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REVIEW PAPER

Investigating Labyrinth Walking as a Tool for Stress Relief in the Workplace

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Abstract

Background. Mindfulness meditation programs are effective in reducing stress but may not always be appropriate for the workplace.
Objective. To determine the effect of walking a labyrinth on stress relief in office workers.
Design. Single factor experimental design for independent groups with pretest and posttest measures.
Setting and Participants. Employees (n = 26) at a medical office in S.E Michigan.
Interventions. The experimental group practiced mindfulness meditation as they walked a labyrinth. The active-control group practiced mindfulness meditation as they walked in the neighborhood. Group three was a waitlist control.
Primary Outcome Measures. The Perceived Stress Scale (PSS10), Copenhagen Psychosocial Questionnaire (COPSOQ II), and diurnal cortisol slope measured self-reported and physiological levels of stress.
Results. A large effect size (η2 = 0.13) was noted for the interaction of mindfulness walking on workplace stress and a moderate effect size (η2 = 0.08) for perceived stress. A large effect size (d = 0.65) was recorded for the change in PSS10 from pretest to posttest in the labyrinth walking group compared to a small effect size (d = 0.5) in the waitlist control group. After walking the labyrinth the odds ratio of being less/much less stressed was 5.49 (95% CI 3.3 - 9.15). Odds ratio of being more/much more relaxed was 51.33 (95% CI 15.68 – 168.06).
Conclusions. Self-reported measures of stress and statistical effect sizes trended in a positive direction for the effect of labyrinth walking on stress. A larger sample size is recommended to determine if this trend is statistically significant.

Keywords: Labyrinth – mindfulness – meditation – workplace – diurnal cortisol slope – stress

Abstrait

Contexte. *Les programmes de méditation de pleine conscience sont efficaces pour réduire le stress, mais ne sont pas toujours appropriés pour le lieu de travail.*
Objectif. *Pour déterminer l'effet de la marche d'un labyrinthe sur le soulagement du stress chez les employés de bureau.*
Conception. *Conception expérimentale à facteur unique pour les groupes indépendants avec mesures pré-test et post-test.*
Cadre et participants. *Employés (n = 26) dans un cabinet médical à S.E Michigan.*
Interventions. *Le groupe expérimental pratiquait la méditation de la pleine conscience en marchant dans un labyrinthe. Le groupe de contrôle actif pratiquait la méditation de pleine conscience alors qu'ils marchaient dans le voisinage. Le groupe trois était un contrôle de liste d'attente.*
Mesures de résultats primaires. *L'échelle de stress perçu (PSS10), le questionnaire psychosocial de Copenhague (COPSOQ II) et la pente du cortisol diurne ont mesuré les niveaux de stress physiologiques et autodéclarés.*
Résultats. *Une grande taille d'effet (η2 = 0,13) a été notée pour l'interaction de la pleine conscience marchant sur le stress au travail et une taille d'effet modérée (η2 = 0,08) pour le stress perçu. Une taille d'effet importante (d = 0,65) a été enregistrée pour le changement de PSS10 du pré-test au post-test dans le groupe de labyrinthe, comparativement à un petit effet (d = 0,5) dans le groupe témoin. Après avoir parcouru le labyrinthe, l'odds ratio d'être moins / beaucoup moins stressé était de 5,49 (IC à 95% 3,3 - 9,15). Odds ratio d'être plus / beaucoup plus détendu était de 51,33 (IC 95% 15,68 - 168,06).*
Conclusions. *Les mesures auto-rapportées du stress et de la taille des effets statistiques ont évolué dans le sens positif de l'effet du labyrinthe sur le stress. Une taille d'échantillon plus grande est recommandée pour déterminer si cette tendance est statistiquement significative.*

Mots clés: *Labyrinthe – attention – méditation – lieu de travail – pente de cortisol diurne – stress*

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Introduction

It is well documented that a stressful work environment is a risk factor for ill-health, both physical and psychological. A meta-analysis of studies published between 1990 and 2013 demonstrated moderately strong evidence of stress in the workplace being significantly associated with the onset of depressive symptoms (Theorell et al., 2015). Fishka and Backe (2015) performed an overview of systematic reviews investigating cardiovascular morbidity and mortality, concluding that a consistent association between the psychosocial work environment and heart disease exists. Stress experienced by the workforce impacts the business owner in terms of lost productivity and higher healthcare costs (Cancelliere, Cassidy, Ammendolia, & Cote, 2011). Productivity losses are typically assessed through absenteeism and presenteeism rates, both of which have been positively associated with work strain and physical and mental health conditions (Darr & Johns, 2008; Schultz & Edington, 2007). It has been suggested that lost productivity due to health reasons can cost employers more than $1,685 per employee each year (Stewart, Ricci, Chee, & Morganstein, 2003). Moreover, it has been calculated that workplace stress contributes from 5-8% of the national spending on healthcare (Goh, Pfeffer, & Zenios, n.d.).

In recent years, employers have introduced worksite wellness programs in an effort to improve or maintain the health and well-being of their employees. A frequently used intervention is mindfulness meditation, a technique that has been shown to be beneficial for both physical and psychological health. Virgili (2015) performed a meta-analysis specifically on the effects of mindfulness-based interventions on the working population, concluding that not only do they significantly reduce psychological distress (effect size, Hedge's g = 0.68), but beneficial results can be maintained over time. However, mindfulness-based trainings such as the classic eight-week mindfulness-based stress reduction (MBSR) program may not be appropriate for smaller business operations due to time commitment for participants and prohibitive cost to the business owner.

Labyrinth walking may offer a much more suitable form of meditation that can potentially lower stress, similar to mindfulness meditation (Ciancosi, 2002). Walking a labyrinth does not require weekly group classes or the need, necessarily for a trained instructor. Employees need only to schedule 10 to 15 minutes for their personal walk and, although each person is walking individually, numerous people can use the labyrinth simultaneously. A labyrinth is a circular pathway, with one entrance and one exit (Figure 1) that offers individuals the time and place to meditate as they walk along its path. Without thinking about where to walk or which way to turn, an individual is able to practice mindfulness meditation more deliberately; being aware of the present moment, intentionally focusing on the breathing, stepping, or repeating a word or phrase, and paying attention to the experience with an open, non-judgmental attitude. Labyrinths are ancient structures dating back 3000 to 4000 years. Without written documentation, historians can only speculate on their original purpose.

Figure 1. Pattern of the Chartres Labyrinth
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The labyrinth has seen resurgence in the U.S., mostly due to the work of the Reverend Dr. Lauren Artress. Installing a replica of the 13th century Chartres Cathedral labyrinth in San Francisco's Grace Cathedral, she has worked diligently to bring the practice of labyrinth walking into mainstream awareness as a form of mindfulness meditation. Artress (2006) states, "the time on the labyrinth is meant to be a reflective and meditative act" (p.98). Although labyrinth walking is becoming more commonplace and has been incorporated into the fields of psychotherapy (Hong & Jacinto, 2012; La Torre, 2004) and oncology (Griffith, 2003), research into labyrinth efficacy is still in its infancy, and most reported benefits are anecdotal in nature.

No studies exist to date on the effect of labyrinth walking on stress in office workers. Therefore, the purpose of this study was to determine the effects of walking a labyrinth on physical and self-reported markers of stress and to determine the feasibility of introducing labyrinth walking in the workplace as a tool for stress relief.

METHODOLOGY

Study Design

The study was a mixed-methods design, the qualitative aspect of which has been described elsewhere. The quantitative study was a single factor experimental design for independent groups with pretest and posttest measures.

Study Setting and Participants

The study took place at an orthopedic medical center in Southeast Michigan. A 25' seven-circuit classical labyrinth was painted outdoors, in the grounds of the clinic. Employees were invited to participate. Exclusion criteria included non-employees, pregnancy, or a pre-established clinical diagnosis of depression, anxiety, or mood disorder. Twenty-six participants, with an average age of 46 years (range 20 – 62) enrolled and completed the study. Only one participant was male. Institutional Review Board approval was received through Rocky Mountain University of Health Professions.

Intervention

Participants were randomly allocated to one of three groups.

Group one – labyrinth walking. Participants in the labyrinth walking group received information regarding the history and current uses of the labyrinth. Also, they were provided with instructions on eliciting the relaxation response (RR) through mindfulness meditation and directions on how to walk a labyrinth mindfully. Participants were instructed to take 10-15 minutes to walk the labyrinth mindfully, three times per week, for eight weeks. Group one logged their walking schedule in a diary including any thoughts and/or comments regarding their experience. After each walk, participants completed the labyrinth walk questionnaire.

Group two – normal walking. The normal walking group was a concurrent active control group allowing for a distinction between labyrinth walking and meditative walking. Participants in group two received the same instructions as group one on how to elicit the RR. Also, they were provided with specific instructions on how to walk in the neighborhood mindfully. Group two participants were instructed to take 10-15 minutes to walk a pre-established route in the neighborhood close to the medical office, three times per week, for eight weeks. The route was set up to measure the same distance as the labyrinth walk. These neighborhood walks were logged in a diary corresponding to the labyrinth walker's protocol. In addition, group two participants completed a walk questionnaire modified to remove the word labyrinth.

Group three – waitlist control. Participants in group three continued their work duties as usual. They completed a modified questionnaire three times per week for eight weeks. This group was informed that, after the study period, they would have the opportunity to participate in walking the labyrinth as well as be given meditative training.

All participants completed a baseline demographic survey, the Perceived Stress Scale (PSS10), and the Copenhagen Psychosocial Questionnaire II (COPSOQ II). Also, each person provided saliva samples prior to the start of and, again, at the conclusion of the eight-week study period. As motivation for adherence, all participants received a text-message at the beginning of each week, thanking them for their participation and reminding them of the requirements for the upcoming week.

Measurement Tools

Perceived Stress Scale. The Perceived Stress Scale (PSS) is a self-report psychometric instrument, designed to measure "the degree to which situations in one's life are appraised as stressful" (Cohen, Kamarck, & Mermelstein, 1983, p. 385). The PSS10 is a 10-item questionnaire that rates the frequency of thoughts and feelings related to situations that occurred in the previous month. Higher PSS scores indicate higher levels of perceived stress. Psychometric testing has shown the Perceived Stress Scale to be reliable (Cronbach's alpha coefficient .75) and valid with construct validity demonstrated with other stress measures (r = .30; Cohen & Williamson, 1988).

The PSS is the most widely used questionnaire for measuring the perception of stress (Sheldon, 1994). It was especially suitable for this study in that it is designed for community populations with a greater than high school education with questions that are generic in nature, and easily understood.

Copenhagen Psychosocial Questionnaire. It was elected to use the Copenhagen Psychosocial Questionnaire (COPSOQ II) due to the manner in which it is designed to assess all aspects of the psychosocial work environment (Pejtersen, Kristensen, Borg, & Bjorner, 2010). It is a tool that measures both the potential stressors and resources of the job site as well being relevant to different levels and fields of employment within the same facility. Higher scores are associated with a more stressful working environment (National Centre for the Working Environment, 2007). The COPSOQ II provides sound psychometric properties demonstrating criterion validity (Pejtersen et al., 2010), suitable test-retest reliability (ICC .70 - .89), and good internal consistency reliability (Crohnbach's alpha .75- .85; Thorsen & Bjorner, 2010).

Salivary cortisol levels. Cortisol is the end product of the hypothalamus-pituitary-adrenal (HPA) axis: one of the key stress-response pathways. Cortisol has a distinct diurnal pattern (Stone et al., 2001). The strongest secretory activity is in the early morning hours with peak levels occurring 30 to 45 minutes after waking. Cortisol levels gradually diminish during the day with the lowest levels occurring around midnight. The steepness of the decline (the diurnal cortisol slope) is an indicator of HPA axis function. A steeper decline is typically associated with greater psychosocial and health outcomes (Smyth, Hucklebridge, Thorn, Evans, & Clow, 2013) whereas a flattened slope is indicative of HPA axis dysfunction (Ross, Murphy, Adam, Chen, & Miller (2014).

For this study, the minimal one-day protocol for saliva collection as described by Adam and Kumari (2009) was followed. This protocol requires a saliva sample to be obtained on waking, 30 to 45 minutes later, and at bedtime on the same day. Waking was defined as "when your eyes open and you are ready to get up" (Cohen et al., 2006, p. 42) and bedtime as "right before getting into bed" (p. 42).

Saliva was collected using the passive drool technique, whereby saliva is pooled in the mouth and then guided through a saliva collection aid into a cryovial. Passive drool is the gold standard when collecting oral fluids (Salimetrics, LLC, n.d.). Participants were requested not to clean their teeth, eat, or drink for 15 minutes prior to the sample collection.

The individual documented the date, waking time, and actual time of saliva collection for each sample. The saliva samples were frozen immediately following collection until shipped for analysis. The samples were mailed to Salimetrics, LLC, Carlsbad, CA, in order to be analyzed for cortisol levels by using the ELISA method. Duplicate testing of the samples was performed to improve accuracy of the results. The analytical sensitivity of the ELISA method test is < 0.007ug/dL, and the correlation between saliva and serum cortisol levels is reported to be 0.91, $p < .0001$ (Salimetrics, LLC).

The Labyrinth Walk Questionnaire. The labyrinth walk questionnaire was designed to assist "the Labyrinth Society in its ongoing efforts to collect data about the labyrinth and the experience of those who walk it" (Rhodes, n.d.-a, p. 4). This questionnaire is completed immediately after walking a labyrinth. Ten emotions or psychological states are listed and the individual is asked to compare how he or she felt before walking the labyrinth as well as after walking. The answers are rated on a five-point Likert scale from much less to much more.

Content validity has been established through pilot testing and peer-review of the questionnaire by those knowledgeable of labyrinth walking. Construct analysis has been substantiated through statistical analysis. A moderate correlation has been established between the questionnaire's ten scales ranging from Spearman's rho -.73 (stressed to relaxed) to .76 (agitated to anxious; Rhodes, n.d.-a).

Statistical Analysis

Research data were analyzed using IBM SPSS® version 21.0 (IBM, 2012). The intention-to-treat protocol was applied whereby data were analyzed according to group assignment. Cortisol values three standard deviations above the mean were removed (Adam & Kumari, 2009). Diurnal cortisol slope was calculated by subtracting the wake-up value from the bedtime value, and dividing by the number of hours between the two samples (Adam & Kumari). The cortisol data were log10 transformed due to a natural tendency for skewness.

Prior to analysis, the data were screened for accuracy, completeness, and normalcy. Missing values were imputed using the multiple regression method.

The assumption for normalcy was accepted therefore parametric testing was utilized. Comparison of the pretest to posttest scores for the individual groups was achieved using a paired t-test. Intervention effects upon the PSS10 and COPSOQ II scores were assessed with the one-way ANOVA. An analysis of covariance (ANCOVA) using time of waking and time since waking as covariates analyzed the diurnal cortisol slope.

	LABYRINTH			NEIGHBORHOOD			CONTROL		
	Pretest	Posttest	Sig.	Pretest	Posttest	Sig.	Pretest	Posttest	Sig.
PSS10	20.38	16.13	.108	19.11	14.67	.162	22.78	20	.172
(SD)	8.26	9.83		9.58	7.65		5.4	6.82	
COPSOQ	69	63.63	.108	81.44	74.11	.162	79.11	72.33	.172
(SD)	15.94	13.48		11.16	12.28		9.43	11.34	
Slope	-0.4656	-0.2666	.275	-0.4732	-0.2701	.395	-0.3593	-0.0857	.074
(SD)	0.3881	0.1672		0.6999	0.5056		0.2484	0.5394	

Table 1: Mean pretest and posttest scores with standard deviations (SD) and significance level (sig.)

RESULTS

Following random allocation to the intervention groups, there were eight participants in the labyrinth group, nine participants in the normal walking group, and nine in the control group. Homogeneity among the three intervention groups at pretest, for all outcome measures, was established using one-way analysis of variance (ANOVA).

The mean pretest and posttsest scores for each of the outcomes can be found in Table 1.

Perceived Stress Scale

All three groups registered a lower score on the Perceived Stress Scale at the end of the study period, with the labyrinth and neighborhood groups demonstrating a larger reduction in scores than the control. The difference between the pretest and posttest means for each group was not statistically significant.

The mean change score of -4.75 (SD = 6.11) for the labyrinth was greater than that of the neighborhood group (-4.22, SD = 8.5) and the control group (-1.89, SD = 5.97).

However, a one-way ANOVA found there to be no significant difference between the change scores, $F(2,23) = 0.423$, $p = .666$. A one-way ANOVA compared the posttest PSS10 scores of the labyrinth, neighborhood, and control groups. No significant difference was found, $F(2,23) = 1.032$, $p = .372$.

Copenhagen Psychosocial Questionnaire

Each of the three intervention groups demonstrated lower COPSOQ II scores at the end of the study period. The reduction in scores, for each group, was not found to be statistically significant. The mean change score was largest for the neighborhood walking group (-7.33, SD 7.05, 95% CI -12.76 to -1.91), followed by the control group (-6.78, SD 7.68, 95% CI -12.90 to -1.10) and the labyrinth walking group (-5.37, SD 11.13, 95% CI -14.68 to 3.93). A one-way ANOVA did not find any statistically significant difference between the change scores, $F(2,23) = .121$, $p = .887$.

After the eight-week intervention, the labyrinth group recorded the lowest COPSOQ II score. No significant difference was found between the posttest scores for each of the three groups, $F(2,23) = 1.718$, $p = .202$.

Diurnal Cortisol Slope

The cortisol awakening response (CAR) refers to the sharp increase in cortisol level that starts 10 minutes after waking and reaches peak levels approximately 30 to 45 minutes after waking. Because a saliva sample taken more than 10 minutes after waking may be measuring the CAR and not the waking cortisol level, the time between waking and the first sample collection was introduced as a covariate (Badrick et al., 2008). Also, the specific wake time was used as a covariate as the diurnal slope is known

	CHI SQUARE	DF	SIG.	ODDS RATIO	95% CI
Much more/more relaxed	93.852	1	.000	51.333	15.68 – 168.058
Much more/more peaceful	93.077	1	.000	32.865	12.771 – 84.576
Much more/more quiet	98.538	1	.000	35.538	13.806 – 91.478
Much less/less anxious	61.612	1	.000	13.003	6.177 – 27.369
Much less/less stressed	46.301	1	.000	5.497	3.302 – 9.151
Much less/less agitated	97.629	1	.000	22.516	10.689 – 47.430

Table 2: Chi square test of independence comparing the labyrinth group to the control group

to be anchored to a person's sleep-wake cycle (Adam & Kumari, 2009).

Typically, the diurnal cortisol slope has a negative coefficient, reflecting the decline in values across the day. The closer the value is to zero, the flatter the diurnal slope. Contrary to expectations, the mean diurnal slope for each of the intervention groups was flatter after the study period. The labyrinth and neighborhood walking groups demonstrated steeper mean diurnal slopes than the control group. However, there was no significant difference between the three groups, $F(2,22) = 0.467$, $p = .633$.

Observed Power and Effect Sizes

Because of the non-statistically significant findings for all analyses, the statistical power of the study was questioned. If a study is underpowered, there is a possibility of making a Type-II error, whereby it is incorrectly concluded that no relationship exists between the research variables. The power of this study ranged from 5% to 32%. Although between group posttest comparisons were not statistically significant, a large effect size ($\eta 2 = 0\ .13$) was observed for the interaction on workplace stress and a moderate effect size ($\eta 2 = 0.08$) on perceived stress was observed. For participants in the labyrinth walking group, pre-to-post-study perceived stress scores exhibited a moderate to large effect size (Cohen's d = 0.65). By comparison, the control group recorded a small to moderate effect size (Cohen's d = 0.5).

Labyrinth Walk Questionnaire

The median number of walks performed by the labyrinth group was 21 (range 4 – 24). In total, the labyrinth walking group completed 153 walks and questionnaires. Compared to before walking the labyrinth, 50% of participants reported they were much more or more relaxed, 57% were much more or more peaceful, and 53% felt much more or more quiet. In the same group, 57% reported being less or much less agitated, 56% were less or much less stressed, and 44% were less or much less anxious after walking the labyrinth. Compared to the control group, a chi square test of independence found significant interactions in favor of the labyrinth walking group (Table 2).

DISCUSSION

The purpose of this study was to determine the effects of walking the labyrinth on physiological measures of stress utilizing the diurnal cortisol slope as an indicator of HPA axis activity, as well as on self-reported measures of perceived stress and stress in the workplace.

This study was innovative in focusing specifically on the use of labyrinth walking to reduce stress in the workplace, as well as researching the potential distinction between mindfulness meditation with normal walking and mindfulness meditation when walking a labyrinth.

Demographic Characteristics

Data from a 2009 survey were used to establish a normative perceived stress scale value of 16.14 (SD 7.56) for adult women (mean age 44.6 years, SD 15.5; Cohen & Janicki-Deverts, 2012). In this study, the medical center employees had a mean baseline PSS10 score of 20.77 (SD 7.77), indicating higher than normal levels of stress prior to the intervention period. Following this eight-week study, the group mean PSS10 score had lowered

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to 16.96 (SD 8.13), equivalent to national normative values. Regarding psychosocial stressors in the workplace, participants in this study reported a mean COPSOQ II score of 76.81, similar to pre-determined average values of 78.8 (COPSOQ II, 2007). Salimetrics LCC, reports normative waking cortisol values of 2.89 – 41.8 nmol/L and bedtime values of 4.99 nmol/L for women aged 31-50 years (Salimetrics, LLC, 2016). Prior to starting this study, employees at the medical center had a mean wake-up cortisol level of 7.92 nmol/L and a bedtime level of 7.82 nmol/L. These values dropped after the eight-week intervention to 2.42 nmol/L at waking and 3.22 nmol/L at bedtime. Taking into account aggregate scores for PSS10, COPSOQ II, and diurnal cortisol slope, it would appear that employees at the medical office who participated in this particular study showed higher than average stress levels at the start of the study that were subsequently lowered to normative levels following the eight weeks intervention. As this change was noted across all experimental groups combined, it cannot be stated categorically that it was a result of the intervention.

Findings

This study included three specific aims:

1. Assess the effect of labyrinth walking on physiological and self-reported markers of stress.

2. Assess any differences in the response of stress markers between normal walking and labyrinth walking.

3. Determine the feasibility of and support for labyrinth walking in an office environment.

Aim one. The hypothesis of this study was that practicing mindfulness meditation while walking the labyrinth would elicit a positive effect on assessable measures of stress. Following the eight-week intervention, measures of perceived stress and psychosocial stressors in the workplace had decreased, with labyrinth group scores being slightly lower than the control group. Despite a lack of statistical significance between the posttest group scores, a large effect size ($\eta 2$ = 0 .13) for the interaction of walking on workplace stress and a moderate effect size ($\eta 2$ = 0.08) for perceived stress was observed. Participants in the labyrinth walking group exhibited a moderate to large effect size (Cohen's d = 0.65) upon perceived stress scores. In this particular study, participants walking the labyrinth recorded a mean change in PSS10 scores of 4.25. Chambers, Phillips, Burr, and Xiao (2016) reported a similar mean change score of 4.4 that was statistically significant ($p < .001$) following a seven-week mantra-based meditation program. The effect sizes for the interaction of mindfulness walking on measures of stress found in this study are similar to those reported in meta-analyses of the effects of MBSR in healthy individuals (Khoury, Sharma, Rush, & Fournier, 2015) and mindfulness-based interventions (MBI) on psychological distress in working adults (Virgili, 2015). Both of these reviews found a medium effect size (Hedges g = 0.55 and g = 0.68 respectively) for within group comparisons, which was reflected in this study with Cohen's d = 0 .48 (COPSOQ II) and Cohen's d = 0.65 (PSS10).

This study hypothesized that the diurnal cortisol slope would be significantly steeper for the labyrinth walking group following the intervention. Contrary to expectations, the diurnal cortisol slope for both the labyrinth and control groups were flatter following the study period. The labyrinth group demonstrated a steeper, but not statistically significant ($p = .202$), slope than that of the control group. This correlated with findings of Chambers et al. (2016) who recorded increases in both morning and evening cortisol levels despite a significant reduction in self-reported stress. Hjortskov, Garde, Orbaek, and Hansen (2004) performed a meta-analysis of studies in the workplace, investigating the association between self-reported stress and cortisol levels. These authors concluded that there was insufficient evidence of such an association.

The literature suggests that using mindfulness meditation to elicit the relaxation response can dampen HPA axis activity, as measured by a reduction in cortisol levels and a steeper diurnal slope (Dusek & Benson, 2009). What is the possible explanation for the increase in salivary cortisol levels and flattening of the diurnal slopes in this study? A meta-analysis of 107 studies explored why stress reduction studies have been associated with both increase and decrease in cortisol levels (Miller, Chen, & Zhou, 2007). Findings indicated that cortisol output is affected by the length of time an individual has been exposed to the stressor, as well as by controllability of the stressor. The diurnal cortisol slope may be steeper or flatter depending on specific characteristics of the stressor, and the day-to-day variability within participants (Kraemer et al., 2006). This variability is evidenced in a study by Branstom et al. (2013). These investigators measured the effect of an eight-week MBSR program attended by cancer patients by analysis of one salivary cortisol sample from each participant upon waking. As a group, they determined no significant decrease in cortisol levels after the intervention period ($p = .30$). However, when the participants were divided into lower versus higher cortisol levels prior to the intervention, they noted that cortisol levels for the lower group increased, yet decreased for the higher group. Commenting on the nature of stress, Hjortskov et al. (2004) suggested that the level and type of stress experienced on a daily basis in the workplace may not be considered a level high enough to evoke HPA axis activation. Indeed, Liao, Brunner, and Kumari (2013) investigated workplace stressors and found no significant association between the job demand-control model of work stress and diurnal cortisol slope.

Aim two. The second aim of this study was to investigate any differences on measures of stress between normal walking meditation and walking meditation in the labyrinth. Would the circular and guided geometry of the labyrinth enhance the experience or effects of the meditation? Previous studies have compared walking meditation to regular walking, with the former being associated with a reduction in cortisol output (Prakhinkt, Suppapitiporn, Tanaka, & Suksom, 2014; Gainey, Himathongkam, Tanaka, & Suksom, 2016), however, this is the first study known to this author that compares walking meditation to labyrinth walking. For both the labyrinth and the normal walking group, PSS10 and COPSOQ II scores reduced after eight weeks of mindfulness meditation. No statistically significant difference was found between the groups from pretest to posttest; however, a medium to large effect size was noted for the change in COPSOQ II scores.

As noted, diurnal cortisol slopes for both groups were flatter post-intervention. After the eight-week study period, the slope of the labyrinth walking group was steeper than that of the normal walking group however the difference between the two groups was not statistically significant.

This study determined that self-reported and physiological measures of stress were influenced equally by walking meditation in the labyrinth and in the neighborhood.

Aim three. The complete qualitative findings from this study are available as a separate publication. The labyrinth walk questionnaire identified 10 emotions. For five of the emotions, benefits were reported in 50 - 57% of the walks: Participants recorded being more or much more relaxed, peaceful, and quiet as well as less or much less stressed and agitated. Rhodes (n.d.-b) accumulated labyrinth questionnaire data from 524 responses over six years. For the same five emotions, he recorded positive changes in 63 – 82% of the walks. Using a chi-square test of independence to compare the frequency of observed to expected responses, each of the emotions reported statistically significant change. The odds ratios ranged from 5.49 (95% CI 3.3 - 9.15) to 51.33 (95% CI 15.68 – 168.06) indicating that individuals were five times less or much less likely to be stressed, and 51 times more or much more likely to be relaxed after walking the labyrinth. These findings reflect those of Zucker, Choi, Cook, and Croft (2016) whose participants walked the labyrinth in an academic library setting. When compared to a non-walking control group, those in the Zucker et al. study who walked the labyrinth reported statistically significant benefits pertaining to the emotions of being relaxed, peaceful, reflective, anxious, stressed, and agitated ($p = .009 – p = .001$).

LIMITATIONS

1. The non-statistically significant findings in this study may have been a result of methodological issues. A lack of power is a common reason for null findings in research. It is possible that this study was underpowered, using a sample size too small to identify statistically significant change. The power of the ANOVA for the posttest between groups comparison in this study was 12% (diurnal cortisol slope), 21% (PSS10), and 32% (COPSOQ II). This notion is supported by the medium to large effect sizes and the trending of scores in the hypothesized direction.

2. There is no consensus in the literature on the effects of mindfulness-based interventions on cortisol levels. Research has reported elevated, lowered, and unchanged cortisol levels following mindfulness meditation (Brand, Holsboer-Trachsler, Naranjo, & Schmidt, 2011; Branstrom et al., 2013; Chambers et al., 2006).This could, in part be due to the characteristics of a stressor affecting the HPA axis in different ways (Miller et al., 2007). A stressor that is perceived as controllable is associated with increased waking cortisol levels whereas an uncontrollable stressor decreases waking values. A stressor that is viewed as a physical threat to the individual lowers morning cortisol levels but increases evening levels, thus resulting in a flatter diurnal slope. And finally, the time since onset of stress affects measures of cortisol: As the stressor becomes chronic, the cortisol output drops to below normal levels. This study did not require participants to identify the source, characteristics, or

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chronicity of stress nor consider potential stressors outside of the workplace.

3. Measuring diurnal cortisol slope in the field has its own limitations. Inconsistency or non-compliance with sampling times can affect the slope (Saxbe, 2008). This was statistically accounted for in this study by including the time since wake-up plus actual wake time as covariates. Kraemer, Giese-Davis, Yutsis, Gallagher-Thomas, and Spiegel (2006) suggest that the test-retest reliability of salivary cortisol levels is stronger when samples are taken over two days ($r = .78$) as compared to one day ($r = .63$). Finally, the diurnal cortisol slope has a wide variability both within and between individuals, being affected not only by stress, but also by social, emotional, and physical factors (Adam, Hawkley, Kudielka, & Caccioppo, 2006). Stone et al. (2001) found that more than 10% of individuals studied had no significant diurnal cortisol slope. Such wide variability may have limited the ability to compare diurnal cortisol slopes over an eight-week period.

4. Once established, walking a labyrinth requires minimal time, training, and costs. However, installation of a permanent labyrinth and the allocation of a dedicated space within the workplace can be an expensive investment.

SUMMARY

This study investigated the effects of walking the labyrinth on measures of stress in a population of office workers.

1. Although not statistically significant, there was a trending of PSS10 and COPSOQ II scores in a positive direction with corresponding moderate to large effect sizes.
2. The diurnal cortisol slopes for all groups were flatter after the eight-week intervention than at pretest. The slope of the labyrinth walking group was steeper than that of the control group at posttest, without statistical significance.
3. No statistically significant differences were identified between labyrinth walking and normal meditative walking on measures of PSS10, COPSOQ II, or diurnal cortisol slope.
4. Statistical analysis of the labyrinth walk questionnaires reported strong, significant and favorable odds of improved emotions after walking the labyrinth.

FUTURE RESEARCH

Reproduction of this research should address the power of the study. Further investigation of the trends and effect sizes that were reported can be achieved by increasing the sample size.

Previous research has compared normal to meditative walking. This study compared meditative walking in the labyrinth to that of a usual walking environment. Future research into labyrinth efficacy could compare non-meditative to meditative walking, both in the labyrinth setting.

Prior to the installation of a labyrinth in the workplace, the business owner would need to be confident of a return-on-investment. Therefore, future research should investigate correlations between labyrinth walking and productivity measures, including absenteeism, presenteeism, and healthcare costs. ■

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