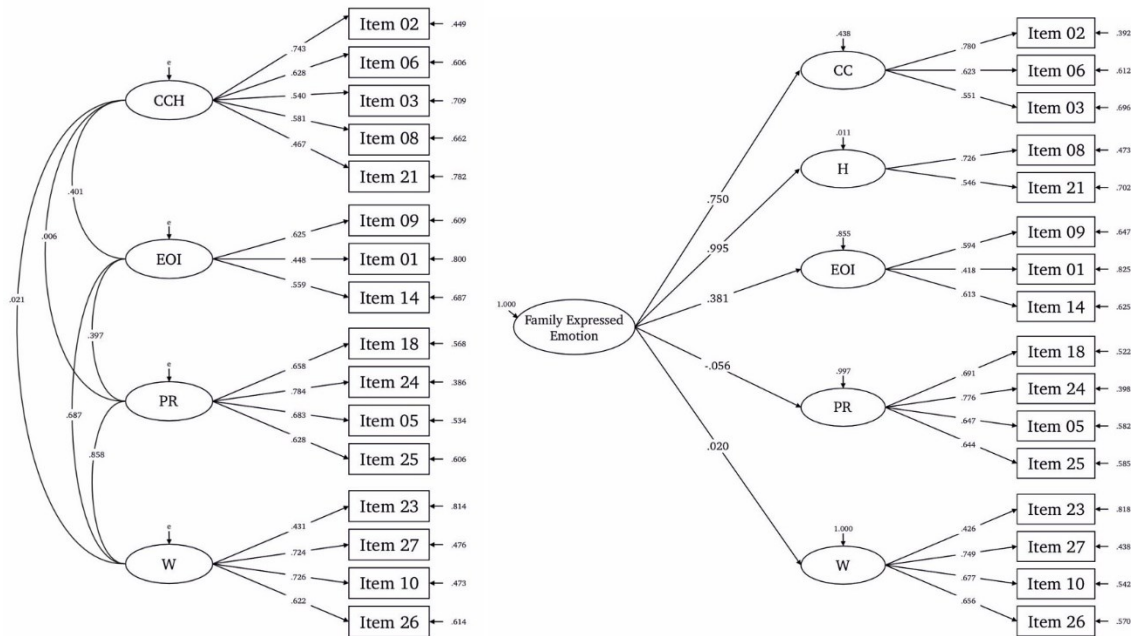
Appendix 1

Factor Structure of Single Factor Model (Model 1/Left Side) and the Five-correlated Factor Model (Model 2/Right Side)



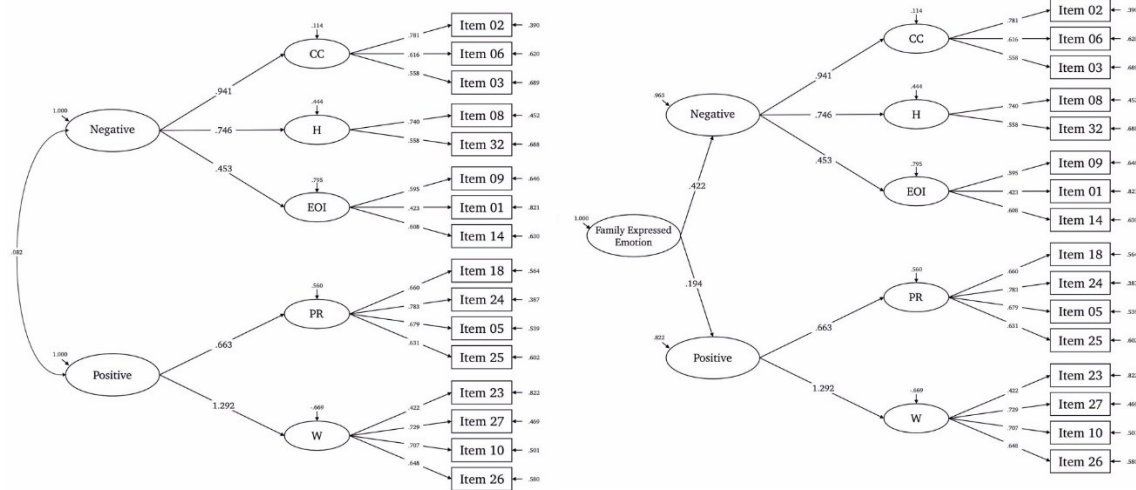
Appendix 2

Factor Structure of the Four-correlated Factor Model (Model 3/Left Side) and Second-order Model (Model 4/Right Side)



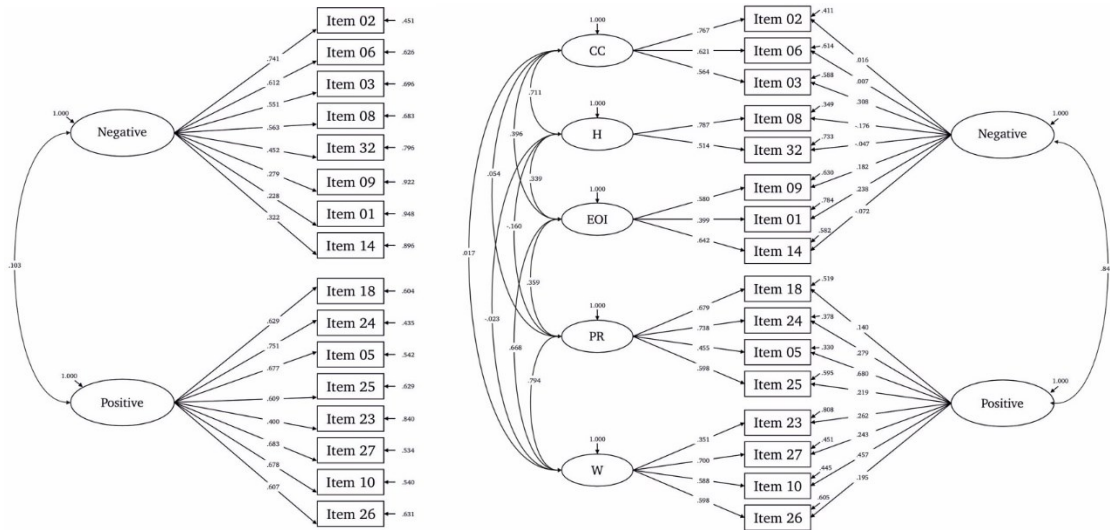
Appendix 3

Factor Structure of the Two-factor Second-order Model (Model 5/Left Side) and the Third-order Model (Model 6/Right Side)



Appendix 4

Factor Structure of the Two-correlated Factors Model (Model 7/Left Side) and the Bifactor Model (Model 8/Right Side)



Appendix 5*Final Item Multidimensional Expressed Emotion Scale for Type 2 DM Patients*

No.	Item
Critical Comments	
02	<i>Mengeluarkan kata-kata pedas jika hasil cek gula darah saya jelek</i> (Making harsh comments when my blood sugar test results are bad).
06	<i>Menyalahkan saya ketika gula darah saya naik</i> (Blaming me when my blood sugar goes up).
03	<i>Mengkritik cara saya mengatur makanan</i> (Criticizing my diet).
Hostility	
8	<i>Menganggap saya orang yang sulit diatur</i> (Considering me a difficult person).
21	<i>Menganggap saya tidak patuh nasihat dokter</i> (Considering me disobeying the doctor's advice).
Emotional Over-Involvement	
09	<i>Mengatur jadwal saya untuk 'ngecek' kadar gula darah saya</i> (Setting up a schedule to 'check' my blood sugar levels.)
01	<i>Tampak cemas jika saya lupa minum obat</i> (Seeming worried if I forget to take my medicine.)
14	<i>Menyiapkan obat sesuai dengan waktu minum obat</i> (Preparing the medicine according to the schedule prescribed for me)
Positive Remarks	
18	<i>Memuji saya pada waktu saya mampu menjalankan diet yang disarankan dokter</i> (Praising me when I comply with the diet recommended by the doctor)
24	<i>Merasa bangga jika saya mematuhi diet</i> (Feeling proud if I comply with the diet)
05	<i>Merasa bangga terhadap usaha saya dalam minum obat sesuai petunjuk dokter</i> (Feeling proud of my efforts in taking medication according to the doctor's instructions).
25	<i>Merasa bangga jika saya rutin berolahraga</i> (Feeling proud if I exercise regularly)
Warmth	
23	<i>Menawarkan untuk mengantar saya cek gula darah</i> (Offering to take me to get my blood sugar checked)
27	<i>Siap membantu saya dalam mengatur diet</i> (Being ready to help me with my diet)
10	<i>Memberikan dukungan agar saya tidak bosan minum obat</i> (Providing support so that I don't get bored of taking my medication).
26	<i>Memberi semangat kepada saya untuk minum obat secara teratur</i> (Understanding my difficulty in dieting).

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