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Clusters by Menopausal Symptoms: Asian American Breast Cancer Survivors

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Abstract

The purpose of this secondary analysis was to determine the clusters of Asian American breast cancer survivors by the severity scores of menopausal symptoms and to explore the characteristics associated with the identified clusters. The data from an ongoing study among 94 survivors were used. The instruments included the Perceived Isolation Scale, the Personal Resource Questionnaire, and the Memorial Symptom Assessment Scale-Short Form. The data analysis was conducted using hierarchical cluster analyses and multinomial logistic analyses. Three clusters were identified: “the cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms (Cluster 1),” “the cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms (Cluster 2),” and “the cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms (Cluster 3).” The clusters had significant differences in the level of acculturation, perceived social isolation, and perceived social support ($p < 0.05$).

Keywords

Breast Cancer; Menopausal Symptoms; Cluster Analysis; Asian American

Breast cancer is the most prevalent cancer by site among Asian American women (American Cancer Society, 2021a; National Cancer Institute, 2021a; U.S. Department of Health and Human Services, 2021). Also, breast cancer is the top cause of deaths for several sub-ethnic groups within Asian American women (Le et al., 2017; Torre et al., 2016). Compared with Whites, Asian American breast cancer survivors reportedly have higher relative risks, lower 5-year survival rates, and lower quality of life (American Cancer Society, 2021a; National Cancer Institute, 2021b; Warmoth et al., 2017; Wen et al., 2014). Here, a breast cancer survivor means “anyone who has been diagnosed with breast cancer, from the time of diagnosis through the balance of her life” (Center for Disease Control and Prevention, 2021). Yet, little information is currently available about the symptom experience of Asian American breast cancer survivors, including their menopausal symptom experience.

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Menopausal Symptoms among Asian American Breast Cancer Survivors

Because of treatment strategies combining surgery, radiation or chemotherapy, over 60 percent of breast cancer survivors are reported to experience at least one menopausal symptom (Mazor et al., 2017). For instance, chemotherapy could cause temporary or permanent ovarian failure, and consequently induce premature menopause (Loibl et al., 2011). Also, endocrine therapy could worsen existing menopausal symptoms (Loibl et al., 2011). Furthermore, stopping hormone therapy might result in unexpected menopausal symptoms (American Cancer Society, 2021b; Loibl et al., 2011; Satija et al., 2014). Despite these findings among breast cancer survivors in general, little is known about menopausal symptom experience of Asian American breast cancer survivors mainly due to lack of studies among this specific population (Im et al., 2018).

For future intervention development, it would be necessary to identify risk groups of Asian American breast cancer survivors who would need help in their menopausal symptom management. A cluster analysis is helpful in identifying risk groups by categorizing those with similar experience (Miaskowski et al., 2017). Also, the findings on the factors associated with the clusters could be used to provide an answer for the association of the specific factors to the experience (Massart & Kaufman, 1983). Thus, a cluster analysis could help identify the groups of Asian American breast cancer survivors with similar menopausal symptom experience and provide the information on the specific characteristics of Asian American breast cancer survivors that are linked to their menopausal symptom experience. Subsequently, a cluster analysis could provide the characteristics of the risk groups that need to be considered in future interventions. However, virtually no cluster analysis has been done to determine the characteristics of Asian American breast cancer survivors that are associated with menopausal symptoms. Rather, most of the existing cluster analyses on menopausal symptoms have been conducted among healthy midlife women during their menopausal transition (Cray et al., 2013; Mishra & Kuh, 2012; Sievert & Obermeyer, 2012).

In this study, the UCSF symptom management model (Dodd et al., 2001) was used to theoretically guide this secondary analysis. This model is broadly used in research on various symptoms of diverse populations (Dodd et al., 2001). The model is composed of three domains, three concepts, and several relevant sub-concepts under individual domains and concepts (Dodd et al., 2001; Linder, 2010). The domains include: “person,” “health and illness,” and “environments.” The concepts consist of: “symptom experience,” “symptom management strategies,” and “outcomes.” Again, individual domains and concepts include sub-concepts under them. In this study, we aimed to identify the clusters of Asian American breast cancer survivors by menopausal symptoms (the major concept of symptom experience; Aim 1) and to examine the associations of specific characteristics (sub-concepts of person, health and illness, and environments) to the identified clusters (Aim 2).

Purpose

The purpose of this secondary analysis was to determine the clusters of Asian American breast cancer survivors by the severity scores of menopausal symptoms and to explore the

characteristics associated with the identified clusters. In other words, the research questions were:

- Research Question 1: What are the clusters of Asian American breast cancer survivors by their total severity scores of menopausal symptoms?
- Research Question 2: What are the specific characteristics that are linked to the clusters of Asian American breast cancer survivors by their total severity scores of menopausal symptoms?

This was a secondary analysis of the preliminary data from an ongoing intervention study among 94 Asian American breast cancer survivors. Data collection has been conducted from 2016 to 2021. More information on the parent study can be found elsewhere (Im et al., 2020).

Methods

The approval from the Internal Review Board was obtained from the institution where the study was conducted.

Settings and Participants

The participants of the parent study were recruited through online and offline communities/support groups (e.g., social media groups) for Asian subethnic populations across the nation. The gatekeepers of the online and offline communities/support groups were requested to announce the study among their members.

The participants were self-identified Chinese, Korean, or Japanese American women who were aged 21 years and older; had a diagnosis of breast cancer within the last five years; could read and write English, Mandarin Chinese (simplified or traditional), Korean, or Japanese; and could have access to the Internet using computers or mobile devices. When potential participants visited the project website, they were asked to review the electronic informed consent form on the project website and consent to participate in the study (by clicking “I agree to participate”). Then, upon their agreement, they were checked against the inclusion/exclusion criteria to determine their eligibility for study participation. Among 273 participants who visited the project website, only 94 (34.4 %) women met the criteria and completed the baseline survey.

The sample size was pre-determined because this was a secondary analysis of the data from a larger ongoing study. Yet, 94 women were adequate for the cluster analysis that was conducted in this study. The minimum number of cases/samples for a cluster analysis is usually no less than 2^k cases, but preferably $5 * 2^k$ (k =the total number of clustering variables; Formann, 1985).

Instruments

Sociodemographic characteristics.—Items on sociodemographic characteristics included: age (in years), sub-ethnicity (Chinese, Korean, or Japan), religion (yes or no), marital status (married/partnered or nonmarried/unpartnered), family income (totally

insufficient, somewhat insufficient, or sufficient more than sufficient), the area of residence (urban or rural), the country of birth (the U.S., or outside the U.S), the level of acculturation (1 = exclusively own ethnic group ~ 5 = exclusively American), the perceived level of social isolation, and perceived social support. The level of acculturation was measured using five questions regarding the level of acculturation in foods, music, customs, close friends, and language that were adopted from the Suinn-Lew Asian Self-identity Acculturation Scale (Suinn et al., 1992). In this study, the scale showed a high degree of internal consistency (Cronbach's alpha = 0.84).

Perceived social isolation was measured using the Perceived Isolation Scale (PIS; Cornwell & Waite, 2009) with six items of social support and three items of interaction/loneliness. Individual items were on a 3-point Likert scale, and the average of the items was calculated as the social isolation score. A higher score meant a higher degree of perceived social isolation. In this study, the scale showed a high degree of internal consistency (Cronbach's alpha = 0.86).

Perceived social support was assessed using 15 items of the Personal Resource Questionnaire (PRQ-2000; Weinert, 2003) in five dimensions of social support: (a) "attachment/intimacy"; (b) "social integration"; (c) "nurturing behavior"; (d) "reassurance of worth"; and (e) "the availability of informational, emotional, and material help." Individual items were on a 7-point Likert scale, and the items' average score was calculated to reflect the level of perceived social support. The higher the score was, the greater the perceived social support was. The instrument's internal consistency was well-established in this study (Cronbach's alpha = 0.94).

Disease Characteristics.—Items on disease characteristics included: perceived health status (1 = "not healthy at all" ~ 6 = "very healthy"), stages of breast cancer (stages 1-5 or unsure), types of breast cancer (invasive or non-invasive), the use of medication (yes or no), radiation therapy (yes or no), chemotherapy (yes or no), surgery (yes or no), hormone therapy (yes or no), pain management (yes or no), and symptom management (yes or no).

Menopausal symptoms.—Based on the Menopausal Symptom Index (MSI; Im, 2006), the items reflective of menopausal symptoms were extracted from the Memorial Symptom Assessment Scale-Short Form (MSAS-SF). The MSAS-SF measures the severity of symptoms (where frequency is not important, such as hair loss) and frequency of symptoms during the past 7 days. The severity scale comprises of 28 physical and psychological symptoms, and the frequency scale includes 4 psychological symptoms. Its use has been well validated among cancer patients in a variety of research settings (Chang et al., 2000).

For this study, only the symptom severity scale was used because it was more informative on the degree to which an individual suffered from a particular symptom. Guided by the MSI (Im, 2006), a total of 18 items derived from the MSAS-SF were categorized into three domains of menopausal symptoms: physical (14 items), psychological (2 items), and psychosomatic (2 items) symptoms. The symptom severity was scored on a 5-point Likert scale (not at all to very much). For each participant, the total score of all symptoms (the average across the domain scores) and the total score of three domain scores were calculated

for data analyses. The derived scale showed a high level of internal consistency (Cronbach's alpha = 0.87).

Data Collection Procedures

When potential participants visited the project website, they were allowed to choose one language version of the website (English, Mandarin Chinese [traditional and simplified], Korean, and Japanese). Then, after reviewing the electronic informed consent form on the website, they were asked to give their consent to participate in the study by pushing the 'I agree to participate' button. Once the consent was obtained, they were checked against the inclusion and strata criteria. When they met the criteria, they were automatically forwarded to the baseline questionnaire including all the instruments described above. All the instruments were available in multiple languages including English, Mandarin Chinese (traditional and simplified), Korean, and Japanese. The non-English versions were prepared using the standard-back translation process (Brislin et al., 1973) by two bilingual research staff members per language. As mentioned above, only the baseline data were used for this secondary analysis.

Data Analysis

All analyses were performed using the SPSS, v.20 (SPSS Inc., Chicago, Illinois). The participants' characteristics were described using descriptive statistics including frequencies, percent, means, and standard deviations. Missing data for continuous variables were managed by mean substitutions only when missing fields for a particular variable were less than 20%; 20% missing values are usually acceptable in educational and psychological studies (Dong & Peng, 2013; Madley-Dowd et al., 2019). Missing data for categorical variables were left missing.

The data were analyzed in two steps. First, a hierarchical cluster analysis (step 1) was conducted to identify the clusters of Asian American breast cancer survivors by menopausal symptoms (Aim 1). Then, multinomial logistic regression analyses (step 2) were performed to determine which factors were significantly associated with the identified menopausal symptom clusters (Aim 2). Specifically, the hierarchical cluster analysis was conducted based on the Ward's clustering method that was conjugated with the squared Euclidean distance. All values were transformed into Z-scores in order to make corrections for outliers prior to the initial analysis. The number of clusters was statistically determined by dendrogram. Characteristics of the clusters were validated using the ANOVAs (the Welch's ANOVA was considered in case of heteroscedasticity) and Chi-square tests. Fisher's exact tests were used when more than 20% of the cells in contingency tables had the expected counts less than 5. Post hoc comparisons were conducted using the Tukey's tests; the Games-Howell tests were employed for the data with distinctly unequal variances. A two-tailed α of 0.05 was used to assess the statistical significance.

Finally, the multinomial logistic regression analyses included only the variables with a p -value less than 0.05 from the likelihood ratio chi-square tests. Multicollinearity among multiple factors was assessed by utilizing the tolerances as well as the variance inflation factors (VIF). The tolerance was above 0.1, not close to 0, indicating that there were no

multicollinearity concerns. The VIF was far below 10, indicating that multicollinearity was not a concern. The model fit was evaluated by using the likelihood ratio chi-square of 35.16 with a p -value < 0.01 . The 95% confidence intervals (CIs) were used to address the clinical relevance of the findings.

Results

Clusters by Menopausal Symptoms and Their Sociodemographic and Disease Characteristics (Aim 1)

A three-cluster solution was selected for this study based on the dendrogram (see Table 1). The clusters included “the cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms (Cluster 1),” “the cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms (Cluster 2),” and “the cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms (Cluster 3).” About 20.2% of the participants were in Cluster 1; 53.2% were in Cluster 2; and 26.6% were in Cluster 3. Cluster 1 had higher severity scores of total, psychological, physical, and psychosomatic symptoms than any other clusters (followed by Cluster 2 and Cluster 3).

Significant differences were found among the clusters only in the level of acculturation ($F[2,91] = 3.46, p = 0.04$), perceived social isolation ($F[2, 91] = 3.83, p = 0.03$), and perceived social support ($F[2, 91] = 3.17, p < 0.05$) (see Table 2). More specifically, those with lower symptom scores were more likely to be acculturated and less socially isolated and to receive higher social support than those with higher symptom scores.

There were no significant differences in the stages and types of breast cancer, radiation therapy, chemotherapy, surgery, hormone therapy, pain management, and symptom management among the clusters (see Table 3). However, Cluster 3 (with low severity scores of total, psychological, physical, and psychosomatic symptoms) reported more favorable perceived health status than Clusters 1 and 2 (with high or moderate severity scores of total, psychological, physical, and psychosomatic symptoms; $F[2, 91] = 7.71, p = 0.00$). In addition, Cluster 3 (with low severity scores of total, psychological, physical, and psychosomatic symptoms) were less likely to use medication than their counterparts (with moderate or high severity scores of total, psychological, physical, and psychosomatic symptoms; $\chi^2[2] = 7.26, p = 0.03$).

Factors Associated with Individual Clusters (Aim 2)

Six factors including sub-ethnicity, the level of acculturation, perceived health status, the use of medicine, perceived social isolation, and perceived social support were adjusted in the final model. Among these factors, only low perceived health status was a significant factor associated with Cluster 1 (reference group = Cluster 3; aOR = 0.38 [95% CI: 0.18 ~ 0.84]) (see Table 4). Also, only the use of medication was a significant factor associated with Cluster 2 (reference group = Cluster 3; aOR = 4.79 [95% CI: 1.26 ~ 18.23]).

Discussion

In this study, three clusters of Asian American breast cancer survivors by menopausal symptoms were identified. Also, significant factors associated with each cluster were identified. Cluster 1 with high severity scores of total, psychological, physical, and psychosomatic symptoms tended to be less acculturated to the U.S. and have higher social isolation and lower social support scores compared with Clusters 2 and 3 with moderate or low severity scores of total, psychological, physical, and psychosomatic symptoms. Also, the perceived health status and the use of medication were significant factors associated with different clusters. Thus, it could be inferred that Asian American breast cancer survivors who are less acculturated, report high perceived isolation, and have low social support would be the groups at high risk of inadequate menopausal symptom management. Also, those who report lower perceived health status and less use of medications would be at high risk of inadequate menopausal symptom management compared with their counterparts. These findings uniquely contribute to the current literature on symptom experience of Asian American breast cancer survivors because little is currently known about the symptom experience of Asian American breast cancer survivors, especially their menopausal symptom experience (Im et al., 2018). Also, as mentioned above, no cluster analysis has been done to determine the characteristics of Asian American breast cancer survivors that are associated with menopausal symptoms, which would be essential information for future development of interventions for this specific population.

The finding that those who were less acculturated tended to be in Cluster 1 (with high severity scores of total, psychological, physical, and psychosomatic symptoms) agrees with the literature. The literature is clear that Asian Americans are a high-risk group of inadequate menopausal symptom management within breast cancer survivors due to their cultural attitudes related to symptom management. For instance, Lim et al. (2012) pointed out Asian Americans' unique breast cancer experience with high burden of pain and symptoms due to their cultural attitudes, beliefs, and values related to illness, gender roles and family obligations, and language barriers. Thus, it could be easily inferred that those who were less acculturated to the U.S. culture (who maintained more Asian cultural attitudes, beliefs, and values) would suffer more from the symptoms that could be easily managed with existing regimens. The findings of this study uniquely support this inference in menopausal symptom experience of Asian American breast cancer survivors.

The finding that those with high perceived social isolation and low social support scores would be a high-risk group for inadequate menopausal symptom management also agrees with the literature. The literature is certain that Asian Americans tended to have poorer quality of life with fewer sources of information and coaching/support compared with Whites (Yoo et al., 2017; Yi et al., 2011). Yet, the interpretation of this finding needs to be carefully made because high social support does not always mean adequate information and support for Asian Americans. Indeed, Tu et al. (2005) found that Chinese Americans lacked information and support despite their high family support. Ashing-Giwa et al. (2004) also reported that family support could frequently result in delays in care seeking and self-deprecation among Asian American breast cancer survivors.

The finding that perceived health status and the use of medication were significant factors associated with different clusters agrees with the literature although there have been no exact reports on these two factors. The literature supported that disease factors such as disease status (stages of cancer) and treatment modalities including medication influenced breast cancer survivors' menopausal symptom experience (Chen et al., 2013; Lammerink et al., 2012).

This study has several limitations to consider. First of all, because the parent study included only those who had access to the Internet, the participants tended to be a selected group of Asian American breast cancer survivors (e.g., technology literate). Second, the data were self-reported, which may lead to information bias such as social desirability bias. Third, the instrument used to measure menopausal symptoms was not one of the tools that were originally developed to measure menopausal symptoms. Fourth, the study relied on cross-sectional data. Thus, the findings could not support causal inferences about the associations that were found in the analysis. Finally, the sample size and variables were pre-set by the parent study.

In this study, three clusters of Asian American breast cancer survivors were identified by their menopausal symptoms, and significant differences in the characteristics among the clusters were found. Also, significant factors associated with the clusters were examined. Based on the findings, the following suggestions are made for future research and practice with Asian American breast cancer survivors. First of all, the factors associated with Cluster 1 (with high severity scores of total, psychological, physical, and psychosomatic symptoms) need to be further examined through future research since this study has several limitations to consider in the interpretation of the study findings. Also, as found in this study, the level of acculturation, perceived isolation, and social support need to be considered in identifying risk groups for inadequate menopausal symptom management and subsequently in developing the design and structure of interventions for this specific population. Finally, researchers and clinicians also need to consider the women's perceived health status and their use of medication in future development of interventions for menopausal symptom management of this specific population.

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Table 1.

Menopausal symptoms by cluster in the three-cluster solution (N=94).

Menopausal Symptoms	Range	Cluster 1 ^a (n=19) Mean ± SD	Cluster 2 ^b (n=50) Mean ± SD	Cluster 3 ^c (n=25) Mean ± SD	Total (N=94) Mean ± SD	F (p)
Psychological symptoms	0.8-3.2	2.3 ± 0.7	1.8 ± 0.4	1.1 ± 0.3	1.6 ± 0.5	45.47 [‡] (0.00 ^{***}) a>b>c [‡]
Physical symptoms	0.8-2.7	2.0 ± 0.4	1.4 ± 0.3	1.0 ± 0.2	1.4 ± 0.4	66.41 [‡] (0.00 ^{***}) a>b>c [‡]
Psychosomatic symptoms	0.8-4.0	2.6 ± 0.6	1.8 ± 0.5	0.9 ± 0.2	1.8 ± 0.7	71.18 [‡] (0.00 ^{***}) a>b>c [‡]
Total symptoms	0.8-3.2	2.3 ± 0.3	1.7 ± 0.2	1.0 ± 0.1	1.6 ± 0.5	209.93 [‡] (0.00 ^{***}) a>b>c [‡]

Note.

^aCluster 1 = The cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms

^bCluster 2 = The cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms

^cCluster 3 = The cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms

[‡]Welch's F test

[‡]Games-Howell post-hoc test

p < 0.00

Table 2.

Participants' sociodemographic characteristics by cluster (continuous variables; N=94).

Characteristics	Cluster1 ^a (n=19) Mean ± SD	Cluster2 ^b (n=50) Mean ± SD	Cluster3 ^c (n=25) Mean ± SD	Total (N=94) Mean ± SD	F (p)
Age (y)	50.6 ± 13.8	51.8 ± 10.8	51.6 ± 10.7	51.5 ± 11.3	0.08 (0.93)
The level of acculturation	2.13 ± 0.80	2.33 ± 0.61	2.63 ± 0.57	2.37±0.66	3.46 (0.04 ^{**}) a<c [¶]
Perceived social isolation	1.9 ± 0.6	1.8 ± 0.4	1.5 ± 0.4	1.7 ± 0.4	3.83 (0.02 [*]) a<c [¶]
Perceived social support	5.0 ± 1.3	5.2 ± 0.9	5.7 ± 0.8	5.3 ± 1.0	3.17 (0.047 [*])

Note.

^aCluster 1 = The cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms

^bCluster 2 = The cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms

^cCluster 3 = The cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms

* $p < 0.05$

** $p < 0.01$

Table 3. Participants' sociodemographic characteristics by cluster (categorical variables; N=94).

Characteristics	Cluster1 ^a (n=19) n (%)	Cluster2 ^b (n=50) n (%)	Cluster3 ^c (n=25) n (%)	Total (N=94) n (%)	χ^2 (p)
Sub-ethnicity					4.40 [§] (0.12)
Chinese	15 (78.95)	29 (58.00)	10 (40.00)	54 (57.45)	
Korean	3 (15.79)	11 (22.00)	7 (28.00)	21 (22.34)	
Japan	1 (5.26)	10 (20.00)	8 (32.00)	19 (20.21)	
Religion					4.16 (0.13)
Yes	12 (63.16)	9 (38.00)	9 (36.00)	40 (42.55)	
No	7 (36.84)	31 (62.00)	16 (64.00)	54 (57.45)	
Marital status					0.08 (0.96)
Married or partnered	12 (66.67)	35 (70.00)	17 (68.00)	64 (68.82)	
Nonmarried or unpartnered	6 (33.33)	15 (30.00)	8 (32.00)	29 (31.18)	
Family income					7.18 (0.31)
Totally insufficient	5 (27.78)	10 (20.41)	2 (8.33)	17 (18.68)	
Somewhat insufficient	7 (38.89)	16 (32.65)	7 (29.17)	30 (32.97)	
Sufficient	6 (33.33)	15 (30.61)	12 (50.00)	33 (36.26)	
More than sufficient	0	8 (16.33)	3 (12.50)	11 (12.09)	
The area of residence					5.51 (0.31)
Urban	19 (100.00)	42 (87.50)	19 (76.00)	80 (86.96)	
Rural	0	6 (12.50)	6 (24.00)	12 (13.04)	
The country of birth					0.91 (0.63)
Yes	3 (15.79)	4 (8.16)	3 (12.50)	10 (10.87)	
No	16 (84.21)	45 (91.84)	21 (87.50)	82 (89.13)	

Note.

^aCluster 1 = The cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms

^bCluster 2 = The cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms

^cCluster 3 = The cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms

[§]Fisher's exact test

Tukey's HSD
 $p < 0.05$ *
 $p < 0.01$ **

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Table 4.

Participants' disease characteristics by cluster (continuous variables; N=94).

Characteristics	Cluster1 ^a (n=19) Mean ± SD	Cluster2 ^b (n=50) Mean ± SD	Cluster3 ^c (n=25) Mean ± SD	Total (N=94) Mean ± SD	F (p)
Perceived health status	2.92 ± 0.95	3.40 ± 1.12	4.18 ± 1.04	3.43 ± 1.13	7.71 (0.00 [*]) a<c [†] , a<b [†]

Note.

^aCluster 1 = The cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms

^bCluster 2 = The cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms

^cCluster 3 = The cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms

^{*} $p < 0.00$

Table 5.

Participants' disease characteristics by cluster (categorical variables; N=94).

Characteristics	Cluster1 ^a (n=19) n (%)	Cluster2 ^b (n=50) n (%)	Cluster3 ^c (n=25) n (%)	Total (N=94) n (%)	χ^2 (p)
Breast cancer stage					3.82(.873)
Stage 1	5 (26.31)	18 (38.30)	7 (30.43)	32 (35.15)	
Stage 2	7 (36.84)	19 (40.43)	11 (47.82)	37 (40.66)	
Stage 3	3 (15.79)	5 (10.63)	2 (8.70)	10 (10.99)	
Stage 4	1 (5.27)	3 (6.38)	1 (4.35)	5 (5.50)	
Unsure	3 (15.79)	2 (4.26)	2 (8.70)	7 (7.70)	
Types of breast cancer					2.40 (0.30)
Invasive	16 (84.21)	34 (80.95)	16 (66.67)	66 (77.65)	
Non-invasive (in situ)	3 (15.79)	8 (19.05)	8 (33.33)	19 (22.35)	
The use of medicine					7.26 (0.03 [*])
Yes	16 (84.21)	43 (89.58)	16 (64.00)	75 (81.52)	
No	3 (17.59)	5 (10.42)	9 (36.00)	17 (18.48)	
Radiation therapy					1.31 (0.52)
Yes	11(57.90)	28 (59.57)	18 (72.00)	51 (62.60)	
No	8 (42.10)	19 (40.42)	7 (28.00)	34 (37.40)	
Chemotherapy					3.39 (0.18)
Yes	12 (63.16)	18 (38.30)	11 (44.00)	41 (45.05)	
No	7 (36.84)	29 (61.70)	14 (56.00)	50 (54.95)	
Surgery					0.38 (0.83)
Yes	12 (63.16)	27 (67.50)	16 (64.00)	55 (60.44)	
No	7 (36.84)	20 (32.50)	9 (36.00)	36 (39.56)	
Hormone therapy					1.50 (0.47)
Yes	9 (47.37)	24 (51.06)	9 (36.00)	42 (46.15)	
No	10 (52.63)	23 (48.94)	16 (64.00)	49 (53.85)	
Pain management					4.31 (0.12)
Yes	8 (42.11)	20 (45.45)	16 (69.57)	44 (51.16)	
No	11 (57.89)	24 (54.55)	7 (30.43)	42 (48.84)	

Characteristics	Cluster1 ^a (n=19) n (%)	Cluster2 ^b (n=50) n (%)	Cluster3 ^c (n=25) n (%)	Total (N=94) n (%)	χ^2 (p)
Symptom management					2.92 (0.23)
Yes	15 (73.68)	28 (66.67)	12 (50.00)	54 (63.53)	
No	5 (26.32)	114 (33.33)	12 (50.00)	31 (36.47)	

Note.

^a Cluster 1 = The cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms

^b Cluster 2 = The cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms

^c Cluster 3 = The cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms

* $p < 0.05$

Table 6.

Factors associated with individual clusters (N=94).

Characteristics	High ^a (vs. Low ^c) Adjusted OR (95% CI)	Moderate ^b (vs. Low ^c) Adjusted OR (95% CI)
Sub-ethnicity		
Chinese	1.00	1.00
Korean	0.17 (0.14-2.06)	0.64 (0.16-2.59)
Japan	0.94 (0.05-16.24)	1.21 (0.23-6.39)
The level of acculturation	0.63 (0.17-2.82)	0.61 (0.23-1.63)
Perceived health status	0.38 (0.18-0.84) *	0.48 (0.24-0.92)
The use of medicine		
Yes	2.35 (0.39-14.23)	4.79 (1.26-18.23) *
No	1.00	1.00
Perceived social isolation	3.80 (0.34-43.14)	1.92 (0.31-11.76)
Perceived social support	0.97 (0.32-3.00)	0.78 (0.32-1.90)

Note. The low symptom cluster was used as a reference group.

OR = Odds Ratio, CI = Confidence Interval

^aCluster 1 = The cluster with high severity scores of total, psychological, physical, and psychosomatic symptoms

^bCluster 2 = The cluster with moderate severity scores of total, psychological, physical, and psychosomatic symptoms

^cCluster 3 = The cluster with low severity scores of total, psychological, physical, and psychosomatic symptoms

* $p < 0.05$

** $p < 0.01$