INTRODUCTION

Breast cancer (BrCa) is the most common malignant tumour among women worldwide (Fan et al., 2014; Li et al., 2016). According to GLOBOCAN 2018, about 2.1 million new cases of BrCa occurred globally in 2018, accounting for almost a quarter of cancer cases among BrCa women. It is the most common diagnosed cancer in most countries (83.24%) and the leading cause of cancer-related death in more than 100 countries (Bray et al., 2018). About two-thirds of BrCa women test positive for the oestrogen receptor (ER) and/or progesterone receptor (PR) (Burstein et al., 2019). Adjuvant endocrine therapy (AET) is an important component of effective therapy for most hormone receptor-positive BrCa women. AET reduces recurrence and mortality in BrCa women significantly (Anderson et al., 2014; Bender et al., 2014; Harrow et al., 2014; Weaver et al., 2013). Updated clinical practice guidelines recommend that hormone receptor-positive BrCa women need 5–10 years of endocrine therapy after surgery (Burstein et al., 2019; Wang et al., 2016). Despite the radical difference made by AET in BrCa outcomes, up to 50% of women do not adhere to prescribed regimens (van Herk-Sukel et al., 2010; Hershman et al., 2010) and 31%–73% of women are non-persistent with AET (Murphy et al., 2012; Xu et al., 2020). Thus, the clear benefits of AET are often lost owing to poor adherence.

The World Health Organization (WHO) defines adherence as “the extent to which a person’s behaviour—taking medication, following a diet and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider” (World...
Health Organization, 2003). Consistent reductions in risk ranging from 27%–68% over 10.5–24 years of follow-up were reported in those patients with the highest adherence to cancer prevention guidelines compared with the lowest adherence (Kabat et al., 2015; Khaw et al., 2008; McCullough et al., 2011; Petersen et al., 2015; Thomson et al., 2014).

Breast cancer is a chronic disease that needs to be closely monitored throughout each patient’s subsequent lifetime. Epidemiologic studies have reported that maintaining or adopting a health behaviour (such as healthy diet and being physically active) after diagnosis may improve BrCa prognosis (George et al., 2011; Holmes et al., 2005; Kelly et al., 2015), while also reducing all-cause mortality (George et al., 2014; Irwin et al., 2011). The health behaviour of BrCa women (such as AET adherence, dietary nutrition status, weight change, physical activity status, smoking, and drinking) was associated with tumour metastasis and recurrence, disease-free survival rate and mortality (Chlebowski, 2013; World Cancer Research Fund International & American Institute for Cancer Research, 2014). Studies have shown that many health behaviours usually co-occur (Spring et al., 2015), therefore, a composite variable may better capture how health behaviour factors synergistically affect BrCa specificity and total mortality. These impacts of a combination of health behaviour on mortality have been investigated in several studies (Kabat et al., 2015; McCullough et al., 2011; Petersen et al., 2015; Thomson et al., 2014), but few have applied a simple questionnaire taking national guidelines into account.

After an extensive literature review, no questionnaire was found that reveals the health behaviour of BrCa women undergoing AET, among the few studies available regarding the health behaviour of BrCa women. For instance, Heitz et al. (2018) proposed a healthy behaviour index (HBI). The HBI was constructed from smoking status, alcohol consumption, dietary pattern, vigorous physical activity, body mass index (BMI), to evaluate associations with all cause and BrCa-specific mortality in non-Hispanic white and Hispanic women. The dietary pattern and vigorous physical activity in HBI are only a general term, which cannot well distinguish health behaviour. According to the WHO definition of health behaviour, medical adherence and maintaining a good mental health are also considered as the categories of health behaviour, these two kinds of behaviour are particularly important for BrCa women with AET, but they were not shown in the HBI. Therefore, HBI is not applicable to BrCa women with AET. Another article reported on the Spanish women’s breast health behaviour questionnaire, which was designed for breast health behaviour in healthy women (Wells et al., 2001). Other studies on health behaviour are some questions or a summary variable about five lifestyles in accordance with relevant guidelines (Chirgwin et al., 2016; Heitz et al., 2018; Kelly et al., 2015; Kwan et al., 2010; Petersen et al., 2015; Warren Andersen et al., 2016), which makes it difficult to really understand the comprehensive state of BrCa women’s health behaviour. Therefore, an easy and composite variable questionnaire was developed that can be used to evaluate the status of health behaviour implementation in BrCa women and to guide health professionals when making decisions about effective intervention to promote health behaviour. Our study aimed to construct and validate a health behaviour questionnaire (HBQ) for BrCa women with AET.

2 | METHOD

2.1 | Participants

This cross-sectional study was conducted during the period from June 2018 to October 2019 in two university hospitals in Shenyang, China. The questionnaire investigation was divided into two steps: pre-experiment (group 1) and psychometrics evaluation (group 2). Initial exploratory factor analysis (EFA) and internal reliability analyses were performed using responses from group 1 (N = 264). Responses from group 2 (N = 329) were used to confirm the factor structure. The cases included in each subsample satisfied the requirement for the sample size to be 5–10 times the number of items for EFA and at least 200 cases for confirmatory factor analysis (CFA).

Inclusion criteria: positive for the ER and/or PR; diagnosed with BrCa; taking endocrine therapy for more than 1 month; BrCa women above 18 years old; facility with the Chinese language; and volunteered participation in the survey.

Exclusion criteria: Women with other malignant tumours history; and patients with other critical diseases (such as severe infection, malignant hypertension, severe cerebrovascular accident, myocardial infarction and heart failure).

2.2 | Health behaviour questionnaire

According to WHO definition of health behaviour, the conceptual and theoretical framework for the HBQ was based on a review of pertinent literature (Fu, 2017; Ma, 2012; Tian & Cheng, 2016). This study defined healthy behaviour in BrCa women as behaviour considered conducive to disease prevention and positive health, including efforts to reduce or eliminate dangerous behaviour such as drinking, smoking, poor diet and the adoption of positive health behaviour such as reasonable nutrition, rest and regular exercise, keep a good mental state, take AET medication regularly as directed by medical professionals. The initial draft of the HBQ for BrCa patients with endocrine therapy was based on the following: guidelines of the Chinese Society of Clinical Oncology Breast Cancer (CSCCO, 2017), guidelines for lifestyle modification for Chinese BrCa survivors (Breast Health Group of the Branch of Women Health of Chinese Preventive Medicine Association, 2017), the American Cancer Society’s Cancer-Anticancer Nutrition and Exercise Guide (Kushi et al., 2012), Chinese Nutrition Therapy Guidelines for Cancer Patients (Chinese Anti-cancer Association Cancer Nutrition & Support Treatment Professional Committee, 2015) and Breast Oncopsychology (Kong & Wu, 2016). Then, the HBQ draft was presented to 10 BrCa endocrine therapy patients and one oncologist, who were asked if there was anything that needed to be added or inconsistent based on their understanding of healthy behaviour.
After modification, the original version of the questionnaire was formed and five experts were consulted, including two BrCa experts, one psychology expert and two nursing experts. The five experts were conducted to determine whether an item should be kept, evaluated the content validity of the original questionnaire, measured with the content validity index (CVI). These five experts evaluated the objectivity, accuracy and comprehensiveness of the questionnaire, as well as the relevance, simplicity and accuracy of each item and measurement objective. The initial questionnaire was formed after the second consultation based on the opinions of five experts. Another 10 BrCa patients with endocrine therapy were asked to evaluate the face validity of the questionnaire to obtain the time required for the
2.3 | Data collection

The questionnaire was administered and explained its purpose, significance and study requirements to the participants beforehand, so as to obtain the participants’ cooperation. The participants were informed that their data would remain confidential. The participants were then instructed to fill in the questionnaire. Meanwhile, items that were not understood by the patient were explained. To ensure accurate and authentic results, items were read aloud to patients with poor eyesight or low education. The questionnaire was filled in anonymously and collected immediately on completion. Exclusion criteria for invalid questionnaires: the number of unanswered items in the questionnaire exceeded 20%; the questionnaire contained undulating or monogrammed answers (Qian & Yuan, 2011).

2.4 | Statistical analysis

2.4.1 | Reliability

Cronbach alpha coefficient was used to reflect the internal consistency of each domain and facet. An alpha value >0.70 was considered acceptable for group comparisons (DeVellis, 2010; Wan et al., 2008). The test-retest reliability (reproducibility) was assessed through calculating the Pearson correlation coefficient (or Spearman rank correlation coefficient for non-normal distribution) of the first and second test data to determine stability of the questionnaire; the interval between the two test times was two weeks.

2.4.2 | Validity

We performed three statistical procedures to explore the construct validity of the HBQ: (a) Pearson correlation coefficient was calculated to find the correlation between items and facets, (b) EFA with varimax rotation was conducted by using principal component analysis to probe the potential structure of the questionnaire. Factors were extracted according to eigenvalues > 1 and (c) CFA using structural equation modelling was carried out to further test the relationship between the observed variables and their underlying latent constructs identified from the EFAs. CFA quality was measured by fitting index, standardized factor load $\lambda$, composite reliability, convergent validity and discriminant validity.

2.4.2.1 The goodness of fit of the overall model was tested using the following judgment criteria: (a) $\chi^2$, (b) $\chi^2$ and degrees of freedom ($\chi^2/df$), (c) goodness-of-fit index (GFI), (d) root mean square error of approximation (RMSEA), (e) root mean square residual (RMR) along with the relative fit indices (f) comparative fit index (CFI) and (g) normed fit index (NFI), (h) incremental fit index (IFI), $\chi^2/df$ value of <3 and RMSEA, RMR of <0.08 indicated good model level, researchers have suggested that GFI, AGFI, CFI, IFI and NFI of 0.8 or greater indicate acceptable level (Abedi et al., 2015).

2.4.2.2 Standardized factor load $\lambda$ reflects the influence of potential variables on the measurement variables, where $\lambda$ above 0.71 is ideal and $\lambda$ above 0.45 indicates decent explanatory power (Tabachnick & Linda, 2007). A composite reliability (CR) above 0.7 is a relatively stable measurement. Raines-Eudy argued that a CR above 0.5 indicates that the measuring tool can obtain basic stability when reflecting a true score (Raines-Eudy, 2000).

2.4.2.3 Convergent validity was determined by measuring the significance level of the factor loading and the average variation extraction value (AVE) of the latent variable. When the factor loading of all items to latent variables reaches a significant level and latent variables can explain a considerable degree of variation, it can be regarded as having convergent validity (Garbarino & Johnson, 1999). AVE was used to extract the values by calculating the average variance of the square root of each dimension and the internal consistency of variables in the structure was tested to determine the validity of convergence. The AVE for each dimension is generally recommended to be >0.5 (Fornell & Larcker, 1981).

2.4.2.4 Discriminant validity was assessed using Square root of AVE: can be understood as the correlation coefficient of data within the underlying variable. According to the criteria given by Fornell and Larcker (Fornell & Larcker, 1981), if the AVE arithmetic square root is greater than the absolute value of correlation coefficient between potential variables, internal correlation is greater than external correlation, indicating that there is a difference between potential variables, then the discriminant validity is high.

Data were analysed using IBM SPSS Statistics (version 25) and AMOS software (version 23). The statistical description included frequency, percentage, maximum, minimum, mean and standard difference. The statistical inference was conducted by t test, factor analysis and Spearman correlation analysis.

2.5 | Ethical considerations

This study was approved by the ethics committee at Liaoing Cancer Hospital (Project No. 20180450). Participants had sufficient information about the purpose, method and process of the research. The participants have the right to freely choose and they can freely choose to participate in or withdraw from the study. All participants signed an informed consent.
3 | RESULTS

3.1 | Participant characteristics

Initially, we collected data from 264 participants, adapting an initial version of the HBQ questionnaire to select the items and then analysed validity and reliability of modified versions by enrolling another 329 participants to finish the survey. Figure 1 shows the preparation and detection of HBQ for BrCa. Participants’ characteristics in the two surveys are shown in Table 1.

3.2 | Project analysis

Project analysis was performed on all 264 valid questionnaires. According to the questionnaire extreme group test method, the score difference between the low group and the high group in item 17 and item 29 was not significant ($p > .05$). Item 4 had a higher missing value of 1.5%. Spearman correlation analysis was adopted and the correlation value for each item was 0.103–0.671. The correlation coefficient between the items and the total questionnaire was <0.4, the factor load value was 0.39–0.757 and Item 30 had a value of <0.4. After a comprehensive analysis, 10 items were deleted, and 27 items were retained.

3.3 | Validity

3.3.1 | EFA with group 1

Structural validity was calculated by EFA. The KMO of the HBQ for BrCa patients with AET was 0.901. The Bartlett sphericity test statistic was 2,786.507 (degrees of freedom: 300, $p < .001$). Information from the research project could thus be extracted effectively and suitable

| Variable | Content | Group 1 (N = 264) | Group 2 (N = 329) |
|----------|---------|------------------|------------------|
|          |         | Cases | Percentage | Cases | Percentage |
| Age      | ≤39     | 32    | 12.1       | 43    | 13.1        |
|          | 40–49   | 112   | 42.4       | 138   | 42.0        |
|          | 50–59   | 94    | 35.6       | 113   | 34.3        |
|          | ≥60     | 26    | 9.8        | 35    | 10.6        |
| Marital status | Unmarried | 3 | 1.14 | 2 | 0.6 |
|          | Married | 234   | 88.6       | 291   | 88.5        |
|          | Widowed | 3     | 1.14       | 2     | 0.6        |
|          | Divorced | 17 | 6.44 | 23 | 7.0 |
|          | Cohabitation | 7 | 2.65 | 11 | 3.3 |
| Occupational status | Yes | 102 | 38.6 | 194 | 59.0 |
|          | No     | 162   | 61.4       | 135   | 41.0        |
| Religious beliefs | Yes | 50 | 18.94 | 74 | 22.5 |
|          | No     | 214   | 81.06      | 255   | 77.5        |
| Smoking | Never smoking | 247 | 93.56 | 273 | 83.0 |
|          | have given up smoking | 15 | 5.68 | 53 | 16.1 |
|          | still smoking | 2 | 0.76 | 3 | 0.9 |
| Drinking | Never | 143 | 54.2 | 170 | 51.7 |
|          | have given up | 26 | 9.8 | 38 | 11.6 |
|          | Still drinking | 95 | 36 | 121 | 36.7 |
| BMI      | <18.5  | 4     | 1.5        | 7     | 2.1         |
|          | 18.5–24.99 | 167 | 63.3 | 186 | 56.5 |
|          | 25–29.99 | 75 | 28.4 | 117 | 35.6 |
|          | ≥30     | 15    | 5.7        | 19    | 5.8        |
| Duration of oral drug (month) | ≤12 | 91 | 34.5 | 119 | 36.2 |
|          | 13–24   | 34    | 12.9       | 74    | 22.5        |
|          | 25–36   | 43    | 16.3       | 51    | 15.5        |
|          | 37–48   | 44    | 16.7       | 49    | 14.9        |
|          | ≥49     | 52    | 19.6       | 36    | 10.9        |
XU et al. for factor analysis. Using the principal component analysis method, the characteristic value is >1, the maximum variance is orthogonal rotation and five common factors are extracted. The gravel diagram is formed after the fifth factor and the cumulative contribution rate is 59.425%. The factor loads for Items 16 and 35 were <0.4. Therefore, items 16 and 35 were removed. Finally, a questionnaire with 25 items and 5 factors was formed. According to the percentage of explanatory variance, the order of each factor was as follows: treatment behaviour (seven items), exercise behaviour (six items), psychological adjustment (five items), diet behaviour (five items) and active medical-seeking behaviour (two items). The results are shown in Table 2.

### Table 2 Factor loadings and item communalities by EFA (N = 264)

| Item | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 |
|------|----------|----------|----------|----------|----------|
| 33   | 0.827    |          |          |          |          |
| 23   | 0.773    |          |          |          |          |
| 21   | 0.75     |          |          |          |          |
| 15   | 0.732    |          |          |          |          |
| 27   | 0.649    |          |          |          |          |
| 1    | 0.637    |          |          |          |          |
| 26   | 0.612    |          |          |          |          |
| 25   | 0.841    | 0.82     |          |          |          |
| 6    |          |          |          |          |          |
| 24   | 0.81     |          |          |          |          |
| 31   | 0.796    |          |          |          |          |
| 13   | 0.71     |          |          |          |          |
| 36   | 0.562    | 0.503    |          |          |          |
| 37   | 0.7      |          |          |          |          |
| 34   | 0.633    |          |          |          |          |
| 12   | 0.656    |          |          |          |          |
| 20   | 0.609    |          |          |          |          |
| 32   | 0.604    |          |          |          |          |
| 9    | 0.757    |          |          |          |          |
| 10   | 0.646    |          |          |          |          |
| 7    | 0.626    |          |          |          |          |
| 8    | 0.622    |          |          |          |          |
| 3    | 0.56     |          |          |          |          |
| 28   | 0.789    |          |          |          |          |
| 2    | 0.741    |          |          |          |          |

Note: Factor loadings below 0.4 are not shown.
Abbreviation: EFA, exploratory factor analysis.

for factor analysis. Using the principal component analysis method, the characteristic value is >1, the maximum variance is orthogonal rotation and five common factors are extracted. The gravel diagram is formed after the fifth factor and the cumulative contribution rate is 59.425%. The factor loads for Items 16 and 35 were <0.4. Therefore, items 16 and 35 were removed. Finally, a questionnaire with 25 items and 5 factors was formed. According to the percentage of explanatory variance, the order of each factor was as follows: treatment behaviour (seven items), exercise behaviour (six items), psychological adjustment (five items), diet behaviour (five items) and active medical-seeking behaviour (two items). The results are shown in Table 2.

#### 3.3.2 CFA with group 2

Five-factor models were obtained through EFA and the results were verified using AMOS software. Item 5: $\lambda$ is 0.33, <0.45, so delete the item and start the CFA again. $\lambda$ ranged from 0.576–0.912, combined
reliability CR ranged from 0.76–0.94, convergent validity AVE ranged from 0.50–0.72 and discriminant validity ranged from 0.71–0.85. The fit indices indicated that the five-factor model provided a good fit to the data: $\chi^2/df$ ratio = 2.561 ($\chi^2$ = 619.86, $df$ = 242, $p < .001$), RMSEA = 0.069, RMR = 0.056, GFI = 0.867, CFI = 0.931, IFI = 0.931, and NFI = 0.892. The results are shown in Table 3 and 4 and Figure 2.

3.4 | Reliability

The Cronbach's $\alpha$ of the HBQ for BrCa patients with AET was 0.934. The split-half reliability of the questionnaire was 0.792. After a two-week interval, another 50 BrCa women were given health behaviour questionnaires. The internal consistency coefficients (ICC) for the total scale were 0.704 ($p < .01$). Table 5 lists the results.

4 | DISCUSSION

In our study, HBQ was developed and its reliability, convergence validity and discriminant validity were tested in total samples of 593 BrCa women with AET. Exploratory factor analysis, reliability analysis and CFA all significantly supported the questionnaire presented in this paper. That indicates that the questionnaire has good reliability and validity. The HBQ can be used to evaluate the status of health behaviour implementation in BrCa women. Studies have shown that maintaining or adopting a health behaviour after diagnosis may improve BrCa prognosis, while also reducing all-cause mortality (George et al., 2014; Kelly et al., 2015). Among the few studies available regarding the health behaviour of BrCa women, few questionnaires that reveal the health behaviour of BrCa women undergoing AET was found.

In our study, 10 patients with BrCa under endocrine therapy were interviewed to see if the description of each item matched the questionnaire itself. The results indicate that these items can accurately express the content to be measured. It is generally believed that an I-CVI above 0.78 indicates better content validity (Shi et al., 2012). In this study, the I-CVI and the S-CVI above that, this indicates that the questionnaire had good content validity.

In the project analysis, there were 10 items with the correlation coefficient < 0.4, which were 4, 5, 11, 14, 17, 18, 19, 22, 29 and 30, respectively. Item 4 (“do you adhere to contraception during...
treatment?)) had a higher missing value, accounting for 1.5%, the analysis found that this item was not applicable to postmenopausal or unmarried patients. The factor loads for Items 16 and 35 were <0.4, they were considered for deletion (Laura et al., 2004; North Carolina State University, 2008). After EFA analysis, 12 items were excluded from the questionnaire. The removal of 12 items did not affect the overall assessment scope of the questionnaire. A questionnaire with 25 items and 5 factors was ultimately formed. The dimension structure of the initial questionnaire formation hypothesis is generated according to the classification of healthy behaviours and activities of patients with chronic disease, which is consistent with the original theoretical conception. Therefore, the questionnaire has a good structural validity.

The AVE value is the sum of the square of the factor loading value, which represents the comprehensive explanatory ability of the potential variable for all measured variables. The larger the AVE value is, the stronger the potential variable of corresponding items can be explained. Conversely, the stronger the variable convergence, the better the convergence effectiveness. The convergence validity was AVE > 0.5, with a minimum not <0.36 (Fornell & Larcker, 1981). The AVE for this questionnaire ranged from 0.50–0.72, indicating

| AVE     | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 |
|---------|----------|----------|----------|----------|----------|
| Factor 1| 0.72     | 0.85     |          |          |          |
| Factor 2| 0.69     | 0.34     | 0.83     |          |          |
| Factor 3| 0.5      | 0.475    | 0.482    | 0.71     |          |
| Factor 4| 0.59     | 0.456    | 0.631    | 0.712    | 0.77     |
| Factor 5| 0.61     | 0.383    | 0.429    | 0.617    | 0.627    | 0.78     |

Note: The value on the diagonal is the square root of AVE, the value of the lower triangle is the Pearson correlation coefficient between different dimensions.
that the questionnaire has good convergent validity. When the value on the diagonal between the dimensions of the discriminant validity is greater than all the values in the row and column, the questionnaire has better discriminant validity. The following results pertain to the fitting degree index: $\chi^2/df < 3$, RMR $< 0.08$, RMSEA $< 0.08$ and PGFI $> 0.5$. The closer that the CFI, IFI, NFI, GFI and AGFI are to 1, the better the fitting degree. This questionnaire obtained a good degree of fit.

A Cronbach’s $\alpha$ coefficient $\geq 0.70$ was reserved for this purpose of the questionnaire (Cronbach, 1951). The comprehensive CFA results showed that the questionnaire had good reliability. The overall Cronbach’s $\alpha$ of the questionnaire was 0.934. This indicates that the questionnaire has good internal consistency and reliability.

### 4.1 Strengths and limitations

The main advantage of this study is the innovativeness of the questionnaire. An extensive review of the literature was conducted before preparing the questionnaire. Thus far, no suitable questionnaire for the health behaviour of BrCa patients with endocrine therapy is available. Further, the concept for the questionnaire was designed on the basis of this literature review and its content was derived from the latest guidelines and standards domestically and abroad. Combined with the psychological characteristics and clinical characteristics of patients with BrCa endocrine therapy, the questionnaire was prepared with the express purpose of making the questionnaire comprehensive and clear. Finally, the results of this study show that this questionnaire can be used as a tool for clinical nursing workers to evaluate the health behaviour of BrCa women and to guide targeted measures to improve the health of patients with BrCa endocrine therapy, which in turn can improve the treatment effect and reduce the cost of treatment.

The HBQ draft was based on a review of the literature and recommendations in the guidelines and we only gave the draft to 10 BrCa endocrine therapy patients and one oncologists, asked if there was anything that needed to be added or inconsistent based on their understanding of healthy behaviour. But if we can carry on the semi-structured interviews with potential stakeholders, such as BrCa patients receiving endocrine therapy and their oncologists, will have a better understanding of the endocrine therapy of BrCa patients health behaviour and will give our questionnaire is more specific.

The health behaviour questionnaire did not find an appropriate questionnaire as the calibration questionnaire, so it was impossible to compare the correlation validity with the criterion-related validation known-groups comparison validation. However, the study carried out CFA on the questionnaire and comprehensively verified the structural validity of the questionnaire through $\lambda$, CR, AVE and square root of AVE and fitting degree index to remedy this limitation.

### 5 CONCLUSIONS

The results demonstrated that the average score of the health behaviour of BrCa women treated with AET was 97.38 (SD 13). Participants whose total score was higher than the average accounted for 53.41%, which was generally in the midrange level in this study. The health behaviour questionnaire developed in our research showed good reliability and validity and can serve as an effective tool for clinical workers to evaluate the health behaviour of BrCa patients with endocrine therapy.

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### CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID
Aiping Wang https://orcid.org/0000-0003-2175-0081

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