Hormone Replacement Therapy and Everyday Memory in Mid-aged New Zealand Women

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While empirical research to date has generally supported positive effects of estrogen on verbal memory performance in women, the literature examining specific effects of Hormone Replacement Therapy (HRT) on cognitive functioning in mid-life women is more equivocal. The Rivermead Behavioural Memory Test-Extended Version (RBMT-E), a measure of everyday memory functioning in adults within an average range of cognitive functioning, was administered to a sample of 104 New Zealand women aged 40 to 60 years who had self-selected to either use or not use HRT (53 HRT users and 51 non-users). Self-report measures of mood, stress, general health and menopausal symptoms were also administered. These variables, along with age and education level, were used in analyses of group differences on the everyday memory measures. Results showed significant differences between the groups for three sub-tests of the RBMT-E: 'Story Immediate', 'Story Delayed', and 'Message Delayed'. Women who use HRT scored higher on these subtests than those who do not use HRT. After calculation of a total profile score (adjusting for age and IQ), HRT users score higher than HRT non-users on the RBMT-E overall measure of Everyday Memory. These pilot results suggest that HRT use in this sample is related to enhanced verbal memory in everyday memory tasks and that the RBMT-E may be a useful tool for further work in this area of research.

Menopause is a time in a woman's life when menstruation stops permanently; it is the last stage of a gradual biological process in which the ovaries reduce their output of the female hormone estrogen. Menopause is considered complete when a woman has ceased to experience periods for twelve months, but the term 'menopausal' is also commonly used to describe the peri-menopause and immediate post-menopause periods in this process:

In addition to the loss of natural estrogen and cessation of periods, hot flushes, headaches, sleep disturbance and night sweats are frequent somatic complaints that are commonly associated with the time of menopause. Longer-term effects of post-menopausal estrogen deficiency include increased risk of osteoporosis and cardiovascular disease. Complaints of memory loss, particularly short-term memory (e.g., the ability to track and remember a conversation) are also commonly reported by menopausal women (Anderson, Hamburger, Liu, & Rebar, 1987). Links between estrogen deficiency and memory include short-term symptoms of forgetfulness around the time of menopause, as well as longer-term effects such as heightened risk for Alzheimer's disease (Birge, 1997).

Hormone replacement therapy (HRT) is prescribed as a treatment for estrogen deficiency in peri- and post-menopausal women, targeting many of the somatic symptoms of menopause (e.g. hot flushes) as well as, controversially, to reduce the risk in post-menopausal women for diseases such as osteoporosis and cardiac disease (Fletcher & Colditz, 2002; Stevenson & Whitehead, 2002). There has been very little research in New Zealand to date regarding HRT use, and none published in regard to the benefits of use. Recent findings do show that New Zealand women are concerned about the benefits and risks of HRT (Stephens, Carryer, & Budge, 2001), and also aware of a purported relationship between menopause and changes in cognitive functioning, such as memory loss, which affects everyday performance (Stephens, 2002). However, scientific support for the use of HRT to offset cognitive deficits in peri- and post-menopausal women has been inconsistent and often contradictory.

Studies of HRT use and memory

Two main types of studies have typically been used to

investigate the effect of HRT on memory and cognition in menopausal women: observational research and randomized, controlled trials. Both observational and experimental studies have found a positive relationship between estrogen use and verbal memory in particular, in both post-surgical and naturally menopausal women (Jacobs et al., 1998; Schmitt et al., 1996; Sherwin 1997, 1998; Wolf et al., 1999). However, there have been studies of equal merit that have failed to find such a link (Polo-Kantola et al., 1998; Barrett-Connor & Kritz-Silverstein, 1993; Matthews, Cauley, Yaffe & Zmuda, 1999).

Some studies have suggested that HRT may also benefit other types of memory functions (e.g. Jacobs et al., 1998). In one study, women receiving HRT made fewer errors on measures of short-term visual memory, visual perception and constructional skills (Resnick, Metter & Zonderman, 1997). The HRT users in this study also maintained their performance over time, whereas HRT non-users showed typical age related increases in memory errors.

Reviews of this literature (Newman, 1999; Rice, Graves, McCurry, & Larsen, 1997; Yaffe, Sawaya, Lierberburg, & Grady, 1998) suggest that while empirical studies generally support a positive effect of estrogen on memory, studies linking HRT and improved memory functioning in menopausal women have failed to draw precise conclusions. One problem is inconsistent control of important additional variables in mid-aged women's lives.

Extraneous variables

A difficulty in clarifying the role HRT may play in memory performance is the presence of confounding variables such as age. An aging process operating independently of any estrogen effect may account for some of the difficulties in memory that are observed in mid-aged women (Sherwin, 1998). Modest gradual decline with aging has been reported (Youngjohn & Crook, 1993) including short-term memory, memory for activities, recognition memory, free and cued recall, and prospective memory (Smith & Earles, 1996).

Psychosocial variables such as stress, sleep difficulties and mood may also affect cognitive functioning. Stress has long been acknowledged as a factor in the impairment of cognitive functioning (Weiten, 1995). Women experience menopause at an age when they may have experienced, or are experiencing, a number of life changes such as divorce, death of spouse or parents, and children leaving home (McKinlay, McKinlay & Brambilla, 1987). These changes have been associated with observable psychological distress noted during menopause (Slaven & Lee, 1998). Sleep deprivation has been associated with concentration and memory impairments (Weiten, 1995), and sleep disturbance has been associated with menopause (Slaven & Lee, 1998). Emotional lability, depression and a decreased sense of well-being are common complaints during menopause (Mayeaux & Johnson, 1996). Controversy exists as to whether the observed changes in mood constitute a menopause related mood disorder, and there is not clear evidence of any increase in depression that is related to the menopausal years (Ballinger, 1990). Some studies suggest that HRT may exert a positive effect on well-being and mood through its alleviation of the somatic symptoms associated with menopause (Palinkas & Barrett-Connor, 1992). Finally, the relationship between mood (in particular depression) and cognitive ability is complex. Much of the literature (but not all), supports the presence of significant and specific impairments in cognitive ability in depressed individuals (Lezak, 1995).

The first aim of the present study

On the basis of the findings to date and a recognition of the importance of age, stress, and mood in relation to memory functioning, the first aim of the study was to test the prediction that mid-aged women using HRT would show better memory functioning than women not using HRT, while taking into account the effects of age, stress and mood. In addition, education and general health, as other variables known to be related to memory performance, were accounted for. On the basis of previous findings, it was expected that the greatest difference between the two groups would be for verbal memory. It was also predicted that age would moderate the relationship between HRT use and memory ability, in that differences in memory ability between HRT users and HRT non-users would be greatest for older women.

Ecological assessment of memory

The majority of studies looking at the effect of estrogen on memory have consisted of traditional laboratory measures of short-term memory. These are largely list learning or paragraph recall tests. Questions about the validity of naturalistic versus laboratory research have highlighted the difficulty in obtaining memory measures that accurately portray how an individual may perform in everyday life (de Wall, Wilson & Baddeley, 1994). In an attempt to develop ecologically valid assessments of memory functioning a concept of "everyday" memory has been developed and defined as: "memory that is involved in the performance of everyday life tasks and measured either outside of the laboratory, or using simulated everyday life tasks, inside the laboratory." (Tomer, Larrabee & Crook, 1994, p.606).

The concept of everyday memory originated from criticisms that memory research undertaken in the laboratory failed to capture, or to represent, memory as it occurred in people's lives (Neisser, 1978). It is now recognised that it is both possible and helpful to study memory outside the laboratory, while acknowledging that issues of control, as well as those of reliability and validity, remain problematic (de Wall et al, 1994). Those aspects of memory that have been identified as being implicated in the impaired performance or failure of everyday tasks include short-term memory, visual and non verbal memory, recall and recognition memory, and prospective memory.

To date, there has been no attempt to use ecologically valid measures of memory in the studies that have investigated the effects of HRT on everyday memory in menopausal women. Following the suggestion that the effect of hormone replacement may extend to aspects of memory other than 'verbal' memory as measured in the laboratory (Jacobs et al., 1998), memory measures are needed to assess

how mid-aged women's memory may function in the context of everyday experience.

An ecologically valid measure of everyday memory with demonstrated reliability and validity is the Rivermead Behavioural Memory Test (Wilson, Cockburn & Baddeley, 1985), which was developed for the assessment of the cognitively impaired and aged. This test has recently been extended to allow for the assessment of normal, younger individuals.

The second aim of the present study

To assess memory functioning in terms of 'everyday' memory, the present study utilised the Rivermead Behavioural Memory Test-Extended Version (RBMT-E) to investigate the relationship of HRT use and memory performance in New Zealand mid-aged women. The RBMT-E is designed for use in younger populations, such as mid-aged, but has received little assessment to date. Thus, the second aim of the study was to evaluate the use of the RBMT-E as a measure of everyday memory with a sample of mid-aged women.

Method

The study employed a cross-sectional between-subjects design, comparing a sample of New Zealand women who were either HRT users or HRT non-users.

Participants

Participants (N=104) were women with an age range of 40-60 years and a mean age of 51.67 years (SD = 4.80). All women were functioning independently in the community and 76.9% (N=80) were employed in full or part-time work; 63% were taking some form of prescribed or 'over the counter' medication, not including HRT; 55% had more than 12 years education, and of this group, 60% were being treated with HRT. Fifty-three (51%) were HRT users and 51 (49%) were HRT non-users. Complete demographic and menopausal status details of the sample, are provided in Table 1. Women with a history of major psychiatric illness or substance abuse, head injury with cognitive, psychiatric or behavioural sequelae, or a current episode of major or minor depression were excluded.

Measures

Memory and Attention: The original Rivermead Behavioural Memory Test (RBMT; Wilson et al.,1985) was designed to predict everyday memory problems in people with acquired, non-progressive brain injury, and also to monitor change over time. The Rivermead Behavioural Memory Test-Extended Version (RBMT-E; Wilson et al., 1999) was developed to enhance the original RBMT for use in normal populations and the result of this extension has been to provide a sensitive measure of memory within the normal range of functioning (de Wall et al., 1994). The RBMT-E has been described as a standardised and reliable measure of everyday memory (Wilson et al., 1999). Because the RBMT-E has been designed to follow the original structure of the RBMT, the new measure capitalises on the established validity and sensitivity of the original RBMT. Normative data for the RBMT-E are available for ages 11-96. The RBMT-E comprises 12 sub-tests, which are labeled

Table 1. Demographic Characteristics of the Sample and HRT Use Groups

	HRT use N=53		HRT non-use N=51		Total N=104	
Age mean years (SD)	52.34	(4.33)	50.98	(5.19)	51.67	(4.80)
Ethnicity						
NZ European	48	(90.6%)	46	(90.2%)	94	(90.4%)
Other Ethnicity	5	(9.4%)	5	(9.8%)	10	(9.6 %)
Education						
High School (<11yrs)	20	(37.7%)	26	(51.0%)	46	(44.2%)
Tertiary (> 12yrs)	33	(62.3%)	25	(49.0%)	58	(55.8%)
Employment						
full/part-time paid	43	(81.1%)	37	(72.5%)	80	(76.9%)
full-time unpaid	10	(18.9%)	14	(27.5%)	24	(23.1%)
Exercise						
>3 times a week	36	(67.9%)	36	(70.6%)	72	(69.2%)
< 3 times a week	17	(32.1%)	15	(29.4%)	32	(30.8%)
Smoking						
Never	27	(50.9%)	36	(70.6%)	63	(60.6%)
Past	21	(39.6%)	12	(23.5%)	33	(31.7%)
Present	5	(9.4%)	3	(5.9%)	8	(7.7%)
Menopause Status						
Pre-menopausal	7	(13.2%)	21	(41.2%)	28	(26.9%)
Menopausal	22	(41.5%)	19	(37.3%)	41	(39.4%)
Post-menopausal	24	(45.3%)	11	(21.5%)	35	(33.6%)
Last Menstruation						
< 12 months	38	(71.7%)	40	(78.4%)	78	(75.0%)
> 12 months	15	(28.3%)	11	(21.6%)	26	(25.0%)
Hysterectomy	23	(43.4%)	13	(25.4%)	36	(34.6%)
Ovarian surgery	14	(26.4%)	1	(2.0%)	15	(14.4%)

according to the everyday tasks involved, and measure memory domains such as: verbal memory ('Story Immediate', 'Story Delayed'); visual memory ('Picture Recognition'); short-term memory for names, events, and procedures, ('First Names', 'Second Names', 'Route Immediate', 'Route Delayed', 'Messages Immediate', 'Messages Delayed'); and prospective memory ('Belongings & Appointments'). Scoring procedures followed were those outlined in the manual to produce a profile score for each participant. The sub-test results may be summed to produce a total score and the alpha coefficient reliability estimate for the sub-tests together in the present study was .66.

The Digit Span subtest of the Wechsler Adult Intelligence Scales-Revised (WAIS-R; Wechsler, 1981) is a measure of attention and immediate verbal recall (Lezak, 1995). The Digit Span subtest comprises two sections, digits forward (where the participants repeat digits in the order given) and digits backwards (where participants repeat digits in the reverse order to how they are presented). Test–retest reliability ranges from 0.66 to 0.89 have been reported for this subtest, depending on age and interval length (Lezak, 1995). The use of the Digit Span in the present study allowed a relatively quick measure of simple attention that is not present in the RBMT-E. Alpha coefficient reliability estimate for the two sections of the scale in the present study was .88.

Intelligence: The NART was utilised both as an estimate of pre-morbid intelligence as well as a necessary component for calculations of RBMT-E profile scores. The assessment of deterioration (especially when mild), without an estimate of prior functioning makes it difficult to determine the extent of cognitive impairment (Nelson, 1991). The National Adult Reading Test (NART; Nelson, 1991; Nelson & Williston, 1991) provides an estimate of pre-morbid intellectual ability, and more specifically, crystallised intelligence (Lezak, 1995). The NART comprises 50 words that are phonetically irregular and arranged in order of increasing difficulty; each incorrectly pronounced word is counted as one error, contributing to a NART error score (50 minus the number of words read correctly). High correlations between the NART and measures of general intellectual ability and education have been reported (Spreen & Strauss, 1998).

Mood: The Profile of Moods Questionnaire (POMS; McNair, Lorr, & Droppelman, 1992) has been widely used as a measure of transient mood states (Nyenhuis, Yamamoto, Luchetts, Terrien & Parmenter, 1999). The POMS has also been shown to be a reliable and valid measure for mood states in both adults and older adults (Gibson, 1997) and has been used in studies involving menopausal women (Slaven & Lee, 1994). Subscales include Tension, Depression, Anger, Vigor, Fatigue, Confusion and a Total Mood Score. Participants are asked to rate on a 5 point scale (0, 'Not at all', to 4, 'Extremely') how they currently feel in terms of various descriptors of mood (e.g. 'annoyed'). The summation of the sub-scale measures (with Vigor weighted negatively), allows a description of a total mood disturbance, with a high score indicating a greater mood disturbance (McNair et al., 1992). The alpha coefficient reliability estimate for this scale in the present study was .87.

The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) is a 20 item scale designed to capture two distinct dimensions of affect (namely, positive and negative affect). Participants rate their experience of each of 10 positive and 10 negative mood descriptions on a 5 point scale (very slightly or not at all, a little, moderately, quite a bit and extremely). In this study participants were asked to indicate the extent of each feeling 'during the past week'. The positive and negative affect items are summed separately for scoring (range 10-50 for each scale), to create 'Positive' (PAS) and 'Negative' (NAS) Affect variables. High scores mean a greater degree of negativity or positivity. The alpha coefficient reliability estimate for the scales in the present study was .91 for the PAS and .87 for the NAS.

Stress: The Social Readjustment Rating Scale (SSRS; Holmes & Rahe, 1967) is a measure of life changes as a source of stress. The scale assigns numerical values to 43 major life events (e.g., 'Death of Spouse' =100; 'Minor Violations of the Law' =11) to reflect the magnitude of readjustment required by the change. Respondents were asked to indicate how often any of the events were experienced during the last year. The values are summed to provide an index of the amount of change-related stress the person has recently experienced (range 11-1,246).

Health: The Women's Health Questionnaire (WHQ) was developed by Hunter (1992) to measure the physical and emotional symptoms experienced by women between the age of 45 and 65 years. The WHQ comprises 36 items that reflect somatic, vasomotor, memory, concentration, sexual behaviour, sleep, menstrual, depressed, and anxious mood symptoms which the participant rates on a 4 (0-3) point scale ('No' to 'Yes, definitely'). The WHQ has been found to be a sensitive measure of response to HRT (Slaven & Lee, 1998; Wilkund et al, 1992). In the present study, 6 subscales of the WHQ were used to measure those aspects of health at menopause not included in the mood measures: subjective memory, concentration, somatic symptoms, vasomotor symptoms, sexual health, sleep and menstrual symptoms. The alpha coefficient reliability estimate for this scale in the present study was .77.

The Short-Form Health Survey Questionnaire (SF-36; Ware & Sherbourne, 1992) was constructed to survey health status and designed for use in clinical practice and research, health policy evaluations and general population surveys. The SF-36 is a 36-item questionnaire that measures eight multi-item dimensions tapping functional status, well-being and overall evaluation of health. High scores on 'Functional Status', 'Well-being' and 'Health Evaluation' indicate the best possible health state. The acceptability, reliability and validity of the SF-36 has been assessed in a New Zealand population (Scott, Tobias, Sarfati & Haslett, 1999) and was considered to be a valid and reliable measure of health-related quality of life. The alpha coefficient reliability estimate for this scale in the present study was .86.

Demographic information and medical history: Demographic data included age, ethnic background, education, employment status and whether or not the women exercised regularly (defined as three or more times per week for 30 minutes). Information was collected regarding

participants' history of head injury, family history of neurological conditions, smoking history, experience of diabetes, hypertension, heart disease, cancer, epilepsy, depression and pre-menstrual tension or symptoms, hysterectomy or ovarian surgery history and menopausal status (self-assigned to pre-menopausal, peri-menopausal or post-menopausal).

Procedures

Approval for the recruitment and testing procedures was granted by the Massey University Human Ethics Committee, Palmerston North. Potential participants were recruited by an advertisement in the local daily newspaper, or volunteered to participate following publicity about the study in daily and community newspapers, on local television, and through word of mouth. Following contact with the researcher (YH), the women were given a brief verbal explanation and offered an information sheet, which was either mailed or faxed to them. An appointment was arranged in the participant's or researcher's home. Any further questions were answered at that time and participants reminded of their rights, including the right to withdraw any time.

Each participant completed the questionnaires and measures used in the study in the following order: Demographic information, WHQ, SF-36, RBMT-E, PANAS, POMS, SRRS, Digit Span and the NART. All testing was completed in a single testing session of approximately one hour in total, of which 35-40 minutes was devoted to RBMT-E testing.

Results

To examine the role of potential confounding variables, the HRT use groups (users and non-users) were compared according to demographic and medical status. As shown in Table 1, there were no differences between the HRT use groups on age, ethnicity, education, employment status, IQ, or the use of concomitant medication. There were significant differences in menopausal status, x^2 (2) = 12.0, $p<.01$; last menstrual period, x^2 (2) = 7.97, $p<.01$; both ovaries removed, x^2 (1) = 5.05, $p<.05$; uterus removed, x^2 (1)= 3.68 $p<.05$; and those reporting the removal of one ovary, x^2 (1) = 6.74, $p<.01$. Women using HRT were more likely to have passed the menopause and more likely to have undergone some form of gynecological surgery.

The HRT-user and HRT non-user subgroups were compared on all measures of cognition, mood, affect, and health. Table 2 shows the means and standard deviations for all participants and the HRT use groups on these measures. One-way ANOVA showed no significant differences between the groups on the POMS, PANAS, SSRS, and SF-36, on the cognitive measures of Digit Span, or the NART. Significant differences were found for vasomotor, t(102)= 2.88, $p<.05$, and menstrual symptoms, t (102) = 2.73, $p<.05$, from the WHQ (see Table 2). HRT non-users reported more problems on the vasomotor symptom sub-scale and reported more menstrual symptoms than HRT users. Overall, HRT non-users reported more symptoms or more difficulties in all of the sub-scales except sleep.

Table 2. Cognitive, Affect and Health Mean Scores (with Standard Deviations) of the Sample and HRT use groups (significant differences between the useage groups indicated).

	HRT use N = 53	HRT non-use N = 51	Total Sample N = 104
Digit Span			
Forward	10.62 (2.35)	10.31 (2.40)	10.46 (2.37)
Backwards	7.45 (2.61)	6.84 (2.26)	7.14 (2.43)
Total Digits	18.08 (4.45)	17.16 (4.02)	17.62 (4.23)
NART			
Mean Errors	6.34 (5.32)	6.69 (4.93)	6.51 (5.11)
Mean Est. IQ	122.99 (6.38)	122.58 (5.91)	122.79 (6.13)
POMS			
Tension	3.34 (5.59)	4.00 (5.1)	3.67 (5.34)
Depression	6.83 (7.95)	9.00 (8.8)	7.91 (8.37)
Anger	7.43 (6.16)	7.40 (6.5)	7.42 (6.33)
Vigor	12.38 (5.20)	10.70 (5.7)	11.54 (5.45)
Fatigue	7.70 (6.60)	8.70 (6.5)	8.20 (6.55)
Confusion	2.60 (4.30)	3.90 (5.3)	3.25 (4.8)
Total Mood	15.60 (27.6)	22.30 (30.1)	18.95 (28.85)
PANAS			
Positive	22.60 (6.04)	21.00 (6.04)	21.80 (6.04)
Negative	15.17 (5.70)	15.70 (6.22)	15.43 (5.95)
WHQ			
Memory	1.08 (0.70)	1.18 (0.73)	1.13 (0.72)
Somatic Sx	0.84 (0.60)	0.90 (0.70)	0.86 (0.62)
Vasomotor Sx	0.43 (0.60)	0.91 (1.03)	0.67 (0.87)*
Sexual Behaviour	0.84 (0.90)	1.01 (0.98)	0.93 (0.95)
Menstrual	0.49 (0.52)	0.86 (0.85)	0.68 (0.73)*
Sleep Problems	0.98 (0.83)	0.89 (0.74)	0.94 (0.52)
Total Score	4.66 (2.66)	5.76 (3.62)	5.20 (3.20)
SF-36			
Health	19.98 (3.4)	20.02 (3.5)	20.00 (3.45)
Functional Status	49.02 (6.2)	48.31 (6.27)	48.66 (6.23)
Well-being	48.62 (5.8)	47.70 (7.45)	48.16 (6.62)
Life Events	5.90 (3.83)	7.50 (4.8)	6.70 (4.31)

*p <.05

To test the prediction that women who use HRT will show better everyday memory ability than those women who do not use HRT, the mean scores for each subscale and the total profile score of the RBMT-E for each HRT use group were compared (see Table 3). Results of independent t- tests showed significant differences for three of the sub-tests of the RBMT-E: 'Story Immediate', t(102) =2.03, $p<.05$; 'Story Delayed', t(102) = 2.00, $p<.05$, and 'Messages Delayed', t(102)=1.99, $p<.05$. A significant difference t (102)= 1.57, $p<.05$ was also found between the two groups on the 'Total Profile RBMT-E.

To test the prediction that age would moderate the relationship of HRT use and memory, the interaction of age and HRT use was tested in a series of hierarchical regression equations with each RBMT-E sub-test profile score and total profile score as the criterion variable. The distribution of scores for 'Messages Delayed', 'Route Immediate' and 'Route Delayed' sub-tests of the RBMT-E were negatively skewed. Logarithmic transformations were conducted for these variables, resulting in normal distributions for regression analysis. The assumptions of normality of distribution, homoscedasticity, linearity and independence of residuals for multivariate analysis were met. 'Age' and 'HRT use' were entered as predictor variables at the first step. An interaction term, 'Age x HRT' (the product of age

Table 3. RBMT-E Sub-test and Total Profile Scores: Means and Standard Deviations

	HRT users (n=53) Mean	(SD)	HRTnon-users (n=51) Mean	(SD)
First Names	2.13	(1.40)	1.67	(1.30)
Second Names	1.90	(1.30)	1.70	(1.20)
Belongings & Appointments	1.50	(1.60)	1.50	(1.60)
Picture Recognition	2.20	(0.95)	2.20	(0.81)
Story Immediate	1.41	(0.71)	1.10	(0.65)*
Story Delayed	1.67	(0.75)	1.30	(0.65)*
Face Recognition	2.54	(1.13)	2.37	(0.90)
Route Immediate	3.60	(0.59)	3.40	(0.77)
Route Delayed	3.70	(0.50)	3.60	(0.55)
Messages Immediate	3.70	(0.75)	3.50	(0.88)
Messages Delayed	3.80	(0.60)	3.50	(0.84)*
Orientation & Date	3.70	(0.76)	3.30	(0.80)
Total profile score	31.64	(5.28)	29.27	(4.31)*

* p <.05.

Table 4. Results of two hierarchical regression equations: RBMT-E sub-test profile scores regressed on 'Age', 'HRT use' and 'Age x HRT' (N= 104).

Criterion Variable	Predictor Variable	Beta	Adj. R^2
Step one: Second Names	HRT use	-.10	
	Age	-.06	.006
Step two: Second Names	HRT use	2.06	
	Age	.57	
	Age x HRT	-2.18*	.023*
Step one: Belongings and Appointments	HRT use	.04	
	Age	.05	.016
Step two: Belongings and Appointments	HRT use	2.28*	
	Age	.70*	
	Age x HRT	-.2.25*	.015

* p <.05

and HRT use scores), was entered at the second step. Criterion variables that showed significant interaction effects were 'Second Names' regressed on 'Age x HRT' and 'Belongings and Appointments' regressed on 'Age x HRT'. The additional variance accounted for by the interaction variable was 4% for 'Second Names', R^2 change =.04, $F(1, 100) = 4.01$, $p<.05$, and 4% for 'Belongings and Appointments', R^2 change = .04, $F(1,100) = 4.24$, $p<.05$. Table 4 shows the result of the regression of these two RBMT-E scores on 'Age', 'HRT use' and Age x HRT' including the significant change in the Beta coefficient for the interaction term.

To examine the shape of this interaction effect, the sample was split at the median age of 52 years and the mean memory scores of the group older than 52 and the group younger than 52 were compared across each HRT use group. An examination of the means of HRT users and non-users above and below the median age of 52 years showed that older HRT users (>52yrs) scored higher, on average, than HRT non-users on 'Second Names' and 'Belongings and Appointments'. Younger HRT users (<52yrs) scored only slightly lower on the same RBMT-E sub-tests than younger women who were HRT non-users. Table 5 shows the means for these subscales across the HRT use groups and that the

Table 5. Mean scores of the HRT use groups on RBMT-E sub-tests which showed an interaction effect between 'Age' and 'HRT use'.

Variables	Mean Scores			
	Age <52yrs		Age >52yrs	
RMBT-E Sub-tests	HRT use (n=49)	HRT non-use	HRT use (n=50)	HRT non-use
Second Names	2.50	2.72	3.00	2.22
Belongings/ Appointments	8.79	9.60	9.33	8.65

shape of the interaction effect was similar across the two sub-tests: HRT use was associated with better memory scores, but only for older women.

The use of the RBMT-E as a measure of everyday memory on a sample of mid-aged women was evaluated. First, the mean scores of the RBMT-E for the present study were compared with the means obtained from the development study of this extended version of the Rivermead (Wilson et al., 1999). The sample was of a similar age (40-55 years) with the means reported for participants described in two age groups, below and above 50 years. For comparison with the participants in the RBMT-E development study, participants in the present study were assigned to three age groups to allow descriptions of participants below and above 50 years of age. Means and standard deviations for both samples are shown in Table 6. Although the development study included both genders and the present study only females, results for all but two of the sub-tests ('Route Immediate' and 'Route Delayed') show similar means and the expected trend towards lower scores with increased age. The scores for 'Route Immediate' and 'Route Delayed' sub-tests were more than three raw score points higher than those shown for the development study.

Second, an examination of frequencies for each of the sub-tests revealed that a high percentage of the participants achieved the maximum score. For both the 'Route Immediate' and 'Route Delayed' sub-tests, 83% of the participants obtained 14 of the possible 15 points. Similarly, for 'Messages Immediate' and 'Messages Delayed' 75% of participants achieved the maximum possible score.

Discussion

The results of this study support the prediction that HRT users show better everyday memory ability than HRT non-users. HRT users did achieve higher scores than HRT non-users on the total RBMT-E profile score (i.e., the overall measure of everyday memory). However, not all aspects of everyday memory as measured by the subtests of the Rivermead showed a significant difference between the HRT use groups. The RBMT-E subtests that reflect verbal memory ability (i.e., "Story Immediate" and "Story Delayed") did show significant differences between the two groups, with HRT users consistently achieving higher scores than HRT non-users. This finding supported the prediction that verbal memory would show the greatest difference between the two groups. Only one other sub-test, 'Messages Delayed', showed a significant difference between the HRT use groups, with HRT users scoring higher than non-users.

Table 6. Comparison of mean scores in the RBMT-E development study (Wilson et al., 1999) and the present sample.

RBMT-E Sub-scales	RBMT-E(Wilson et al.,1999) Mean Scores		RBMT-E(present study) Mean Scores		
	<50yrs (n=68)	>50yrs (n=53)	<50yrs (n=30)	50-53 (n=37)	54-60 (n=37)
First Names	3.68	3.70	3.73	3.14	3.73
Second Names	3.10	2.77	2.60	2.78	2.60
Appointments/Belongings	10.13	10.45	9.27	8.51	9.51
Story Immediate	8.77	9.24	8.13	8.32	8.41
Story Delayed	8.07	8.16	7.40	7.57	7.73
Picture Recognition	13.10	12.43	14.70	14.49	13.59
Face Recognition	12.59	12.15	12.73	13.19	13.19
Route Immediate	11.38	11.53	14.63	14.46	14.32
Route Delayed	11.04	10.87	14.50	14.35	14.30
Messages Immediate	5.63	5.53	5.50	5.73	5.54
Messages Delayed	5.72	5.42	5.73	5.62	5.62
Orientation & Date	13.13	13.17	13.17	13.38	13.38

The two groups in the present study were equivalent in all the characteristics that were considered as possible confounds (education, mood, affect, stress and general health). Although the women in each group had "self-selected" to take HRT or to not take HRT, and such groupings are not without bias, the current results do support other findings regarding HRT and memory in the literature. The results of this study add support to previous research that has indicated that HRT may assist to maintain, or enhance, verbal memory ability in women at mid-life (Sherwin, 1988; Schmitt et al., 1996). Other studies (Matthews et al., 1999; Resnick et al., 1998) have suggested that HRT may enhance other aspects of memory, however, the finding of a significant difference between the HRT use groups on the RBMT-E in the present study seems to reflect a strong verbal memory component.

The prediction that age would be negatively related to memory ability was not supported. Although several negative correlations of age with the RBMT-E scores were indicated, none of these reached significance. Previous studies have reported that chronological age exhibits a significant influence on the RBMT scores (Wilson et al., 1985), and the RBMT-E development study (Wilson et al., 1999) showed age effects on 'Story Delayed', 'Route Immediate', Route Delayed', 'Messages Delayed' and 'Appointment and Belongings'. These effects may be due to discrepancies in the size of the age differences in the samples. In the present study, the size of the age difference (i.e., 40-60 years) was smaller than the RBMT-E development study (16-89 years). It is likely that the sizes of the correlations observed in the present study were attenuated because of the restricted range of the sample. Alternatively, other studies, with a greater range, have reported a minimal relationship between RBMT scores and age, although with much older participants (Fraser, Glass & Leathem, 1999). The absence of any significant relationship of the RBMT-E with age in the present study is supported by research that has indicated that everyday memory is relatively stable until the later decades of life (Youngjohn et al., 1993).

The prediction that age would moderate the relationship between HRT use and memory ability received limited support. Regression analysis showed that the interaction of age with HRT use explained additional variance in some types of memory scores, in addition to that explained by age and HRT usage differences alone. Older women who were HRT users performed better than older women who were non-users, in memory recall for names and for remembering to do things in the future, i.e. prospective memory. In contrast, among the younger women, HRT users performed at much the same level as HRT non-users. The support for a moderating effect on a relationship between HRT use and age adds to previous research that has suggested that HRT use may assist to maintain memory as age increases. Resnick et al. (1997), in an assessment of longitudinal change in memory performance, found that women who did not use HRT, showed predicted age-associated increase in memory errors, whereas, HRT users maintained a stable performance over time. In the present study, the moderating effect of age was minimal (less than five percent of the total variance that may explain the criterion variable), and appears confined to a limited number of 'everyday memory' tasks. However, it is interesting to note that this age interaction effect is shown with tests of prospective memory, which is an aspect of memory widely accepted as exhibiting age related changes (Smith et al., 1996). This adds support to the literature suggesting that HRT may protect against age-associated decline (Sherwin, 1997).

In general, the RBMT-E had good face validity for the participants in this study, and yielded scores of everyday memory, which were sensitive to HRT group status. A comparison of the RBMT-E development study with the present study yielded similar mean scores for all but two of the sub-tests ('Route Immediate' and 'Route Delayed'). However, restricted ranges of two other sub-tests ('Messages Immediate' and 'Messages Delayed') suggested the presence of ceiling effects. Also, the age effects demonstrated in the development study of the RBMT-E (Wilson et al., 1999) were not replicated in the present study. This lack of significant age effects on the RBMT-E scores, raises the question of whether the age adjustments recommended in the manual were relevant for the present study. In addition,

it suggests that age effects for the RBMT-E may not be generalisable to other populations, supporting the observations of Fraser et al., (1999). An additional problem in using this measure for memory related research is that the sub-tests of the RBMT-E have been developed for clinical assessment and are not systematically related to theoretical constructs that have been used to describe the various aspects of memory functioning to date. For the purposes of the present study, an assessment was made regarding the aspects of memory, such as verbal memory or prospective memory, that were being tapped by the different sub-tests, on the basis of definitions of these types of memory. However, there is no empirical work that supports these assumptions. Validity studies of the construct definitions of the sub-tests of the RBMT-E, would be a useful contribution to the development of this measure for research purposes.

The findings from the present study are limited by the observational nature of the study. Observational studies are typically susceptible to biases and confounding factors. The women in this sample were recruited as a result of advertisement and may not be representative of the population. This may also have favored the selection of women who had some concerns about their memory. A further limitation to the interpretation of the findings was the restricted nature of the sample. The higher than average IQ of the sample limits the generalisability of the findings to the population at large. In addition, the lack of random assignment to HRT and HRT non-use groups meant that group differences might be due to unassessed confounding factors. While attempts were made to control for possible confounds (e.g., age, education, health, mood and affect), it is possible that other confounds such as socioeconomic status may have contributed to the results (Steffens et al., 1999). Finally, the cross-sectional design of the present study did not allow for assessment of participants' memory before HRT use and therefore prevents any attribution of causality to HRT. For these reasons this study is regarded as a pilot whose results are sufficiently interesting to warrant replication and encourage the development of the assessment of the everyday memory construct in such younger populations.

Conclusions

The present study demonstrates a relationship between HRT use and some aspects of everyday memory performance in mid-aged women. This supports the findings of previous studies that have shown a beneficial effect of HRT use on memory in peri-menopausal women (Sherwin, 1998) and suggests that this positive relationship may extend to verbal memory in everyday memory tasks. HRT users consistently scored higher on verbal memory sub-tests of the RBMT-E, and on the overall measure of everyday memory. Women over 52 years who were HRT users performed better on everyday memory tasks than HRT non-users on the RBMT-E, adding confirmation to other studies that suggest HRT may benefit older peri-menopausal and post-menopausal women. However, the HRT benefit did not appear to extend to younger HRT users, who performed similarly to HRT non-users. The RBMT-E proved to have good face validity with this population, and has the potential to become a useful tool for the assessment of everyday memory in a normal mid-aged population. Research on the potential cognitive effects of hormone replacement therapy for women is of interest to health care providers, who try to advise patients as best they can about potential risks and benefits of any form of treatment. Often both consumers and providers of health care look to large overseas studies of treatment efficacy for advice, yet smaller studies in a local context, particularly when they address psychological functioning, can be more ecologically valid. For New Zealand women, weighing up the risks and benefits of HRT, including the physical, psychological and cognitive sequelae of such treatments must be part of their decision-making process. The issues surrounding HRT use and its potential effects are complex, and some facets of the picture, such as the effects of HRT on everyday memory, remain an evolving story.

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