Development and Psychometric Evaluation of the Sexual and Reproductive Health Questionnaire for Women With Type 1 Diabetes Mellitus: A Study Protocol for a Sequential Exploratory Mixed-Methods Study

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Abstract

Objectives: Type 1 diabetes mellitus (T1DM) can profoundly influence different dimensions of health such as sexual and reproductive health (SRH). The aim of this study is to develop and evaluate the psychometric properties of the Sexual and Reproductive Health Questionnaire for Women With Type 1 Diabetes Mellitus (SRHQ-WT1DM).

Materials and Methods: This protocol for a sequential exploratory mixed-methods study has two phases. Conducting a literature review, the first phase of the study will develop the items of SRHQ-WT1DM. Data analysis in this phase will be performed using directed content analysis and according to the framework proposed by the United Nations Population Fund (UNFPA) and the World Health Organization (WHO) for SRH in women. The second phase will evaluate the psychometric properties of SRHQ-WT1DM through a methodological study. Face and content validity will be evaluated both qualitatively and quantitatively, and construct validity will be done by exploratory factor analysis and convergent validity. The questionnaire’s reliability and stability will be examined using internal consistency (by Cronbach’s alpha calculation) and test-retest method (by Intraclass correlation coefficient calculation), respectively. Descriptive statistics, Pearson correlation coefficient, and independent t-test will also be used. Women with T1DM who are of childbearing age and have unknown mental disorders will be selected as participants in the study from the Iranian Diabetes Society.

Discussion: Development and psychometric evaluation of a specific tool for SRH assessment in women will help identify and fulfill their SRH-related needs and improve dimensions of their SRH.

Keywords: Sexual health, Reproductive health, Women, Type 1 diabetes mellitus, Protocol, Psychometrics properties

Introduction

Type 1 diabetes mellitus (T1DM) is considered to be a critical public health problem (1). It is a metabolic disorder caused by chronic hyperglycemia following the autoimmune destruction of pancreatic beta cells and subsequent absolute deficiency of insulin (2). Recently, the statistics by the International Diabetes Federation (IDF) showed that 463 million adults worldwide have diabetes mellitus. The prevalence of diabetes mellitus (DM) among Iranian adults is about 9.6% (3). Around 10% of people with DM suffer from T1DM (4). Currently, more than 1.1 million kids and adolescents (under 20-years-old) suffer from T1DM. In Iran, the prevalence of T1DM among this age group is 7.8 cases per 1000 (5) and 36% of diabetes among Iranian is T1DM (6).

The most important complications of DM for women are limb amputation, decreased self-esteem due to body image, and concerns over marital relationships and sexual and reproductive health (SRH) (6). Chronic insulin deficiency and hyperglycemia exert serious negative effects on reproductive system (7,8) and causes menstrual disorders, delayed menarche, early menopause, infertility (9) and sexual dysfunction in women (8). Pregnant women suffering from T1DM are more likely to be at risk of hypertension, overweight, inadequate blood glucose control, preeclampsia, infections, and delivery through cesarean section. Furthermore, their neonates are more likely to experience congenital defects, prematurity, early neonatal death, macrosomia, dystocia, and damages to the brachial nerve plexus (10).

A key step in improving SRH among women with T1DM is to assess their SRH through valid and reliable
The onset of childhood T1DM has profound and long-lasting effects on a person’s health. The first step in improving SRH of women with T1DM is to recognize the current situation using a valid and reliable tool. Although numerous studies and questionnaires have examined different dimensions of SRH of these women, the items of these questionnaires do not cover all the components of the concepts of SRH for this group. These questionnaires are not designed specifically for these people, are not adequately comprehensive, and focus more on the control of the patient’s blood sugar status, nutrition, physical care measures in diabetes, exercise and the like. The design and psychometric evaluation of SRH assessment tools for women with type 1 diabetes mellitus will be performed for the first time by directed content analysis method on existing texts. The review study will be of the literature review type and based on the WHO and UNFPA classification of the concept of women SRH, the articles will be analyzed based on thematic similarity and the initial matrix will be formed.

### Key Messages

- The onset of childhood T1DM has profound and long-lasting effects on a person’s health.
- The first step in improving SRH of women with T1DM is to recognize the current situation using a valid and reliable tool.
- Although numerous studies and questionnaires have examined different dimensions of SRH of these women, the items of these questionnaires do not cover all the components of the concepts of SRH for this group.
- These questionnaires are not designed specifically for these people, are not adequately comprehensive, and focus more on the control of the patient’s blood sugar status, nutrition, physical care measures in diabetes, exercise and the like.
- The design and psychometric evaluation of SRH assessment tools for women with type 1 diabetes mellitus will be performed for the first time by directed content analysis method on existing texts.
- The review study will be of the literature review type and based on thematic similarity and the initial matrix will be formed.

Instruments. As World Health Organization (WHO) and the United Nations Population Fund (UNFPA) have suggested, women’s SRH can be divided into the six main categories of safe motherhood (11,12), family planning (11,12), sexually transmitted diseases (12), human immunodeficiency virus and acquired immunodeficiency syndrome (11,12), sexual history and function (13), and sexual and gender-based violence (11). There are different measurement tools which address some aspects of these six main dimensions. Some of the more common tools are as follows:

- The 39-item Diabetes questionnaire (Diabetes-39) covers dimensions such as energy and mobility, DM control, anxiety, social burden, and sexual functioning (13).
- The Female Sexual Function Index (FSFI) measures the sexual function of women in six dimensions of sexual desire, subjective arousal, vaginal lubrication, orgasm, sexual satisfaction, and dyspareunia (14).
- The Golombok-Rust Inventory of Sexual Satisfaction (GRISS) has four dimensions of marital satisfaction, marital relationships, marital interests, trust, and respect (15).
- The Female Sexual Distress Scale (FSDS) contains items on sexual distress, sexual dissatisfaction, and shame over sexual problems (16).
- Diabetes Quality of Life (DQOL) has items on the two main dimensions of caring behaviors and satisfaction with DM management (17).
- The Audit of Diabetes-Dependent Quality of Life (ADDQOL) has items on social and family life, nutrition, and physical exercise (18).
- The Hudson Index of Sexual Satisfaction has items of this index measure the level, severity, and marital problems in couples (19).
- The Sexual and Reproductive Needs Assessment Questionnaire: This questionnaire was developed and psychometrically evaluated in Zimbabwe by the New Dimension Consulting (NEDICO) and UNFPA (20) includes several items on demographic characteristics as well as 114 items in six main dimensions.

None of the mentioned tools is found to be comprehensive for assessing SRH of women with T1DM. Moreover, some of them are too lengthy, or assess blood glucose control, nutrition, and routine DM care, DM effects on employment, caring behaviors, physical exercise, and satisfaction with DM status with limited items, if any, in SRH. The questionnaire developed by NIDECO is also a general questionnaire and does not address the specific aspects of DM effects on SRH. For example, it does not include the uses and complications of contraceptive methods for women with DM, DM-related problems in pregnancy, DM-related birth complications, and the long-term impacts of DM on various aspects of SRH such as puberty and menstruation. Given the non-comprehensiveness of the existing SRH assessment questionnaires for women with T1DM and the gap in this regard, it is essential to develop valid and reliable tools in this area. Therefore, the present study will be conducted to reduce this gap. This study aims to develop and evaluate the psychometric properties of the Sexual and Reproductive Health Questionnaire for Women with Type 1 Diabetes Mellitus (SRHQ-WT1DM).

### Materials and Methods

#### Study Setting and Participants

This study will be conducted in the central building of the Iranian Diabetes Society in Tehran, Iran. Eligible participants will be married women of reproductive ages (15–49 years), those whose T1DM was diagnosed at least one year before the study (the members of the Iranian Diabetes Society), and women with at least one child. Purposive sampling method will be used in this study.

This exploratory sequential mixed methods study will have two phases. The first phase develops the SRHQ-WT1DM based on the results obtained for review of literature and using directed content analysis. The second phase will be a quantitative methodological study for evaluation of the psychometric properties of SRHQ-WT1DM.

#### Phase 1. SRHQ-WT1DM Development

Waltz et al (21) have proposed a four-step approach for instrument development. The four steps of this approach are selection of a conceptual model, explaining the objectives for the scale, development of the blueprint, and construction of the tool. In the present study,
1. The conceptual model of SRHQ-WT1DM will be developed using the results of literature review which will be analyzed through a directed content analysis based on the WHO and UNFPA theoretical framework of SRH in women.
2. The objectives will be designed based on the dimensions of SRH of women with T1DM.
3. The blueprint will contain the more specific dimensions of the concept, i.e., its subcategories, as well as a primary estimation of the necessary items for each subcategory.
4. The most appropriate and relevant items will be produced and grouped into categories and subcategories according to their similarities. Figure 1 shows the algorithm of the design tools of the study.

Development of the Conceptual Model and Production of the Item Pool
In order to develop the conceptual model and produce the item pool, the related literature will be reviewed to access the literature on the concept of SRH in women with T1DM. The model will be developed based on the SRH model of WHO and UNFPA and the collected data will be analyzed and categorized based on this model.

Search Strategy
The intended keywords identified based on the model of WHO and UNFPA for SRH (Table 1). Search queries will be searched in the English databases of PubMed, Web of Science, SCOPUS, and Embase, and the search engine Google Scholar and Persian databases of Magiran, SID and IranDoc. The search protocol will be limited to the 2000–2019 period and Boolean operators “AND” and “OR” will be used to combine search results. Inclusion criteria will be the articles published in English or Persian, the articles published between 2000 and 2019, and those whose full texts are available. Documents will not be included if they have addressed the complications of chronic DM for vital body organs, SRH in men, type 2 DM or gestational DM, comparison of pharmacological methods and laboratory findings, women of non-productive years, and epidemiologic trends of DM. The characteristics of the retrieved documents will be entered into the EndNote software and duplicate records will be removed. Then, the titles and the abstracts of the remaining documents will be assessed based on the objectives of the study and the most appropriate documents will be identified.

Data Analysis
Eligible documents included in the study will be analyzed through directed content analysis based on the SRH model of WHO and UNFPA. In directed content analysis, data coding starts using the theory or the findings of former relevant studies (22). In some cases, there is an incomplete theory about a phenomenon and, hence, directed content analysis is used to further develop it (23). Models or theories used in directed content analysis help us have a structured process of analysis (24) and identify the primary categories (25). The included documents and instruments will be assessed and the primary items of SRHQ-WT1DM will be constructed and divided into subcategories and categories according to their similarities and, thereby, the primary version of the questionnaire will be developed. A panel of experts in SRH, endocrinology, and gynecology will be formed to assess the appropriateness of the items.

Phase 2. Psychometric Evaluation
This phase, using a methodological study, will assess the psychometric properties of SRHQ-WT1DM. These properties will include face, content, and construct validity as well as reliability.

Content Validity Evaluation
Qualitatively evaluating the content validity, twenty pediatricians, SRH, endocrinology, and gynecology will be asked to evaluate and provide written feedback on the wording, grammar, and items allocation.
Quantitatively investigating the content validity, content validity ratio (CVR) and content validity index (CVI) will be calculated (21). For CVR calculation, the same experts will be asked to rate the essentiality of each item based on a 3-point scale (1-3): “Essential”, “Useful but not essential”, and “Unessential”. Then, CVR will be calculated using the following formula, CVR = (ne-N/2)/(N/2), where Ne is the number of experts who rate an item “Essential” and N is the total number of experts. Lawshe and others pointed that when the number of experts is twenty, the items with a CVR greater than 0.42 are considered to be appropriate (26).
In order to calculate CVI, the same experts will be

Figure 1. Algorithm of Tool Design Steps.
asked to rate the relevant items based on a 4-point scale (1-4): "Irrelevant", "Needs major revision", "Relevant but needs revision", and "Completely relevant". Then, the CVI of each item will be calculated by dividing the number of experts rated it 3 or 4 by the total number of the experts. CVI value is interpreted as follows: less than 0.7: unacceptable; 0.7-0.79: items need revision; and more than 0.79: acceptable (21). The assessment of content validity will also be done by calculating Kappa and weighted Kappa. Kappa is used to assess intra-rater and inter-rater agreement. It considers chance agreements and adjusts agreement for them (27). Therefore, it is preferable to a simple agreement coefficient. Kappa will be calculated via the following formula, \( K = \frac{Pr(a) - Pr(e)}{1 - Pr(e)} \), where \( Pr(a) \) is the actual observed agreement and \( Pr(e) \) is chance agreement. Kappa coefficient ranges from 0 ("Disagreement") to 1 ("Complete agreement") and is interpreted as excellent (>0.74), good (0.60–0.74), and relatively good (0.40–0.59). In the present study, Kappa values that are more than 0.7 are acceptable.

### Face Validity Evaluation
In the qualitative face validity evaluation, 10 women with T1DM will be interviewed about the difficulty, appropriateness, and clarity of the items and, then they will be revised according to their comments (28). In quantitative face validity evaluation, we will ask 10 other women with T1DM to rate the significance of each item based on a 5-point scale. Their rating scores will be used to calculate item impact score multiplying the significance of the item by the number of women rated the intended item 4 or 5. Item impact scores higher than 1.5 will be considered acceptable (29).

Item analysis: Item analysis is a method for face validity evaluation and is performed through item difficulty coefficient, discriminant coefficient, and the Loop method. The Loop method will be used in the present study. In this method, the reliability coefficients of all items and the total reliability coefficient of the scale are calculated. Then, the scale's total reliability coefficient is calculated after excluding each item one by one. If the exclusion of an item leads to a significant decrease in the total reliability coefficient, that item is considered to be an important and essential one (30). Item analysis in the present study will be performed in a pilot study on 35 women with T1DM in which reliability coefficient will be calculated after the exclusion of each item, and the results will be used to judge about the item significance. Reliability coefficients greater than 0.7 will be considered acceptable.

### Construct Validity Evaluation
Construct validity is defined as the degree showing the appropriateness of an instrument for the measurement of the intended construct (31). The construct validity of SRHQ-WT1DM will be assessed using exploratory factor analysis (EFA) and convergent validity evaluation.

In EFA, sampling adequacy will be assessed using the Kaiser-Meyer-Olkin (KMO) method and a KMO statistic greater than 0.8 will be considered acceptable. Data appropriateness for EFA will also be evaluated using the Bartlett's Sphericity test. Factors will primarily be extracted through Varimax rotation based on eigenvalues greater than 1 and scree plot. The minimum factor loading will be 0.4 (32). The minimum sample size for EFA will be considered to be 200 (32) or 5-10 participants per item (33). Finally, five T1DM-afflicted women will be selected per item from the Iranian Diabetes Society to complete SRHQ-WT1DM. Their data will be used for EFA using the SPSS software.

### Convergent Validity Evaluation
The 8-item Short Form Survey (SF-8) will be used for the convergent validity evaluation of SRHQ-WT1DM. The SF-8 is the short form of Health-Related Quality of Life Profile and can be used for health assessment in people with chronic disease (34). Participants will be asked to complete SRHQ-WT1DM and SF-8 and, then, Pearson's correlation analysis will be used to assess the correlation.
between the scores of these two instruments. A correlation coefficient of more than 0.7 will be considered acceptable.

**Reliability Evaluation**

Reliability refers to the extent to which the apparent differences in the scores of a test are due to actual differences in the studied characteristics, and to what extent the differences can be attributed to random error (35). The reliability of SRHQ-WT1DM and measurement stability will be evaluated using internal consistency and test-retest methods.

**Internal Consistency Evaluation**

In internal consistency evaluation, items are evaluated in terms of their conceptual appropriateness by using methods such as Cronbach’s alpha, split-half, and Kuder-Richardson (36). In the present study, Cronbach’s alpha will be calculated for SRHQ-WT1DM and all its dimensions. The possible range for Cronbach’s alpha is 0–1, with higher scores showing greater internal consistency (21).

**Evaluation of Stability by Test-Retest**

This method determines whether the score of a person for a scale remains stable over time. Intra class correlation coefficient (ICC) is usually used for methods with repeated measurements such as test-retest. This coefficient tests the stability over time and is sensitive to systematic error in the data (36). In this study, for the evaluation of the stability, SRHQ-WT1DM will be completed by 30 women two times and in an interval of two weeks. Then, ICC will be calculated for the questionnaire and its dimensions using the SPSS software. Coefficients greater than 0.7 will be considered acceptable.

**Responsiveness**

Responsiveness is defined as the ability of an instrument in detecting changes when they happen (37, 38). The responsiveness of SRHQ-WT1DM will be assessed by calculating the standard error of measurement (SEM) and the minimum detectable changes (MDC).

SEM calculation: SEM will be calculated using the following formula, $SEM = SD_{\text{Pooled}}(1-R)$, where R is an estimation of reliability (either Cronbach’s alpha or ICC) and $SD_{\text{Pooled}}$ is calculated by dividing the sum score of $SD_1$ and $SD_2$ by 2 (i.e., $SD_{\text{Pooled}} = [SD_1 + SD_2]/2$). In the present study, $SD_1$ and $SD_2$ will be the standard deviations of the scores of the test and the pretest measurements for stability assessment, while R will be the total ICC of the questionnaire.

MDC calculation: MDC will be calculated using the following formula, $MDC = SEM \times 1.96 \times 2$.

**Interpretability**

Interpretability is the minimal important change (MIC) in the score of the intended instrument or the degree to which the change in the score of the instrument is meaningful. In other words, MIC is the lowest change in the score of the instrument which indicates an improvement or aggravation of patients’ conditions in response to a specific therapeutic intervention and leads to changes in the treatment process (39). The interpretability of SRHQ-WT1DM will be determined by assessing sampling adequacy, calculating MIC, and determining ceiling and floor effects.

Sampling adequacy assessment: Sampling adequacy will be determined using KMO method. This method assesses the proportion of variance among variables, with lower proportion showing more appropriate data for EFA (40). KMO varies from 0 to 1. A KMO value greater than 0.8 will be considered acceptable in the present study.

MIC calculation: MIC is the lowest change in the mean score of an instrument which is considered important by respondents (41). It is calculated using the following formula, $MIC = 0.5 \times SD$ of $\Delta$ score, where $\Delta$ score is the deviation of changes between the test and the retest measurements and 0.5 is a moderate effect size (36). An MIC greater than MDC shows that the intended instrument has acceptable responsiveness (42,43).

**Ceiling and Floor Effects**

Ceiling and floor effects happen when most respondents obtain high and low scores, respectively, for the intended instrument (44). The value of ceiling and floor effects should be less than 20% (45). In our study, ceiling and floor effects will be determined by calculating the percentage of participants who obtain the highest and lowest scores, respectively, for SRHQ-WT1DM.

**Scoring**

An instrument can be scored using a Likert scale and a standard 0–100 scale (21). The SRHQ-WT1DM will be scored based on a 5-point Likert scale, in which the higher the scores, the better SRH. Moreover, scores will be altered into the 0–100 scale through the following formula (46).

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\text{Score in the 0-100 scale} = \frac{\text{Theraw score} - \text{The lowest possible raw score}}{\text{The highest possible raw score} - \text{The lowest possible raw score}}
\]

The 0–100 score of SRHQ-WT1DM also can be interpreted as follows: scores 0–25: poor SRH; scores 25–50: moderate SRH; scores 50–75: good SRH; and scores 75–100: excellent SRH.

**Data Analysis**

All of the statistical analysis in the psychometric evaluation phase will be performed using the Statistical Package for the Social Sciences software (SPSS, version 23.0 for Windows; SPSS Inc., Chicago, IL). The descriptive statistics of mean, standard deviation, absolute frequency, and relative frequency will be used for data description. The Pearson’s correlation analysis, independent t test, intra
Discussion
This study aims to develop SRHQ-WT1DM and its constructive dimensions through a literature review and evaluate its psychometric properties through a methodological study. Articles extracted from selected databases are analyzed based on the research objectives and according to WHO and UNFPA classifications of SRH based on the thematic similarity. The items obtained from the final articles, sub-categories and categories will form the concept of SRH in women with T1DM. In the next step, standard steps of psychometrics will be performed and the opinions of the target group will be used.

Reproductive system disorders are very common in women with T1DM and up to 40% of them develop reproductive system problems at some point in their lives (9). Chronic hyperglycemia and absolute lack of insulin, in addition to toxic effects on the surface of the brain and ovaries, affect the function of the reproductive and sexual systems by damaging the walls of arteries and the autonomic nervous system (7, 8) and consequently lead to late puberty, menstrual cycle disorders, infertility, adverse pregnancy complications and premature menopause (47,48). Sexual function is affected by T1DM because of changes in blood flow, increased incidence of vaginal infections, decreased vaginal lubrication, and long-term complications such as neuropathy (49,50). Pre-gestational diabetes is associated with an increased risk of adverse maternal and fetal outcomes (51). Hypertension (52,53), preeclampsia (54-56), increased body mass index and obesity (57-59), blood sugar disorder (66), Seizure (59), emergency cesarean section (58,60,61), infections (69,59), post-partum hemorrhage (62) and death (63,64) increase in pregnant women with T1DM. Common problems in fetuses of mothers with T1DM include low birth weight (55,65), macrosomia (65,66) and shoulder dystocia (67), intrauterine growth restriction (68), congenital malformations (69-71), preterm labor(61,72-74), icterus and death (53,67).

The effects of types 1 and 2 DM on reproduction are different and can be distinguishable from each other. As T1DM starts in childhood, it has profound effects on SRH. However, most SRH assessment instruments used for women with T1DM are general health assessment instruments which focus on the general aspects of SRH and are appropriate for general populations. Moreover, SRH assessment is usually neglected in health assessments. A careful SRH assessment using SRH-specific valid and reliable instruments can affect and be affected by DM management. Using SRHQ-WT1DM in DM care centers can facilitate the identification of the challenges in providing care services for patients with T1DM and help improve their SRH.

One of the limitations of the present study is the widespread concept of SRH among women, which will result in retrieving a large number of documents in the literature review phase of the study and will require a great amount of effort for screening and selecting the most appropriate documents. In addition, only Persian and English articles whose full texts are available will be examined.

In summary, T1DM is increasing among women who are in their reproductive age, and its effects on the health and functions of the reproductive and sexual systems are observable. To assess the current situation and plan effective measures to improve the reproductive health of women with T1DM, it is necessary to design a specific tool with appropriate validity and reliability. The present study is a protocol for designing of this tool.

Authors' Contribution
NA, GO, AE and HAM designed the study and conducted the research. NA, GO, AE, AR, SK and FJCH monitored, evaluated, and analyzed the result of the study. Further, NA, GO, AE and HAM reviewed the article. All authors approved the final manuscript and took responsibility for the integrity of the data.

Conflict of Interests
The authors declare that they have no competing interests.

Ethical Issues
This study has been approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran. (Reference no: IR.SBMU.PHARMACY.REC.1399.218).

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