Menopause characteristics of women with physical disabilities from poliomyelitis

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Abstract

Objective: To describe menopause characteristics of women with physical disabilities from poliomyelitis.

Methods: Nine hundred and nine women with a history of poliomyelitis completed a survey on health, physical functioning, emotional well being and menopause.

Results: The majority of the sample was postmenopausal having had a natural menopause around the average age of 50.3 years; 34.7% of the sample had had hysterectomies. Thirty-nine percent were using some form of hormone replacement therapy (HRT). Menopause symptoms were clustered into psychological, somatic-sensory, somatic-sleep and vasomotor factors. Among never and past HRT users, there were significant differences in menopause factor severity by menopause status. Somatic/sleep symptoms were lowest in never users; past users had significantly higher vasomotor symptoms; desire for sexual activity and painful intercourse did not vary by HRT use. Compared to population estimates, post-polio women had similar rates of hysterectomies overall, but among some age cohorts they had significantly lower rates, contrary to expectations. However, they used HRT at significantly higher rates than expected.

Conclusions: This study suggests that basic menopause characteristics of women with polio are generally similar to those of their non-disabled peers. There were few substantial differences in severity of menopause symptoms by HRT use, which is critical in light of the dearth of studies examining its risk–benefit ratio among women with physical disabilities. Until such studies provide some evidence of the specific risks or benefits to women with physical disability, each woman should carefully weigh the known risks and benefits with her physician.

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1. Background

With advances in health care, women with physical disabilities are living longer than previous generations and are making the transition through menopause in greater numbers than ever before [1]. Of the 30 million women with physical disabilities in the United States, more than 16 million, over the age of 50 years [2], are constituting a large and growing population of women who have been relatively understudied in regard to their psychological and physiological experience of menopause. Women with physical disabilities in general have long been neglected in rehabilitation research [3] and little is known about their menopause characteristics and the synergistic effects of physical disability and the menopause transition [4] and its subsequent effects on health and well being.

Physiological changes due to menopause and their effects on health can place women with physical disabilities at a higher risk for problems due to their narrower margin of health. Autoimmune disorders, more common in women [5], have been shown to be influenced by estrogen [6,7]. For women with epilepsy, declines in estrogen at menopause can lower seizure thresholds [8,9]. Treatment of diseases like rheumatoid arthritis or multiple sclerosis, with cortico-steroids [10,11] and epilepsy with anti-convulsants [2] accelerates bone loss, especially in postmenopausal women. Conversely, the use of estrogen has been found to improve motor disability in postmenopausal women with Parkinson's disease [12].

For women who use wheelchairs or other mobility aides, estrogen loss at menopause can accelerate the risk of osteoporosis already present due to inactivity. Estrogen loss compromises collagen content and vascular profusion in the skin that can result in diminished skin integrity and tissue resiliency, which can lead to skin breakdown and pressure sores [2]. The periurethral region of the bladder is sensitive to estrogen loss [2] and may exacerbate pre-existing bladder dysfunction in some women.

There are a variety of factors that can influence the age of natural menopause including race, parity, socioeconomic status, smoking, and body mass index [13–16]. In general, the average age at menopause or final menstrual period among Caucasian women in the U.S. is 51 years of age. Although not widely studied, the age at menopause onset is presumed to be younger in women with disabilities [2]. While this has been shown in some conditions such Down's syndrome [17] and epilepsy [8], the association of physical disability and early menopause has not been empirically studied across a variety of disabling conditions. Similarly, incidence of hysterectomy is presumed to be higher in women with physical disabilities, although this has not been specifically studied in the literature.

The use of hormone replacement therapy (HRT) among women with disabilities has only recently begun to receive attention [18–20] and little is known about its health–benefit ratio for women with physical disabilities. Results from the Women's Health Initiative (WHI) indicate the use of combination HRT is contraindicated in a number of acute conditions including acute stroke or transient ischemic attack, pulmonary embolism, recent deep vein thrombosis and active systemic lupus erthyematosus [2], although its interaction with chronic conditions and physical disability also has not been widely studied.

Women polio survivors are among one of the largest populations of women with physical disabilities in the U.S. They have been referred to as the front runners calling attention to the effects of physical disability on aging. As a result of the U.S. polio epidemics of the 1940s and 1950s these women have now reached middle age and beyond. For those who contracted polio in childhood or early adolescence with resultant paralysis, menopause may coincide with onset or worsening of post-polio sequelae, characterized by new or progressive muscle weakness, joint and muscle pain and fatigue, which can emerge after years of stability [21,22] resulting in restricted mobility and loss of independence.

In 2003–2004 we conducted a large study in the U.S. to explore the synergy between menopause and physical disability characterized by post-polio sequelae. This paper describes their menopause characteristics and compares selected characteristics to their non-disabled peers.

2. Materials and methods

2.1. Data collection and sample

In January 2003, letters of invitation were sent to female and male members of Post Polio Health International (PHI; St. Louis, MO). Eligibility criteria was

self-report of having contracted the poliomyelitis virus; because of the national scope of the study, self-reports could not be verified by either physical examination or review of medical records. However, investigators were confident that the vast majority of individuals correctly reported having had an acute bout of polio in the past.

2.2. Measures

A written survey mailed to participants' homes was used in this study. The survey was comprised of standardized measures and non-standardized items. Domains of the survey included general health status, presence of health problems, physical functioning, emotional well being, polio history and menopause history. Relevant domains from this survey for the purpose of this current analysis are described below. This is followed by a brief description of the population and cohort samples for comparison on selected menopause characteristics.

2.2.1. Menopause status

The staging of menopause was determined by self-report of menstrual cycle characteristics, an accepted way of establishing menopause status [23] in the absence of a single biological marker to predict menopause [24]. Pre-menopause was defined by no changes in menstrual cycle regularity. Peri-menopause was defined by menstrual cycle irregularity and experience of some symptoms and/or not yet 12 months since the final menstrual period (FMP). Post-menopause was defined by a minimum of 12 months since the FMP; this is further delineated by *early* (1–5 years since FMP) and *late* post-menopause (≥5 years) [25].

2.2.2. Menopause symptoms

The *Menopause symptom list* (*MSL*) [26] is a 25-item scale of symptoms commonly associated with menopause. Items are rated for frequency and severity using 6-point Likert scales. Frequency scores range from 0 (never) to 5 (almost always) and severity scores range from 0 (not applicable) to 5 (extreme). A factor analysis of the MSL with a sub-sample of women from this study is reported elsewhere [27]. Four sub-scales resulting from this factor analysis were used in the present study: Factor 1 (psychological) consists of eight items that exactly replicate the psychological factor on the original MSL. Factor 2

(somatic-sensory) is comprised of two items related to sensory loss and two related to dehydration. Factor 3 (somatic-sleep) is comprised of two items related to sleep disturbance and two items related to vascularity. Factor 4 (vasomotor) is comprised of two items that describe the core elements of vasomotor symptoms, namely hot flushes and sweating.

2.2.3. Hormone replacement therapy use

Various aspects of HRT use also were collected including current usage, reasons for taking HRT, the kind taken, and side effects. For women formerly using HRT, length of use, reasons for discontinuing use and age at time of discontinuing were collected. For these analyses, women were categorized as current users, never users or past users. For current users, hormone use was defined by either estrogen or estrogen plus; the use of selective estrogen reuptake modulators (SERM), topical estrogen creams or progestin alone were not included as HRT for these analyses.

2.2.4. Polio history

Information about the year polio was contracted, age at the time, length of hospitalization (if recalled) and the type of polio contracted was collected.

2.2.5. Physical functioning

The *Functional Status Questionnaire* (*FSQ*) [28] was originally developed for comprehensive and efficient assessment of activities of daily living (ADL) reflected by physical, psychosocial, social and role functioning in ambulatory medical patients. The two scales of physical functioning, basic activities of daily living (BADL) and intermediate activities of daily living (IADL), were used in this study. Both scales are rated on 5-point Likert scales ranging from 1 (usually did not do because of health) to 4 (usually did with no difficulty); 0 refers to usually did not do because of other reasons. The BADL scale is comprised of three items referring to basic self care ability (e.g., bathing and dressing, walking indoors); the IADL contains six items referring to more demanding self-care activities (e.g., walking, driving a car, grocery shopping). Raw scores are standardized and total scores range from 0 to 100; scores falling below 88 on the BADL and below 78 on the IADL are considered to be in the "warning zone" suggesting compromised ability to perform ADLs. In this study, internal consistency (Cronbach's alpha) was

0.77 for the BADL and 0.87 for the IADL; scores were normally distributed.

2.2.6. Comparison to U.S. population estimates and non-disabled cohort samples

Although this study did not include a non-disabled comparison group, by using population and other national cohort data, comparisons on selected menopause and health variables provide some insight into possible differences and similarities of menopause characteristics in these women compared to their non-disabled peers. Two sources of data were used to make these comparisons.

The *Behavioral Risk Factor Surveillance System* (BRFSS) is conducted annually to assess national estimates of health risk behaviors among U.S. adult populations. The BRFSS is administered by the Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. Data used in this present study were collected in 2002 ($N = 247,964$) [29].

After the release of the WHI findings in 2002 [30], estimates of HRT use showed a precipitous drop [31,32]. This current study was conducted in the spring and summer of 2003, 9–12 months after the release of the WHI report, thus post-WHI estimates of HRT use in the U.S. are most appropriate for comparison. Buist et al. examined prescribing patterns of oral estrogen and estrogen use from September 1, 1999 to June 31, 2002 (baseline) and December 31, 2002 (follow-up) [33]. Data were drawn from an observational cohort of 16,586 women aged 40–80 years who were enrolled in five health maintenance organizations in the U.S. The 2002 follow-up data were used to compare rates of use of HRT use to the polio sample.

2.3. Data analysis

Analyses included descriptive statistics for determining socio-demographic characteristics, menopause status characteristics, HRT use, and scores on standardized scales. One-way multivariate analysis of variance (MANOVA) was used to test group differences on sets of continuous data, here the four menopause symptom factors described above; Wilk's Lambda is reported as the test of significance for differences among groups on a linear combination of the dependent variables. We used a Bonferroni correction for post hoc testing to

reduce the risk of Type I errors given multiple comparisons. Effect sizes using partial eta^2 were used to ascertain if group differences were likely to be clinically meaningful or primarily due to the effects of a large sample size; the values of effects sizes were based on Cohen's guidelines [34] where 0.01 = small effect, 0.06 = moderate effect and 0.14 = large effect. To compare this post-polio sample and national estimates from their same age, non-disabled cohorts, Chi-square analyses and odds ratios were used to examine differences in proportions and estimate risk, respectively, for hysterectomy and HRT use. For the Chi square analyses, standardized residual (SR) values were used to test differences between observed and expected values; SR values ≥ 2.0 indicated statistically significant differences between observed and expected values.

3. Results

3.1. Socio-demographic characteristics

The 909 women in this study came from 49 states in the U.S. and were roughly distributed among its four regions (Northeast, 17%; Midwest, 33%; South, 25%; and West, 25%). As expected, the sample was primarily late middle aged although the age range of participants was quite large with the youngest 34 and the oldest 91 years (mean age 63.5 ± 9.0 years). In general, participants were Caucasian, well-educated and retired; socio-demographic and polio characteristics are given in Table 1.

3.2. Polio history

The peak year of acute polio infection was 1952 ($N = 121$; range 1913–1971) at an average age of 7.99 ± 6.8 years (median = 6.0 years, mode = 2 years). The majority of individuals reported having contracted spinal polio ($N = 639$; 70.5%) followed by a combination of spinal and bulbar polio ($N = 171$; 18.8%) and bulbar ($N = 18$; 0.6%). A small minority ($N = 79$; 8.7%) were not certain about the type of polio they had as they were too young to remember.

3.3. Physical functioning

For nearly half of the sample, basic and intermediate activities of daily living (BADL and IADL) fell below

Table 1
Socio-demographic characteristics of the sample ($N = 909$)

Current age (mean, S.D.)	63.49 (9.1)
Age at polio onset (mean, S.D.)	7.99 (6.8)
Years post-polio (mean, S.D.)	55.51 (7.5)
Educational attainment (%)	
Less than high school	1.2
High school or GED	17.4
Some college	29.0
College degree	28.3
Graduate degree	24.1
Marital status (%)	
Married	61.2
Separated	0.8
Divorced	14.1
Widowed	11.7
Never married	12.2
Occupational status (%)	
Working full or part time	29.7
Retired, not medical	22.2
Retired, medical reasons	36.1
Other	11.9

optimal ranges (47.5% and 82.5%, respectively) suggesting substantial limitations in physical functioning.

3.4. Menopause status

Twelve percent of the women ($N = 112$) were early postmenopausal and 70.3% ($N = 640$) were late postmenopausal. A minority were peri-menopausal (9.8%, $N = 89$) and very few were pre-menopausal (2.2%, $N = 20$); the latter was not included in any of the analyses using menopause status. Forty-seven women (5.3%) were unable to recall the year of their FMP and thus were not classified into early or late post-menopause. For naturally menopausal women ($N = 392$) their average age at their final menstrual period (FMP) was 50.3 (4.3) years.

Reason for cessation menstruation was primarily due to natural menopause ($N = 392$; 43.2%). However, 34.7% of the women ($N = 311$) had hysterectomies (either with ovaries removed [$N = 151$] or without ovaries removed [$N = 160$]) at an average age of 40.6 ± 8.2 years. Reasons given for having a hysterectomy (not mutually exclusive categories) were fibroids (50.2%), heavy menstrual periods (41.2%), other reasons (32.4%), bleeding (15.8%), cervical abnormalities (8.7%), cancer (5.5%), and hygiene (0.3%).

3.5. Use of HRT in sample

The majority of women in the sample were not currently using any form of HRT ($N = 552$, 57.6%). Of these, 221 (24.3%) had never used HRT and 303 (36.6%) were past users. Another 28 women did not provide sufficient information to ascertain if they were past or never users and were not included in these analyses.

Three hundred and fifty-seven women (39.3%) were using HRT. Of those, 46.2% were using estrogen without progestin ($N = 165$), 31.1% were using estrogen plus progestin ($N = 111$), 9.2% were using SERMs ($N = 33$) and the rest were using either estrogen cream ($N = 13$), progestin alone ($N = 12$) or did not provide a name for the type of HRT they used ($N = 23$). Women using estrogen had done so for almost twice as long as women using estrogen plus progestin (13.67 ± 10.6 versus 7.64 ± 7.7 years, respectively; $t = 4.99$, $p \leq 0.001$). The 303 past users discontinued using HRT at an average age of 57.0 ± 9.4 years after an average 7.9 ± 5.3 years of use. The most common reason cited for discontinuing use was safety concerns (59.7%), followed by "other" reasons (31.0%), side effects (29.0%), and a lack of efficacy (7.3%).

3.6. Menopause symptom prevalence

The prevalence and mean severity of all menopause symptoms among current users, non-users and past users are given in Table 2. As noted in the table, not all items loaded on one of the four menopause factors in the original factor analysis of the MSL that is reported elsewhere [35]. Prevalence and severity of all symptoms are reported here, but only factor scores computed using severity ratings were used in the analyses reported below.

3.7. Menopause symptom severity by menopause status (never and past users only)

There was a statistically significant difference by menopause status on the combined menopause factors for never and past users ($N = 450$): Wilk's Lambda $= 0.908$; $F_{(8,888)} = 5.49$, $p \leq 0.001$, partial eta$^2 = 0.05$. On the psychological factor [$F_{(2,447)} = 19.01$, $p \leq 0.001$, partial eta$^2 = 0.08$],

Table 2
Prevalence and mean severity scores[a] of menopause symptoms by HRT use

Item (factor # or NA)[b]	Current users (N = 357)		Never users (N = 221)		Past users (N = 303)	
	Regularly to almost always[c] (%)	Severity, mean (S.D.)	Regularly to almost always (%)	Severity, mean (S.D.)	Regularly to almost always (%)	Severity, mean (S.D.)
Hands and feet cold despite rest of the body being warm (NA)	45.3	2.74 (1.1)	49.4	2.86 (1.2)	51.2	2.78 (1.1)
Loss of interest in and desire for sexual activity (NA)	39.5	2.73 (1.3)	32.1	2.82 (1.4)	38.9	2.71 (1.2)
Difficulty falling or staying asleep (3)	38.6	2.67 (1.2)	36.2	2.54 (1.1)	46.2	2.64 (1.2)
Waking up early in the morning and unable to fall back to sleep (3)	27.4	2.19 (1.1)	19.3	2.12 (1.1)	26.4	2.15 (1.1)
Weight increase in the last year of more than 5% (NA)	25.5	2.45 (1.2)	15.8	2.19 (1.1)	23.4	2.35 (1.1)
Feeling tense or wound up (1)	25.5	2.29 (0.9)	22.3	2.24 (0.9)	23.5	2.32 (0.9)
Difficult in keeping your mind upon tasks (1)	25.4	2.12 (0.9)	17.8	2.06 (1.1)	20.5	2.01 (0.9)
Constipation (NA)	23.2	2.1 (1.1)	13.2	1.83 (1.0)	17.2	2.01 (1.0)
Feeling of dryness in the eyes (2)	21.2	2.13 (1.1)	18.8	2.14 (1.1)	26.1	2.28 (1.0)
Numbness or loss of sensation in hands and feet (2)	20.4	2.261.1)	18.6	2.17 (0.9)	23.1	2.17 (1.0)
Pain in the head, but not severe enough to call a migraine (3)	20.2	2.25 (1.0)	13.6	2.11 (1.0)	19.5	2.26 (1.1)
Tense and tight feelings in the head or body (NA)	20.2	2.33 (1.1)	11.8	2.03 (1.0)	16.5	2.16 (0.9)
Hot flushes or a feeling of heat that suddenly occurs (4)	18.5	2.32 (1.2)	21.2	2.44 (1.0)	32.0	2.38 (1.1)
Feeling unhappy, miserable or sad without reason (1)	18.2	2.21 (1.1)	14.1	2.03 (0.9)	13.5	1.98 (0.9)
Sweating without exerting energy (4)	16.4	2.14 (1.2)	16.2	2.12 (1.0)	27.1	2.33 (1.1)
Shortness of breath (NA)	16.0	2.06 (1.0)	14.5	2.07 (0.9)	18.6	2.01 (1.0)
Loss of feeling or tingling or prickling sensations (2)	15.6	2.28 (1.1)	16.7	2.24 (1.0)	15.8	2.19 (1.1)
Concerned and upset about things for no reason (1)	14.9	1.89 (1.0)	14.0	1.84 (0.9)	14.5	1.86 (0.9)
Easily upset or annoyed (1)	14.9	1.92 (1.0)	13.6	1.99 (1.0)	16.1	2.00 (0.9)
Easily aroused or stirred up (1)	12.3	1.94 (0.9)	13.6	1.98 (0.9)	19.1	2.11 (1.0)
Changes in moods or feelings for no reason (1)	11.5	1.90 (1.0)	12.2	1.87 (0.9)	13.3	1.88 (0.9)
Painful or difficult sexual intercourse (NA)	10.7	2.39 (1.2)	6.9	2.21 (1.2)	11.9	2.31 (1.3)
Crying or wanting to cry without reason (1)	9.3	1.9 (1.0)	6.8	1.85 (0.9)	6.7	1.75 (0.9)
Heart beating quickly or strongly (NA)	7.6	1.98 (0.9)	7.3	1.76 (0.9)	9.9	1.89 (0.9)
Loss or desire or interest in food and eating (NA)	6.1	1.71 (0.9)	6.9	1.64 (0.9)	3.7	1.58 (0.8)

[a] Severity ratings range from 1 = slight to 5 = extreme; cases with 0 for frequency (never) were excluded (pairwise) from the analysis.

[b] 1 = Factor 1, psychological; 2 = Factor 2, somatic/sensory; 3 = Factor 3, somatic/sleep; 4 = Factor 4, vasomotor; NA refers to those items that did not load on a factor in the MSL factor analysis reported elsewhere [51].

[c] Ranked in order from highest to lowest frequency for current users.

late postmenopausal women had statistically significant lower factor scores than both peri-menopausal and early postmenopausal women. On the vasomotor factor [$F_{(2,447)} = 8.80$, $p \leq 0.001$, partial eta^2 = 0.038], late postmenopausal women had statistically significant lower factor scores than both peri-menopausal and early postmenopausal women. While there was a significant *F*-test for the somatic/sleep factor [$F_{(2,447)} = 4.83$, $p = 0.008$, partial eta^2 = 0.021], there were no significant between group differences after Bonferroni correction. Finally, there were no significant differences on the somatic/sleep factor. All effects sizes for significant comparisons were quite small. Mean menopause factor severity scores by menopause status for never and past users combined are given in Table 3.

3.8. Menopause symptom severity and HRT use

Mean scores on each of the menopause factors were then compared between current users, never users and past users using MANOVA. There was a statistically significant difference by HRT user status on the combined menopause factors: Wilk's Lambda = 0.963; $F_{(8,782)} = 3.67$, $p \leq 0.001$, partial eta^2 = 0.018. On the somatic/sleep factor [$F_{(2,785)} = 4.920$, $p = 0.008$, partial eta^2 = 0.012], never users had significantly lower factor scores than current users and past users ($p = 0.046$ and 0.007, respectively). On the vasomotor factor [$F_{(2,785)} = 8.28$, $p \leq 0.001$, partial eta^2 = 0.021], past users had significantly higher vasomotor factor scores than current users and never users ($p \leq 0.001$ and $p = 0.030$, respectively). All effects sizes for significant comparisons were quite small. There were no significant differences on the psychological and somatic/sensory factors. Mean menopause factor severity scores by HRT use status are given in Table 3.

3.9. Sexuality and HRT

Two items from the MSL were analyzed to explore the relationship of HRT use and sexuality; specifically loss of interest in and desire for sexual activity and painful or difficult intercourse. Current users, never users and past users were compared on each of these items with respect to frequency and severity using MANOVA. For all comparisons, there were no significant differences between groups.

3.10. Hysterectomy prevalence comparison to population estimates—differences in prevalence and estimated risk

Difference in prevalence and estimated risk of hysterectomy for the post-polio women compared to the overall rate of hysterectomy among the BRFSS women ($N = 148,702$) was calculated and revealed significant differences ($\chi^2 = 51.2$, $p \leq 0.001$; OR = 1.6, 95% C.I. = 1.40, 1.85). Upon closer examination, however, approximately a third of BRFSS sample was comprised of women under the age of 40 ($N = 50,070$) and for whom hysterectomy rates are quite low. A sub-sample of women 40+ years of age ($n = 95,241$) was thus created for comparison to the polio sample. Rates of hysterectomy in the post-polio women and the selected sample from the BRFSS were nearly identical (34.1% versus 34.3%, respectively; $\chi^2 = 0.031$, $p = 0.861$; OR = 0.99, 95% C.I. = 0.86, 1.13).

Differences in prevalence and estimated risk were then calculated within age group strata. For women

Table 3

Mean scores and standard deviations for menopause symptom factors as a function of menopause status and HRT use

Menopause symptom factor(s)	Menopause status (never and past users only)			Hormone use status		
	Peri-menopause ($N=55$) M (S.D.)	Early post-menopause ($N=56$) M (S.D.)	Late post-menopause ($N=339$) M (S.D.)	Current users ($N=262$) M (S.D.)	Never users ($N=202$) M (S.D.)	Past users ($N=282$) M (S.D.)
Factor 1, psychological	13.15 (6.2)	13.65 (6.8)	9.04 (6.5)	10.67 (6.8)	9.48 (6.9)	10.56 (6.7)
Factor 2, somatic/sensory	3.90 (3.0)	4.38 (3.4)	3.69 (3.1)	3.87 (3.2)	3.60 (3.1)	3.88 (3.0)
Factor 3, somatic/sleep	6.37 (3.1)	6.28 (3.0)	5.12 (3.1)	5.63 (3.2)	4.89 (3.2)	5.80 (3.0)
Factor 4, vasomotor	4.11 (2.5)	3.98 (2.0)	2.90 (2.5)	2.67 (2.6)	2.83 (2.4)	3.47 (2.6)

Note: The *N* reported in each column refers to sample size utilized in the specific analysis reported in the table and reflects some missing data for the factors.

40–49 years old, there was no significant difference in prevalence between groups ($\chi^2 = 0.63$, $p = 0.428$). Similarly, estimated risk was not significantly different for the post-polio women (OR = 1.49, 95% C.I. = 0.55, 4.00). For women 50–59 years old, there was a significant difference in prevalence of hysterectomy between groups ($\chi^2 = 6.78$, $p = 0.009$). Specifically, women in the polio sample had fewer observed cases than expected of hysterectomy (100 observed versus 123 expected; SR = −2.1). Similarly, estimated risk for the post-polio women was lower than the national comparison group and was statistically significant (OR = 0.73, 95% C.I. = 0.58, 0.92).

For women 60–64 years old, differences in prevalence were not statistically significant ($\chi^2 = 2.05$, $p = 0.152$) nor was estimated risk (OR = 0.79, 95% C.I. = 0.58, 1.07). For women 65+ years old, there was a significant difference in prevalence between groups ($\chi^2 = 9.64$, $p = 0.002$). Specifically, there were less observed than expected cases of hysterectomy for the post polio women (140 observed versus 169 expected cases; SR = −2.3). Similarly, estimated risk for hysterectomy was significantly lower for the post-polio women (OR = 0.71, 95% C.I. = 0.69, 0.72). These analyses are summarized in Table 4.

3.11. Rates of HRT use in comparison to a non-disabled sample

Using 2002 HRT prevalence data from a combined sample of 149,607 women [33], difference in prevalence and estimated risk of using either estrogen or estrogen plus progestin were examined. For estrogen users, there was a statistically significant difference in prevalence ($\chi^2 = 22.96$, $p \leq 0.001$). Specifically, nearly twice as many post-polio women as expected were using estrogen (163 observed versus 84 expected cases; SR = 8.7). Similarly, estimated risk for using estrogen among these women was nearly twice that of the national comparison group (OR = 2.1, 95% C.I. = 1.79, 2.45). For the estrogen plus progestin users, there also was a statistically significant difference in prevalence ($\chi^2 = 83.48$, $p \leq 0.001$). Specifically, for the post-polio women there were significantly more observed than expected cases (111 observed versus 72 expected cases, SR = 4.6). Similarly, there was one and half times greater estimated risk of use among post-polio women compared to the non-disabled cohort (OR = 1.6, 95% C.I. = 1.30, 1.94). These data are summarized in Table 4.

4. Discussion

This study is one of the first to examine the characteristics of menopause in women who have a substantial, and for many a lifelong, physical disability. Contrary to speculation about early menopause in some women with physical disabilities, women in this sample experienced their final menstrual at the same age, on average, as their non-disabled peers. Overall, the estimated risk of hysterectomy also was similar to national estimates; comparisons within age strata indicated that for women in the 50–59 and 65+ years old groups, prevalence and estimated risk was actually *lower* than the national comparison groups contrary to

Table 4
Comparisons between polio sample and non-disabled cohort samples

Comparison variable	Polio sample % (N)	Non-disabled cohort % (N)	χ^2	Sig.	Odds ratio[a]	95% C.I.
Hysterectomy						
Total BRFSS sample	34.1% (310)	23.9% (33,966)	51.20	≤0.001	1.62	1.40, 1.85
40+ years total sample	34.1% (310)	34.3% (32,709)	0.031	0.861	0.99	0.86, 1.13
40–49 years	22.7% (5)	16.5% (4,646)	0.63	0.458	1.49	0.55, 4.00
50–59 years	28.7% (100)	35.4% (8,872)	6.786	0.009	0.73	0.58, 0.92
60–64 years	39.3% (66)	44.8% (4,239)	2.051	0.152	0.79	0.58, 1.07
65+ years	37.9% (140)	46.0% (14,952)	9.638	0.002	0.71	0.69, 0.72
HRT use						
Estrogen	17.9% (163)	9.1% (13,684)	22.958	≤0.001	2.1	1.79, 2.45
Estrogen plus progestin	12.2% (111)	7.9% (11,825)	83.478	≤0.001	1.6	1.30, 1.94

[a] Post-polio sample is the reference group.

expectations. However, these post-polio women used HRT at significantly higher rates than expected.

The specificity and nature of menopause symptoms have been the subject of vigorous debate [36,37] and their interaction with physical disability is even less well understood. Because of the spectrum of symptoms, ranging from those closely associated with hormone levels, such as hot flushes or vaginal dryness, to more broad psychosocial symptoms, such as depression or anxiety, it is difficult to establish a true "menopausal syndrome" [38]. In general, this sample reported experiencing a range of menopause symptoms, the most prevalent of which were somatic (cold hands and feet, sleep disturbance) and loss of interest in and desire for sexual activity.

However, a caveat is important to consider when assessing symptoms in this or other populations of women with physical disabilities. Standardized instruments, such as the MSL, written for and standardized on non-disabled samples have limitations when used in the context of disability. A primary problem in this approach is that symptoms associated with a disabling condition may be misattributed to what the scale purports to measure thus confounding measurement of the construct itself. The clustering of symptoms from the factor analysis of the MSL reported elsewhere [35] reflects this potential confounding factor. Specifically, the somatic/sensory and somatic/sleep factors reflect some of the core sequelae in post-polio health problems. While these factors sometimes differed by menopause status in this current study and did so in expected directions, effect sizes were quite small and as such these factors are less likely to be particularly sensitive or useful factors in understanding the expression of menopause symptoms in the context of post polio sequelae because of the potential for the confounding influence of disability. Until there is greater understanding of how menopause symptoms manifest in the context of certain disabling conditions, the development of specialized instruments that control for such confounders will be restricted.

Vasomotor symptoms, characterized by hot flushes, are the hallmark of menopause experienced by a majority of women (50–80% [39,40]); this was similarly found in this sample (65%). In an analysis of a sub-sample of 190 women aged 40–65 years and not using HRT drawn from these 909 women published elsewhere [35], no differences in vasomotor

symptom severity by menopause status were found. In this current analysis, however using the larger age range (34–91 years), peri-menopausal and early postmenopausal never and past users reported a statistically significantly higher vasomotor factor severity (albeit quite modest) than late postmenopausal women. It is likely that the inclusion of older women (65+) in this later analysis increased the variability of vasomotor symptom severity.

In examining menopause symptom factor severity by HRT use, never users reported the lowest somatic/sleep symptoms compared to current and past users although this was a modest difference. Past users reported the highest vasomotor symptoms compared to current and never users, although again this was a small difference. The greater severity of symptoms experienced by past users may indicate that they had higher symptomatology than never users to begin with, but for reasons other than efficacy (i.e., safety concerns, side effects) they discontinued use. Therefore it is reasonable to assume that their vasomotor symptoms will indeed be worse than never users (who likely did not have severe enough symptoms to warrant HRT use) and current users (whose symptoms are reduced by the HRT) as we found in this analysis.

Little is known about the prevalence of HRT use among women with disabilities or other chronic illness or their reasons for using HRT [19]. Furthermore, there have been neither cross-sectional nor large, randomized controlled trials addressing HRT's potential risks and benefits for women with physical disabilities. Becker and colleagues [18,19] have investigated the decision to use HRT among women with physical disabilities. Among a sample of 166 women with physical disabilities resulting from a variety of chronic conditions (e.g., multiple sclerosis, joint/connective tissue disorders), three-fourths were post-menopausal, of whom 50% were using HRT, which is a higher rate than found in this current study. However, it is important to note that Becker and colleagues' study was performed prior to the release of the WHI trial stoppage; recent studies have indicated that the WHI had a marked impact on HRT use rates in the U.S. [31,41].

The current study was conducted after the WHI release and comparisons to a large, non-disabled cohort [33] indicated that the estimated risk for estrogen and estrogen plus progestin use among the post-polio women greater than national estimates of their non-

disabled peers. Because of limitations in physical activity and mobility, many women with disabilities are already at a risk for cardiovascular disease or thromboembolism and therefore potentially face an even greater health risk with use of either estrogen or estrogen plus progestin which have been associated with similar co-morbidities [30,42–45].

With higher rates of both estrogen and estrogen plus progestin use in this sample and particularly in the absence of studies examining the risk–benefit ratio of HRT for women with physical disabilities [46], the efficacy of its use in mitigating symptoms is critical given the potential risks of HRT use already established in non-disabled women. However, in this sample, the use of HRT did not confer substantial benefits in terms of symptom reduction; what differences were found were quite modest. There also were no differences in desire for sexual activity or painful intercourse by HRT use. It is important to consider that while many women with physical disabilities may enjoy an active sex life, Nosek et al. [47] found significant differences in level of sexual activity, response and satisfaction in a large sample of women with physical disabilities in comparison to a non-disabled cohort. There were no differences in the desire for sexual activity and severity of disability was not associated with level of sexual activity. Although we did not specifically ask about availability of a partner and although a majority of women in this study were married, items about sexuality were most frequently left blank with anecdotal comments about a lack of partner, which will impact these findings. These findings suggest caution for women who may consider HRT for reducing menopause symptoms that may be associated with both menopause and physical disability (e.g., sleeping problems, pain, or fatigue) given the unknown risk profile for women with physical disabilities.

4.1. Limitations and recommendations for future research

One of the most prominent features of this sample is the overwhelming proportion of women who are postmenopausal. The advent of the polio vaccine in 1955 essentially eradicated the disease in the U.S. and as a result, very few women who had polio are now in early middle age and in pre and peri-menopause. Future studies aiming to understand the interaction of disability and menopause should involve women with

other disabling conditions that allow for a broader range of the menopause continuum than we have here. While there are some advantages to having a demographically homogeneous sample such as this one when exploring uncharted territory (thereby reducing confounds many of which may not yet be identified), race and ethnicity can impact the experience of menopause symptoms, and as such, findings from this study cannot be generalized to other non-Caucasian populations of women with physical disabilities. Future studies should involve more diverse samples and include those psychosocial factors known to impact menopause symptom experience to better understand how they in turn interact with physical disability.

Another important consideration for future studies examining menopause in the context of physical disability is the use of appropriate control or comparison groups. The use of men as comparisons in the extant menopause literature is virtually non-existent; two studies that have used men as a comparison group for symptom measurement (presented as "mid life" symptoms) have found few differences in report of symptoms with the exception of vasomotor [48,49]. We argue that the inclusion of men with a similar disabling condition or functional limitations is necessary in studies of menopause in the context of physical disability. To account for the unique effects of the disability apart from menopause, a group with the condition but no menopause is needed. Similarly, these studies also require the inclusion of non-disabled women to control for the effects of menopause.

Physical disability does not exist in isolation; rather it predisposes many women to the development of other co-morbid health conditions and accelerated aging as a result of restricted mobility. The transition through menopause and aging also is associated with the development or exacerbation of co-morbid diseases in non-disabled women [50]. As such, the relationship between menopause, disability and the development of other co-morbid diseases is an important area of further study.

5. Conclusions

This study suggests that basic menopause characteristics of these women with physical disability as a result of polio in childhood are generally similar

to those of their non-disabled peers. However, perhaps even more so than their non-disabled peers, these women should be fully aware of the health changes associated with menopause and their own personal risk profile for co-morbid disease, such as cardiovascular disease and osteoporosis as they are more vulnerable to such health conditions. The apparent lack of substantial benefit in symptom reduction by HRT is perhaps one of the most important findings of this study in light of the dearth of studies examining the risk–benefit ratio of HRT use among women with physical disabilities. Accordingly, until such studies provide some evidence of the specific risks to health these women face, each should carefully weigh the known risks and benefits with their health care providers in light of their narrower margin of health and vulnerability to co-morbid health conditions due to limitations in physical activity.

Because so little is known about menopause – a normal biological milestone in every woman's life – and its unique characteristics in women with physical disabilities, women who are post-polio are, fairly or not, put in the position of having to educate both themselves and their health care providers about how they may or may not differently experience menopause. Future studies examining menopause in the context of disability should, as much as possible, utilize methods and measures employed by the large U.S. studies of menopause, such as the SWAN and WHI and include comparison groups of men with the same disability and non-disabled women peers to control for the effects of disability and menopause, respectively.

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